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The State Route 188–Cottonwood Creek Project

The Sedentary to Classic Period Transition in Tonto Basin

Edited by Eric Eugene Klucas, Richard Ciolek-Torrello, and Holly Warner

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Richard Ciolek-Torrello, general editor

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ABSTRACT

This document is the second of three volumes presenting the results of a two-phase data recovery program conducted by Statistical Research, Inc. (SRI), at nine prehistoric sites and segments of a historical-period road along a 3.8-mile segment of State Route (SR) 188 near Jakes Corner. The investigations were undertaken under contract with the Arizona Department of Transportation (ADOT) (ECS Contract 99-60, TRACS H4476-03D) because of anticipated impacts to cultural resources located within the SR 188 right-of-way (ROW). The project area is located in western Gila County, mostly within the administrative boundaries of the Tonto National Forest (TNF) (Special-Use Permit No. 2700-4), although a small portion of one archaeological site extends onto private property. The project begins near Milepost 269.8, about 3 km north of Slate Creek, and ends at Milepost 273.6, near Jakes Corner. The area encompasses portions of Sections 17, 18, 20, 21, 22, 26, 27, 34, and 35, Township 8 North, Range 10 East and Sections 2, 3, 10, 15, 22, 23, 26, and 27, Township 7 North, Range 10 East, on the 1977 Gisela, Arizona, and 1964 (photoinspected 1978) Kayler Butte, Arizona, 7.5-minute U.S. Geological Survey quadrangle.

The investigated prehistoric sites were situated along three small drainages near the boundary between the upper and lower Tonto Basin. Two limited-activity sites were located along Hardt Creek near Jakes Corner. AZ O:15:41/583 was a pre-Classic period *horno* and nearby AZ O:15:103/2061 was a low-density artifact scatter of unknown prehistoric age. A single early Classic period field house, AZ U:3:404/2011, was located on a ridge above Gold Creek. The remaining sites were located in the vicinity of Cottonwood Creek on a terrace adjacent to the Tonto Creek floodplain. The Vegas Ruin (AZ U:3:405/2012) provided the most-extensive sample, including 1 cobble-adobe-foundation compound, 5 Miami/Roosevelt phase pit structures, 38 burials, dozens of extramural features, and 4 Archaic period roasting features. The Crane site (AZ U:3:410/2017) consisted of 1 late Sedentary period or Miami phase pit house, and 1 Roosevelt phase roomblock, midden, and 7 burials. The Rock Jaw site (AZ U:3:407/2014) was a late Sedentary period to early Miami phase farmstead with two superimposed pit houses and several extramural pits. AZ U:3:408/2015 was an extensive multicomponent site, of which we investigated 1 pre-Classic period midden. The remaining 2 prehistoric sites were low-density artifact scatters (AZ U:3:406/2013 and AZ U:3:409/2016) that may date to the late Sedentary–Classic periods. The final site was a segment of the historical-period Forest Highway 9 (AZ U:3:246/1381), also known as the historical Globe-Payson highway.

Our field investigations and the results of chronometric determinations are discussed in Volume 1. Project syntheses and conclusions are presented in Volume 3. In this volume, we present the results of analyses of recovered ceramics, lithics, vertebrate and invertebrate remains, macrobotanical and pollen, and human osteology and dentition from the prehistoric sites. No historical-period artifacts were recovered.

In this volume, Chapter 2 presents a discussion of the formal and typological characteristics of over 20,000 sherds, 3 modeled clay artifacts, and 221 complete or reconstructible vessels. Most of these vessels were plain red ware and Salado Red Corrugated bowls and jars recovered from mortuary contexts at the Vegas Ruin and Crane site. Also present were small numbers of a variety of Little Colorado White Ware and Cibola White Ware, as well as Pinto Black-on-red vessels. In addition to these ceramic types, the decorated sherd collection included small numbers of Hohokam Buff Ware, a variety of Roosevelt Red Ware, Kana'a Black-on-white, San Juan Red Ware, Reserve Indented Corrugated, and McDonald Painted Corrugated. Chapter 3 presents a petrographic analysis of 55 plain and red ware sherds from the Vegas Ruin and Crane site, as well as 16 clay samples from local deposits and the linings of domestic hearths.

Chapter 4 discusses the analysis of over 4,500 flaked and ground stone artifacts. The majority of these were flaked stone tools but there also were 266 ground stone tools and 39 ground stone ornaments. Prehistoric people of the project area relied on locally available materials to meet their stone-tool needs. Nonlocal materials, such as obsidian, turquoise, and steatite, were used only occasionally. Argillite, which was easily accessible, was also used for the manufacture of ornaments. Only a small amount of obsidian was recovered and 5 specimens were submitted for X-ray Fluorescence (XRF) analysis, which indicated that most obsidian was derived from the distant Government Mountain source, with the remainder from the Superior source. Projectile points were most numerous in burial contexts at Vegas Ruin; Sedentary Side-notched and Classic Side-notched points were the most

numerous types. Several Archaic period dart points were also recovered. One of these may represent an Archaic period occupation at Site 103/2061, but the others appear to be heirlooms. Trough metates and manos were among the most numerous ground stone artifacts, although basin and slab metates were also common. The stone-tool collection included a surprisingly small number of tabular tools.

The project yielded a collection of almost 3,000 faunal specimens, all of which were analyzed as discussed in Chapter 5. Faunal indexes indicated that riparian resources formed a minor component of the prehistoric diet. Temporal shifts in the lagomorph index values indicate a greater number of cottontails compared to jackrabbits were likely available and dispatched during the pre-Classic–Classic transition. This situation changed during the Classic period, when the lagomorph index value declined, suggesting a reduction in sufficient cottontail habitat or that perhaps communal hunts were conducted with greater frequency. Large-game index values indicate that artiodactyl availability increased dramatically during the Classic period. Many of the artiodactyl elements from the Vegas Ruin and Crane site had been worked into bone tools that were interred with the dead.

In Chapter 6, we describe the more than 300 pieces of shell recovered from both mortuary and nonmortuary contexts. There were 11 marine and 3 freshwater and terrestrial genera represented, of which *Glycymeris*, *Laevicardium*, and *Olivella* were the most common. The great majority of this collection consisted of complete or fragmentary shell ornaments, primarily beads, although pendants and bracelets were also common. The remainder consisted of unfinished artifacts and waste material primarily from *Laevicardium* shell, reflecting local manufacturing activities.

Chapter 7 discusses the results of analyses of 83 flotation samples, 47 archaeological soil samples, and 59 pollen-wash samples obtained from mortuary vessels. The archaeobotanical record suggests that pre-Classic period people were relying upon at least four domesticated/managed plants (agave, cotton, little barley, and beans), and a variety of wild annual and perennial plants. Maize was notably absent. During the Classic period, there was a shift in emphasis to maize and agave, although cotton and gourds or squash were also present. Throughout the long chronological sequence from the Archaic period through the Classic period, groups burned juniper, mesquite, and creosote-bush wood; sought reedgrass and other grass stems for other needs; and only occasionally brought in a number of other wood types either available locally or possibly recovered as driftwood.

Osteological analyses, presented in Chapter 8, indicate that the individuals were healthy and the osteological indicators of infection, degenerative changes, porotic hyperostosis, and—to some extent—trauma, are consistent with other reports of neighboring Tonto Basin peoples. One of the individuals exhibited a condition—pituitary dwarfism—that is rarely observed archaeologically. Although the sample was small, the relatively high incidence of genetic abnormalities such as Klippel-Feil syndrome and dwarfism may reflect genetic isolation of the resident population. The dental analyses discussed in Chapter 9 suggest similar rates of caries and enamel hypoplasia as other populations in Tonto Basin. Analysis of dental-trait frequencies suggest the SR 188–Cottonwood Creek Project population was most closely related to the other Tonto Creek and Mogollon populations.

The volume is completed with a diverse set of appendixes in the attached DVD-ROM. Appendix A.1 includes the ceramic attribute recording methods and definitions and is accompanied by Appendixes A.2 and A.3, which include the photographs and descriptive information for the reconstructible vessels. Appendix B.1 includes the results of the XRF analysis by Steven Shackley, and Appendix B.2 includes descriptive tables of the lithic artifacts. Appendix C.1 presents basic descriptive data on shell artifacts. Appendix D.1 includes the results of the flotation analyses by Karen Adams, and Appendixes D.2 and D.3 include the pollen analysis reports by Owen Davis. Osteological field recording forms detailing recovered osteological elements for each burial are presented in Appendix E.1. Finally, Appendix F.1 describes the morphological dental crown traits used to examine genetic affiliations.

CHAPTER 1

Introduction

Eric Eugene Klucas

This document is the second of three volumes reporting the results of a two-phase data recovery project conducted by Statistical Research, Inc. (SRI), for the Arizona Department of Transportation (ADOT) along a 3.8-mile-long segment of State Route (SR) 188 in Gila County, Arizona. The work was conducted through ECS Contract 99-60 (TRACS H4476-03D) with ADOT on lands administered by Tonto National Forest (TNF). In Volume 1, we present the results of field investigations at nine prehistoric and one historical-period site that were to be impacted by proposed modifications to SR 188. Volume 2 contains the results of artifact and other specialized analyses of data collected from the prehistoric sites in the sample (Table 1). Synthetic studies integrating the field and analysis data are presented in Volume 3. Much of the raw data that constitute the foundation for these studies are presented in the appendixes attached to this volume.

Project Summary

The Cottonwood Creek Project (CCP) area is located at the transition between the upper and lower portions of Tonto Basin in central Arizona (Figures 1 and 2). Because Volume 1 contains a detailed discussion of the physical and cultural setting of the project, only a brief summary of the relevant information is provided here. The right-of-way (ROW) comprises a narrow band along the current alignment of SR 188. Beginning in the south, the highway follows the edge of the Pleistocene terrace west of the broad floodplain of Tonto Creek. The southern portion of the project area is dominated by a desert-scrub biotic community characterized by stands of mesquite and palo verde trees; cactus, such as prickly pear, cholla, and saguaro; and numerous species of desert grasses, forbs, and shrubs. The transitional nature of vegetation in the area is reflected in the presence of a small number of juniper trees observed on the terraces above the floodplain. The terrace is cut at several points along the project corridor by small tributaries of Tonto Creek that drain the eastern slopes of the Mazatzal Mountains.

The impacted sites located in the southern portion of the project are clustered around Cottonwood Creek, one of the small tributaries west of Tonto Creek (Figure 3). These include two late Sedentary/early Classic period habitation sites, the Vegas Ruin (AZ U:3:405/2012) (Figure 4) and the Crane site (AZ U:3:410/2017) (Figure 5), both representing small, multi-household farmsteads or hamlets. An earlier, possibly Archaic period component was also identified at the Vegas Ruin. Other habitation sites in this area include the Rock Jaw site (AZ U:3:407/2014), a small late pre-Classic or early Classic period farmstead and AZ U:3:408/2015, a large, dispersed, multicomponent site encompassing several discrete habitation loci (see Figure 3). All four of the habitation sites were only partially contained within the project ROW. Major portions of the habitation areas at the Vegas Ruin, Crane site and the Rock Jaw site were contained within the ROW; however, only a peripheral area of one habitation locus at Site 408/2015 was contained within the ROW. The ROW also impacted two additional prehistoric sites in this section of the project corridor: AZ U:3:406/2013 and AZ U:3:409/2016. Site 406/2013 encompassed a sparse lithic and ceramic artifact scatter east of the current alignment of SR 188. Although no buried cultural deposits were identified within the ROW, a small arroyo outside the ROW exposed a lens of ashy, artifact-bearing sediments. Site 409/2016 encompassed a sparse lithic and ceramic artifact scatter below the ridge containing the Crane site. No subsurface cultural deposits were identified within the ROW. Indeed, it is possible that the artifact scatter recorded as Site 409/2016 may simply reflect sheet wash from the Crane site.

Moving north, the project corridor passes through a man-made cut in a large schist outcrop that divides Tonto Basin into its upper and lower zones (Fuller et al. 1976). North of this outcrop, the basin is constricted along several smaller drainages, among them Gold, Hardt, and Rye Creeks. In

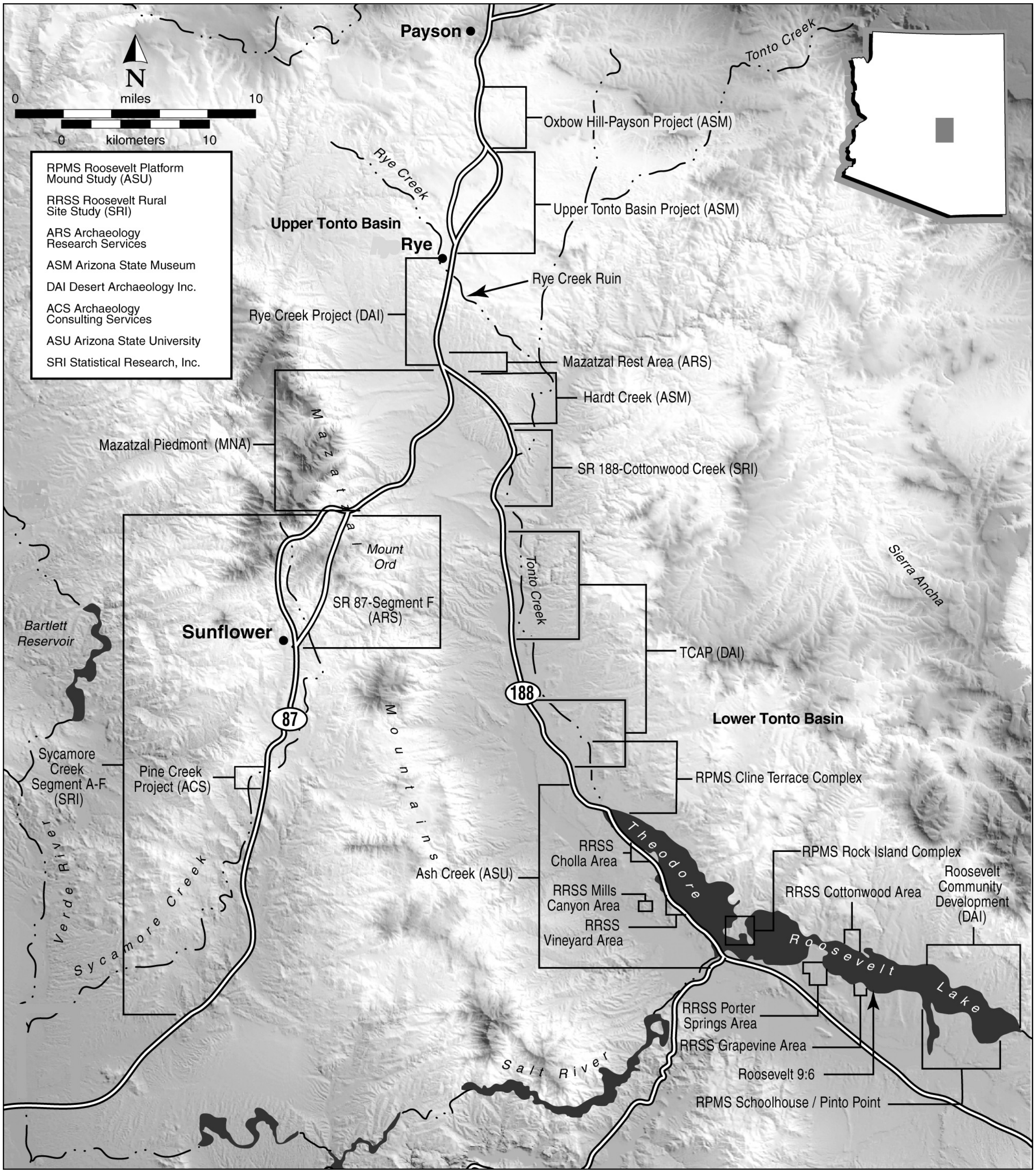

Figure 1. Overview of central Arizona showing projects mentioned in the text.

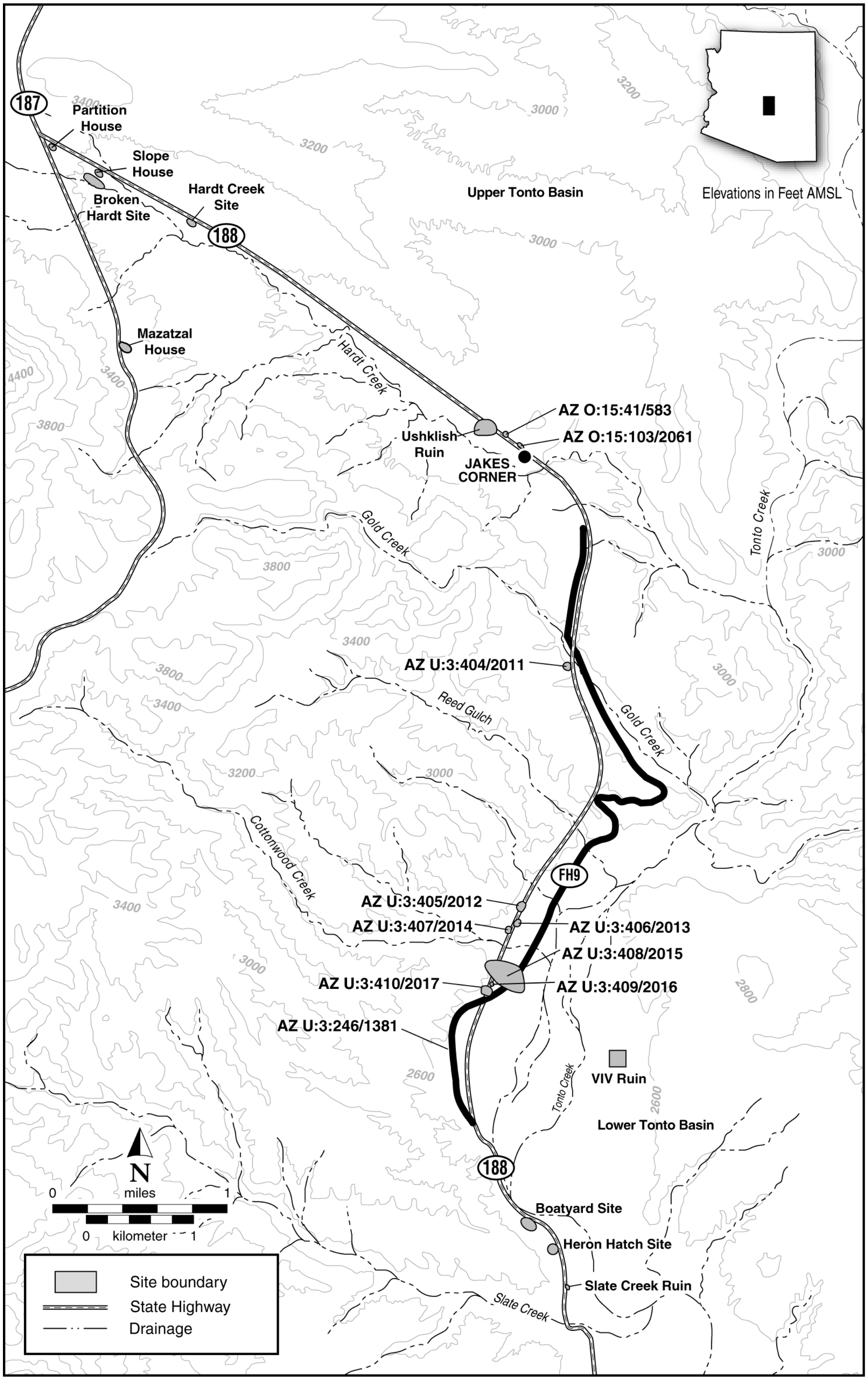

Figure 2. The SR 188–Cottonwood Creek Project and nearby sites.

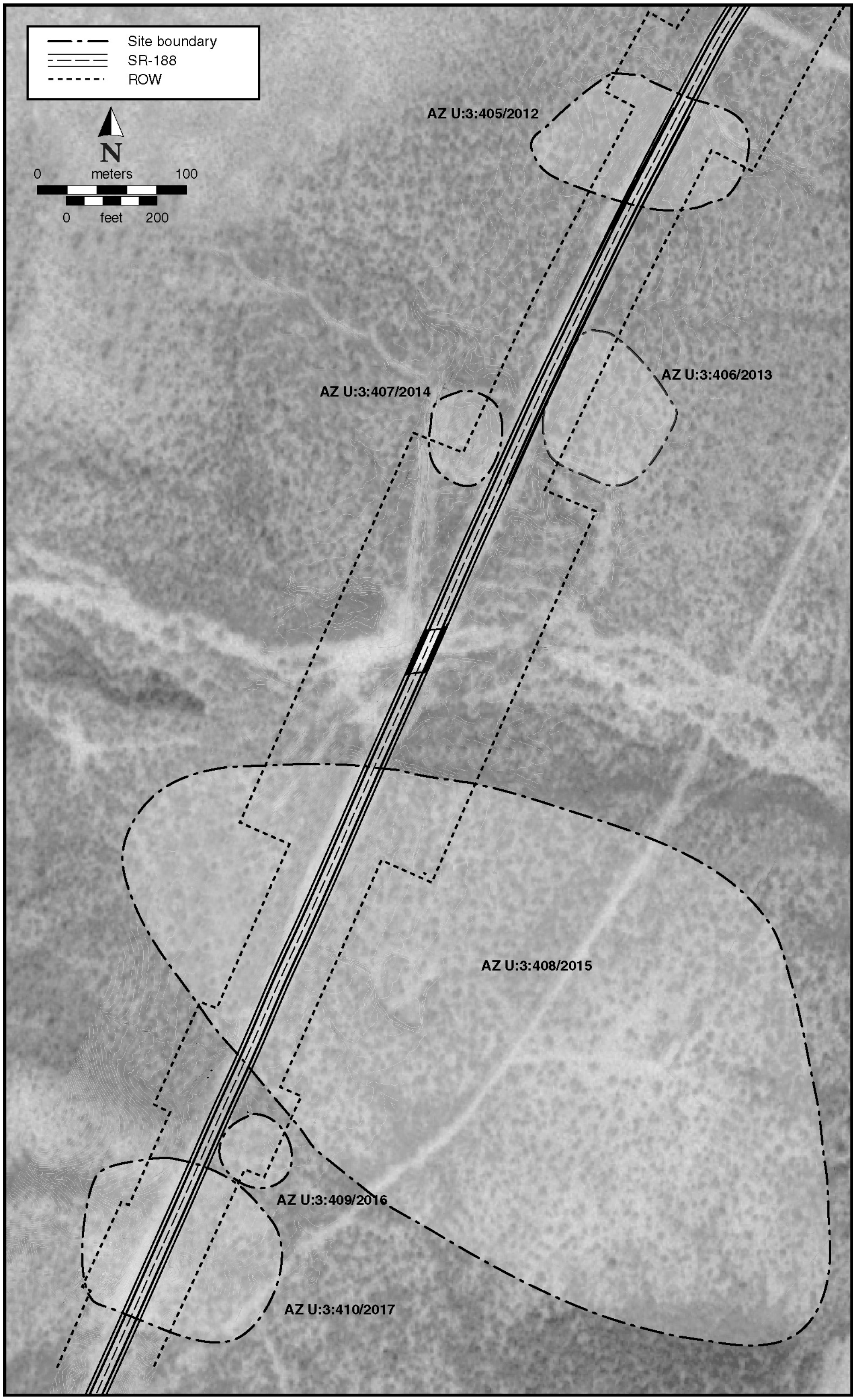

Figure 3. Prehistoric sites in the Cottonwood Creek area.

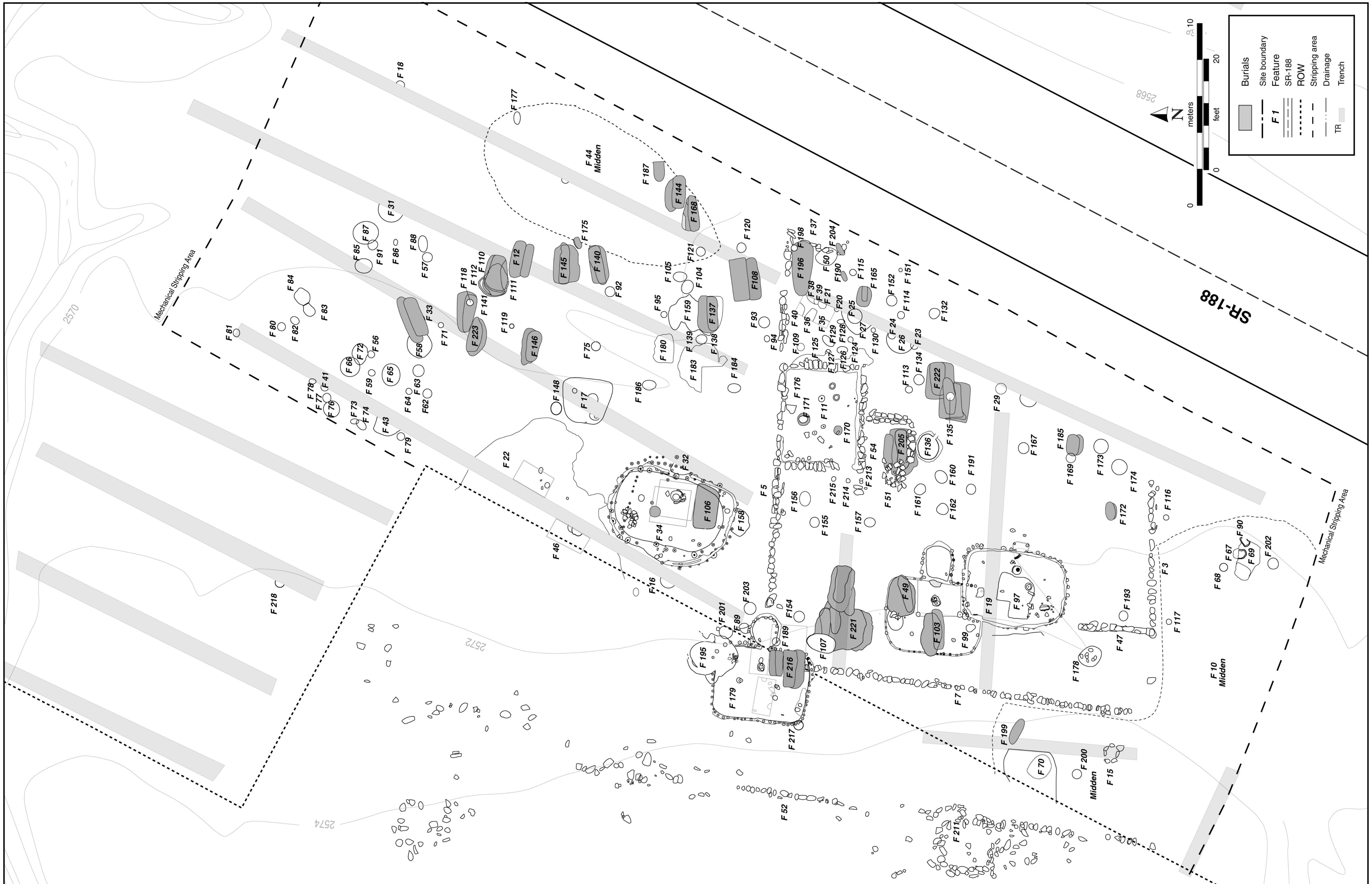

Figure 4. The Vegas Ruin (405/2012).

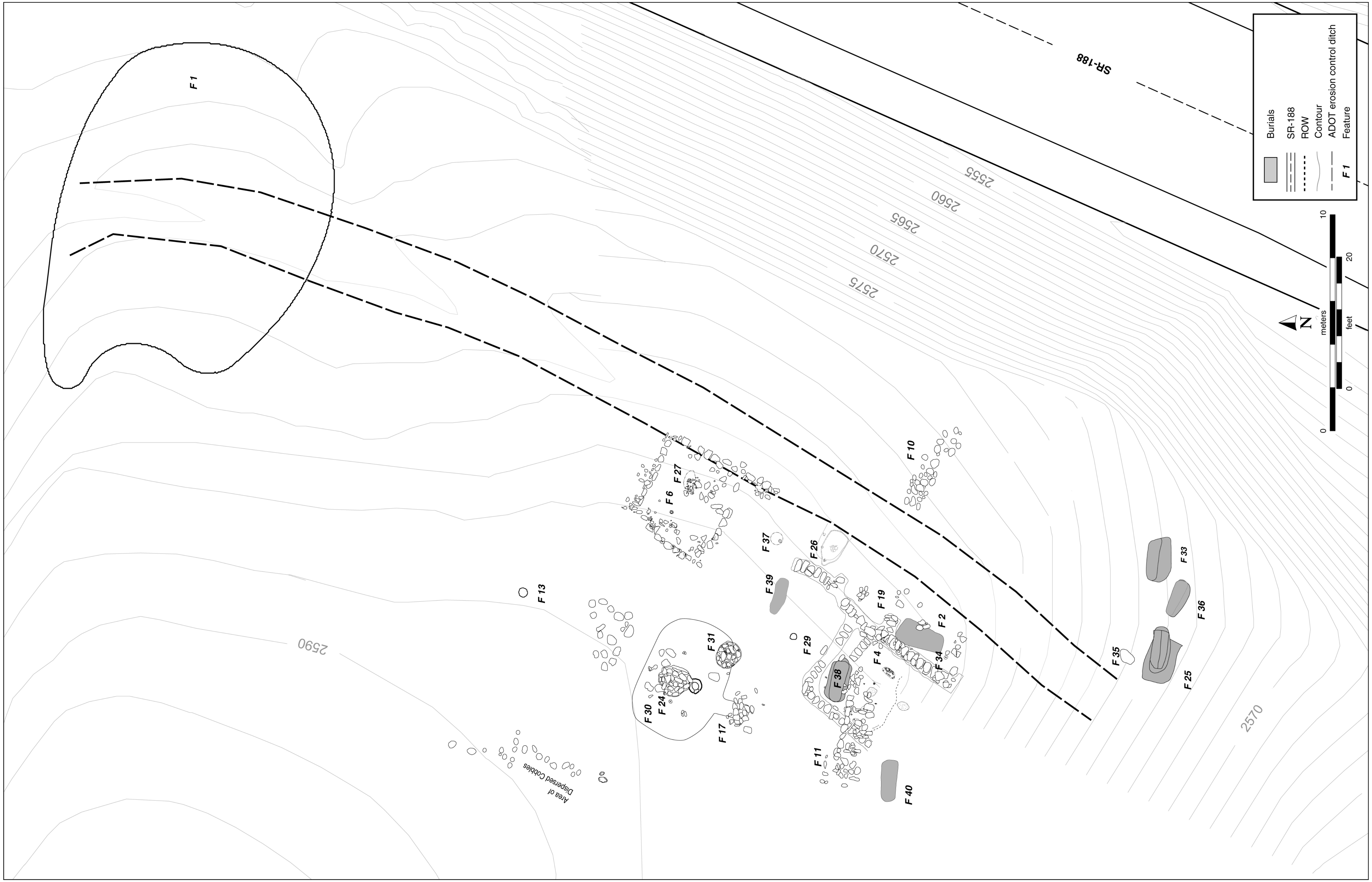

Figure 5. The Crane site (410/2017).

these areas, there is a decrease in the number and variety of desert species coupled with an increase in juniper, piñon pine, and grasses. In further contrast to the southern portion of the project area, the northern area lacks the wide expanse of alluvial soils that characterizes the Tonto Creek floodplain, resulting in greater spatial limitations to agricultural activities.

Three prehistoric sites in the northern portion of the project area were impacted by the proposed improvements to SR 188. AZ U:3:404/2011 included a Classic period cobble-adobe-foundation field house situated on a broad ridge overlooking Gold Creek (Figure 6). The remaining two sites were located in the lower portion of the Hardt Creek valley. AZ O:15:103/2061 consisted of a dispersed scatter of lithic and ceramic artifacts, with much of the site extending onto private property beyond the ROW (Figure 7). AZ O:15:41/583 encompassed a large *horno* and associated debris approximately 100 m southeast of the site of Ushklish (AZ O:15:31 [ASM]), a multicomponent pre-Classic and Classic period habitation site (see Figure 7) (Haas 1971).

The single historical-period site investigated during the CCP is the former Globe-Payson Highway (AZ U:3:246/1381), also referred to as Forest Highway (FH) 9 (see Figure 2). Because no materials associated with this site were found during our data recovery investigations, it is excluded from the analyses in this volume.

Research Themes

In accordance with the TNF's cultural resource management plan (Wood et al. 1989), we used the concepts of historic contexts, themes, and property types (see Dart and Doelle 1988) to evaluate and organize the cultural resources in the project area and to develop a coherent research strategy (Ciolek-Torrello and Klucas 1999). We focused our research on three historic contexts: subsistence and settlement; demography; and exchange, trade, and commerce. Within each of these contexts, we selected a number of research themes and devised a field strategy that could provide the requisite data for addressing each theme. A substantial body of comparative data is currently available, because several recent projects in Tonto Basin have framed their research around these same contexts. Although discussed in detail in the treatment plan (Ciolek-Torrello and Klucas 1999), a brief summary of these themes and the requisite data is presented here. Those questions that require the synthesis of multiple lines of evidence are explored further in Volume 3.

Subsistence and Settlement

In their overview of cultural resources encompassed by the TNF, Macnider and Effland (1989) outlined a number of subsistence-related research topics, including land-use patterns, plant domestication, agricultural strategies, and the technologies associated with food preparation and storage. With these issues in mind, we framed a number of more-specific questions that were used to help guide our sampling strategy and analyses. These included identifying the level of agricultural dependency, the selection and acquisition of natural resources, and assessing the level and nature of group and individual mobility.

Many of the questions pertaining to subsistence are addressed in this volume and in Volume 3 through the analysis of direct data, such as pollen, macrobotanical remains, and faunal bone. In order to maximize the potential that these kinds of data would be recovered, our sampling strategy focused on the kinds of features that experience has shown produce carbonized botanical and faunal materials, such as burnt houses, hearths, and pits. In addition to these indicators, several lines of indirect evidence were also investigated, including implements and features used for food processing and storage.

The degree of mobility or sedentism of a group is an integral part of their strategy for exploiting an environment. The degree of sedentism of pre-Classic period farmers in central Arizona remains an unresolved issue (Elson 1992; Vanderpot et al. 1999; Welch 1994). By examining the distribution of modern biotic communities, soils, and paleoclimate (see Ciolek-Torrello and Welch 1994; Huckell 1993), we attempt in Volume 3 to make predictions about food productivity, resource choices, and patterns of mobility. In Volume 3, these predictions are compared against subsistence data obtained from habitation sites and the locations of agricultural features, specialized resource-procurement and -processing sites, and field houses.

Demography

Regional population growth and decline; aggregation and dispersion across the landscape; population movements; ethnicity; and questions concerning health, for example diseases, epidemics, nutrition, and diet, represent the primary research issues under this theme. Issues related to health are usually addressed with data derived from skeletal populations. Although human remains were recovered from the CCP sites, the stricture against destructive analysis limited the extent to which human remains could contribute to the latter theme. For example, analyses of bone chemistry may have provided important insight on questions of diet and population movement (Ezzo 1992, 1993). Instead, important information about health was obtained directly from nondestructive examination of human bone and dentition and indirectly from subsistence data.

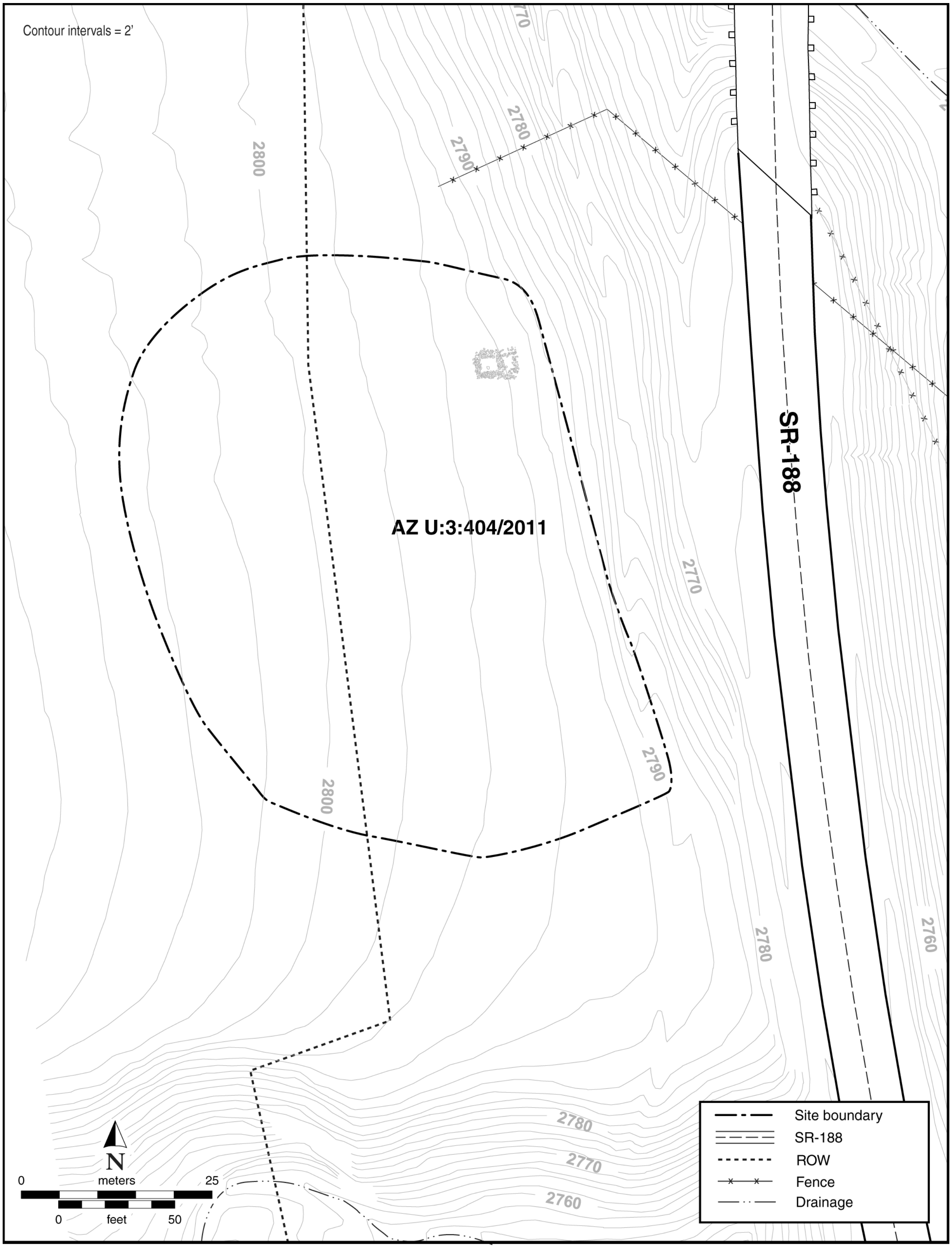

Figure 6. Site 404/2011.

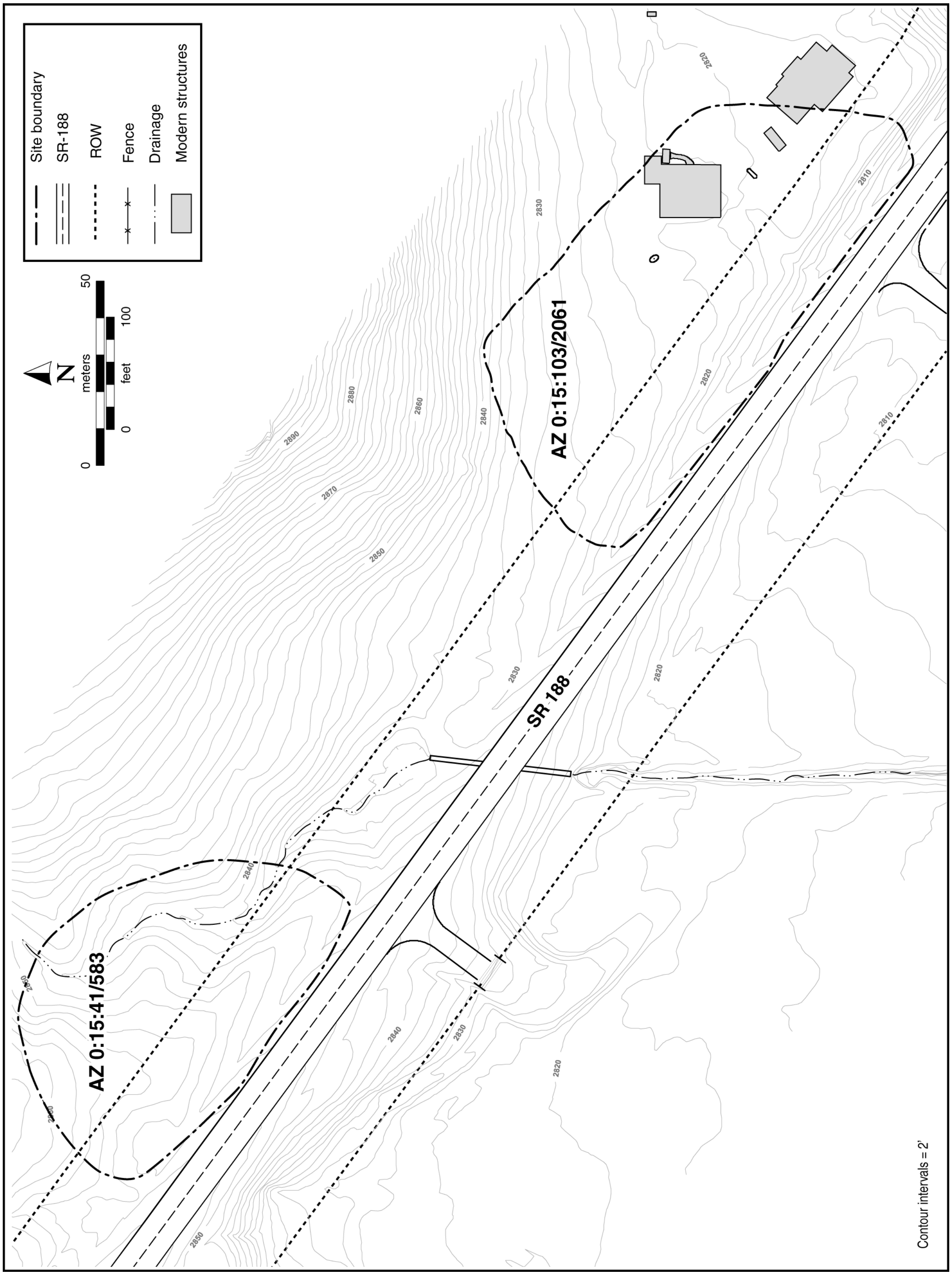

Figure 7. Prehistoric sites in the Hardt Creek area.

Ethnicity and participation in different sociopolitical-ideological systems of populations have been at the center of debate since the beginning of research in the region. Until recently, the consensus considered Tonto Basin to be part of the periphery of Hohokam culture, which was centered in the Phoenix Basin (Wood 1985; Wood and McAllister 1980). Scholars believed that Tonto Basin remained well integrated in the Hohokam regional system (Wilcox 1979) until the Classic period (Doyel 1976, 1978; Effland and Macnider 1991; Wood and McAllister 1980). Others have argued for a breakdown of this pattern during the Sedentary period (Ciolek-Torrello 1987; Elson et al. 1992). The ethnic affiliation of the Classic period Salado culture has been an even more contentious issue (Doyel and Haury 1976). Rice (1990) has suggested that the Salado were descendants of the Colonial period Hohokam settlers who adapted to local upland conditions. Others have maintained that the Salado were an ethnically diverse or Mogollon-affiliated culture that was heavily influenced by Hohokam culture and desert adaptation (Ciolek-Torrello 1987; Haas 1971; Hohmann 1992; Pilles 1976; Whittlesey and Reid 1982). As we discuss in Volume 3, architectural styles, material culture, and the treatment of the dead all provide important insight into the extent of possible Hohokam immigration and participation in Hohokam sociopolitical and ideological systems in the project area. These issues also provide some clues as to whether such migration or contact varied over time or whether it varied between the northern and southern portions of the project area.

Demographic issues pertinent to the Classic period include the development of intercommunity organizational systems, the geographic expansion of settlement, changes in regional interactions, and the relationship between agricultural intensification and the growth and distribution of population. It remains unclear when population peaked in the Classic period (compare Wood 1992 and Ciolek-Torrello et al. 1994), or if all portions of the region experienced similar demographic fluctuations. The Classic period also witnessed the development of much greater variation in site size and function than previous periods. Some researchers have attributed this variation to the development of hierarchically organized socioeconomic and political systems (Rice 1985, 1990; Wood 1989). Others (Ciolek-Torrello and Whittlesey 1994; Whittlesey and Ciolek-Torrello 1992) have argued that Classic period settlements were short lived and that few were contemporaneously occupied. These hypotheses are explored further in Volume 3 through an examination of the numbers and types of habitation structures; material culture indicators of ethnicity, such as ceramic and lithic artifact types; subsistence strategies; and, perhaps most importantly, human burials.

Exchange, Trade, and Commerce

Two research issues under this theme were effectively addressed with CCP data. The first issue is the nature or degree of interaction of pre-Classic and Classic period cultures in the project area with surrounding areas. In Volume 3, we ask questions such as, "How important was the interaction with the Hohokam core area and did such interaction vary within the project area or was the primary focus of cultural interaction elsewhere?" The presence of Hohokam Buff ware ceramic vessels and ritual items, such as palettes, censers, and figurines, commonly reflect interaction with the Hohokam, whereas white wares, polychrome ceramics, and intrusive red wares suggest exchange with Mogollon and Anasazi regions. The second issue we explore in Volume 3 is the degree of economic specialization exhibited by the prehistoric inhabitants of the project area. Palettes, stone censers, and projectile points are all commodities that have been proposed to have been made by craft specialists. Additional information regarding this issue was provided by the investigation of the raw materials used to manufacture craft products.

Summary of Volume 2

The research themes discussed above served as a guide for the analyses of artifactual and ecofactual data collected during the CCP. Although analytical methods that would provide the requisite data for the examination of these questions were selected, we were also mindful that these questions are certainly not exhaustive. Alternate approaches to the study of these materials are certainly possible. For that reason, the following chapters provide, first and foremost, detailed descriptions of the collections. More-detailed treatments of the research issues are reserved for Volume 3, in which several lines of evidence are brought together to create a much firmer interpretive foundation than that afforded by any single data set.

In Chapter 2, Heckman, Deaver, and Klucas describe the ceramic collections from the project sites. These data include 221 complete or reconstructible vessels, most of which were recovered from mortuary contexts. Taking advantage of this relatively large collection of vessels, the authors include a detailed examination of vessel form and how these data can inform on questions of vessel function—a question treated in greater detail in Volume 3. Ceramic data that are applied to questions of cultural affiliation and chronology are also presented. Chapter 3 presents the results of a petrographic analysis conducted on a sample of ceramic sherds collected from the project sites. These data are used to examine ceramic-production technology.

Chapter 4 presents the results of analyses carried out by Wegener, Hintzmann, and Rosenthal on the lithic collection, including both flaked and ground stone artifacts. Special attention is paid to materials recovered from mortuary contexts, including what appears to be a flint knapping tool kit recovered from one of the inhumations. General data on raw-material selection and manufacturing technology are also presented.

Chapters 5, 6, and 7 describe the recovered faunal, shell, archaeobotanical materials, respectively. In the faunal chapter, Wegener also presents data on bone tools, a class of artifacts whose potential for informing on questions of subsistence is often overlooked. In Chapter 6, Vokes presents the results of his analysis of shell materials. Although dominated by exotic species present in the form of jewelry and ornaments, the shell collection provides additional data on the local environment. In Chapter 7, Adams and Ciolek-Torrello present the results of flotation and macrobotanical analyses, providing an examination of variability in plant use across space and over time through a comparison of the SR 188 project data with those from several earlier projects in the area. This chapter is concluded with a summary and comparison of the pollen analysis results. More-detailed integration of the paleobotanical data with other subsistence related data is presented in Volume 3.

The final two chapters present the results of analyses conducted on the human remains impacted by the CCP. In Chapter 8, Minturn and Heilman present the results of their analysis of the skeletal remains from the impacted burials. In Chapter 9, Lincoln-Babb discusses the results of her analysis of dentition. Although emphasizing the importance of these data for the examining questions of health and diet, Lincoln-Babb also compares several nonmetric genetic traits expressed in the teeth that provide insight into population movement and affiliation. Finally, the volume concludes with several appendixes containing, among other things, analytical methods, summary tables, and the results of the pollen analyses.

A Note on Phase Designations

Most of the prehistoric sites in the SR 188–CCP sample were occupied across the transition from the pre-Classic to the Classic period (ca. A.D. 1150), a time of significant cultural change across the U.S. Southwest. This makes assigning phase designations to individual features at the sites exceptionally difficult, if not impossible. For that reason, we designated most of these sites simply as late pre-Classic/early Classic period for this volume. A more detailed examination of chronological issues for the CCP sites is presented in Volume 3. Some of the sites produced few, if any, unambiguous temporal markers. Because of the presence of pottery at these sites, we identified them simply as Formative period. As indicated above, several features at the Vegas Ruin were ascribed to the Archaic period based on their stratigraphic position and lack of ceramics. No finer temporal determination could be made for these features.

A Note on Site Designations

All of the project sites carry multiple designations. These include registration numbers conforming to systems managed by TNF and the Arizona State Museum (ASM), as well as project-specific recording systems used by the various institutions and cultural resource management firms that have conducted work in the area. The multiplicity of site designations can result in confusion, especially when referring to sites already described in the literature under other designations. As a means of reducing this confusion, we use the following conventions in this report. In addition, we gave names to several sites to simplify our narrative descriptions and interpretive discussions.

Most sites are described by a composite number incorporating both the TNF and ASM designations. All of the project sites are located in the Tonto Basin Ranger District of the TNF, which is designated AR-03-12-06. Sites within this district are assigned sequential site-specific identifiers appended to the Tonto Basin District number. The project area also lies within two site-survey quads used by ASM—AZ U:3 and AZ O:15. For the sake of brevity, we use a variety of abbreviations throughout the report. In section headings and the initial reference to a site in any chapter, a composite number that includes the complete ASM designation followed by the site-specific TNF identifier is used—for example, "AZ U:3:404/2011." We use the complete ASM designation in these instances to distinguish between the two quads. The "ASM/TNF" suffix is not used for site designations in the remainder of this report. For named sites, the name precedes the number in the initial mention and section headings; only the name is used in subsequent references—for example, "the Vegas Ruin (AZ U:3:405/2012)" and then "Vegas Ruin." Subsequent text references to unnamed sites include only the site-specific ASM and TNF numbers—for example, "Site 404/2011." For the title and body of tables and for figure captions, named sites are identified by the name and the site-specific number (e.g., "Vegas Ruin [405/2012]"); for unnamed sites, we use only the site-specific number (e.g., "Site 404/2011"). A concordance of the various site designations for the CCP sites is presented in Table 1.

Table 1. Cottonwood Creek Project Sites and Features in the Right-of-Way

ASM No.	TNF No.	SRI Designation	Site Name	Location	Occupation
AZ O:15:41	AR-03-12-06-583	Site 41/583		Hardt Creek	pre-Classic period *horno,* possible early Classic component
AZ O:15:103	AR-03-12-06-2061	Site 103/2061		Hardt Creek	Archaic-Formative period lithic scatter
AZ U:3:404	AR-03-12-06-2011	Site 404/2011		Gold Creek	early Classic period field house
AZ U:3:405	AR-03-12-06-2012	Site 405/2012	Vegas Ruin	Cottonwood Creek	4 Archaic period roasting features, 5 late Sacaton–Miami phase pit structures; early Classic period compound and burial ground
AZ U:3:406	AR-03-12-06-2013	Site 406/2013		Cottonwood Creek	late Sedentary–early Classic period artifact scatter
AZ U:3:407	AR-03-12-06-2014	Site 407/2014	Rock Jaw	Cottonwood Creek	late Sedentary–early Classic period farmstead
AZ U:3:408	AR-03-12-06-2015	Site 408/2015		Cottonwood Creek	2 pre-Classic period middens, extramural features, and 1 burial; early Classic period rock alignment
AZ U:3:409	AR-03-12-06-2016	Site 409/2016		Cottonwood Creek	late Sedentary–early Classic period artifact scatter
AZ U:3:410	AR-03-12-06-2017	Site 410/2017	Crane	Cottonwood Creek	1 possibly Archaic hearth; 1 late Sacaton–early Miami phase pit structure; early Classic period compound, 2 granaries, midden, and burial ground
AZ U:3:246	AR-03-12-06-1381	Site 246/1381	Globe-Payson Highway (FH 9)		5 segments of a historical period road and associated features

Key: ASM = Arizona State Museum; FH = Forest Highway; SRI = Statistical Research, Inc.; TNF = Tonto National Forest.

CHAPTER 2

Ceramic Analysis

Robert A. Heckman, William L. Deaver, and Eric Eugene Klucas

This chapter presents the analysis of ceramic artifacts recovered from nine prehistoric archaeological sites during the CCP. The project area extended along a 3.8-mile segment of SR 188 south from Hardt Creek. A total of 29,815 ceramic artifacts was recovered during the two-phase data recovery operations. Of these, 20,535 artifacts were selected for analysis, including 221 complete or reconstructible vessels that were mostly obtained from mortuary contexts and 3 modeled clay artifacts. The collection represents a relatively narrow sample in terms of the kinds of sites represented and their date of occupation. By far the largest portion of the collection was recovered from two late Sedentary to early Classic period occupation sites, the Vegas Ruin (AZ U:3:405/2012) and the Crane site (AZ U:3:410/2017), both of which produced materials from domestic and mortuary contexts. Smaller Classic period collections were recovered from Site AZ U:3:404/2011, a small Classic period field house, and Site AZ U:3:408/2015, a dispersed multicomponent site with limited subsurface cultural deposits within the ROW. Slightly earlier materials were recovered from the Rock Jaw site (AZ U:3:407/2014), a late pre-Classic to early Classic period farmstead, and Site AZ O:15:41/583, a late pre-Classic period limited-activity site possibly associated with the nearby Ushklish site (AZ O:15:31 [ASM]), a multicomponent pre-Classic and Classic period habitation site. The remaining sites, AZ U:3:406/2013, AZ U:3:409/2016, and AZ O:5:103/2061, produced small ceramic collections from surface contexts.

The goals of the ceramic analysis were twofold. The first was to describe and quantify the collections in a manner that would allow for comparisons with published data from other projects. Second, data were collected that would help address the research questions defined for the project. These questions followed the broad research themes outlined by TNF in their cultural resource management plan (Wood et al. 1989). Because these are discussed in detail elsewhere (Ciolek-Torrello and Klucas 1999), only those themes amenable to investigation through the ceramic collection are discussed here. After we completed our initial sort of collected materials, we further refined our specific research questions.

Given our understanding of the project sites, we believed that three of TNF's research themes could be successfully addressed: subsistence and settlement; demography; and exchange, trade, and commerce. Within each theme we defined several more related specific questions and identified the kinds of data required to investigate them (Ciolek-Torrello and Klucas 1999:Table 1). For a number of these themes, such as subsistence, determining vessel function and the distribution of functional types can provide important insight. Toward this end, we recorded several attributes relating to vessel form, which presumably is strongly correlated with vessel function (see below). Other research themes relate to exchange and regional interaction. As a means of addressing these questions, two lines of evidence were explored. First, because it has been long recognized that ceramic decorative style has a strong spatial component, detailed analysis of all painted sherds, reconstructible vessels, and whole vessels was undertaken. Second, recent work in Tonto Basin and elsewhere in the Southwest has suggested that petrographic analyses of nonplastic inclusions in the clay body may shed light on the source of the raw materials that were used and, by extension, the locus of manufacture of the pottery. As a means of addressing this question, we recorded paste composition and inclusions present in a sample of the plain ware sherds. Although this technique may have also shed light on the sources of decorated pottery, sourcing decorated wares would have been more complicated because most decorated wares were not locally made.

The extraordinary collection of whole and reconstructible vessels recovered provides an excellent data set. In this chapter we provide descriptive summaries of the vessel data in conjunction with the sherds. Vessel data are summarized in Table 2. Photographs and analysis of each vessel are

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
1	Vegas Ruin	133	inhumation	red plain	bowl	100	1,700	1,704	19.2	20.0
2	Vegas Ruin	196	inhumation	red plain	jar	99	—	2,501	9.5	19.0
3	Vegas Ruin	181	inhumation	red plain	bowl	100	620	662	15.1	16.0
4	Vegas Ruin	103	inhumation	red plain	bowl	99	—	4,717	24.1	25.1
5	Vegas Ruin	22	borrow pit	Salado Red Corrugated	bowl	100	740	759	14.0	15.1
6	Vegas Ruin	22	borrow pit	Salado Red Corrugated	bowl	98	—	494	11.2	12.2
7	Vegas Ruin	142	inhumation	Salado Red Corrugated	bowl	99	—	4,329	26.8	27.8
8	Vegas Ruin	143	inhumation	Salado Red Corrugated	bowl	90	—	1,286	16.6	17.6
9	Vegas Ruin	22	borrow pit	Salado Red Corrugated	bowl	93	—	1,503	16.0	17.2
10	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	100	2,925	3,008	23.0	23.8
11	Crane site	38	inhumation	Salado Red Corrugated	bowl	97	—	4,405	25.3	26.3
12	Vegas Ruin	146	inhumation	Walnut (Style B) Black-on-white	bowl	100	3,660	3,951	25.7	26.7
13	Vegas Ruin	168	inhumation	red plain	bowl	80	—	5,832	29.1	30.0
14	Vegas Ruin	108	inhumation	Salado Red Corrugated	bowl	98	—	6,000	27.3	28.4
15	Vegas Ruin	108	inhumation	Salado Red Corrugated	bowl	97	—	2,073	21.4	22.6
16	Vegas Ruin	145	inhumation	red plain	bowl	100	4,640	5,254	30.9	31.9
17	Vegas Ruin	207	inhumation	red plain	bowl	100	3,415	3,808	28.4	29.5
18	Vegas Ruin	207	inhumation	Pinto Black-on-Red	bowl	100	3,485	3,647	24.3	25.9
19	Vegas Ruin	137	inhumation	Leupp Black-on-white	bowl	100	2,385	2,414	19.6	30.0
20	Vegas Ruin	144	inhumation	Snowflake Black-on-white	bowl	100	1,230	1,320	15.4	16.8
21	Vegas Ruin	144	inhumation	red plain	bowl	70	—	2,887	23.1	24.4
22	Crane site	33	inhumation	Tularosa or Pinedale Black-on-white	bowl	100	1,100	1,199	15.2	16.5

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
23	Vegas Ruin	101	inhumation	red plain	bowl	99	3,150	3,215	24.1	25.2
24	Vegas Ruin	142	inhumation	red plain	bowl	100	2,120	2,241	19.5	20.5
25	Vegas Ruin	33	inhumation	red plain	jar	100	620	728	7.9	12.7
26	Vegas Ruin	219	inhumation	red plain	bowl	100	1,370	1,533	18.7	19.7
27	Vegas Ruin	175	inhumation	red plain	jar	80	—	1,303	7.9	17.2
28	Vegas Ruin	14	inhumation	Salado Red Corrugated	bowl	70	—	3,813	23.8	25.0
29	Vegas Ruin	12	inhumation	Roosevelt Black-on-white	jar	99	800	728	7.1	12.0
30	Vegas Ruin	33	inhumation	Roosevelt Black-on-white	jar	100	1,350	1,474	8.3	15.0
31	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	100	2,150	2,201	20.4	21.4
32	Vegas Ruin	33	inhumation	red plain	bowl	95	—	1,238	15.9	17.0
33	Vegas Ruin	33	inhumation	brown corrugated	jar	45	—	5,431	12.9	24.0
34	Vegas Ruin	12	inhumation	red plain	bowl	100	880	1,076	15.2	16.3
35	Vegas Ruin	33	inhumation	Walnut (Style A) Black-on-white	bowl	100	1,220	1,309	16.1	17.1
36	Vegas Ruin	33	inhumation	Walnut (Style B) Black-on-white	bowl	100	2,540	3,137	22.9	23.8
37	Vegas Ruin	133	inhumation	red plain	jar	100	1,050	1,197	7.3	15.6
38	Vegas Ruin	133	inhumation	red plain	jar	100	1,300	1,185	8.3	15.0
39	Vegas Ruin	106	inhumation	red plain	jar	100	1,220	1,415	9.0	16.0
40	Vegas Ruin	33	inhumation	Salado Red Corrugated	bowl	100	3,860	3,543	19.7	22.4
41	Vegas Ruin	49	inhumation	Salado Red Corrugated	jar	100	—	1,482	8.1	15.2
42	Vegas Ruin	108	inhumation	Salado Red Corrugated	bowl	90	350	381	9.5	10.6
43	Vegas Ruin	133	inhumation	red plain	bowl	85	—	2,151	17.5	18.4
44	Vegas Ruin	33	inhumation	red plain	bowl	100	—	2,942	23.7	25.0

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
45	Vegas Ruin	102	inhumation	Salado Red Corrugated	bowl	90	—	745	11.0	12.9
46	Vegas Ruin	185	inhumation	Salado Red Corrugated	bowl	90	460	521	9.3	11.2
47	Crane site	38	inhumation	Salado Red Corrugated	jar	98	850	902	7.2	13.2
48	Vegas Ruin	14	inhumation	Salado Red Corrugated	bowl	100	—	6,956	32.0	33.0
49	Vegas Ruin	14	inhumation	Salado Red Corrugated	bowl	100	—	8,527	26.4	27.2
50	Vegas Ruin	101	inhumation	Salado Red Corrugated	bowl	100	2,785	2,918	22.9	23.9
51	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	99	3,660	3,740	24.0	24.9
52	Vegas Ruin	166	inhumation	Salado Red Corrugated	bowl	100	4,460	4,554	26.7	27.6
53	Vegas Ruin	146	inhumation	red plain	bowl	99	3,500	3,460	25.0	26.2
54	Vegas Ruin	33	inhumation	red plain	bowl	85	—	6,129	29.1	30.0
55	Vegas Ruin	142	inhumation	red plain	bowl	100	4,660	4,674	26.8	27.7
56	Crane site	21	inhumation	Pinto Polychrome	bowl	100	2,850	2,854	20.4	22.1
57	Crane site	33	inhumation	Salado Red Corrugated	bowl	97	4,760	4,578	25.2	26.3
58	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	95	—	4,274	25.0	26.0
59	Vegas Ruin	106	inhumation	red plain	jar	100	—	1,332	8.3	16.5
60	Vegas Ruin	101	inhumation	Salado Red Corrugated	bowl	100	970	1,044	16.3	17.3
61	Vegas Ruin	133	inhumation	brown plain	jar	100	60	55	3.0	6.4
62	Vegas Ruin	101	inhumation	red plain	bowl	99	1,880	1,973	21.2	22.3
63	Vegas Ruin	143	inhumation	red plain	bowl	100	—	3,347	22.1	23.0
64	Vegas Ruin	144	inhumation	Salado Red Corrugated	bowl	100	—	3,930	24.1	25.1
65	Vegas Ruin	141	inhumation	Salado Red Corrugated	bowl	100	—	1,157	16.0	17.0
66	Vegas Ruin	140	inhumation	red plain	bowl	80	—	1,313	17.4	18.5
67	Vegas Ruin	141	inhumation	red plain	jar	100	1,980	1,980	11.0	16.8

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
68	Vegas Ruin	49	inhumation	Walnut (Style A) Black-on-white	bowl	100	3,380	3,399	19.7	21.1
69	Vegas Ruin	106	inhumation	red plain	bowl	98	—	3,354	24.5	25.9
70	Vegas Ruin	142	inhumation	Salado Red Corrugated	bowl	100	245	229	8.3	9.8
71	Vegas Ruin	108	inhumation	red plain	jar	99	1,210	1,321	7.4	15.3
72	Vegas Ruin	108	inhumation	Snowflake Black-on-white	jar	100	—	10,461	8.3	31.4
73	Vegas Ruin	142	inhumation	red plain	bowl	100	1,580	1,742	16.3	17.9
74	Vegas Ruin	106	inhumation	red plain	jar	99	885	956	7.2	14.1
75	Vegas Ruin	137	inhumation	Salado Red Corrugated	bowl	90	—	3,383	23.6	24.7
76	Vegas Ruin	142	inhumation	red plain	bowl	100	1,190	1,214	13.0	15.4
77	Vegas Ruin	143	inhumation	red plain	bowl	99	—	1,803	20.5	21.5
78	Vegas Ruin	143	inhumation	Salado Red Corrugated	jar	100	710	777	7.5	12.6
79	Vegas Ruin	142	inhumation	red plain	jar	100	—	1,374	7.8	15.6
80	Vegas Ruin	141	inhumation	Salado Red Corrugated	bowl	100	3,480	3,532	22.4	23.3
81	Vegas Ruin	137	inhumation	red plain	jar	100	1,200	1,229	8.1	14.8
82	Vegas Ruin	145	inhumation	red plain	bowl	100	1,170	1,126	15.4	16.4
83	Vegas Ruin	146	inhumation	red plain	bowl	100	1,700	1,876	16.6	17.5
84	Vegas Ruin	207	inhumation	red plain	bowl	100	—	6,198	30.2	31.3
85	Vegas Ruin	168	inhumation	red plain	jar	100	1,270	1,211	7.0	15.6
86	Vegas Ruin	145	inhumation	red plain	jar	100	1,450	1,467	8.7	15.6
87	Vegas Ruin	168	inhumation	red plain	bowl	95	—	5,004	28.4	29.5
88	Vegas Ruin	181	inhumation	red plain	jar	100	595	650	7.4	12.0
89	Vegas Ruin	181	inhumation	Salado Red Corrugated	jar	100	530	577	5.7	11.4
90	Vegas Ruin	181	inhumation	red plain	bowl	100	170	171	7.8	8.6

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
91	Vegas Ruin	166	inhumation	Salado Red Corrugated	jar	100	870	872	7.6	14.5
92	Vegas Ruin	144	inhumation	Salado Red Corrugated	jar	100	1,040	1,140	9.1	14.5
93	Vegas Ruin	144	inhumation	Salado Red Corrugated	jar	100	420	430	5.6	10.6
94	Vegas Ruin	103	inhumation	red plain	jar	100	1,410	1,428	9.4	14.8
95	Vegas Ruin	103	inhumation	red plain	bowl	100	—	1,424	17.1	18.0
96	Vegas Ruin	103	inhumation	Salado White-on-red	jar	98	—	609	7.3	11.3
97	Vegas Ruin	133	inhumation	red plain	jar	100	1,470	1,540	10.0	16.0
98	Vegas Ruin	206	inhumation	Walnut Black-on-white	bowl	100	1,140	1,222	16.8	17.9
99	Vegas Ruin	146	inhumation	Snowflake Black-on-white	jar	99	920	992	5.5	14.0
100	Vegas Ruin	207	inhumation	red plain	jar	100	840	—	6.4	14.8
101	Vegas Ruin	207	inhumation	red plain	bowl	100	660	605	14.0	14.8
102	Vegas Ruin	207	inhumation	red plain	bowl	100	1,320	1,397	18.2	19.0
103	Vegas Ruin	207	inhumation	red plain	jar	100	1,330	1,331	6.3	15.2
104	Vegas Ruin	207	inhumation	Reserve Black-on-white	jar	100	1,420	1,399	7.0	15.9
105	Vegas Ruin	220	inhumation	red plain	neckless jar	100	1,010	979	2.6	13.4
106	Vegas Ruin	133	inhumation	Salado Red Corrugated	bowl	98	—	2,342	21.9	22.8
107	Vegas Ruin	49	inhumation	Reserve Black-on-white	jar	97	—	2,009	6.9	17.9
108	Vegas Ruin	207	inhumation	red plain	eccentric (jar)	100	830	824	3.8	13.2
109	Vegas Ruin	219	inhumation	Salado Red Corrugated	bowl	100	1,230	1,164	18.4	19.4
110	Vegas Ruin	172	inhumation	red plain	bowl	100	1,220	1,118	14.8	15.6
111	Vegas Ruin	165	inhumation	red plain	bowl	100	—	665	12.5	13.5

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
112	Vegas Ruin	103	inhumation	brown corrugated	indeter-minate	30	—	—	—	—
113	Vegas Ruin	181	inhumation	Salado Red Corrugated	bowl	100	—	2,927	21.5	23.5
114	Vegas Ruin	181	inhumation	Salado Red Corrugated	bowl	100	—	4,858	23.4	24.5
115	Vegas Ruin	102	inhumation	red plain	jar	100	—	1,274	9.1	15.2
116	Crane site	38	inhumation	Salado Red Corrugated	bowl	99	600	675	15.3	16.2
117	Crane site	38	inhumation	red plain	bowl	100	—	1,093	13.3	14.4
118	Crane site	38	inhumation	red plain	bowl	100	—	1,034	13.7	14.9
119	Crane site	38	inhumation	red plain	bowl	100	—	1,586	16.6	17.4
120	Crane site	38	inhumation	red plain	bowl	100	—	1,239	16.7	17.7
121	Crane site	38	inhumation	red plain	bowl	98	—	1,832	18.0	19.0
122	Crane site	38	inhumation	Salado Red Corrugated	bowl	100	—	1,841	21.4	22.3
123	Crane site	38	inhumation	red plain	bowl	99	—	1,998	18.5	19.1
124	Crane site	38	inhumation	Salado Red Corrugated	indeter-minate	99	—	3,207	17.5	18.4
125	Crane site	38	inhumation	Salado Red Corrugated	jar	99	1,850	1,923	9.1	16.1
126	Crane site	40	inhumation	red plain	bowl	60	—	1,686	18.0	19.0
127	Crane site	40	inhumation	brown corrugated	indeter-minate	10	—	—	—	—
128	Crane site	38	inhumation	Salado Red Corrugated	jar	70	—	1,299	7.7	14.7
129	Crane site	38	inhumation	red plain	bowl	100	—	2,130	18.1	19.0
130	Crane site	38	inhumation	Salado Red Corrugated	jar	98	—	1,117	9.2	14.2
131	Crane site	38	inhumation	red plain	bowl	100	310	270	9.62	10.7
132	Crane site	38	inhumation	Salado Red Corrugated	jar	99	—	624	5.6	10.9

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
133	Crane site	39	inhumation	red plain	jar	92	—	1,627	9.1	15.6
134	Crane site	39	inhumation	red plain	bowl	99	—	1,433	12.3	15.5
135	Crane site	25	inhumation	red plain	jar	85	—	1,251	9.2	15.1
136	Crane site	33	inhumation	Salado Red Corrugated	bowl	100	1,740	1,835	16.8	17.9
137	Crane site	25	inhumation	red plain	bowl	50	—	2,915	20.8	22.0
138	Crane site	21	inhumation	red plain	jar	40	—	—	—	15.1
139	Vegas Ruin	137	inhumation	Salado Red Corrugated	bowl	99	2,740	2,894	22.1	23.0
140	Vegas Ruin	140	inhumation	red plain	ladle	95	390	378	11.6	12.4
141	Vegas Ruin	182	inhumation	red plain	bowl	100	—	1,024	17.5	18.4
142	Crane site	33	inhumation	brown corrugated	jar	99	—	379	4.5	10.3
143	Vegas Ruin	106	inhumation	red plain	bowl	100	—	1,457	19.6	20.5
144	Vegas Ruin	137	inhumation	Salado Red Corrugated	jar	90	—	16,266	14.7	35.9
145	Vegas Ruin	181	inhumation	red plain	bowl	100	—	4,697	29.2	30.0
146	Vegas Ruin	207	inhumation	red plain	bowl	100	3,540	3,718	27.0	28.1
147	Vegas Ruin	182	inhumation	red plain	jar	100	—	—	—	—
148	Vegas Ruin	182	inhumation	red plain	jar	100	—	2,146	8.9	18.2
149	Vegas Ruin	102	inhumation	red plain	bowl	15	—	3,095	20.9	22.0
150	Vegas Ruin	207	inhumation	Salado Red Corrugated	bowl	100	—	5,120	24.6	25.5
151	Vegas Ruin	181	inhumation	red plain	bowl	100	—	2,373	20.9	22.0
152	Vegas Ruin	204	inhumation	red plain	bowl	100	—	1,624	12.2	15.5
153	Vegas Ruin	182	inhumation	red plain	bowl	99	—	2,976	24.4	25.5
154	Vegas Ruin	182	inhumation	red plain	bowl	95	—	3,030	19.0	21.8
155	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	95	—	3,311	25.7	27.0

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
156	Vegas Ruin	103	inhumation	red plain	bowl	100	—	987	16.1	17.0
157	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	100	—	858	14.0	15.0
158	Vegas Ruin	103	inhumation	Salado Red Corrugated	bowl	100	—	1,474	13.2	16.0
159	Vegas Ruin	102	inhumation	Salado Red Corrugated	bowl	35	—	—	9.7	12.6
160	Vegas Ruin	146	inhumation	red plain	bowl	100	—	2,104	22.4	23.5
161	Vegas Ruin	181	inhumation	Salado Red Corrugated	bowl	100	—	1,524	17.4	18.5
162	Vegas Ruin	166	inhumation	Salado Red Corrugated	bowl	100	—	2,936	20.9	22.2
163	Vegas Ruin	206	inhumation	red plain	bowl	45	—	192	10.3	11.0
164	Vegas Ruin	190	inhumation	Snowflake Black-on-white	jar	35	—	—	3.3	6.5
165	Vegas Ruin	181	inhumation	red plain	bowl	100	1,440	—	—	—
166	Vegas Ruin	106	inhumation	red plain	scoop	100	1,360	—	—	—
167	Vegas Ruin	166	inhumation	Salado Red Corrugated	bowl	86	—	1,666	15.0	17.0
168	Vegas Ruin	144	inhumation	red plain	bowl	70	—	—	25.4	26.7
169	Vegas Ruin	103	inhumation	Salado Red Corrugated	effigy vessel	100	400	—	—	—
170	Vegas Ruin	14	inhumation	red plain	bowl	80	—	7,136	35.4	37.0
171	Vegas Ruin	172	inhumation	red plain	jar	95	—	1,062	6.4	15.6
172	Vegas Ruin	101	inhumation	red plain	jar	100	—	—	—	—
173	Vegas Ruin	175	inhumation	red plain	bowl	85	—	3,818	24.0	25.0
174	Vegas Ruin	207	inhumation	red plain	jar	100	—	—	—	—
175	Vegas Ruin	182	inhumation	red plain	bowl	20	—	3,532	28.7	30.0
176	Vegas Ruin	141	inhumation	red plain	bowl	100	—	1,029	15.9	16.8
177	Vegas Ruin	145	inhumation	red plain	bowl	90	—	1,528	17.4	18.5

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
178	Vegas Ruin	206	inhumation	red plain	trilobed jar	100	70	—	—	—
179	Vegas Ruin	49	inhumation	Salado Red Corrugated	bowl	99	1,840	1,845	19.1	20.1
180	Vegas Ruin	106	inhumation	red plain	bowl	100	1,010	1,029	15.6	16.6
181	Vegas Ruin	181	inhumation	red plain	bowl	100	—	1,272	14.0	18.1
182	Vegas Ruin	181	inhumation	red plain	bowl	80	—	953	16.3	17.0
183	Vegas Ruin	190	inhumation	red plain	bowl	35	—	1,100	17.6	18.5
184	Vegas Ruin	190	inhumation	red plain	jar	95	—	863	7.6	13.5
185	Vegas Ruin	14	inhumation	brown corrugated	scoop	95	410	—	—	—
186	Vegas Ruin	146	inhumation	red plain	bowl	90	—	3,351	23.8	25.0
187	Vegas Ruin	146	inhumation	red plain	bowl	85	—	4,372	24.3	25.0
188	Vegas Ruin	182	inhumation	red plain	bowl	80	—	3,372	25.8	27.0
189	Vegas Ruin	140	inhumation	red plain	jar	20	—	—	9.3	15.4
190	Vegas Ruin	172	inhumation	Salado Red Corrugated	bowl	60	—	1,049	16.1	17.0
191	Vegas Ruin	204	inhumation	Salado Red Corrugated	bowl	90	—	336	8.5	11.4
192	Vegas Ruin	196	inhumation	red plain	bowl	100	—	2,031	19.3	20.1
193	Crane site		nonfeature	red plain	bowl	80	—	—	—	—
194	Crane site	38	inhumation	Salado Red Corrugated	eccentric	100	—	—	—	—
195	Crane site	40	inhumation	red plain	bowl	85	—	3,076	22.3	23.5
196	Crane site	40	inhumation	red plain	indeter-minate	70	—	—	—	—
197	Vegas Ruin	152	adobe-lined pit	red plain	bowl	90	—	875	15.6	17.0
198	Vegas Ruin	221	inhumation	red plain	bowl	95	—	3,101	22.6	23.5
199	Vegas Ruin	21	inhumation	red plain	bowl	15	—	6,944	23.1	30.5

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
200	Vegas Ruin	221	inhumation	red plain	bowl	15	—	—	17.5	21.4
201	Vegas Ruin		nonfeature	red plain	indeter-minate	10	—	—	—	—
202	Vegas Ruin	195	borrow pit	Snowflake Black-on-white	bowl	20	—	—	18.7	19.5
203	Vegas Ruin	50	pot break	brown plain	indeter-minate	30	—	—	—	—
204	Vegas Ruin	69	borrow pit	red plain	bowl	35	—	582	13.4	14.0
205	Vegas Ruin	69	borrow pit	Salado Red Corrugated	bowl	20	—	482	13.1	14.0
206	Vegas Ruin	57	cache	brown plain	jar	30	—	—	18.3	—
207	Crane site	6	structure	red plain	bowl	40	—	2,334	23.8	25.0
208	Crane site	26	possible structure	Salado Red Corrugated	bowl	60	—	607	13.8	14.8
209	Crane site	30	pit house	red plain	bowl	35	—	—	11.5	15.6
210	Crane site	26	possible structure	Salado Red Corrugated	bowl	65	—	222	7.1	9.5
211	Crane site	26	possible structure	Salado Red Corrugated	jar	70	—	319	4.0	10.5
212	Crane site	28	pit	red plain	bowl	40	—	1,119	17.6	18.5
213	Crane site	26	possible structure	Salado Red Corrugated	jar	70	—	1,921	8.9	20.0
214	Crane site	26	possible structure	Salado Red Corrugated	jar	25	—	—	19.0	—
215	Crane site		nonfeature	red plain	bowl	15	—	—	50.7	52.0
216	Vegas Ruin	106	inhumation	Roosevelt Black-on-white	bowl	85	—	1,970	19.8	20.6
217	Vegas Ruin	127	cache	red plain	jar	100	—	183	3.8	8.2

Table 2. Provenience, Typological, and Dimensional Information for Reconstructible Vessels from CCP Sites (*continued*)

Vessel No.	Site[a]	Feature No.	Feature Type	Ware	Form	Completeness (%)	Measured Volume (ml)	Calculated Volume (ml)	Rim Orifice Diameter (cm)	Maximum Vessel Diameter (cm)
218	Vegas Ruin	146	inhumation	Walnut (Style B) Black-on-white	bowl	100	4,370	4,721	24.3	25.4
219	Crane site	25	inhumation	brown plain	bowl	40	—	1,724	21.2	22.5
220	Crane site	25	inhumation	red plain	bowl	100	—	2,711	24.3	25.5
221	Vegas Ruin	140	inhumation	red plain	bowl	<10	—	—	15.2	—

[a]Includes Vegas Ruin (405/2012) and the Crane site (410/2017).

presented in Appendixes A.2 and A.3. A detailed interpretation of the vessel data is presented in Volume 3.

In Chapter 3 of this volume, we used petrographic analysis to address a second question. Rather than attempting to identify the provenance of the raw materials, we used these data to explore more fundamental questions of ceramic technology. For example, were the nonplastic inclusions being intentionally added to the clay or are these materials present naturally in the selected clay sources? Beyond its value for understanding ceramic technology, the resolution of this question is crucial for the evaluation of studies seeking to identify ceramic manufacturing loci. As discussed in Chapter 3 of this volume, if the petrographic analysis can be taken at face value, the prehistoric potters were using clays that already had inclusions in it that would act as temper, and they did not need to add materials such as minerals or lithics.

We begin the chapter with a discussion of the analytical methods selected for the study. This includes a discussion of sample selection and the selection of attributes that were recorded. This is followed by a brief discussion of the typological distinctions that we made, including how our types compare with other regional systems, specifically that used by TNF. Next, we present a short description of Tonto Basin ceramics, providing a comparative base line for the CCP collection. For concordance between the TNF ceramic types and the typology followed in this analysis, see Table 3. We then present site-specific discussions of the collection, closing with a brief discussion of the place of the CCP collections in the broader context of Tonto Basin.

It should be noted that many of the research questions discussed above are not fully addressed in this chapter. Several lines of evidence are required to adequately explore some topics, and in these cases, the reader is directed to Volume 3.

Recent Ceramic Analyses in the Study Area

Archaeologists working in the Southwest have had an advantage over researchers working in many other areas in that the Formative period is characterized by rich ceramic traditions expressing considerable variation in both form and decoration. Much of the patterning in this variability has largely been seen as dependent on time, culture, or both. These assumptions are reflected in the goals of many ceramic studies, such as dating archaeological deposits or assigning cultural affiliation. In recent years, however, archaeologists working in central Arizona have expanded their ceramic-research horizons to address such issues as vessel function and how these data can inform on questions of domestic organization and subsistence (Heckman 2002; Vint 2000b), and they have performed compositional analyses of sherds as a means of identifying the provenance of the raw materials (Heidke and Miksa 2000; Miksa et al. 2003). These data are then used to investigate patterns of ceramic exchange and the organization of ceramic production.

For comparative purposes, we have selected two projects in the immediate environs of the CCP for discussion. Although these studies are not exhaustive in terms of the range of ceramic variation in the region or the kinds of questions to which ceramic data have been applied, they provide a more than adequate survey of the kinds of questions that have been pursued and suggest productive avenues for further research. Because detailed summaries of these projects have been presented elsewhere (see citations below), the discussion here is limited to the goals and results of the ceramic analyses.

The State Route 87–Sycamore Creek Project

The SR 87–Sycamore Creek project consisted of 29 prehistoric sites along a 25-mile-long corridor through the Mazatzal Mountains west of the CCP project area (Vanderpot et al. 1999). The sample of sites included habitation and limited-activity sites dating from the late Archaic period through the Classic period, although the ceramic collection was dominated by materials from a single late pre-Classic period farmstead, the Roundup site (Klucas and Woodson 1999).

Ceramic analyses for the SR 87–Sycamore Creek project were directed toward addressing questions within four broad research themes: chronology, settlement function, production and exchange, and cultural affiliation and interaction (Montgomery et al. 2003). Of these, the most substantive contribution to our understanding of the prehistory of the area concerned the last of these four research themes. In addressing these questions, data on production technology were used along with the more traditional indicators of ceramic form and decoration, as well as a petrographic analysis of selected ceramic sherds, sands, and rock samples (Miksa et al. 2003).

The ceramic data from the SR 87–Sycamore Creek project revealed significant variability in ceramic design and production technology across space and over time that may reflect a shift in cultural boundaries. Because these findings are presented in detail elsewhere (Montgomery et al. 2003), only a brief summary is offered here. During the pre-Classic period, occupation of the SR 87–Sycamore Creek project area was limited to the southern portions of the project area, characterized by a desert-scrub biotic community. The cultural focus of the Sycamore Creek area during this period appears to have been toward the Phoenix Basin. This was reflected in a decorated ceramic collection dominated by buff wares that were technologically and stylistically indistinguishable from examples recovered from the Salt-Gila area.

Table 3. Concordance between the SRI Categories and Types of Unpainted Ceramics and the Tonto National Forest Ceramic Types (Wood 1987)

SRI Ceramic Category or Type	Tonto National Forest Ceramic Type	Surface Treatment	Inclusions
Brown plain (sand-sized inclusions)	Gila Plain, Salt variety (Wood 1987:11)	smoothed, no slip	feldspar, quartz, and mixed lithics (granite)
	Tonto Plain, Verde variety (Wood 1987:13–14)	smoothed, no slip	feldspar, quartz, and mixed lithics (granite)
	Tonto Plain, Tonto variety (Wood 1987:14–15)	smoothed, no slip	diabasic sand
	Vosberg Plain (Wood 1987:22–24)	smoothed, no slip	diabasic sand
Brown plain (sand-sized inclusions with metamorphics)	Gila Plain, Gila variety (Wood 1987:11)	smoothed, no slip	feldspar, quartz, and mixed lithics (granite, and metamorphics)
Wingfield Plain	Wingfield Plain (Wood 1987:18–19)	smoothed, no slip	phyllite
Mogollon brown ware (Forestdale/Woodruff)	Forestdale Plain Wood (1987:74–75)	smoothed, no slip, exterior highly polished, smudged interior	sand
Local Mogollon brown ware	no equivalent	smoothed, no slip, exterior highly polished, smudged interior	feldspar, quartz (few lithics)
Salado Red Corrugated	Salado Red (Wood 1987:34–35)	corrugated exterior with red slip (thin, raspberry color), blackened or smudged interior, polished	sand, diabasic sand
Red plain (sand-sized inclusions)	Gila Red, Salt variety (Wood 1987:29)	smoothed, red-slipped exterior, smudged, or blackened interior	sand
	Gila Red, Verde variety (Wood 1987:30)	smoothed, red-slipped exterior, smudged, or blackened interior	feldspar, quartz
	Tonto Red (Wood 1987:27–28)	smoothed, red slip	sand
Red plain (sand-sized inclusions with metamorphics)	Santan Red (Wood 1987:28)	smoothed, red-slipped exterior, smudged, or blackened interior	feldspar, quartz, and mixed lithics (granite, and metamorphics)
	Gila Red (Wood 1987:28–29)	smoothed, red slip	schist
Brown corrugated (sand-sized inclusions)	Tonto Corrugated (Wood 1987:19)	indented corrugated exterior, tool polished, no slip	feldspar, quartz, and mixed lithics (granite)
	Vosberg Corrugated (Wood 1987:24–25)	indented corrugated exterior, tool polished, no slip	diabasic sand
Brown corrugated (sand-sized inclusions with metamorphics)	no equivalent	obliterated, indented corrugated exterior tool polished, no slip	gneiss, schist, phyllite

Table 3. Concordance between the SRI Categories and Types of Unpainted Ceramics and the Tonto National Forest Ceramic Types (*continued*)

SRI Ceramic Category or Type	Tonto National Forest Ceramic Type	Surface Treatment	Inclusions
Fine-pasted corrugated	no equivalent	obliterated, indented corrugations and tool polished, no slip	fine quartz
Gray corrugated	no equivalent	unmodified corrugation	fine quartz
Fine-paste red ware	no equivalent	smoothed well-polished exterior with slip, interior smudged	fine feldspar, quartz

A Phoenix Basin origin for these wares was supported by the petrographic analysis, which suggested that none of the decorated buff wares was locally made. In addition to the buff wares, a small number of Cibola White Ware and Tusayan White Ware sherds were recovered at two of the pre-Classic period habitation sites, suggesting at least minimal contact with the Mogollon-Anasazi areas to the north and east. By the Classic period, occupation had shifted to the northern, upland portions of the project area, accompanied by a change in cultural focus as reflected in the ceramic collection. Ceramics with "Hohokam" attributes were largely absent, with buff wares representing between 1 and 4 percent of the collection. These were replaced, albeit in small numbers, by types assigned to the Mogollon-Anasazi ceramic group, including examples of Little Colorado White Ware and single sherds of Hopi Yellow Ware and McDonald Painted Corrugated. Along with these, a moderate number of red plain sherds were also observed. As with the pre-Classic period sample, petrographic analyses indicated that most of the Classic period ceramics were not locally produced.

Tonto Creek Archaeological Project

The Tonto Creek Archaeological Project (TCAP), conducted by Desert Archaeology, Inc. (DAI), under contract to ADOT, involved data recovery operations at 27 prehistoric sites along an 8-mile-long segment of SR 188 (Clark and Vint 2000). The northern boundary of the TCAP project area is coterminous with the southern boundary of the CCP. Occupying a similar geographic setting and containing several sites contemporary with the CCP sample, data from the TCAP project can be used as a point of comparison and also to augment the smaller CCP collections.

Ceramic analyses conducted as part of TCAP were directed toward addressing questions of chronology (Vint 2000a), production (Heidke and Miksa 2000), and vessel function (Vint 2000b, 2000c). Because specific aspects of these studies are referred to in the appropriate chapters of this volume, they will not be repeated here. Notable among these, however, are the observations made concerning shifting loci of regional interaction that concur with those for the SR 87–Sycamore Creek project discussed above. The TCAP data, along with those from other projects in Tonto Basin, suggest that the change in regional interaction at the pre-Classic–Classic period transition occurred across central Arizona. As argued for the adjacent Sycamore Creek valley, the pre-Classic period sample reflects cultural contact with the Hohokam of the Salt/Gila area. This was greatly reduced by the Classic period, when the dominant influence, at least in decorated ceramics, was from the Anasazi and Mogollon areas to the north and east.

Petrographic analyses were conducted on the TCAP materials in an attempt to identify loci of ceramic production (Heidke and Miksa 2000). These data were then used to infer patterns of ceramic exchange and the extent, if any, of production specialization. These studies revealed that, as suspected, there was little evidence for the production of decorated ceramics in Tonto Basin, with the exception of small-scale production early in the Classic period. Ceramic production within the basin appears to have been limited to utilitarian wares for which, it has been argued, a specialized system of production and exchange had developed. These studies suggested that the impetus for this system was competition for agricultural land resulting from an influx of people into the basin during the Classic period. In their model, newcomers without access to arable land turned to ceramic production as a means of acquiring agricultural goods.

The TCAP ceramic sample contained an unusually large number of complete and reconstructible vessels, providing a substantial database for the study of vessel function. Although the majority of these vessels were recovered from mortuary contexts, it was argued that the pots were used for domestic rather than ritual functions, an interpretation supported by the larger percentage of vessels exhibiting typical use-wear patterns. Vessel function was assigned following an analysis of several metric attributes, including vessel volume, aperture diameter, maximum diameter, and neck and shoulder height (Vint 2000b). Following the assignment of vessel function, the collection was examined with an eye toward identifying any type-specific variation that may have been present, such as the specialized production of specific pottery types.

Methods

This section provides a brief description of the specific methods for sorting, sampling, and recording the ceramic collection. As mentioned above, we selected analytical methods that allowed us to provide a generalized description of the ceramic collection and address project-specific research questions. The analysis involved recording a number of morphological attributes and assigning the individual artifacts to specific descriptive categories. For the latter, we used a combination of traditional Southwest types and general descriptive categories that served to facilitate comparisons with collections from other projects. The descriptive categories provide shorthand documentation for some variables, such as inclusions, that were not recorded independently during the initial sort (see discussion below).

Sampling and Data Recording

A stratified sampling strategy and three phases of recording produced the data for the subsequent analyses. This included an initial sort of the collection (Phase 1) and detailed attribute recording (Phase 2). Whole and reconstructible vessels were recorded separately (Phase 3). The goals and methods for each of these phases are discussed below. A detailed description of the terms and variables used in the recording of the ceramic material is presented in Appendix A.1. The initial sort was conducted by Robert A. Heckman. Heckman and Alex Kurota carried out detailed attribute recording on a sample of unpainted sherds. Data from painted sherds were recorded by William L. Deaver. Heckman and Deaver recorded the data from whole and reconstructible vessels.

Initial Sort

The objective of the initial sort was to provide a general characterization of the ceramic collection. These data were then used to facilitate sample selection for more-detailed attribute recording. We used a conservative approach that allowed for categorizing material without the use of labels that imply cultural affiliation or origin of manufacture. Because the typological systems relating to unpainted pottery in the Southwest are in a state of flux, we used a combination of descriptive categories and traditional Southwestern types as the main sorting criteria for the unpainted pottery. The descriptive categories encompass considerable variability with respect to specific attributes. The attributes and typological categories that we used are presented in Appendix A.1, Tables A.1.1 and A.1.2. Other information geared toward characterizing the collection and facilitating sampling decisions included categories relating to the presence of a slip, corrugation, or paste characteristics. Subtle differences in surface treatment (e.g., degree of polish, presence or absence of striations) are subsumed within a single category. A concordance linking our general descriptive categories to existing typologies, specifically that used by the TNF (Wood 1987), is presented in Table 3.

Because several of the descriptive categories used in the initial sort were defined to address specific research questions, a brief discussion of their characteristics is warranted. One of these questions concerned the nature of the interaction with adjacent culture areas. In the Phoenix Basin, for example, ceramics are often characterized by the presence of metamorphic inclusions in the clay body. Thus, a descriptive category for those ceramics was created as a means of identifying potential trade wares. A distinction was also made between “local” Mogollon Brown wares and those likely to have been imported. Local Mogollon Brown wares possessed inclusions similar in mineralogy and lithology to the bulk of the plain wares from the project. The category evokes the Mogollon label primarily based on the relatively fine texture of the paste and the extremely well-polished exterior and the smudged interior surface. It should be noted, however, that because no compositional analyses were performed on the collection, this distinction was made entirely on a macroscopic assessment.

Archaeologists working with Mogollon ceramics have traditionally divided the brown plain wares into two groups, Forestdale Smudged and Woodruff Smudged. Haury (1985:205–207) described Forestdale Smudged as a polished brown ware with extremely fine inclusions, burnished interior and exterior surfaces, smudged interiors, and a bluish gray core. Woodruff Smudged, originally defined by Mera (1934), differs from Forestdale Smudged in having thinner walls, a coarser paste, and a poorer surface finish (Haury 1985:212). Forestdale Smudged and Woodruff Smudged appear to represent points on a continuum of variation rather than being purely discrete types. Further, researchers have seemed to assign the type labels based on geography. Forestdale Smudged is often used in central Arizona (e.g., Whittlesey 1994) and Woodruff Smudged is commonly used in northern Arizona in the Little Colorado River–Petrified Forest region (e.g., Goetze 1994). Therefore, these are considered to be imported nonlocal ceramics in Tonto Basin (Wood 1987:74–75). For our purposes, these types were combined into a single category.

All ceramics from the project sites were examined during the initial sort, with the exception of those from the Vegas

Ruin. The decision to sample the collection from the Vegas Ruin was made when it was clear that the volume of ceramics from the site would far exceed that from all of the other sites combined. Indeed, over 79 percent of the ceramic artifacts collected during the CCP were recovered from the Vegas Ruin. Furthermore, the plain ware collection exhibited considerable redundancy in terms of represented ceramic types. Thus, we limited our sample of plain ware sherds largely to those recovered from feature contexts. All rim sherds, painted sherds, and reconstructible vessels were examined regardless of their recovery context.

Expanded Attribute Recording

The descriptive data generated during the initial sort helped refine our sampling strategy for the next phase of expanded attribute recording. The objectives of this more-detailed study were designed to contribute to the project's larger research themes (Ciolek-Torrello and Klucas 1999). We recorded detailed metric and formal attributes on all rim sherds (plain and painted) recovered from the project sites (see Table A.1.2). The methods used to record morphological attributes are discussed below.

Inclusions

A qualitative characterization of the lithic and mineral inclusions for all of the unpainted rim sherds was made in an effort to compare the results with microregional patterns of production and exchange inferred from recent quantitative petrographic studies (Heidke and Miksa 2000; Miksa et al. 2003). Although our qualitative characterization is not directly comparable to these studies, some general comparisons are possible. The method used to record the inclusions in the unpainted rim sherds employed a Nikon Stereoscopic Zoom Microscope (Model SMZ-2B/2T) fitted with a fiber-optic ring illuminator. The analyst made a general characterization of the mineral and lithic inclusions observed. No attempt was made to provide an exhaustive inventory of each mineral and rock fragment observed in the sherd cross section. The analyst recorded four variables relating to the inclusions—rock or mineral type, size, sorting, and roundness. Rock and mineral types were identified following Chesterman's (1978) guide to rocks and minerals of North America. The analyst made a subjective judgment concerning which rocks, minerals, or both were most abundant within the sherd cross section and recorded the type or types of rocks, minerals, or both, that were present. A similar judgment was made for the size, sorting, and roundness/sphericity variables. The analyst chose from a list of nominal variables relating to size ranges—fine, medium, and coarse—which was most "representative" (Appendix A.1, Figure A.1.7). Like the size variables for inclusions, the sorting of inclusions was divided into three categories—poorly, medium, and well sorted. The angularity and sphericity were recorded as a single variable. The analyst made a subjective judgment and characterized the grains by combining a number from the *y*-axis and *x*-axis (see Figure A.1.7). For example, the least-rounded and most-spherical grain would have a value of "31"; conversely, the most-rounded and least-spherical grain would have a value of "99."

Surface Treatment

Representing one of the last stages of the manufacturing process, the techniques used to finish the interior and exterior surface of a vessel reflect deliberate and patterned choices made by the potters. The standard treatments are usually variants of smoothing or texturing. In addition, a slip may be applied to one or more of the vessel surfaces. Rice (1987:141–152) has provided multiple examples of these treatments and how they articulate with cultural groups. Observations of surface treatment were made on a sample of rim sherds and all of the reconstructible vessels. The purpose for recording these attributes derived from the assumptions that variability in surface treatments reflects learned and patterned motor-skill habits that may relate to cultural groups (Arnold 1985) and that variability in surface treatments may provide insight on vessel function (Shepard 1985:187).

Several variables relating to surface treatment were recorded for the interior and exterior surface on a sample of rim sherds and all of the reconstructible vessels (see Table A.1.2 and Appendix A.1). The majority of the variables relate to the type and degree of polish; characteristics of the slip, if applied; and the characteristics of blackening. Six secondary finishing techniques were also recorded—namely, whether the vessel was tool polished, smoothed, wiped, scored, scraped, or unfinished—providing a qualitative characterization of the surface treatment applied to a specific vessel (see Appendix A.1). These six variables are not mutually exclusive, as single vessels are capable of exhibiting a number of the techniques. When a surface was determined to be tool polished, other observations followed that further characterized that treatment. Other surface treatment variables, such as the presence of blackening, slip, and corrugation, were recorded independently. Slip color observations were standardized through the application of Munsell values.

Painted Pottery

We looked at the exotic black-on-white and black-on-red pottery as a resource for helping us to determine the chronology of the CCP occupations and as a resource for mapping the pattern of regional exchange and interaction between the people who once lived along the Jakes Corner portion of the

SR 188 highway in prehistory and the peoples native to other regions. To this end, we compared the technological and stylistic qualities of the ceramics with extant pottery descriptions for the ceramic traditions on and above the Mogollon Rim. The exotic pottery discussed in this section represents the San Juan Red Ware, Little Colorado White Ware, Tusayan White Ware, Cibola White Ware, Showlow Red Ware, Roosevelt Red Ware, and, perhaps, the White Mountain Red Ware traditions. The classification of pottery to the typological categories was derived primarily by reference to the descriptions provided by Carlson (1970), Colton and Hargrave (1937), Gladwin and Gladwin (1930, 1931), Goetze and Mills (1993), and Hays-Gilpin and Van Hartesveldt (1998), among others referenced below. The pottery was classified by William L. Deaver with assistance from Stephanie M. Whittlesey.

The traditional pottery classification system of this region was established early in the twentieth century by researchers working at the Museum of Northern Arizona (Colton and Hargrave 1937). This classificatory rubric organized variation in prehistoric ceramics along two axes. One axis could be called "the people and place" axis, because it defined regional and local ceramic traditions based on patterns of ceramic technology and methods of manufacture. These traditions were characterized as ceramic wares and series. The other axis could be called the "time" axis, because it defined different periods in the culture histories of these regions based on changes in ceramic styles. Individual pottery types represent the unique constellation of spatial and temporal qualities occurring at the interstices between the space and time axes.

This simplified model of Southwest pottery typology is elementary to most researchers. It is presented here not for enlightenment but to highlight two categories of ceramics we found at the CCP sites that could not be definitively placed into specific typological categories. Ceramicists often face some difficulties in classifying sherds into type categories, because the sherds often lack some characteristics to make a positive classification. We faced a similar situation; however, the two categories we discuss here arose from deficiencies in the typological framework and not from the lack of definitive qualities on the ceramics.

The first category is a group of Cibola White Ware ceramics that were decorated with attributes characteristic of Little Colorado White Ware and Tusayan White Ware decorative styles, particularly the Walnut and Tusayan styles. There is no widely accepted typological category for this group of pottery. We have followed the lead of Pomeroy (1962) and Zedeño (1992) and classified this pottery as Roosevelt Black-on-white, but we note that this application is contrary to the positions taken by Lindauer (1995:53), Vint (2000a), and others who consider Roosevelt Black-on-white to be a poorly defined or ambiguous pottery type. We do not wish at this point to digress into a lengthy argument of the merits for and against Roosevelt Black-on-white as a valid category, when, ultimately, it resolves presently to a matter of opinion. We think that Zedeño's (1992) argument is sufficient to support Roosevelt Black-on-white as a classificatory category. Regardless of our intellectual disagreement over the naming of this category, a group of Cibola White Ware ceramics that were painted with decorative styles considered more characteristic of the late Pueblo II and early Pueblo III periods of the Little Colorado River and Tusayan Regions is an archaeological reality. What we classify here as "Roosevelt Black-on-white" is synonymous with what Vint (2000a:27–32) has named "Little Colorado White Ware/Kayenta-like Cibola." Even if only a heuristic device, the qualities embodied by Roosevelt Black-on-white encompass the qualities we observed on this particular group of Cibola White Ware, albeit with a less cumbersome moniker.

We also had difficulty classifying the black-on-red pottery, particularly the small sherds that had unenlightening remnants of the painted decoration. We recognized three potential candidates: Showlow Red Ware, Roosevelt Red Ware, and White Mountain Red Ware. We had three primary technological characteristics to consider in classification: paste color, tempering agent, and paint pigment. A careful perusal of the current descriptions of the three candidate wares revealed ambiguities among all three. For example, Showlow and Roosevelt Red Ware typically have brown ware pastes and carbon paint (Colton and Hargrave 1937; Hays-Gilpin and Van Hartesveldt 1998:155–158); however, Carlson (1970:7) has noted that the early White Mountain Red Ware type Puerco Black-on-red can often have a light brown to orange color and thin, watery paint. Another ambiguity was found between Showlow and Roosevelt Red Ware. The practice of adding ground-sherd grog as a tempering agent distinguishes Showlow series from its developmental predecessor (Hays-Gilpin and Van Hartesveldt 1998:139). They further noted that the Showlow Black-on-red can be distinguished from Roosevelt Red Ware because the former contains sherd and the latter is usually sand tempered (Hays-Gilpin and Van Hartesveldt 1998:156). However, Stinson (1996) provided just the opposite distinction between Showlow and Roosevelt Red Ware for the collection she investigated from the Silver Creek Drainage. White and Burton (1992) discovered that Roosevelt Red Ware can be divided into two primary groups: one tempered with sherd grog and the other tempered with sand. There is a variability in the tempering materials used in the early Roosevelt Red Ware that makes such a dichotomy between Showlow and Roosevelt Red Ware impossible.

The black-on-red pottery from the CCP sites typically had a brown-to-gray-firing clay body; sherd and sand temper; and a thin, watery, black paint. Without further clarification among the three reference wares, these fragments could not be classified definitively into any of the candidate wares. Thus, the sherds are largely ambiguous with regard to the people and place axis in the classificatory rubric. Still, we presumed that these sherds were either Showlow Red Ware or Roosevelt Red Ware, because we had no definitive examples of any White Mountain Red Ware in our collection.

The situation was not as hopeless when the sherds carried enough of the design to allow us to discern the decorative style. In these cases, we relied strongly on the styles to differentiate the pottery by wares. Typically, the first Roosevelt Red Ware, Pinto Black-on-red, is decorated in a Tularosa or Pinedale style (Hays-Gilpin and Van Hartesveldt 1998:156). Some of the black-on-red pottery was decorated in Holbrook, Puerco, and Wingate styles. These styles predate the Tularosa and Pinedale styles, and thus these three styles were classified as Showlow Black-on-red, and the black-on-red pottery decorated in a Tularosa or Pinedale style (Carlson 1970:90–91) was classified as Pinto Black-on-red.

Whole and Reconstructible Vessels

In any ceramic study, the most behaviorally meaningful analytical unit is the vessel. Even when dealing with individual sherds, the ultimate goal should be to provide inferences relating to the container they represent. Fortunately, the CCP sample included 221 whole and reconstructible vessels. Although most of the sample was recovered from mortuary contexts, the collection appears to represent vessels that once functioned within the context of food preparation, consumption, and storage. This assumption is borne out by the consistent presence of use wear on the vessels, indicating that they were not made exclusively as mortuary goods. Instead, they likely represent vessels removed from domestic use and therefore provide an excellent data set to address questions of subsistence, settlement function, and economic specialization.

Data collection for the whole and reconstructible vessels focused on the metric and morphological attributes useful for determining vessel function. Variables recorded for all of the vessels are listed in Table A.1.2. The collective attributes recorded for whole and reconstructible vessels also provided the comparative foundation for the analyses and functional inferences applied to the rim sherds. A combination of nominal and metric variables provided the basis for recording and characterizing vessel morphology. A complete description of these variables is provided in Appendix A.1. The nominal variables provide a descriptive characterization of the vessel, such as whether the vessel possessed a restricted orifice. Further distinctions were made concerning the general vessel morphology. Examples of the formal categories used in classifying the vessels and rim sherds are presented in Figure A.1.8.

In addition to the formal characterizations, several directly measured attributes provide more-detailed data on vessel morphology. The methods and terminology used to record and characterize vessel morphology borrow heavily from Shepard (1985) who developed a systematic and replicable way of measuring and characterizing vessel morphology beyond the commonly used categories of jar and bowl. Figure A.1.8 illustrates the position of the characteristic contour points relative to standardized vessel measurements. Shepard (1985:227) demonstrated the fundamental importance of these points, in that they are used to calculate vessel dimensions, and they help to define vessel parts. Measurements pertaining to orifice diameter, maximum body diameter and aperture are taken at specific contour points along the vessel's profile (see Figure A.1.8). To facilitate our discussion, a vessel index was calculated for all vessels for which measurements could be taken. This index was created by assigning arbitrary numeric values to each of the characteristic profile points listed in Table A.1.3.

Tonto Basin Ceramics

One component of the research agenda was to place the CCP ceramic collections within the larger context of Tonto Basin. In this section we provide a brief discussion focused on the ceramic signatures of the cultural phases defined for Tonto Basin (Table 4). We also discuss some of the established trends in settlement patterns and other aspects of material culture associated with each phase. We limit the discussion to only those phases relevant to the CCP ceramic collections.

Sacaton/Ash Creek Phase

The Sacaton/Ash Creek phase dates from approximately A.D. 950 to 1150 (Ciolek-Torrello 1994; Clark 2000; Elson 1996). This span of time is often referred to as the Sedentary period by researchers with the caveat that the it varies from the traditional use of Sedentary period used in the Phoenix area (Ciolek-Torrello 1994; Elson and Gregory 1995). In fact, Ciolek-Torrello et al. (1994:590) have characterized the Sedentary period as the "least understood of the post-Archaic occupations in the Tonto Basin." Unlike the earlier hamlet- and village-sized settlements of the Colonial period, the Sedentary period represents dispersed short-term settlements with either an agricultural or wild-plant food emphasis (Ciolek-Torrello 1994).

Accompanying these apparent shifts in settlement pattern and function are changes in regional influences. These changes are inferred from the shift in ceramic imports from the Hohokam area to the south to Pueblo II ceramics, such as Cibola and Tusayan white wares reflecting a northern focus (see Table 4). The unpainted pottery consists of untextured brown wares and small numbers of red-slipped pottery (e.g., Sacaton Red).

Table 4. Tonto Basin Phases and Associated Ceramics (from Clark 1992; Doyel 1978; Elson 1996; Haas 1971; Vint 2000a; Whittlesey 1994)

Ceramic Ware and Type	Phase					
	Gila (A.D. 1300–1350)	Roosevelt (A.D. 1250–1300/1320)	Miami (A.D. 1150–1200/1250)	Sacaton/ Ash Creek (A.D. 950–1150)	Santa Cruz (A.D. 850–950)	Gila Butte/Deer Creek (A.D. 750–850)
Painted						
Cedar Creek Polychrome	X	X				
Fourmile Polychrome	X					
Sityatki Polychrome	X					
Jeddito Polychrome	X					
San Carlos Red-on-brown	X					
Gila Polychrome	X					
St. Johns Polychrome		X				
Pinedale Black-on-red		X				
Pinedale Polychrome		X				
Tularosa Black-on-white		X				
Pinedale Black-on-white		X				
Pinto Black-on-red		X				
Pinto Polychrome		X				
Gila Black-on-red		X				
Gila Polychrome, Pinedale Style		X				
Snowflake Black-on-white			X			
Reserve Black-on-white			X			
Walnut Black-on-white			X	X		
Padre Black-on-white			X	X		
Sacaton Red-on-buff				X		
Holbrook Black-on-white				X		

Table 4. Tonto Basin Phases and Associated Ceramics (*continued*)

Ceramic Ware and Type	Phase					
	Gila (A.D. 1300–1350)	Roosevelt (A.D. 1250–1300/1320)	Miami (A.D. 1150–1200/1250)	Sacaton/ Ash Creek (A.D. 950–1150)	Santa Cruz (A.D. 850–950)	Gila Butte/Deer Creek (A.D. 750–850)
Black Mesa Black-on-white				X		
Sosi Black-on-white				X		
Reserve Black-on-white				X		
Puerco Black-on-white				X		
Three Circle/Cerros Red-on-white				X		
Santa Cruz Red-on-buff					X	
Kiatuthlanna Black-on-white					X	
Kana'a Black-on-white					X	
"Local" Red-on-browns					X	
Gila Butte Red-on-buff						X
Lino Black-on-gray					X	X
Plain						
brown plain	X	X	X	X	X	X
Gila Plain			X	X	X	X
Wingfield Plain				X	X	
Forestdale Smudged				X		
Lino Gray						X
Red						
Salado Red	X	X	X			
Tonto Red		X	X			
Gila Red			X			
Sacaton Red				X		
Corrugated						
Brown Obliterated Corrugated	X	X	X			
Red corrugated						
Salado Red Corrugated	X	X	X			

Miami and Roosevelt Phases

The Miami phase dates from approximately A.D. 1150 to 1200/1250 and the Roosevelt phase dates to approximately A.D. 1250–1300/1320 (see Ciolek-Torrello 1994; Clark 2000; Elson and Gregory 1995). Collectively, these phases represent the early Classic period in Tonto Basin. The settlement trend of dispersed, short-term farmsteads continued. However, an increase in population and the presence of sizable permanent villages with public architectural features, such as platform mounds, provide a contrast with the Sedentary period. The trend reflecting a northern influence during the Sedentary period reached a zenith during the early Classic. Rather than representing indirect or passive interaction inferred from imported ceramics, the early Classic period represents wholesale changes in architecture (from pit houses to cobble-adobe-foundation compounds), mortuary practices (cremation to inhumation), and other aspects of material culture.

Of course, these changes are reflected in ceramics (see Table 4). A dramatic increase in red-slipped pottery (smoothed and corrugated) was accompanied by an ever-increasing array of painted pottery, reflecting a deepening tie to northern groups (Clark 2001; Whittlesey 1994). The unpainted pottery is characterized by smoothed brown plain ware and the addition of obliterated corrugated ware, providing another tangible element reflecting a connection to northern groups.

Results

In the following section we provide descriptive characterizations of the ceramic collections from the CCP sites. To facilitate the discussion, we have combined several of the sites into two groups based largely on level of effort and the size of the collection. The first group consisted of sites with ceramic collections consisting of less than 300 total artifacts. Collections from three of the sites, Sites 103/2061, 406/2013, and 409/2016, were recovered exclusively from surface contexts—no subsurface cultural deposits were identified in the portions of the sites contained within the ADOT ROW. The fourth site in this group, Site 404/2011, consisted of a Classic period field house that was apparently used for a limited period of time. No subsurface cultural deposits were identified beyond the field house itself. The second group includes two habitation sites and one limited-activity site that produced ceramic collections containing between 1,000 and 2,000 total artifacts. These sites include Site 41/583, encompassing a large *horno* within the ADOT ROW; the Rock Jaw site, a small, late pre-Classic or early Classic period farmstead; and Site 408/2015, a widely dispersed multicomponent site with several scattered habitation loci. We close the section with an examination of the collections from the two largest sites in the project, the Vegas Ruin and the Crane site, both characterized by analyzed samples in excess of 5,000 artifacts.

Project Sites with Small Ceramic Collections

We begin with a discussion of the sites with ceramic collections consisting of less than 300 total artifacts. Site-specific ceramic data are listed in Table 5. The investigated portions of three of the sites, Site 103/2061, Site 406/2013, and Site 409/2016, were entirely surficial in nature. Site 103/2061 encompassed a surficial artifact scatter, including 4 body sherds from at least 3 different vessels of different wares—Salado Red Corrugated, brown plain, and red slipped. Insufficient data were obtained to determine the form of the vessels. The Salado Red Corrugated sherd had diabase and granite inclusions. The inclusions in the brown plain and red-slipped vessel fragments consisted of quartz and feldspar minerals and some pink granite rock fragments. The portion of Site 406/2013 within the ROW produced a total of 275 sherds, including 3 rim sherds. This collection consisted almost entirely of brown plain ware, with small amounts of Salado Red, brown corrugated, red plain, and Wingfield Plain. Also present were 8 indeterminate sherds of Tusayan White Ware and Little Colorado White Ware. Site 409/2016 was completely contained within the ROW. A total of 7 brown plain sherds were recovered during surface collections at the site (see Table 5), none of which was rim sherds. The final site in this group, Site 404/2011, represented the remains of a small Classic period field house (see Volume 1). Almost half of the collection consisted of brown plain, with substantial numbers of Salado Red Corrugated, red plain, and a small number of brown corrugated. Six rim sherds were recovered.

The Ceramic Collections and Sampling Strategy

Table 6 presents the typological breakdown of the ceramics collected from the four sites discussed above. Here we present the results of the analyses for those sherds that met the sampling strategy defined for the project (Ciolek-Torrello and Klucas 1999). This called for detailed recording of rim sherds only. A total of nine rim sherds, six from Site 404/2011 and three from Site 406/2013, constituted the sample of sherds from the four small sites for which observations were made on the inclusions. The collections contained few temporally diagnostic sherds. The presence of Salado Red Corrugated and red plain with a smudged interior, along with a few brown corrugated from Sites 404/2011 and 406/2013, suggest Classic period occupations. The ceramic signature

Table 5. Ceramic Totals from Sites with Small Collections

Site	Sherds		Total
	Body	Rim	
103/2061	4	—	4
404/2011	170	6	176
406/2013	272	3	275
409/2016	7	—	7

Table 6. Ceramic Types from Sites with Small Collections

Ceramic Ware and Type	Site			
	103/2061	404/2011	406/2013	409/2016
Little Colorado White Ware				
Indeterminate black-on-white	—	—	1	—
Tusayan White Ware				
Indeterminate black-on-white	—	—	8	—
Gila Basin Hohokam				
Wingfield Plain	—	—	4	—
Salado Red				
Salado Red Corrugated	1	34	2	—
Red plain				
Red plain (smudged interior)	2	34	3	—
Brown ware				
Brown plain	1	92	254	7
Brown corrugated	—	13	2	—
Indeterminate brown or red plain	—	3	1	—
Total	4	176	275	7

and proximity of Site 406/2013 to the Rock Jaw site suggests that it was a surficial component of the Rock Jaw site. The collections from Sites 103/2061 and 409/2016 had too few ceramics to make any meaningful inference concerning the timing and nature of the occupation.

Inclusions

Table 7 categorizes the sampled sherds by ceramic ware and inclusion types. Only two types of inclusions were identified in the collection—diabase and feldspar/quartz. All of the Salado Red Corrugated sherds contained diabase. The red plain ware with a smudged interior contained feldspar/quartz, and the brown plain wares contained either diabase or feldspar/quartz. No granitic grains were observed in conjunction with the feldspar/quartz inclusions for either. The Salado Red Corrugated sherds with the diabase inclusions also contained abundant small platelets of free and embedded gold biotite.

Vessel Form and Metric Attributes

Table 8 presents the vessel forms recorded for the rim sherds. Unfortunately, only two rim sherds were complete enough to

Table 7. Nonplastic Inclusions in Unpainted Rim Sherds at Sites with Small Collections

Inclusion Type, by Ceramic Ware	Site	
	404/2011	406/2013
Salado Red Corrugated		
Diabase	2	1
Red plain (smudged interior)		
Feldspar/quartz	2	—
Brown plain		
Diabase	1	1
Feldspar/quartz	1	1
Total	6	3

Table 8. Vessel Form Recorded for Rim Sherds at Sites with Small Collections

Vessel Form, by Ceramic Ware	Site 404/2011 Rim Form			Site 406/2013 Rim Form		
	Direct	Flaring	Indeterminate	Direct	Flaring	Indeterminate
Bowls (unrestricted)						
Salado Red Corrugated	2	—	—	—	—	—
Red plain (smudged interior)	—	1	—	—	—	—
Jars with necks						
Salado Red Corrugated	—	—	—	—	1	—
Red plain (smudged interior)	—	1	—	—	—	—
Indeterminate						
Brown plain	—	—	2	1	—	1
Total	2	2	2	1	1	1

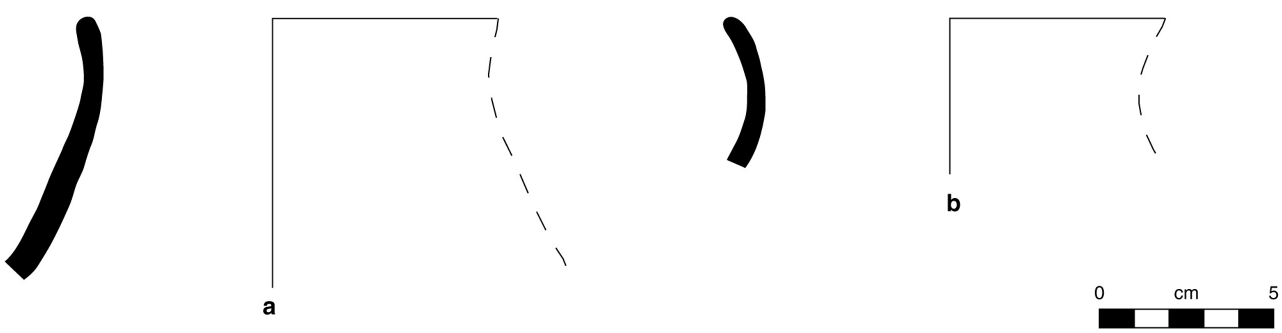

Figure 8. Rim profiles from the two sherds with orifice diameters large enough to measure: (*a*) red plain (smudged interior) from the fill of Feature 2, Site 404/2011; (*b*) Salado Red Corrugated, from the surface of Site 406/2013.

obtain an orifice diameter. Reconstructed profiles of these vessels are presented in Figure 8. One of the rims, recovered from Site 404/2011, was from a jar with an orifice diameter of 13.4 cm (see Figure 8a). The second was recovered from Site 406/2013 and produced a measurable orifice diameter of 11.8 cm (see Figure 8b).

Summary of Small Ceramic Collections

The interpretive value of the ceramic artifacts recovered from the four sites discussed in this section is limited by the size and content of the collections. No temporally diagnostic painted sherds were identified at any of the sites. In spite of this, the ceramics recovered from Site 404/2011 do provide some temporal information. The relative abundance of unslipped and red-slipped obliterated corrugated sherds recovered from the two architectural features, in conjunction with the sherds from red-slipped, smoothed-exterior vessels, is consistent with a Classic period occupation. In fact, 10 of the Salado Red Corrugated sherds were found in direct contact with the floor of field house. This supports the architecturally based Classic period date assigned to the site. In contrast, drastically fewer red wares were recovered from Site 406/2013, where brown plain predominated. The ceramic collections from the remaining two sites, Sites 103/2061 and 409/2016, provided no data on site function or chronology other than suggesting a Formative period occupation.

Collections from Small Habitation Sites

The pre-Classic period sample of the CCP was obtained from portions of three sites cut by the ADOT ROW—Site 41/583, the Rock Jaw site, and Site 408/2015. Two of these, Sites 41/583 and 408/2015, represented small habitation loci of larger, multicomponent sites. The Rock Jaw site, although extending beyond the ADOT ROW, appears to consist of a single pre-Classic period farmstead. All produced ceramic collections containing between 1,000 and 2,000 individual artifacts. In addition to the size of the collections, several temporal and morphological similarities were also observed. We begin this section with a brief summary of the sampled portions of the three sites. We follow this with a characterization of the ceramic collections and a discussion of the data.

Site AZ O:15:41/583

The portion of Site 41/583 investigated during the CCP encompasses the remains of a large *horno* and debris associated with roasting activities (see Volume 1). The site may represent peripheral activities relating to the occupation of Ushklish Ruin, located approximately 100 m to the northwest. Haas (1971) previously characterized Ushklish Ruin as a multicomponent site consisting of a Colonial period hamlet and a small Classic period habitation.

The Rock Jaw Site (AZ U:3:407/2014)

The Rock Jaw site encompassed the remains of a small farmstead (see Volume 1). The two superimposed pit structures and 10 associated extramural pits were identified on the second terrace overlooking the current channel of Tonto Creek. Feature 1 represented the earliest habitation structure at the site. The arrangement of postholes and the presence of a floor groove indicate that Feature 1 was an example of the house-in-a-pit architectural style. The later habitation structure (Feature 3) appears to represent a replacement of Feature 1. The evidence suggests that Feature 1 was abandoned and burned and Feature 3 was built directly over the remains of the earlier structure. Both structures had formal hearths. Extramural features identified at the Rock Jaw site included 7 earthen pits and 3 hearths. The 3 hearths were excavated and exhibited fire-hardened, oxidized walls.

Site AZ U:3:408/2015

Only a small portion of this large, dispersed, multicomponent site extended into the ADOT ROW. Consequently, relatively few features were excavated. The site consisted of several discrete habitation loci, including a number of cobble-adobe-foundation field houses and two small compounds located on the terrace overlooking Tonto Creek. The presence of midden deposits throughout the site area suggests intensive, punctuated occupations. Data recovery resulted in the complete excavation or sampling of eight features—a cobble-adobe-foundation wall segment, three extramural hearths, one extramural pit, two midden areas, and one human burial. The three hearths likely represent the remains of small, extramural cooking pits. The single extramural pit was shallow. The two midden deposits represent sizable cultural deposits within the alluvial mantle that extended over much of the site area. The two midden deposits were sampled using 1-by-2-m test pits. The single burial recovered was that of a flexed child resting on his or her side within a shallow (approximately 35 cm) pit. No ceramic containers accompanied the individual.

The Ceramic Collections and Sampling Strategy

Data recovery efforts at Site 41/583 recovered 1,894 sherds, 43 percent of which were recovered from the fill of the *horno*.

Table 9. All Ceramic Artifacts by Type from Small Habitation Sites

Ceramic Ware and Type	Site 41/583	Rock Jaw (407/2014)	Site 408/2015
Little Colorado White Ware			
Holbrook Black-on-white	—	2	—
Holbrook Black-on-white, Style B	—	1	1
Holbrook or Walnut Black-on-white	—	4	1
Indeterminate Little Colorado White Ware	—	13	—
Cibola White Ware			
Red Mesa Black-on-white	—	—	1
Indeterminate Cibola White Ware	5	3	9
Tusayan White Ware			
Lino Gray	1	—	—
Kana'a Black-on-white	—	—	1
Black Mesa Black-on-white	1	—	—
Black Mesa or Sosi Black-on-white	1	—	—
Sosi Black-on-white	—	1	—
Indeterminate Pueblo II black-on-white	1	—	—
Indeterminate Tusayan White Ware	32	3	8
Indeterminate white ware			
Indeterminate black-on-white	—	10	5
Gila Basin Hohokam			
Wingfield Plain	19	196	32
Santa Cruz Red-on-buff	1	—	1
Santa Cruz or Sacaton Red-on-buff	3	1	5
Sacaton Red-on-buff	2	2	8
Indeterminate red-on-buff	16	3	10
Indeterminate buff ware (no paint)	9	7	33
San Juan Red Ware			
Deadmans Black-on-red	—	—	1
Indeterminate San Juan Red Ware	—	—	1
Salado Red			
Salado Red Corrugated	2	1	14
Red plain			
Red plain (smudged interior)	10	45	42
Brown ware			
Brown plain	1,791	1,021	1,101
Brown corrugated	—	—	12
Indeterminate brown or red plain ware	—	1	4
Total	1,894	1,314	1,290

Table 10. All Ceramic Artifacts Recovered from Small Habitation Sites

Site	Sherds		Modeled Artifacts	Total
	Body	Rim	Figurine	
41/583	1,843	51	—	1,894
Rock Jaw (407/2014)	1,263	51	—	1,314
408/2015	1,204	83	3	1,290

The remaining sherds were collected from nonfeature contexts and among the roasting debris adjacent to the feature. Tables 9 and 10 present the breakdown of the typological categories recovered from the site. The collection is dominated by brown plain sherds—red-slipped and painted sherds were present in low frequencies. The sampling strategy called for detailed recording on all unpainted rim sherds. Metric attributes were recorded for the painted rim sherds. The remaining unpainted body sherds were recorded only during the initial sort. The presence of Santa Cruz and Sacaton Red-on-buff sherds in conjunction with Black Mesa Black-on-white and Lino Gray sherds provides consistent evidence for a pre-Classic period occupation. The presence of Salado Red Corrugated and red-slipped sherds with smudged interiors, albeit in low numbers, indicates a Classic period use of the site as well.

A total of 1,314 sherds were collected during data recovery efforts at the Rock Jaw site (see Table 9). Approximately 45 percent of the sherds were recovered from feature contexts. The remaining sherds came from general site contexts. As with Sites 41/583 and 408/2015, the painted ceramics suggest a primarily pre-Classic period use of the portion of the site within the ROW. Like the other two sites, the collection was dominated by brown plain ware. Much higher frequencies of Little Colorado White Ware, albeit still in low numbers, were present than at the other two sites. The site also contained low frequencies of Cibola White Ware, Tusayan White Ware, and Sacaton Red-on-buff. The frequency of Wingfield Plain stands in stark contrast to the other two sites. These ceramics all point to a Sacaton phase age for this site. A single Salado Red Corrugated sherd and small numbers of red ware complete the collection. Detailed attribute recording was limited to the unpainted rim sherds. Metric attributes were recorded for the painted rims. The unpainted body sherds were recorded during the initial sort only.

A total of 1,290 sherds were collected during data recovery efforts at Site 408/2015. Less than half (42.5 percent) of the sherds were collected from feature contexts. This was a diverse collection that contained Red Mesa Black-on-white, Kana'a Black-on-white, and San Juan Red Ware, along with Santa Cruz and Sacaton Red-on-buff. These ceramic types point to an extended pre-Classic period occupation, whereas small numbers of Holbrook, Salado Red Corrugated, red plain, and brown corrugated point to an early Classic period occupation. Three fragments of anthropomorphic ceramic figurines, all seemingly from different objects, were collected from the midden debris in the upper fill of the inhumation burial.

Inclusions

Inclusion types were recorded only for the unpainted rims. Table 11 provides a breakdown of the types of mineral and rock inclusions observed in the sample. Feldspar/quartz proved to be the dominant inclusion type. Some of the brown plain ware rim sherds also contained varying amounts of granitic rock fragments; however, no mica or biotite was observed. The few examples of red plain and the single example of brown corrugated with feldspar/quartz inclusions had no visible fragments of granite. Those sherds with fragments of diabase were easily identified. The diabase had copious amounts of free and embedded black minerals in conjunction with what appeared to be pink granitic rock fragments. Wingfield Plain rim sherds were only recovered from the Rock Jaw site. The Wingfield Plain body sherds recovered from the other two sites all contained abundant coarse and angular phyllite fragments, almost to the exclusion of other identifiable materials.

Vessel Form and Metric Attributes

The fragmentary condition of the rim sherds collected from Site 41/583, the Rock Jaw site, and Site 408/2015 precludes a detailed evaluation of vessel forms, although a general assessment is possible. Rim form treatment showed little variation within or between sites. Flared- and direct-rim forms were observed on jars and bowls. The bowl-to-jar ratios for each of the sites are presented in Table 12. The painted category shows a consistent pattern of bowls outnumbering jars by a large margin. Given that presumably all of the painted pottery in the sample derived from regions outside Tonto Basin, this may reflect the fact that bowls could be nested and more easily transported. Bowls outnumbered jars in the sample of the locally produced unpainted rims as well.

Heckman (2003) has demonstrated that orifice diameter can effectively serve as a proxy for vessel size, with the

Table 11. Nonplastic Inclusions in Unpainted Rim Sherds from Small Habitation Sites

Inclusion Type, by Ceramic Ware	Site 41/583	Rock Jaw site (407/2014)	Site 408/2015
Red plain (smudged interior)			
Feldspar/quartz	—	2	6
Phyllite/schist	—	—	2
Indeterminate rocks and minerals	—	1	—
Brown plain			
Diabase	3	9	18
Feldspar/quartz	38	16	41
Gneiss/schist	—	1	—
Phyllite/schist	2	—	—
Grog/sherd	—	—	2
Brown corrugated			
Feldspar/quartz	—	—	1
Wingfield Plain			
Phyllite	—	8	—
Total	43	37	70

Table 12. Bowl-to-Jar Ratios Calculated Using Rim Sherds

Site	Bowl-to-Jar Ratios		
	Painted	Unpainted	Combined
41/583	6:1	4.25:1	4.60:1
Rock Jaw (407/2014)	11:1	2.20:1	3.37:1
408/2015	7:1	6.10:1	6.28:1

strongest relationship found in the case of bowls. Orifice diameter was measured for those rim sherds large enough to produced dependable results (Figure 9). The bowl rims show the greatest variability in orifice diameter. These data also show that the larger jar forms were recovered from the Rock Jaw site. The smaller orifice diameters observed for bowl rims from Site 408/2015 suggest smaller bowls. Despite the low numbers of jar rim sherds with a measurable orifice diameter, they seem to reflect a similar range of variation. The neckless jars were represented by a single example from each site. This small sample precludes any statistically significant comparisons; nonetheless, they likely represented radically different vessel sizes. The neckless jar from Site 408/2015 had an orifice diameter of 3 cm, and as shown in Figure 9, appears to have represented a small vessel. Conversely, the example from the Rock Jaw site had an orifice diameter of 15 cm, representing a fragment of a much larger vessel. The neckless jar from Site 41/583 likely represented a vessel of a size intermediate to the other two vessels.

Summary

The three sites discussed above constitute the bulk of the pre-Classic period sample for the CCP. Moreover, the small sample of decorated sherds that were encountered indicates occupations dating to the later end of the pre-Classic period sequence. A low frequency of Salado Red Corrugated sherds suggests minimal use of the investigated portions of sites during the Classic period.

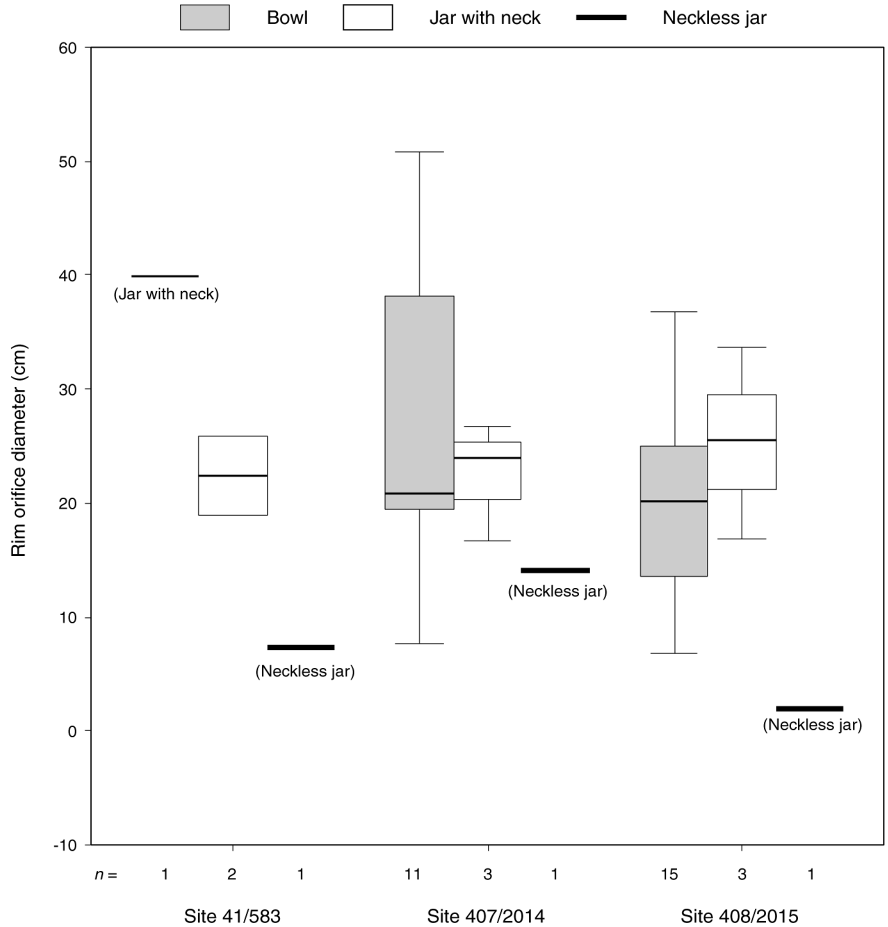

Figure 9. Box plots showing the distribution of orifice diameters for vessels from Site 41/583, the Rock Jaw site (407/2014), and Site 408/2015. Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

The ceramics collection from the Rock Jaw site were slightly more diverse in ceramic type, vessel form, and, possibly, vessel size, than Sites 41/583 and 408/2015. Because the three collections were roughly contemporaneous, this variability probably represents functional differences. Of the excavated samples at the three sites, only the Rock Jaw site contained a clear habitation loci with both habitation structures and extramural features in the sample.

Collections From Large Habitation Sites

By far, the largest and most diverse ceramic collections recovered during the CCP were obtained from two pre-Classic–early Classic period habitation sites flanking Cottonwood Creek: the Vegas Ruin and the Crane site. Both sites consisted of several habitation features, including pit structures and aboveground cobble-adobe-foundation rooms and a wide array of extramural features within the ROW. Furthermore, both the Vegas Ruin and the Crane site encompassed several inhumation burials that produced most of the complete and reconstructible ceramic vessels collected during the project. These sites produced diverse collections and afforded the best opportunities to address ceramic-dependent research issues.

The Vegas Ruin (AZ U:3:405/2012)

The Vegas Ruin represented the remains of at least three occupational episodes with the earliest dating to the Archaic period. The two later occupations date to the pre-Classic–Classic period transition, and the final occupation dates to the early Classic period (see Volume 1). The remains of 5 pit houses, 1 cobble-adobe-foundation compound with a single room, 38 inhumation burials, and 133 extramural features represent pre-Classic–Classic period transition and early Classic period occupations.

The Ceramic Collection and Sampling Strategy

Data recovery efforts at the Vegas Ruin resulted in the collection of 16,313 ceramic artifacts. Because of its size, the collection was sampled for both the initial sort and for expanded attribute recording. Sampling decisions followed the same criteria as the other site collections. All reconstructible vessels, unpainted rim sherds, and painted sherds were recorded, regardless of recovery context. The remaining sample of unpainted body sherds came from primarily screened feature contexts, test pits, and some unscreened stripping units and hand trenches. No detailed recording was done on the body sherds.

Table 13 provides the relative proportions of wares for the sample by context. The relatively high percentage of painted pottery reported for the site, 8 percent, is likely inflated because of the sampling criteria; recall that all painted sherds were recorded. If all of the pottery collected from the site is used in the calculation, the proportion is reduced to 3 percent. The relative proportions of corrugated pottery—Salado Red Corrugated and unslipped, obliterated corrugated—represent nearly 20 percent of the sample. The red-slipped (smoothed exterior, smudged interior) is almost equal in percentage to the brown plain pottery in the analyzed sample.

Table 13 also presents the relative frequency of sherds and vessels by general ware. The extraordinarily large number of vessels resulted from the excavation of 37 inhumation burials at the Vegas Ruin. The majority of the vessels were from burial contexts. The remaining vessels came from a cache and secondary refuse in pit fill deposits. The 10 body sherds from mortuary contexts likely represent sherds that were not intentionally interred with the individuals. These sherds were recovered from the fill surrounding the body, making a definitive association difficult at best. Much less ambiguous are the complete, or nearly complete, vessels found carefully placed around the body (see Volume 1). Comparing the two contexts reveals some differences in the general wares. The mortuary collection contained few unpainted and nonslipped wares. Nearly 87 percent of the vessels were red-slipped, both smoothed and corrugated, whereas painted pottery was also overrepresented when compared to the collection from domestic contexts. Based on relative frequencies, red-slipped and painted pottery were the preferred ceramic funerary accompaniments.

Table 14 provides a complete listing of the ceramic wares and types identified in the sample. The painted ceramics associated with the Vegas Ruin overwhelmingly corresponded to a Miami-Roosevelt occupation. Furthermore, the presence of Cibola White Ware, Little Colorado White Ware, and Tusayan White Ware provided evidence suggesting contact with northern groups. The low frequencies of Sacaton/Ash Creek phase associated types present likely represent ephemeral use of the area prior to the intensive occupation represented by the compound and pit structures.

Inclusions

Observations on inclusions were made on 896 rim sherds and 158 whole vessels (Table 15). The dominant inclusion type was feldspar/quartz (62.0 percent) followed by diabase inclusions (34.3 percent). The diabase inclusions showed a strong association with the corrugated ceramics, including both Brown Obliterated Corrugated and Salado Red Corrugated types, whereas feldspar/quartz was associated with the brown plain and red plain categories. The feldspar/quartz inclusions were distinctive in that the grains were relatively well sorted (of equal size) and well rounded. Occasionally, grains of pink granite were noted in association with the feldspar/quartz inclusions. The diabase inclusions exhibited more variability. Invariably, the sherds and vessels characterized with diabase inclusions had free grains of pyroxene, a black, glassy mineral. The moderate to poorly sorted examples often contained pyroxene embedded within a white and pink groundmass. Several examples characterized as diabase also contained extremely fine, gold-biotite minerals.

Vessel Form and Metric Attributes

Table 16 presents the vessel forms by general context collected from the Vegas Ruin. Vessel form was recorded for rim sherds and vessels only. These data are illustrated in Figures 10 and 11. The generalized vessel form categories showed little variation between the mortuary and domestic contexts. The bowl-to-jar ratios (including jars with and without necks and indeterminate jars) for the mortuary (2.5:1) and domestic (2.6:1) contexts reveal a negligible difference between these contexts. Some vessel forms were present in the mortuary contexts, however, that were not represented in the domestic contexts, and vice versa. Neckless jars were absent from mortuary contexts and seemed to be rare in domestic contexts. Other rare vessel forms included scoops and eccentric vessel forms that were present in mortuary and domestic contexts, albeit in very low numbers. A single effigy vessel was recovered from an inhumation burial—no effigy vessel fragments were recovered from domestic contexts.

Using orifice diameter as a proxy indicator of vessel size revealed a difference between jars recovered from mortuary and domestic contexts. These data are presented in Figure 12. The

Table 13. Ceramic Categories by General Contexts for the Vegas Ruin (405/2012)

Ceramic Category	Domestic						Mortuary				Total	
	Body Sherd		Rim Sherd		Vessel		Body Sherd		Vessel			
	n	%	n	%	n	%	n	%	n	%	n	%
Painted	439	7.5	102	10.2	1	7.7	2	20.0	18	11.0	562	8.0
Brown plain	2,520	42.8	200	20.1	2	15.4	3	30.0	1	0.6	2,726	38.6
Brown corrugated	294	5.0	42	4.2	—	—	—	—	3	1.8	339	4.8
Red plain (smudged interior)	1,811	30.8	402	40.4	6	46.2	1	10.0	95	57.9	2,315	32.7
Salado Red Corrugated	822	14.0	250	25.1	4	30.8	4	40.0	47	28.7	1,127	15.9
Total	5,886	100	996	100	13	100	10	100	164	100	7,069	100

Table 14. All Ceramic Artifacts by Type from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Count	Percentage within Type	Percentage of Total Ceramics
Little Colorado White Ware			
St. Josephs Black-on-white	2	0.9	<0.1
Holbrook Black-on-white	2	0.9	<0.1
Holbrook Black-on-white, Style B	9	4.2	0.1
Holbrook or Walnut Black-on-white	30	14.0	0.4
Padre Black-on-white	5	2.3	0.1
Walnut Black-on-white	34	15.9	0.5
Walnut (Style A) Black-on-white	17	7.9	0.2
Walnut (Style B) Black-on-white	3	1.4	<0.1
Leupp Black-on-white	6	2.8	0.1
Indeterminate Little Colorado White Ware	106	49.5	1.5
Subtotal, Little Colorado White Ware	214	100	3.0
Cibola White Ware			
Red Mesa Black-on-white	6	2.2	0.1
Red Mesa or Puerco Black-on-white	1	0.4	<0.1
Puerco Black-on-white	2	0.7	<0.1
Puerco or Reserve Black-on-white	5	1.8	0.1
Gallup or Reserve Black-on-white	2	0.7	<0.1
Snowflake Black-on-white	33	11.9	0.5
Reserve Black-on-white	8	2.9	0.1
Reserve or Tularosa Black-on-white	3	1.1	<0.1
Tularosa Black-on-white	7	2.5	0.1
Pinedale Black-on-white	1	0.4	<0.1
Roosevelt Black-on-white	24	8.6	0.3
Indeterminate Pueblo II Cibola White Ware	1	0.4	<0.1
Indeterminate Pueblo III Cibola White Ware	2	0.7	<0.1
Indeterminate Cibola White Ware	183	65.8	2.6
Subtotal, Cibola White Ware	278	100	3.9
Hohokam Buff Ware			
Wingfield Plain	3	37.5	<0.1
Santa Cruz or Sacaton Red-on-buff	1	12.5	<0.1
Indeterminate red-on-buff	1	12.5	<0.1
Indeterminate buff (no paint)	3	37.5	<0.1
Subtotal, Hohokam Buff Ware	8	100	0.1
Roosevelt Red Ware			
Pinto Black-on-red	3	75.0	<0.1

Table 14. All Ceramic Artifacts by Type from the Vegas Ruin (405/2012) (*continued*)

Ceramic Ware and Type	Count	Percentage within Type	Percentage of Total Ceramics
Indeterminate Roosevelt Red Ware	1	25.0	<0.1
Subtotal, Roosevelt Red Ware	4	100	0.1
Salado Red			
Salado Red Corrugated	1,127	98.8	15.9
Salado White-on-red	14	1.2	0.2
Subtotal, Salado Red	1,141	100	16.1
Tusayan White Ware			
Kana'a Black-on-white	3	60.0	<0.1
Indeterminate Tusayan White Ware	2	40.0	<0.1
Subtotal, Tusayan White Ware	5	100	0.1
Reserve Series			
Reserve Indented Corrugated, smudged	2	16.7	<0.1
McDonald Painted Corrugated	6	50.0	0.1
Indeterminate painted Reserve Indented Corrugated	4	33.3	0.1
Subtotal, Reserve Series	12	100	0.2
Showlow or Roosevelt Red Ware			
Showlow Black-on-red, Wingate Style	1	10.0	<0.1
Showlow Black-on-red, Holbrook Style	2	20.0	<0.1
Showlow Black-on-red, Puerco Style	1	10.0	<0.1
Indeterminate Showlow or Roosevelt Red Ware	6	60.0	0.1
Subtotal, Showlow or Roosevelt Red Ware	10	100	0.1
San Juan Red Ware			
Deadmans Black-on-red	1	100	<0.1
Red ware			
Red plain	2,315	100.0	32.7
Black-on-red	1	<0.1	<0.1
Subtotal, red ware	2,316	100	32.8
Brown ware			
Brown plain	2,726	88.9	38.6
Brown corrugated	340	11.1	4.8
Subtotal, brown ware	3,066	100	43.4
White ware			
Indeterminate black-on-white	2	100	<0.1
Brown or red ware			
Brown or red plain	12	100	0.2
Total	7,069		100

Table 15. Nonplastic Inclusions in Unpainted Rims and Vessels Recovered from the Vegas Ruin (405/2012)

Inclusion Type	Brown Corrugated		Brown Plain		Red Plain		Salado Red Corrugated		Reserve Indented Corrugated		Total	Percent
	Rims	Vessels	Rims	Vessels	Rims	Vessels	Rims	Vessels	Rims	Vessels		
Granite	4	—	2	—	—	1	—	2	—	—	9	8.5
Diabase	32	1	53	—	24	2	213	36	—	—	361	34.3
Feldspar/quartz	6	1	143	2	377	84	36	3	1	—	653	62.0
Quartz	—	1	—	—	—	—	—	—	—	—	1	0.1
Indeterminate	1	—	2	1	1	14	1	10	—	—	30	2.8
Total	43	3	200	3	402	101	250	51	1	—	1,054	100

Table 16. Vessel Form Frequencies from Domestic and Mortuary Contexts from the Vegas Ruin (405/2012)

Vessel Form	Context				Total
	Domestic			Mortuary	
	Rim Sherds	Vessels	Subtotal	Vessels	
Bowl	534	9	543	112	655
Jar with neck	194	2	196	44	240
Neckless jar	7	—	7	—	7
Indeterminate jar	2	—	2	—	2
Ladle	—	—	—	1	1
Scoop	2	—	2	2	4
Eccentric	1	—	1	3	4
Effigy vessel	—	—	—	1	1
Indeterminate	256	2	258	1	259
Total	996	13	1,009	164	1,173

jars with necks from the mortuary contexts exhibited a narrower distribution and much smaller orifices than the jars from domestic contests. The contrast in orifice diameter distributions reflects the presence of smaller jars in the mortuary contexts. Conversely, the similar distribution of orifice diameters for bowls reflects no apparent bias in the mortuary collection.

The gross categories of bowls and jars presented above contain a considerable amount of formal variability within the categories. Some of the bowl forms, for example, are restricted, whereas others represented out-flaring rims (see Figure 11). We present summary data for each category below.

Bowls

Bowls are the most diverse formal category of vessels recovered from the Vegas Ruin. A total of 23 restricted bowl forms were defined for the sample of whole and reconstructible vessels (Table 17). Restricted bowls with direct rim forms (see Figure 11f) constituted 47.8 percent of the category, whereas the remaining 52.2 percent possessed a flaring rim (see Figure 11d). None of the painted types represented by the vessels exhibited rim treatments other than direct. Table 18 presents the breakdown of restricted bowls represented by rim sherds. The variability in whole and reconstructed vessels was mirrored in the unpainted rim sherds.

Vessel volume was calculated for 20 of the 23 restricted bowl forms. Three restricted bowls were excluded, because they lacked bases. These data are presented in Figure 13. The 5 painted bowls represented slightly larger vessels than the red plain and Salado Red Corrugated categories. The distribution of the red plain category, however, was affected by an extreme outlier measuring approximately 7,000 ml. This bowl, designated V 199, was recovered from Feature 21, an inhumation burial (see Volume 1). The minimum volume for the 20 restricted bowl forms was 229 ml, with an average volume of 2,173 ml. The standard deviation of this distribution was 1,644 ml, placing V 199 approximately three standard deviations above the mean (this outlier is shown on Figure 13).

A total of 98 unrestricted bowls were recorded among the whole and reconstructed vessels (see Figure 11a–c, e). Data on rim treatments for these vessels are presented in Table 19. As with the painted restricted bowl forms, the painted unrestricted bowls were dominated by those with direct rims (see Figure 11e). Figure 14c shows the single everted rim form documented for the complete vessels. Approximately 32 percent of the red plain ware corresponds to flaring-rim forms (see Figure 11b). Forty-five percent of the Salado Red Corrugated bowls were classified as unrestricted bowls with flaring rims. Finally, a single red plain vessel recorded as an unrestricted bowl exhibited a square or polygon plan view (see Figure 14). The vessel was recovered from Feature 181, an inhumation burial (see Volume 1). Because of its unusual form, this vessel was not included in the summary tables above. Aside from the vessel's morphology, it corresponded in every respect with the other red plain vessels with smudged interiors that were recovered.

Table 20 presents the rim treatments recorded for the rim sherds. As with the complete vessels, direct rims dominated the collection. The two everted rim forms corresponded to

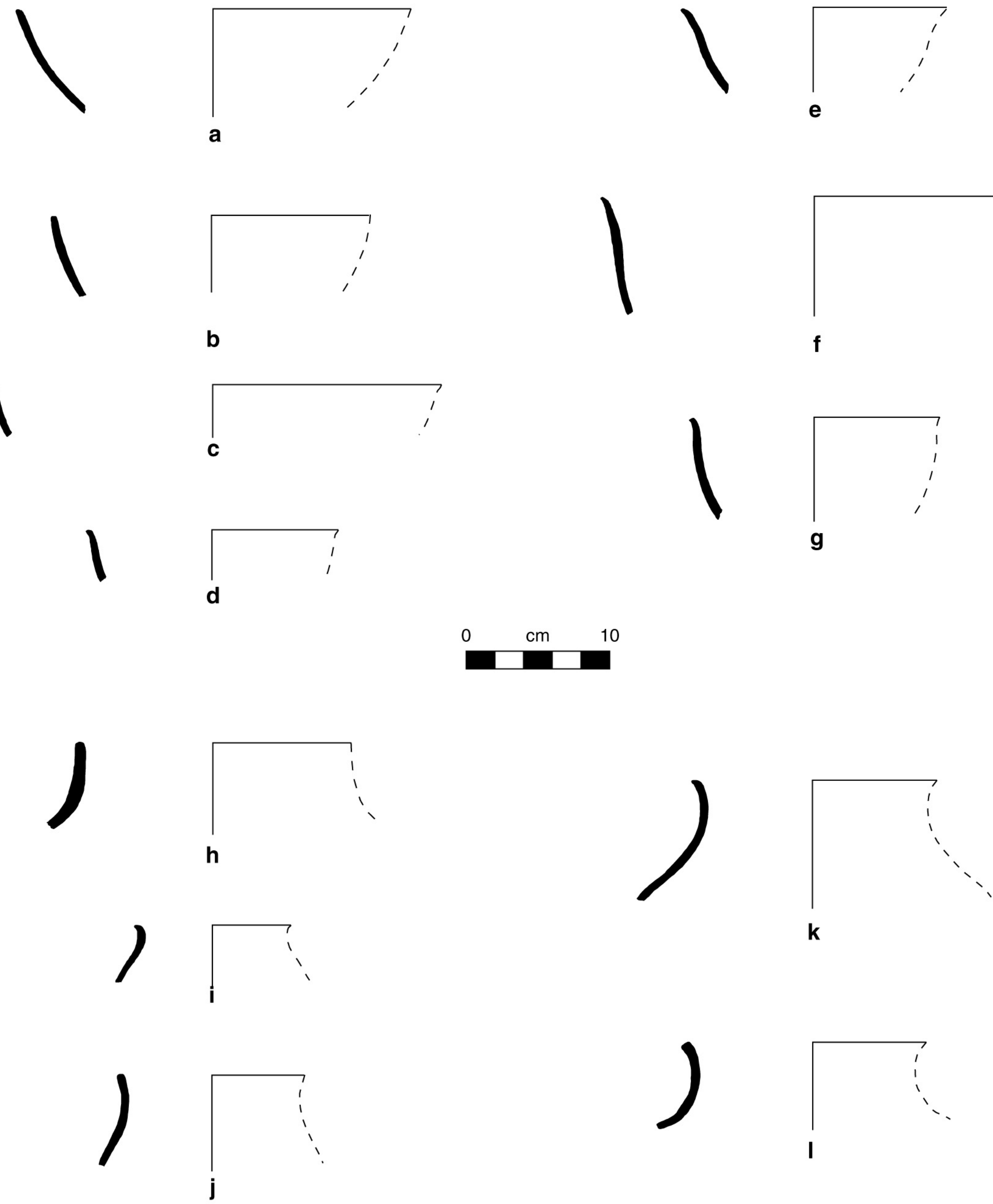

Figure 10. Examples of vessel forms represented by rim sherds recovered from Vegas Ruin (405/2012): (*a*) red plain, from midden fill (Feature 10); (*b*) Holbrook Black-on-white, from overburden above burial cribbing (Feature 12); (*c*) red plain, from fill of room (Feature 11); (*d*) red plain, from fill of pit structure (Feature 34); (*e*) Salado Red Corrugated, from Stripping Unit 335; (*f*) Salado Red Corrugated, from midden fill (Feature 10); (*g*) red plain, from midden fill (Feature 10); (*h*) brown plain, from fill of pit structure (Feature 99); (*i*) Salado Red Corrugated, from fill of borrow pit (Feature 22); (*j*) brown plain, from fill of pit structure (Feature 49); (*k*) Salado Red Corrugated, from fill of roasting pit (Feature 16); (*l*) red plain, from Stripping Unit 352.

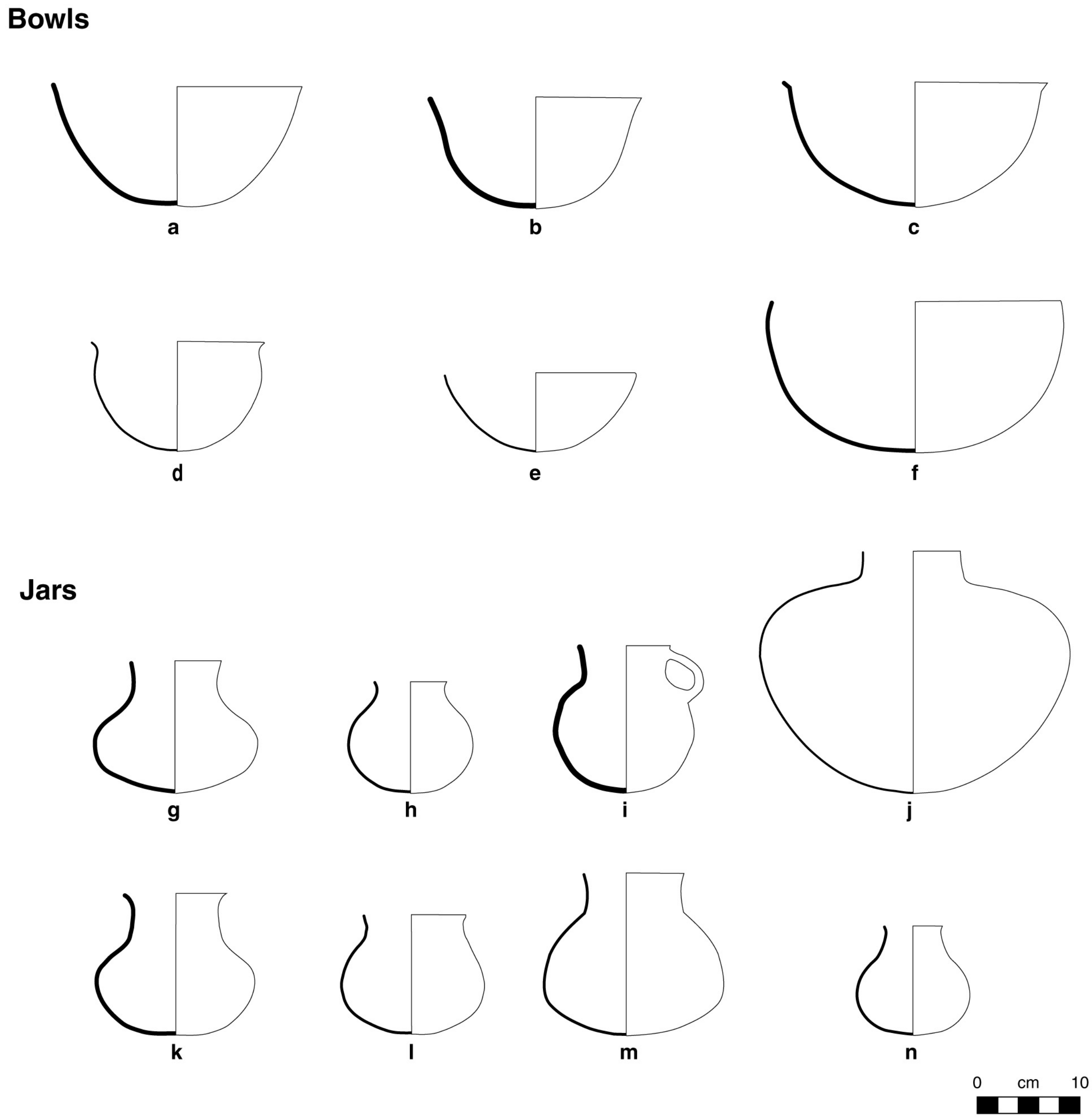

Figure 11. Examples of vessel forms represented by complete vessels recovered from inhumation burials at the Vegas Ruin (405/2012): (*a*) red plain (Vessel 23, Feature 101); (*b*) Salado Red Corrugated (Vessel 31, Feature 103); (*c*) Walnut Black-on-white (Vessel 12, Feature 146); (*d*) red plain (Vessel 83, Feature 146); (*e*) Salado Red Corrugated (Vessel 109, Feature 219); (*f*) Leupp Black-on-white (Vessel 19, Feature 137); (*g*) red plain (Vessel 59, Feature 106); (*h*) Salado Red Corrugated (Vessel 78, Feature 143); (*i*) Roosevelt Black-on-white (Vessel 30, Feature 33); (*j*) Snowflake Black-on-white (Vessel 72, Feature 108); (*k*) red plain (Vessel 39, Feature 106); (*l*) Salado Red Corrugated (Vessel 92, Feature 144); (*m*) red plain (Vessel 148, Feature 182); (*n*) Salado Red Corrugated (Vessel 89, Feature 181).

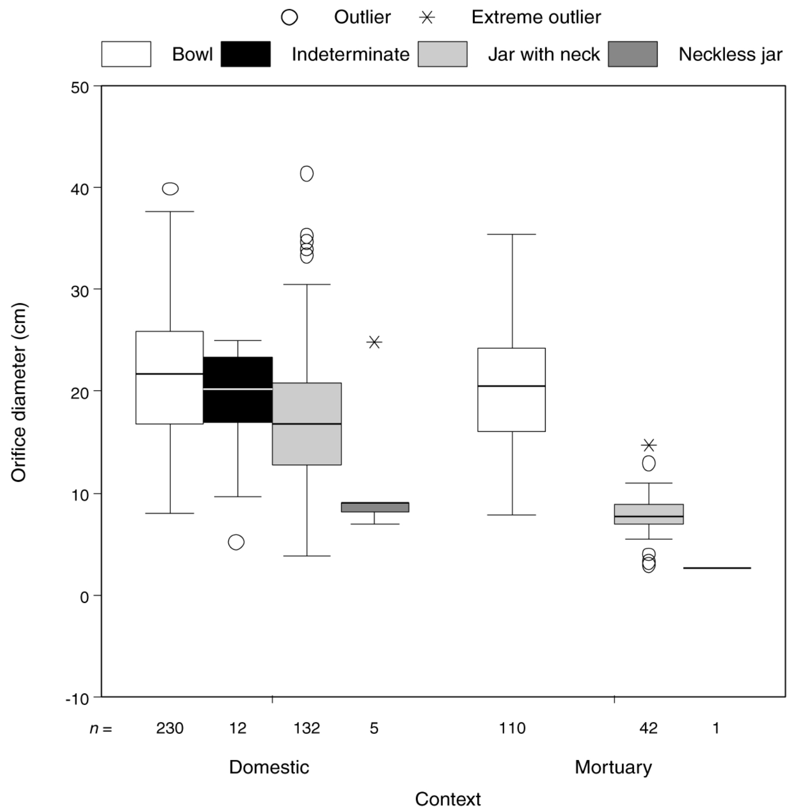

Figure 12. Box plots showing the distribution of orifice diameters for vessels from mortuary and domestic contexts from Vegas Ruin (405/2012). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

intrusive painted types for the Reserve Series and Little Colorado White Ware. The flaring rim forms for the Salado Red Corrugated and red plain with smudged interiors primarily represented deep bowl forms with slightly flaring rims (see Figure 10e–g).

Volume was calculated for 95 of the 97 unrestricted bowl forms (see Appendix A.1) The distribution of the sample had a minimum volume of 171 ml, a maximum volume of 8,527 ml, an average volume of 2,678 ml, and a standard deviation of 1,764 ml. One of the unrestricted bowls was omitted because a complete profile was not preserved. Volume was also not calculated for the polygon bowl described above because its irregular form precluded the use of the method we employed, which requires bilateral symmetry. Because the vessel was complete, however, a direct volume measurement of 1,440 ml was obtained. This is close to the average value for the conventional bowl forms. Figure 15 presents the volume distribution for the unrestricted bowls by general ware. No immediate trends or biases were indicated within the general ware categories. Like the restricted bowls, the largest vessels are represented by the outliers in the Salado Red Corrugated and red plain categories.

Jars

A total of 47 reconstructible jars were identified from the Vegas Ruin sample. All of these were jars with necks, with the exception of 1 eccentric neckless jar. A much smaller sample of neckless and indeterminate jars was also recorded in the form of rim sherds only (see Table 16). Because neckless and indeterminate jar forms were only recovered in the form of rim sherds, we could not calculate their volume or form. As a result, the focus of this discussion is on the reconstructible jars with necks. Of the 47 neckless jars, 3 were symmetrical along two axes, rather than the more commonly observed single axis (Figure 16). All 3 of these vessels were red plain (smudged interior) from burial contexts. Volume could only be measured directly for V 100 (840 ml); the other 2 vessels were only partially reconstructed, precluding a direct volume measurement. The remaining 44 jars with necks represented a diverse array of forms. The prevailing rim treatment used was subtle variations of flaring rims (Table 21; see Figure 11g–i, k–m). However, some examples of straight rim treatments were recorded, and these treatments were largely associated with painted vessels (see Figure 11j).

Table 17. Ceramic Types Associated with Restricted Bowl Forms for Whole Vessels from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Restricted Bowls		Total
	Direct	Flaring	
Little Colorado White Ware			
Walnut (Style A) Black-on-white	1	—	1
Walnut (Style B) Black-on-white	1	—	1
Leupp Black-on-white	1	—	1
Cibola White Ware			
Snowflake Black-on-white	1	—	1
Roosevelt Red Ware			
Pinto Black-on-red	1	—	1
Salado Red			
Salado Red Corrugated	4	6	10
Red plain			
Red plain (smudged interior)	2	6	8
Total	11	12	23

Table 18. Ceramic Types Associated with Restricted Bowl Forms for Rim Sherds from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Restricted Bowls				Total
	Direct Rim	Everted Rim	Flaring Rim	Indeterminate Rim	
Cibola White Ware					
Snowflake Black-on-white	1	—	—	—	1
Roosevelt Black-on-white	—	—	—	1	1
Salado Red					
Salado Red Corrugated	—	—	4	—	4
Red Ware					
Red plain (smudged interior)	3	2	7	1	13
Total	4	2	11	2	19

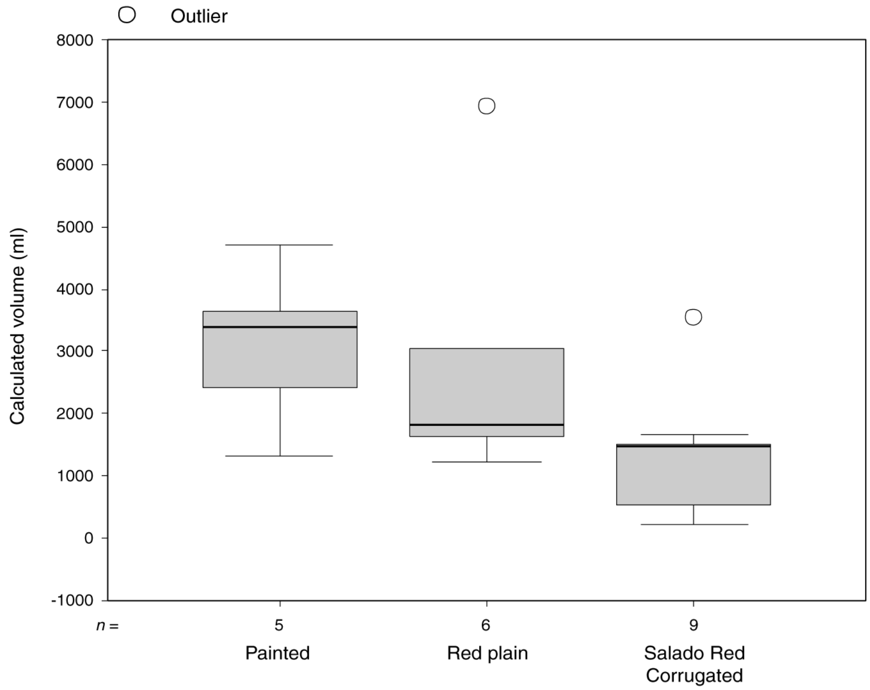

Figure 13. Box plots showing the volume distribution for restricted bowls by general ware from the Vegas Ruin (405/2012). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

Table 19. Ceramic Types Associated with Unrestricted Bowl Forms for Whole Vessels from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Unrestricted Bowls			Total
	Direct Rim	Flaring Rim	Everted Rim	
Cibola White Ware				
Roosevelt Black-on-white	1	—	—	1
Snowflake Black-on-white	1	—	—	1
Little Colorado White Ware				
Walnut (Style A) Black-on-white	1	—	—	1
Walnut (Style B) Black-on-white	1	—	1	2
Walnut Black-on-white	1	—	—	1
Red Ware				
Red plain (smudged interior)	40	19	—	59
Salado Red				
Salado Red Corrugated	18	15	—	33
Total	63	34	1	98

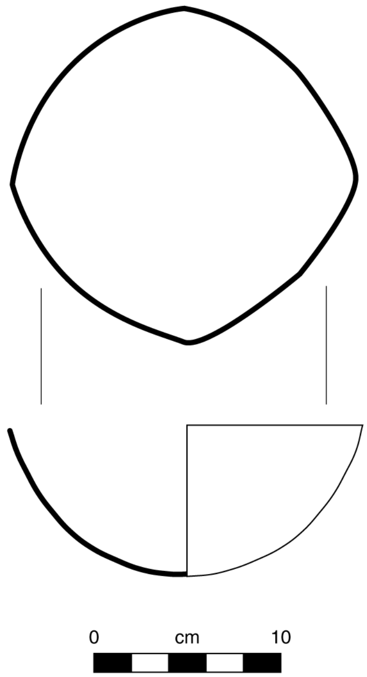

Figure 14. Unrestricted bowl (Vessel 165) with a squared plan view from Feature 181 (inhumation) at Vegas Ruin (405/2012).

The rim sherds exhibited slightly more variation in rim treatment. As with the vessels, however, flaring rims dominated (Table 22). Figure 9i–l shows some selected examples of flaring rim treatments. In addition, an example of a straight rim treatment from a red plain vessel is presented in Figure 10h.

Volume was calculated for 40 of the 47 vessels classified as jars with necks. The volume was not calculated for the remaining 7 vessels, either owing to their irregular shapes or incomplete profiles. The volume of the remaining jars ranged from 55 to 16,266 ml, with an average of 1,907 ml and a standard deviation of 2,904 ml. Close examination of these data reveal 3 extreme statistical outliers—a Salado Red Corrugated vessel with a volume of 16,266 ml, a Snowflake Black-on-white vessel with a volume of 10,461 ml, and a brown corrugated vessel with a volume of 33,543 ml. Removing these outliers revealed a relatively tight distribution with a range of 55–2,501 ml, an average volume of 1,172 ml, and a standard deviation of 516 ml. Figure 17 presents the volume distribution of the jars with a neck by general ceramic ware, excluding the statistical outliers. The red plain category showed the greatest range of volumes; however, the general distributions by ceramic ware did not vary greatly.

Ladle and Scoop

A single red plain ladle (V 140) was recovered from the Feature 140 inhumation burial at the Vegas Ruin (Figure 18a). The ladle volume was calculated at approximately 378 ml. A small section of the broken handle extended from the ladle rim. The rest of the handle was not recovered, suggesting that the vessel broke prior to being deposited in the grave.

Two oblong vessels recovered form the Vegas Ruin were classified as scoops (see Figure 18b, c). The first, V 166, was a red plain with a relatively shallow profile exhibiting a small amount of wear on the base and no visible wear elsewhere on the vessel's surface (see Figure 18b). The capacity of V 166 was directly measured and was approximately 1,360 ml. The second scoop, V 185, was a Brown Obliterated Corrugated vessel with minimal wear on the base only. The directly measured volume for V 185, approximately 410 ml, was considerably smaller than that recorded for V 166.

Eccentric and Effigy Vessels

Three vessels and one rim sherd from the Vegas Ruin were characterized as eccentric vessel forms (see Table 16). The three complete vessels represented radically different vessel shapes (Figure 19a–c). The single rim sherd appears to have represented a lobed jar. The two lobed vessels depicted in Figure 19a and b may have been gourd effigies. Lobed vessels similar to these have been reported from Snaketown and sites within Tonto Basin (Haury 1976; Vint 2000b:179). V 105 had a directly measured volume of approximately 1,010 ml, and V 108 was slightly smaller, with a capacity of approximately 824 ml. These two red plain vessels exhibited minimal use wear on the interior or exterior surfaces. The other eccentric vessel form was also a red plain ware with three chambers (see Figure 19c). This unique vessel had three separate chambers and could conceivably hold three different liquids. The division of the chambers does not extend up the neck of the vessel, however, so if three different liquids were poured from the container they would become mixed. V 178 had an extremely small volume of 70 ml compared with the other two lobed jars recovered from the site.

V 169 was a Salado Red Corrugated pot characterized as a "bird" effigy. The oblong shape of the vessel body resembled other Salado Red Corrugated vessels reported from nearby sites that, in some cases, had applique wings and tails (Vint 2000b:Figure 4.5 and 4.6). V 169 had what appeared to be a strap handle that broke in prehistory, prior to the vessel's interment in the Feature 103 inhumation (see Figure 19d). The vessel exhibited extensive basal abrasion and some chipping and wear around the rim. The vessel was relatively small with a directly measured volume of 407 ml. Dixon (1963) referred to morphologically similar vessels as "culinary shoe-pots" and reported a wide distribution across North and

Table 20. Ceramic Types Associated with Unrestricted Bowl Forms for Rim Sherds from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Unrestricted Bowls				Total
	Direct Rim	Flaring Rim	Everted Rim	Indeterminate Rim	
Little Colorado White Ware					
Holbrook Black-on-white, Style B	1	—	—	2	3
Holbrook Black-on-white	—	—	—	1	1
Holbrook or Walnut Black-on-white	1	—	—	4	5
Leupp Black-on-white	—	—	1	1	2
Walnut (Style A) Black-on-white	3	1	—	4	8
Walnut Black-on-white	1	—	—	3	4
Indeterminate Little Colorado White Ware	5	1	—	7	13
Cibola White Ware					
Puerco Black-on-white	—	1	—	—	1
Red Mesa Black-on-white	—	—	—	2	2
Reserve Black-on-white	2	—	—	1	3
Roosevelt Black-on-white	—	1	—	4	5
Snowflake Black-on-white	5	1	—	2	8
Indeterminate Cibola White Ware	6	1	—	10	17
Roosevelt Red Ware					
Pinto Black-on-red	1	—	—	—	1
Salado Red					
Salado Red Corrugated	38	82	—	22	142
Salado White-on-red	—	1	—	1	2
Tusayan White Ware					
Kana'a Black-on-white	1	—	—	—	1
Indeterminate Tusayan White Ware	1	—	—	—	1
Reserve Series					
McDonald Painted Corrugated	—	—	1	—	1
Reserve Indented Corrugated, smudged	—	—	—	1	1
Painted Indented Corrugated, smudged	1	—	—	—	1
Showlow or Roosevelt Red Ware					
Showlow Black-on-red, Holbrook Style	—	—	—	1	1
Showlow Black-on-red, Wingate Style	—	—	—	1	1
Indeterminate Showlow or Roosevelt Red Ware	1	—	—	1	2
Red ware					
Red plain (smudged interior)	104	67	—	46	217
Brown ware					
Brown corrugated	3	4	—	1	8
Brown plain	32	10	—	9	51
Total	207	170	2	124	502

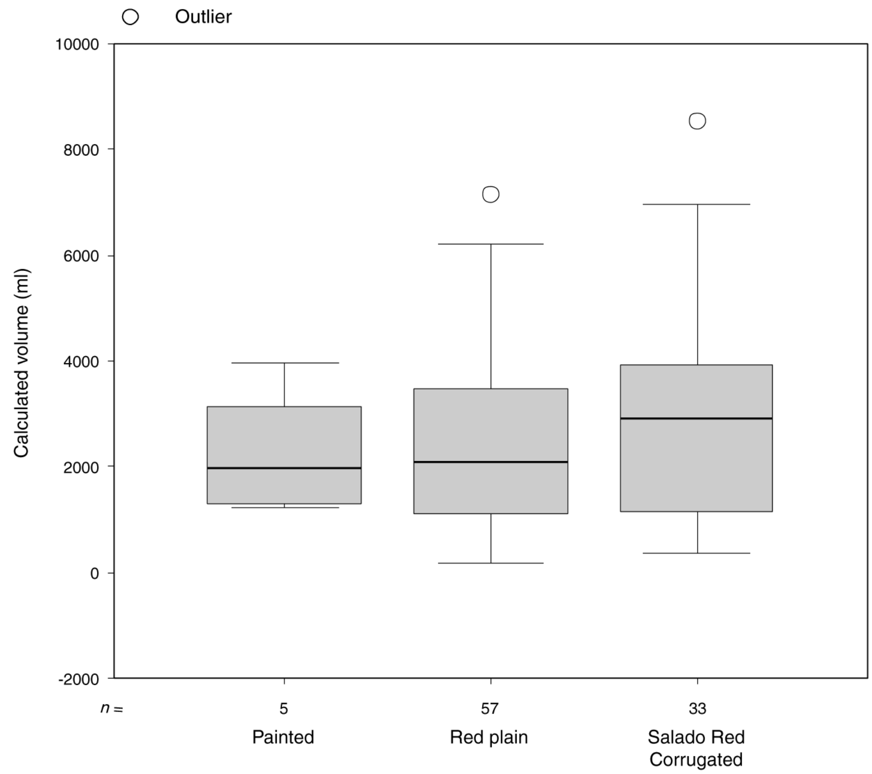

Figure 15. Box plots showing volume distribution for unrestricted bowls by general ware for Vegas Ruin (405/2012). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

South America. Dixon suggested that the vessel form reflects the diffusion of a cooking technique across an impressive geographic area spanning several hundred years. These oblong jars seem to have appeared sometime after A.D. 1150 in the Southwest (Dixon 1963).

The Crane Site (AZ U:3:410/2017)

The Crane site represents the remains of a small early Classic period hamlet. Wegener and Klucas (see Volume 1, Chapter 8) estimated that approximately 50 percent of the site was contained within the ADOT ROW. Two spatially discreet cob-ble-adobe-foundation architectural units constituted the visible surface features at the site. Only the easternmost portion of the site fell within the ADOT ROW. Data recovery efforts revealed a diverse array of feature types—house structures, midden deposits, extramural hearths and pits, granaries, and human burials—testifying to the intensive occupation.

The Ceramic Collection

Data recovery efforts at the Crane site yielded 8,502 ceramic artifacts (Table 23). All ceramic artifacts from all contexts were recorded during the initial sort. The expanded attribute recording included 630 sherds, including 178 painted rim and body sherds and 452 unpainted rims. A total of 44 vessels, 2 painted and 42 unpainted, were also recorded from the Crane Site. As with the Vegas Ruin, a very small percent of the ceramic artifacts were painted; in this case, just over 2 percent. Painted types represented in the collection are shown in Table 24. Nearly half of the ceramics recovered exhibited a red-slipped surface. These are divided evenly among smoothed red plain with a smudged interior and Salado Red Corrugated. Most of the whole and reconstructible vessels were recovered from inhumation burials—only 10 of the 44 whole and reconstructible vessels from the Crane site were recovered from nonmortuary contexts.

Inclusions

The observations on inclusions were made only on the unpainted rim sherds and the reconstructible or whole vessels. These data are presented in Table 25. The dominant inclusion type in the collection was feldspar/quartz, present in 54.66 percent of the sample, followed closely by diabase,

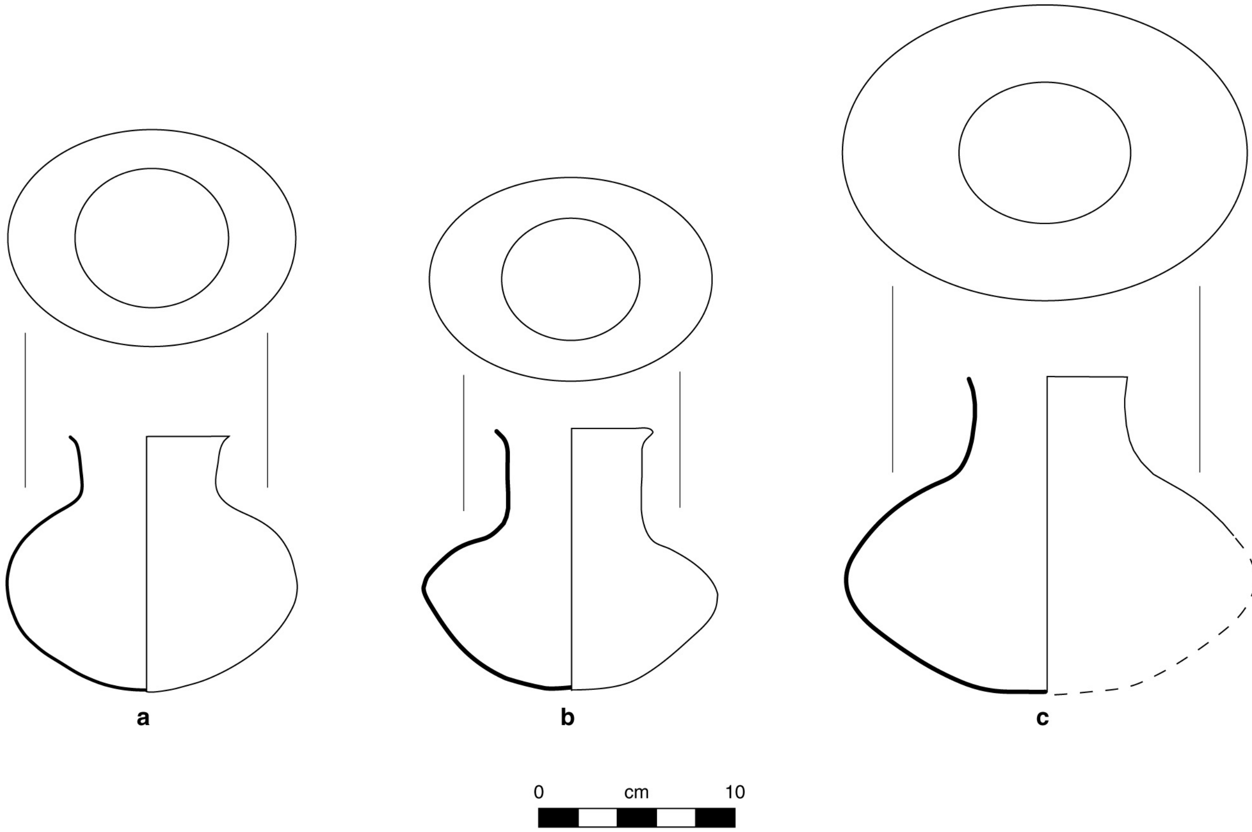

Figure 16. Jars (with necks) that are symmetrical on two axes, all are from inhumation burials from the Vegas Ruin (405/2012): (*a*) red plain (Vessel 100, Feature 207); (*b*) red plain (Vessel 174, Feature 207); (*c*) red plain (Vessel 172, Feature 101).

at 41.90 percent. Diabase and feldspar/quartz inclusions were observed in all of the unpainted ceramic categories. Feldspar/quartz inclusions were also found in proportionally greater quantities in the brown and red plain wares with smoothed surface treatments. Diabase and feldspar/quartz inclusions reached nearly equal portions in the brown corrugated category, whereas diabase dominated the Salado Red Corrugated category, as it was present in over 76 percent of the sample.

Vessel Form and Metric Attributes

Vessel form was only recorded for rim sherds and vessels. These data are listed in Table 26. The vessel-form categories exhibited little variability between materials from domestic and mortuary contexts. The bowl-to-jar ratio for the domestic contexts at 2.9:1 is only slightly higher than the 2.3:1 bowl-to-jar ratio recorded for the vessels from mortuary contexts. Two of the vessel form categories are represented in low numbers but are mutually exclusive by context. Neckless jars were only recovered from domestic contexts, and the only eccentric vessel form was found in association with an inhumation burial. Figure 20 provides examples of rims classified as bowls and jars with a neck. Figure 21 presents examples of complete vessels classified as bowls and jars.

Figure 22 presents the distribution of orifice diameters for rim sherds and vessels by context. Using the reconstructible vessel data, hierarchical cluster analysis, and discriminant analysis, Heckman modeled vessel size for rim sherds (Heckman 2002; see also Volume 3). Based on these analyses, we were able to use orifice diameter as a proxy measure of vessel volume. These data, in turn, suggest that the bowls recovered from mortuary contexts possessed a similar range in volume as those recovered from domestic contexts. Conversely, the jars recovered from mortuary context exhibited a much smaller range of orifice diameters than did those recovered from domestic contexts, suggesting that a

Table 21. Ceramic Types Associated with Jars with Necks for Whole Vessels from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Jars with Necks			Total
	Flaring Rim	Straight Rim	Indeterminate Rim	
Cibola White Ware				
Snowflake Black-on-white	1	2	—	3
Reserve Black-on-white	—	2	—	2
Roosevelt Black-on-white	2	—	—	2
Salado Red				
Salado Red Corrugated	6	1	—	7
Salado White-on-red	1	—	—	1
Red ware				
Red plain (smudged interior)	24	1	1	26
Brown ware				
Brown plain	2	—	—	2
Brown corrugated	1	—	—	1
Total	37	6	1	44

Table 22. Ceramic Types Associated with Jars with Necks for Rim Sherds from the Vegas Ruin (405/2012)

Ceramic Ware and Type	Jars with Necks					Total
	Flaring Rim	Everted Rim	Upturned Rim	Straight Rim	Indeterminate Rim	
Little Colorado White Ware						
Indeterminate Little Colorado White Ware	—	—	—	—	2	2
Cibola White Ware						
Snowflake Black-on-white	2	—	—	—	—	2
Indeterminate Cibola White Ware	1	—	1	—	3	5
Salado Red						
Salado Red Corrugated	31	—	4	3	5	43
Salado White-on-red	1	—	—	—	—	1
Red ware						
Red plain (smudged interior)	39	1	2	3	11	56
Brown ware						
Brown plain	43	—	7	5	10	65
Brown corrugated	13	—	3	2	1	19
Total	130	1	17	13	32	193

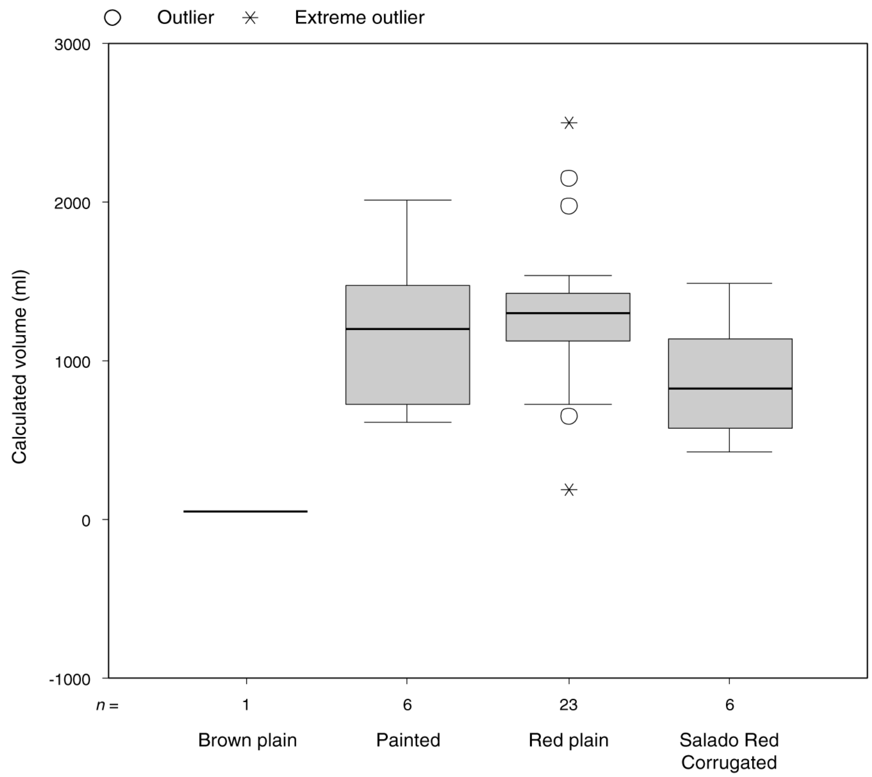

Figure 17. Box plots showing the volume distribution of jars (with necks) from Vegas Ruin (405/2012) (note extreme outliers removed, see text). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

selection process favoring small jars was in place for funerary offerings. No such bias is apparent for the bowls.

Bowls

Bowls constitute the largest formal category of vessels recovered from the Crane site (see Table 26). Bowls within the group of whole and reconstructible vessels that exhibited restricted profiles varied by typological category (Table 27). From this admittedly small sample of restricted bowl forms, the two painted and one Salado Red Corrugated vessels had direct-rim treatments (see Figure 21b, c). Conversely, four of the five red plain (smudged interior) vessels had flaring-rim forms (see Figure 21a) and a single vessel had an upturned rim form (see Figure 20b). The variability in rim-form treatment observed among the whole and reconstructible vessels was mirrored in the collection of rim sherds (Table 28). The painted wares again exhibited direct rim restrictions to the exclusion of other treatments. The greatest variability in rim treatment was observed for the red plain with a smudged interior.

The unrestricted whole and reconstructed bowls showed little variation in the rim-form treatments by general ware (Table 29). Figure 21e and f provides examples of unrestricted-bowl forms with direct rim treatments and Figure 21g and h presents examples of flared-rim treatments. The rim forms for unrestricted bowl rim sherds followed the same pattern as those for the vessels and even that of the restricted bowl forms. The painted rim sherds overwhelmingly exhibited direct rim treatments (Table 30; see Figure 20d) and the greatest variability in rim treatments was observed for the unpainted categories.

Seven of the eight restricted bowls were complete enough to calculate their volume. Figure 23 shows the box plot distribution of the calculated volume by general ceramic ware. The single Salado Red Corrugated bowl was much smaller than the other vessels, with a volume of 222 ml. The largest restricted bowl in the collection was a Pinto Polychrome bowl with a calculated volume of 2,854 ml. Grouped together, the seven vessels had an average volume of 1,490 ml.

Two of the unrestricted bowl forms were not complete enough to calculate volume. Figure 24 shows the volume

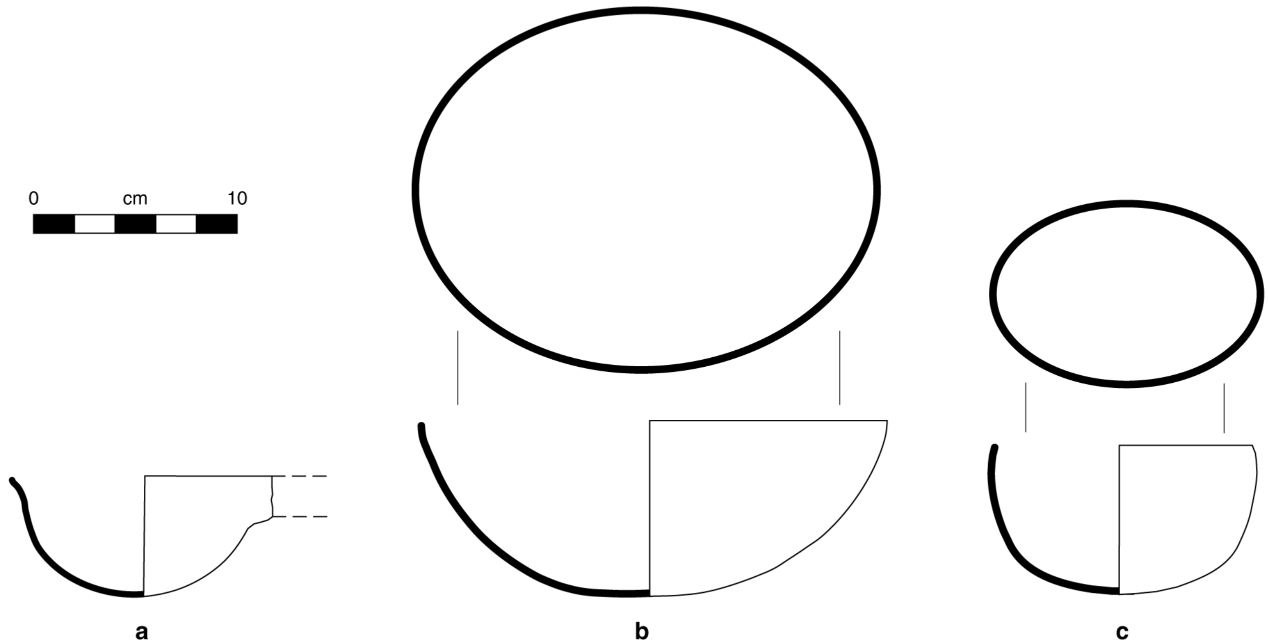

Figure 18. Examples of the three specialized vessels recovered from inhumation burials at the Vegas Ruin (405/2012): (*a*) red plain ladle (Vessel 140, Feature 140); (*b*) red plain (Vessel 166, Feature 106); (*c*) Brown obliterated corrugated (Vessel 185, Feature 14).

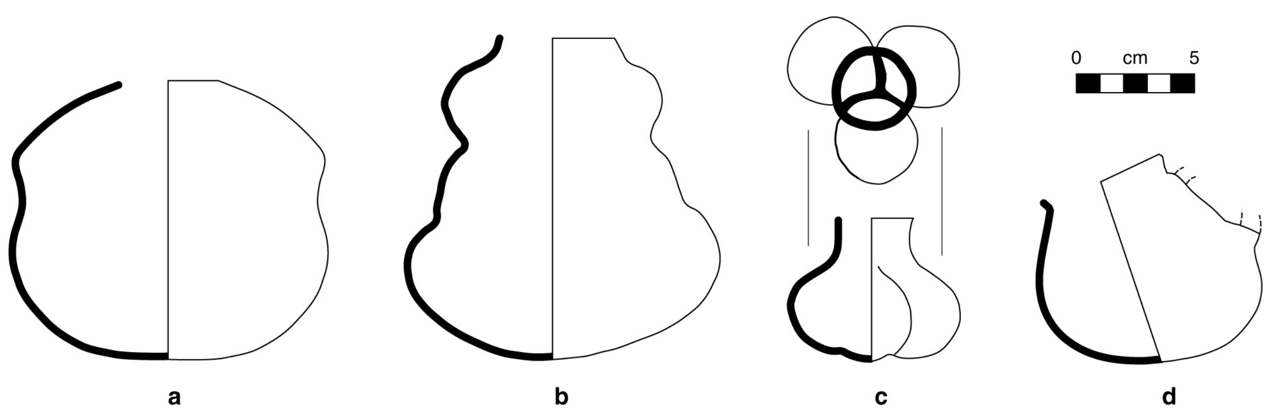

Figure 19. Eccentric forms (*a–c*) and an effigy vessel (*d*) recovered from inhumation burials at Vegas Ruin (405/2012): (*a*) red plain (Vessel 105, Feature 220); (*b*) red plain (Vessel 108, Feature 207); (*c*) red plain (Vessel 178, Feature 206); (*d*) Salado Red Corrugated effigy vessel (Vessel 169, Feature 103).

Table 23. Ceramic Categories by General Contexts for the Crane Site (410/2017)

Ceramic Category	Domestic						Mortuary		Total	
	Body Sherd		Rim Sherd		Vessel		Vessel			
	n	%	n	%	n	%	n	%	n	%
Painted	210	2.6	28	5.8	—	—	2	5.9	240	2.8
Brown ware	3,349	42.0	111	23.1	—	—	1	2.9	3,461	40.7
Brown corrugated	1,087	13.6	96	20.0	—	—	2	5.9	1,185	13.9
Red ware	1,710	21.4	117	24.4	5	50.0	17	50.0	1,849	21.7
Salado Red Corrugated	1,622	20.3	128	26.7	5	50.0	12	35.3	1,767	20.8
Total	7,978	100	480	100	10	100	34	100	8,502	100

distribution by general ware for the unrestricted whole and reconstructible bowls complete enough to calculate volume. The single brown plain vessel had a volume in line with the 1,900 ml mean calculated for all 18 vessels. This is also true of the mean calculated using only those vessels in the red plain (smudged interior) and Salado Red Corrugated categories.

Jars

The collection of jars from the Crane site was dominated by those with necks (see Table 26). Only three rim sherds were from vessels categorized as neckless jars. A total of 12 of the whole and partial vessels recovered represented jars with a neck (Table 31). Flaring (see Figure 21i, l, m) and straight (see Figure 21j, k) rim forms represented the two rim treatments found on the vessels. Figure 25 presents the volume distribution by general ware for the 10 out of 12 vessels complete enough to calculate volume. Collectively, the jars exhibited a volume range from 0.3 to 1.9 liters with a mean of 1.1 liters and a standard deviation of 0.6 liters. The rim sherds exhibited flared (see Figure 21h–j) and upturned (see Figure 21g) rim treatments (Table 32). Interestingly, none of the whole vessels exhibited upturned rim treatments, instead, straight treatments were used. Conversely, no straight treatments were observed on the rim sherds.

Eccentric

Figure 26 shows V 194, a canteen, typed as Salado Red Corrugated. The vessel was unique in form among the ceramic collection from the entire project. The vessel in plan and profile meets the classic proportions and morphology of modern canteens. The protrusion around the neck likely provided a convenient anchor for attaching a strap. The scalloped edge and corrugated body give the impression of a turtle shell when the vessel is viewed dorsally (see Figure 26b).

Summary: The CCP Ceramic Collections

As we indicated above, the main goal of this chapter and Appendixes A.1–A.3 was to describe the ceramic collections from the nine prehistoric sites investigated during the CCP. As a means of ensuring that these descriptive analyses were relevant to the broader project aims, we selected those attributes that would contribute to the investigation of the questions and themes listed in the research design (Ciolek-Torrello and Klucas 1999). That being said, no archaeological project exists in a vacuum. For our work to have relevance and lasting value, the data must also be compatible with prior research and contribute to the investigation of a wide range of regional issues. For that reason, a balance must be struck between project-specific goals and the more general, regional concerns.

Although our observations on the ceramic collections contribute to our investigation of the questions and themes listed in the research design, the ceramic data alone are insufficient for a comprehensive investigation of any of them. It is only through the synthesis of multiple lines of evidence, including data derived from the analysis of all classes of artifacts and ecofacts, that interpretations can be made with confidence. Volume 3 contains several of these synthetic treatments. Nonetheless, comparisons of ceramic data alone can, at the very least, reveal patterns that may warrant further investigation. We

Table 24. Painted Pottery Recovered from the Crane Site (410/2017)

Ceramic Ware and Type	Count	Percentage Within Type	Percentage of Total Painted Pottery
Little Colorado White Ware			
St. Joseph Black-on-white	1	4.0	0.6
Holbrook Black-on-white, Style A	2	8.0	1.1
Holbrook or Walnut Black-on-white	7	28.0	3.9
Padre Black-on-white	1	4.0	0.6
Walnut Black-on-white	3	12.0	1.7
Walnut (Style B) Black-on-white	2	8.0	1.1
Indeterminate Little Colorado White Ware	9	36.0	5.0
Subtotal, Little Colorado White Ware	25	100	14.0
Cibola White Ware			
Red Mesa Black-on-white	1	1.0	0.6
Puerco Black-on-white	1	1.0	0.6
Snowflake Black-on-white	11	10.7	6.1
Reserve Black-on-white	2	1.9	1.1
Tularosa Black-on-white	1	1.0	0.6
Tularosa or Pinedale Black-on-white	1	1.0	0.6
Pinedale Black-on-white	1	1.0	0.6
Roosevelt Black-on-white	13	12.6	7.3
Indeterminate Cibola White Ware	72	69.9	40.2
Subtotal, Cibola White Ware	103	100	57.5
Hohokam Buff Ware			
Sacaton Red-on-buff	2	15.4	1.1
Casa Grande Red-on-buff	1	7.7	0.6
Indeterminate red-on-buff	4	30.8	2.2
Indeterminate buff (no paint)	6	46.2	3.4
Subtotal, Hohokam Buff Ware	13	100	7.3
Roosevelt Red Ware			
Pinto Black-on-red	4	30.8	2.2
Pinto Polychrome	3	23.1	1.7
Pinto Polychrome, salmon variety	3	23.1	1.7
Pinto or Gila Polychrome	2	15.4	1.1
Gila Polychrome	1	7.7	0.6
Subtotal, Roosevelt Red Ware	13	100	7.3
Salado Red			
Salado White-on-red	1	100	0.6
Tusayan White Ware			

Table 24. Painted Pottery Recovered from the Crane Site (410/2017) (*continued*)

Ceramic Ware and Type	Count	Percentage Within Type	Percentage of Total Painted Pottery
Kana'a Black-on-white	1	33.3	0.6
Indeterminate Tusayan White Ware	2	66.7	1.1
Subtotal, Salado Red	3	100	1.7
Reserve Series			
McDonald Painted Corrugated	2	100	1.1
Showlow or Roosevelt Red Ware			
Indeterminate Showlow or Roosevelt Red Ware	4	100	2.2
Red ware			
Purple-on-red	1	50.0	0.6
Black-on-red	1	50.0	0.6
Subtotal, red ware	2	100	1.1
Brown ware			
Indeterminate red-on-brown	1	100	0.6
White ware			
Indeterminate black-on-white	12	100	6.7
Total	179		100

close this chapter with a brief discussion of some of these patterns and their implications for further research.

General Patterns in the CCP Ceramic Collections

In terms of their represented ceramic collections, the sites constituting much of the CCP sample are conspicuous by the redundancy exhibited by the plain ware vessels. This is especially true of the Vegas Ruin and the Crane site. Minimal variability is evident in terms of represented types, and such indicators of manufacturing technology as nonplastic inclusions. Given that the two sites are functionally similar, are separated by less than 1 km, and are temporally similar, these similarities are not surprising.

In terms of the CCP collection as a whole, much of the variability that is present likely reflects temporal differences, such as the higher percentage of buff wares recovered from the late pre-Classic period Rock Jaw site and Site 41/583 when compared with the early Classic period habitation sites. Even in these cases, however, the differences are more quantitative than qualitative—most of the buff ware types identified at Site 41/583 and the Rock Jaw site are present, albeit in smaller numbers, at the Vegas Ruin and Crane Site. This likely reflects the temporally transitional nature of these sites.

The collection of locally made pottery from the CCP sites is dominated by brown plain wares and Salado Red, the latter including Salado Red Corrugated. In contrast to the limited variability in technological and typological characteristics of the plain ware, the broad range of ceramic forms represented by these types provides further evidence that most of the ceramic needs were met through access to local sources.

Painted Wares

In terms of painted wares, the CCP collections follow patterns observed throughout Tonto Basin. Virtually all of the painted ceramics were imported into the basin—no evidence of a local painted tradition is evident. This is reflected in the low percentage of painted ceramics recovered from the CCP sites. The percentage of painted pottery recovered from the Vegas Ruin, including both sherds and whole vessels, is about 8 percent. The percentage from the Crane site is even lower, with 2.8 percent of the collection consisting of painted

Table 25. Nonplastic Inclusions Identified in Unpainted Rims and Vessels Recovered from the Crane Site (410/2017)

Inclusion Type	Brown Corrugated		Brown Plain		Red Plain		Salado Red Corrugated		Total	
	Rims	Vessels	Rims	Vessels	Rims	Vessels	Rims	Vessels	n	%
Granite with garnet	2	—	—	—	—	—	2	—	4	0.8
Diabase	39	1	26	—	30	—	98	13	207	41.9
Feldspar/quartz	51	1	82	1	86	21	25	3	270	54.7
Igneous volcanic	—	—	1	—	—	—	—	—	1	0.20
Indeterminate	4	—	2	—	1	1	3	1	12	2.4
Total	96	2	111	1	117	22	128	17	494	100

Table 26. Vessel Form Frequencies Recorded from Domestic and Mortuary Contexts from the Crane Site (410/2017)

Vessel Form	Context				Total
	Domestic			Mortuary	
	Rims	Vessels	Subtotal	Vessels	
Bowl	251	7	258	21	279
Jar with neck	85	3	88	9	97
Neckless jar	3	—	3	—	3
Eccentric	—	—	—	1	1
Indeterminate	141	—	141	3	144
Total	480	10	490	34	524

sherds and vessels. These percentages straddle the combined 6.3 percent decorated wares reported for the TCAP sites (Vint 2000d:334). It should be noted that, as with the TCAP sites, most of the white wares associated with the CCP sites were recovered from mortuary contexts, possibly reflecting a specialized function for these wares.

The low frequency of painted sherds from the Vegas Ruin and Crane site stands in stark contrast to the great diversity of individual painted types represented within the collection. The painted collection from the Vegas Ruin, which consisted of a total of 584 sherds and whole vessels, included eight clearly defined types of Little Colorado White Ware, eight types of Cibola White Ware, two types of Tusayan White Ware, and two types of Roosevelt Red Ware, as well as examples of Salado Red, San Juan Red, and a small number of buff wares. The Crane site exhibited similar diversity of painted types represented in what was a much smaller collection of decorated ceramics, consisting of only 180 individual ceramic artifacts. This apparent incongruity between the diversity of painted types represented in the ceramic collections and the relatively low frequency of painted types likely reflects the socioeconomic mechanisms that brought the wares to Tonto Basin. Given the limited number of painted wares in the overall collections, it is unlikely that a system of regular, direct trading contact between the CCP sites and the ceramic source areas was in operation. Possible alternatives are that these pots were either obtained locally, or represented ad hoc trading opportunities of individual households, perhaps reflecting familial contacts with populations on the Colorado Plateau and Phoenix Basin.

Functional Analyses of Mortuary Ceramics

Because of a lack of intact floor assemblages from the domestic features, the mortuary collections from the Vegas Ruin and the Crane site arguably provide the highest quality ceramic data from the CCP. Although directly representing a set of nondomestic behaviors, several lines of evidence suggest that mortuary collections can contribute to investigations of other aspects of domestic behavior. First, many of the vessels recovered from mortuary contexts exhibited use-wear patterns suggesting that they had served a more mundane domestic function before being interred. Second, the similarities in bowl-to-jar ratios between the collections recovered from mortuary and domestic contexts cited above suggests that the content of the mortuary assemblages may reflect an attempt to replicate domestic assemblages. These topics receive further treatment in Volume 3.

Ceramic Production, Regional Interaction, and Exchange

Several recent projects in central Arizona have used petrographic analyses of ceramic sherds as a means of reconstructing trade patterns (Heidke and Miksa 2000; Miksa et al. 2003). In these analyses, key minerals of a known provenance are used to identify likely ceramic manufacturing loci, data that are then used to reconstruct patterns of distribution and exchange. These studies are predicated on a number of assumptions about how raw materials are selected and used in ceramic production. Among these is the assumption that the presence of nonplastic inclusions in the clay results from the conscious addition of these inclusions to the clay, implying a high degree of control over the composition of the paste. Further, it is assumed that the raw materials were collected from a limited area around the manufacturing locus. Thus, if the provenance of the raw materials can be identified, the locus of manufacture for individual vessels can be proposed.

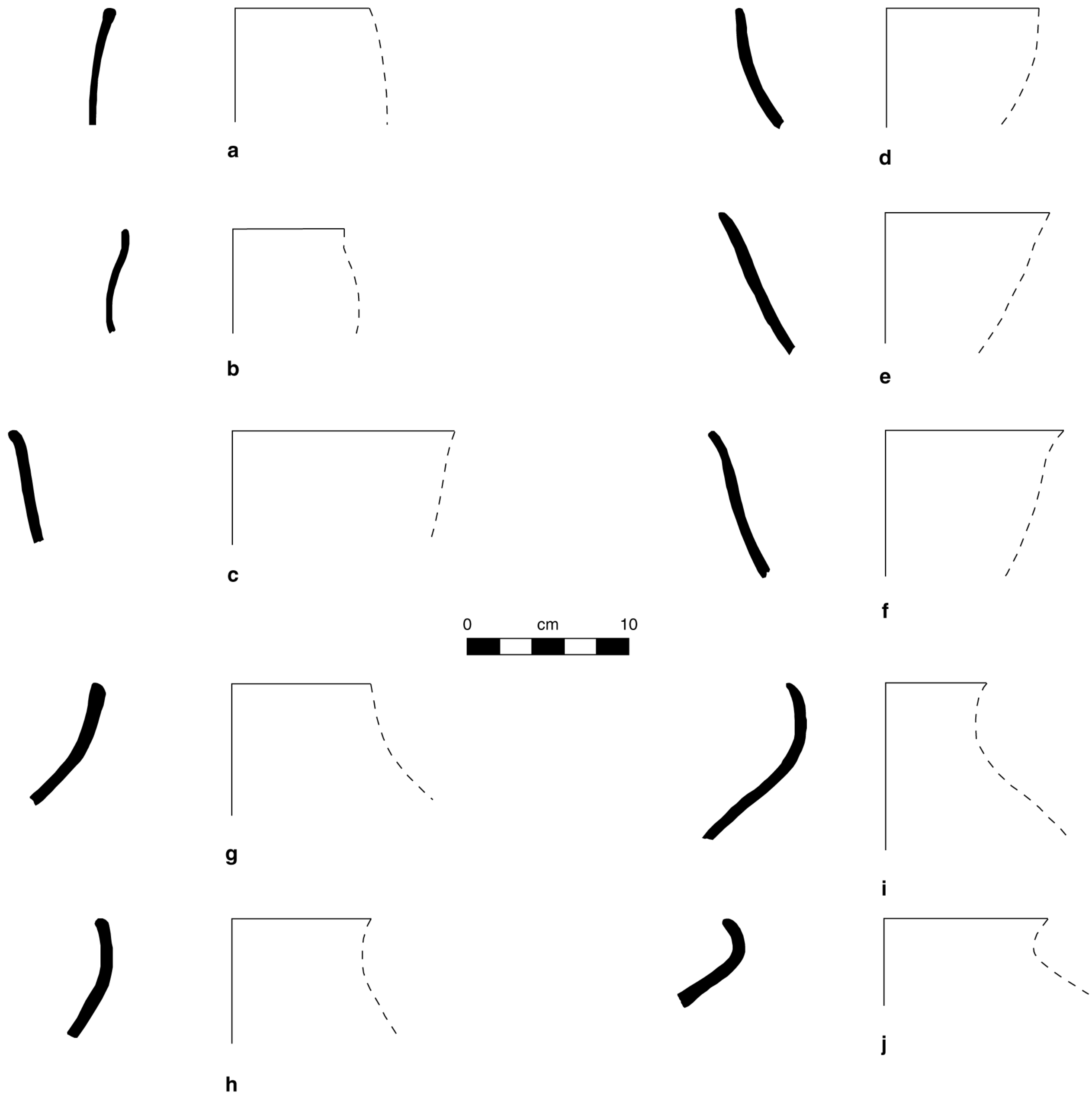

Figure 20. Examples of vessel forms represented by rim sherds recovered from the Crane site (410/2017): (*a*) red plain (smudged interior), from midden fill (Feature 1); (*b*) brown corrugated, from Wall Trench 62; (*c*) red plain (smudged interior), from midden fill (Feature 1); (*d*) Salado Red Corrugated, from midden fill (Feature 1); (*e*) brown corrugated, from Stripping Unit 302; (*f*) brown plain, from midden fill (Feature 1); (*g*) brown corrugated, from midden fill (Feature 1); (*h*) Salado Red Corrugated, from Hand Trench 260; (*i*) brown plain, from midden fill (Feature 1); (*j*) brown plain, from midden fill (Feature 1).

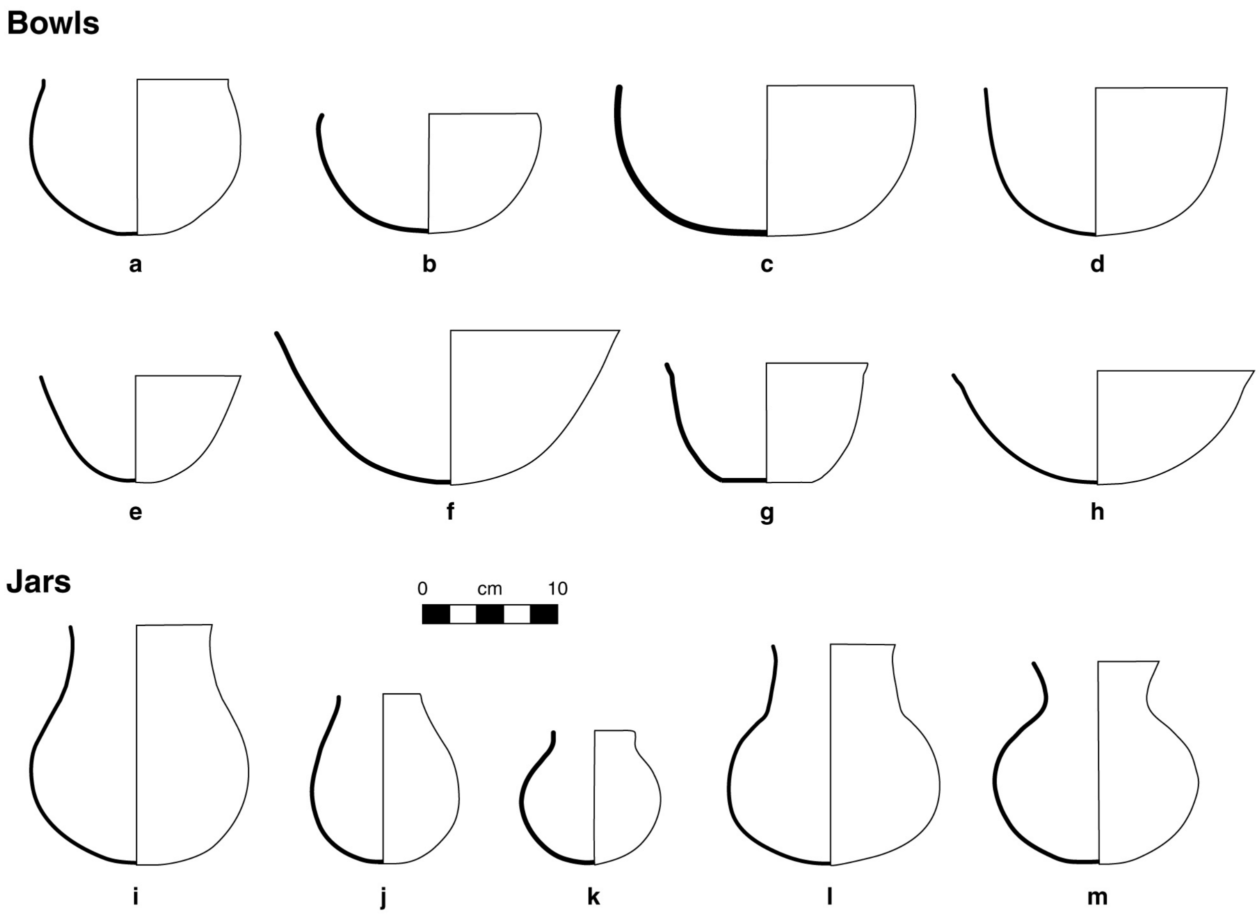

Figure 21. Examples of vessel forms represented by complete vessels recovered from the Crane site (410/2017) (all vessels recovered from inhumation burials except [e] which is from the fill of a structure): (*a*) red plain (smudged interior) (Vessel 134, Feature 39); (*b*) Tularosa or Pinedale Black-on-white (Vessel 22, Feature 33); (*c*) Pinto Polychrome (Vessel 56, Feature 21); (*d*) Salado Red Corrugated (Vessel 136, Feature 33); (*e*) Salado Red Corrugated (Vessel 208, Feature 26); (*f*) red plain (smudged interior) (Vessel 220, Feature 25); (*g*) red plain (smudged interior) (Vessel 118, Feature 38); (*h*) Salado Red Corrugated (Vessel 122, Feature 38); (*i*) Salado Red Corrugated (Vessel 125, Feature 38); (*j*) Salado Red Corrugated (Vessel 132, Feature 38); (*k*) brown corrugated (Vessel 142, Feature 33); (*l*) red plain (smudged interior) (Vessel 133, Feature 39); (*m*) red plain (smudged interior) (Vessel 135, Feature 25).

The goals of the petrographic analysis conducted for the CCP were somewhat different. Lacking access to adequate baseline data on the provenance of the observed nonplastic inclusions, a fine-grained study of manufacturing locales was not deemed feasible. Instead, we explored what the petrographic analyses could tell us about the production process itself. Because this is discussed in detail in Chapter 3, only a brief summary is offered here. A comparison of thin sections taken from sherds recovered from the CCP sites against samples of local clays, as well as thin sections from archaeomagnetic samples taken from clay-lined hearths, suggest that little, if any, additional nonplastic inclusions were added to the clays used by the local potters. Thus, the selected clays apparently contained sufficient nonplastic inclusions to meet the performance requirements of production and use without the addition of supplemental sands.

In terms of regional interaction and exchange, the most conspicuous ceramic indicators of these processes are painted vessels and sherds. Although not present in great numbers, the painted ceramics observed in the CCP collections do provide some insight into changing patterns of interaction in Tonto Basin. These data are consistent with observations that

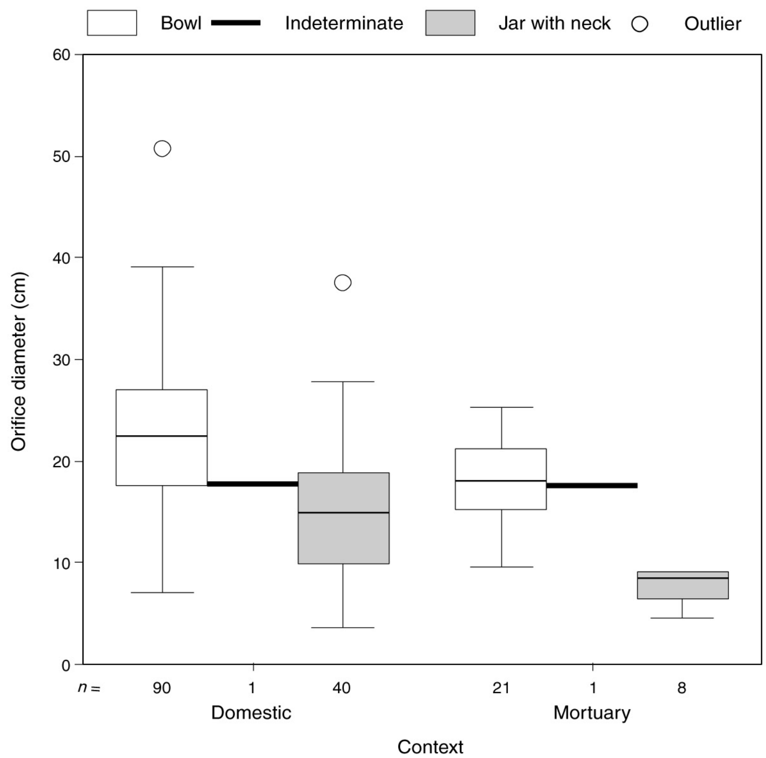

Figure 22. Distribution of orifice diameters for rim sherds and vessels by context at the Crane site (410/2017). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

Table 27. Ceramic Types of Restricted Bowl Forms for Whole Vessels from the Crane Site (410/2017)

Ceramic Ware and Type	Restricted Bowls			Total
	Direct	Flaring	Straight	
Cibola White Ware				
Tularosa or Pinedale Black-on-white	1	—	—	1
Roosevelt Red Ware				
Pinto Black-on-white	1	—	—	1
Salado Red				
Salado Red Corrugated	1	—	—	1
Red ware				
Red plain (smudged interior)	—	4	1	5
Total	3	4	1	8

Table 28. Ceramic Types of Restricted Bowl Forms for Rim Sherds from the Crane Site (410/2017)

Ceramic Ware and Type	Restricted Bowls			Total
	Direct	Flaring	Straight	
Little Colorado White Ware				
Indeterminate Little Colorado White Ware	1	—	—	1
Roosevelt Red Ware				
Pinto Black-on-white	1	—	—	1
Salado Red				
Salado Red Corrugated	1	—	—	1
Red ware				
Red plain (smudged interior)	6	3	2	11
Brown ware				
Brown plain	3	—	—	3
Brown corrugated	—	—	1	1
Total	12	3	3	18

Table 29. Ceramic Types of Unrestricted Bowl Forms for Whole Vessels from the Crane Site (410/2017)

Ceramic Ware and Type	Unrestricted Bowls			Total
	Direct	Flaring	Straight	
Salado Red				
Salado Red Corrugated	3	3	—	6
Red ware				
Red plain (smudged interior)	6	6	1	13
Brown ware				
Brown plain	1	—	—	1
Total	10	9	1	20

Table 30. Ceramic Types of Unrestricted Bowl Forms for Rim Sherds from the Crane Site (410/2017)

Ceramic Ware and Type	Unrestricted Bowls			Total
	Direct	Flaring	Indeterminate	
Little Colorado White Ware				
Holbrook Black-on-white, Style A	1	—	—	1
Holbrook or Walnut Black-on-white	1	—	1	2
Walnut Black-on-white	2	—	—	2
Cibola White Ware				
Snowflake Black-on-white	—	—	1	1
Indeterminate Cibola White Ware	3	1	1	5
Roosevelt Red Ware				
Pinto Black-on-red	2	—	—	2
Reserve Series				
McDonald Painted Corrugated	1	—	—	1
Gila/Salt Basin Hohokam Buff Ware				
Indeterminate red-on-buff	1	—	—	1
Indeterminate red ware				
Indeterminate purple-on-red	—	1	—	1
Indeterminate white ware				
Indeterminate black-on-white	2	1	—	3
Salado Red				
Salado Red Corrugated	37	24	12	73
Red ware				
Red plain (smudged interior)	45	13	4	62
Brown ware				
Brown plain	25	8	1	34
Brown corrugated	20	16	2	38
Total	140	64	22	226

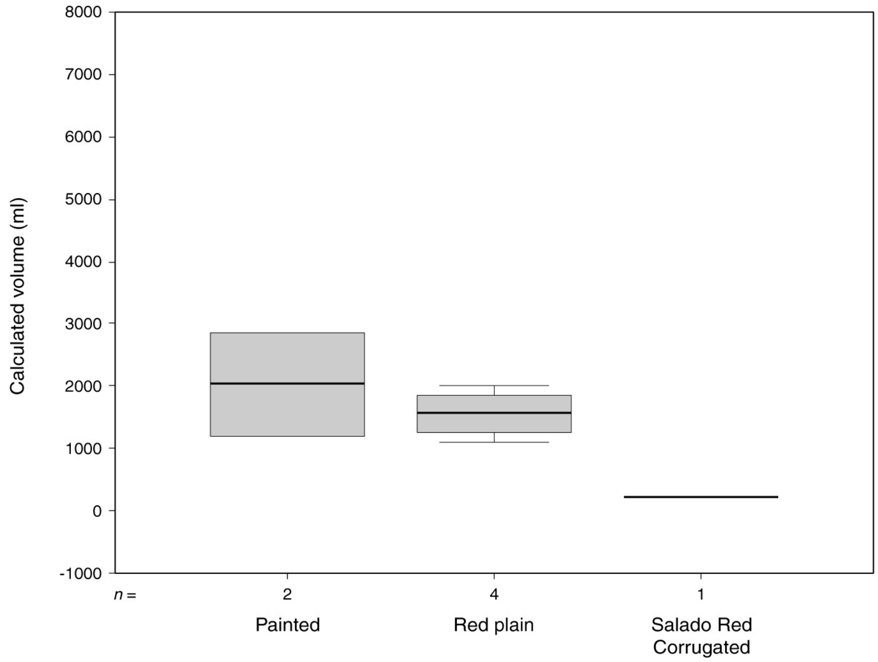

Figure 23. Box plots showing the volume distribution by general ceramic ware at the Crane site (410/2017). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

have been made elsewhere in the basin, suggesting a shift in regional interaction from the pre-Classic period, when ties to the Phoenix Basin were most evident, to the Classic period, when white wares from the Colorado Plateau became the dominant imported ceramic types. Because buff wares also virtually disappeared in the Phoenix Basin at the end of the pre-Classic period, however, the existence of this shift in regional interaction cannot be supported with ceramic data alone. The implications of these patterns are explored in greater detail in Volume 3.

Chronology

In addition to providing data in regional interaction, painted ceramics also serve as important chronological indicators. This is especially true of those white ware types that have been cross-dated through dendrochronology. With the exception of the burials, however, the CCP collections provided little data that could be used to date individual features. However, these data can provide valuable information on the occupational history of settlements and regions.

A cursory analysis of the imported decorated ceramics from the most extensively excavated CCP sites, the Vegas Ruin and the Crane site, point to an occupation spanning the transition from the pre-Classic to the Classic period (ca. A.D. 1150). This reinforces the observations made with other classes of data, including architecture, suggesting a temporally transitional character for the CCP sites. The dominance of white wares among the collection of decorated ceramics further illustrates the link between the pre-Classic–Classic period transition and increasing interaction with the Colorado Plateau, a link that is explored more fully in Volume 3.

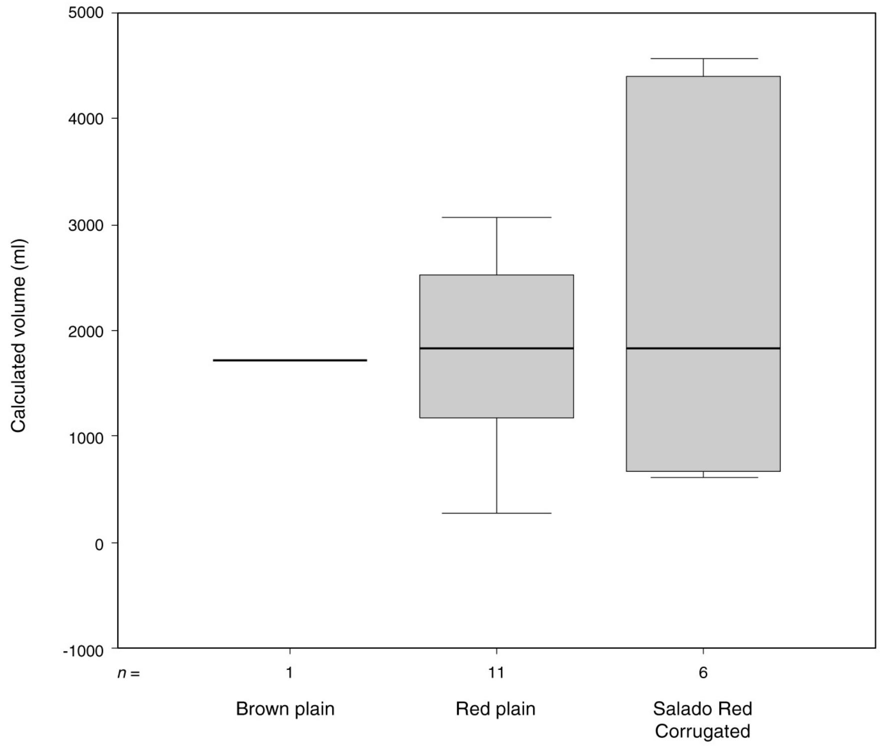

Figure 24. Box plots showing volume distribution for unrestricted bowls by general ware for the Crane site (410/2017). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

Table 31. Ceramic Types Associated with Jars with Necks for Whole Vessels from the Crane Site (410/2017)

Ceramic Ware and Type	Jars with Necks			Total
	Flaring Rim	Straight Rim	Indeterminate Rim	
Salado Red				
Salado Red Corrugated	5	3	—	8
Red ware				
Red plain (smudged interior)	2	—	1	3
Brown ware				
Brown corrugated	—	1	—	1
Total	7	4	1	12

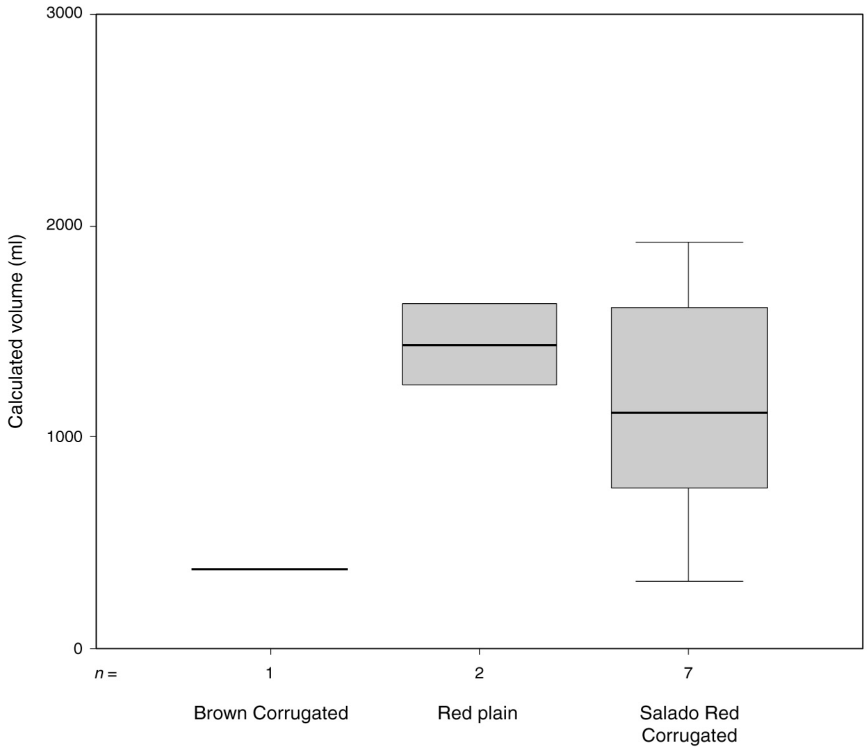

Figure 25. Box plots showing volume distribution for jars with a neck by general ware for the Crane site (410/2017). Whiskers indicate the third quartile of a normally distributed population. Boxes represent the first and second quartiles, and the lines bisecting the boxes indicate the median.

Table 32. Ceramic Types Associated with Jars with Necks for Rim Sherds from the Crane Site (410/2017)

Ceramic Ware and Type	Jars with Necks				Total
	Direct	Flaring	Upturned Rim	Indeterminate Rim	
Cibola White Ware					
Snowflake Black-on-white	—	—	—	1	1
Indeterminate Cibola White Ware	—	1	1	—	2
Salado Red					
Salado Red Corrugated	1	10	5	3	19
Red ware					
Red plain (smudged interior)	—	1	5	4	10
Brown ware					
Brown plain	—	15	8	3	26
Brown corrugated	1	12	9	5	27
Total	2	39	28	16	85

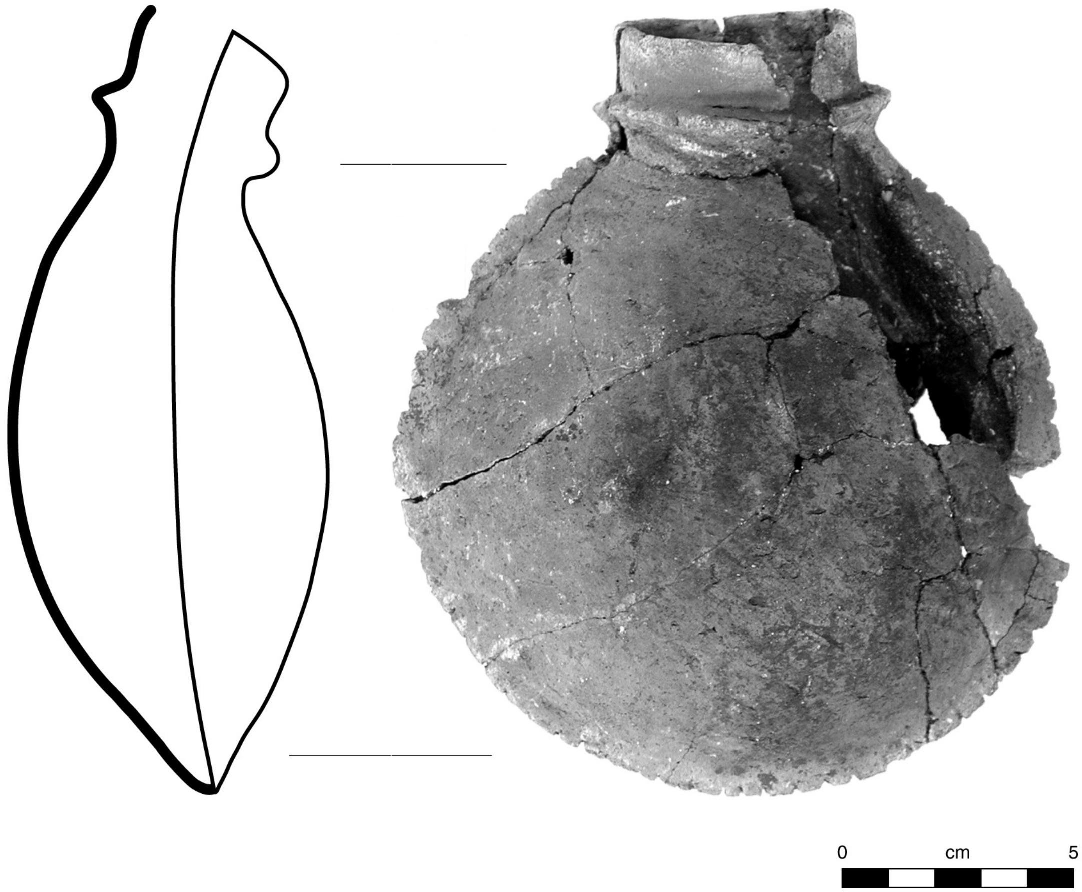

Figure 26. Vessel 194, a canteen from the Crane site (410/2017), typed as Salado Red Corrugated.

CHAPTER 3

Petrographic Analysis

David V. Hill and Margaret E. Beck

Studies of ceramic composition, mineralogical and/or chemical, are often used not only to identify the raw materials but also to suggest where manufacture occurred. Identifying the source is important for the study of production systems, exchange networks, and the adoption of outside ceramic traditions (Abbott 2000; Mills and Crown 1995:8–10; Shepard 1985:165–168, 336–341; Zedeño 1994). Analysts in central Arizona generally rely on the petrographic analysis of temper to determine place of origin (Whittlesey 1998:420).

Our emphasis, however, in this petrographic study is somewhat different. We focus instead on ceramic manufacturing techniques, which may be related to raw-material availability, cultural identity or tradition (M. Stark 1995), and craft specialization or standardization (B. Stark 1995). The first two steps of manufacture, materials procurement and preparation (Rye 1981; see also M. Stark 1995:Table 15.1), are reflected in physical and chemical composition.

This study is not primarily an attempt to find clay or temper sources, although our data suggest more than one source or production locale is represented. We are interested in the nature of the ceramic paste itself. What kinds of pastes were considered suitable for ceramic manufacture by these potters, and how were these achieved? There are often several combinations of different raw materials and processing techniques that will produce similar pastes. We suggest that potters preferred raw materials that required minimal processing to produce the desired paste. Of course, past and present potters have often violated least-effort assumptions (Whittlesey 1998:441–442), so we use comparative samples and ethnographic accounts to support our hypothesis of minimal processing. At least some of the vessels in the sample were apparently made from residual clays, with some of the coarser inclusions removed and the remainder serving as natural temper. It should be noted that although firing does affect the structure of clay minerals, it does not alter the mineral inclusions.

Choice of Analytical Techniques

In our treatment plan (Ciolek-Torrello and Klucas 1999:39), we proposed that petrography might be used together with other compositional techniques, such as inductively coupled plasma spectrometry (ICPS), to explore variation in raw materials. We later decided against the use of ICPS because of the lack of comparative data.

ICPS has been most frequently used in the Southwest with the weak-acid extraction technique (e.g., Simon 1994; Simon and Ravesloot 1995; Stark et al. 1995; Zedeño 1994). Weak-acid extraction is a partial dissolution or "leaching" technique argued to reduce the chemical contribution of tempering materials such as quartz sand (Burton and Simon 1993, 1996). The 1 M hydrochloric acid used for dissolution leaches elements from silicate structures and is too weak to break down the structures themselves. Some investigators have been highly critical of weak-acid extraction as a partial extraction technique; because not everything is dissolved, it is not clear what contributes to the measured elemental concentrations and what does not (Neff et al. 1996). One factor is firing temperature, which has a significant effect on extract chemical composition (Montgomery and Whittlesey 1998; Neff et al. 1996). The need to control firing temperature variability means that the results of other analyses using weak-acid extraction cannot be combined, unless analyzed sherds were refired to the same temperature prior to analysis.

These problems can be avoided with use of a total extraction technique with ICPS. For example, an extraction with hydrofluoric (HF) and perchloric ($HClO_4$) acid was used with inductively coupled plasma atomic-emission spectroscopy (ICP-AES) for ceramics from the Fence Lake project (Beck 2006) in west-central New Mexico. The same technique was used by SWCA Environmental Consultants (SWCA) for analysis of ceramics from the Arizona side of the Fence Lake project (Hagopian et al. 2004), allowing comparison of the two databases. This extraction technique is not commonly used in central Arizona, and no comparative data are available for the SR 188 project area.

The treatment plan also suggested that we would conduct refiring experiments to examine ceramic technology. After initial examination of the collection, however, we observed insufficient variability in the plain ware pastes to merit this procedure. Instead, we concentrated all our resources on the petrographic study discussed below.

Methods

Fifty-five ceramic sherds were submitted for petrographic analysis, including 39 sherds from the Vegas Ruin (AZ U:3:405/2012) and 16 sherds from the Crane site (AZ U:3:410/2017). These sherds represent four ware types: brown corrugated, brown plain, red plain, and Salado Red Corrugated. A higher percentage of red wares were selected owing to their greater variability. The sherds were selectively sampled from a wide range of contexts, including features, mechanical trenches, test pits, wall trenches, stripping units, and hand trenches. In addition to ceramics, we submitted 16 clay samples for petrographic analysis. These included 4 sediment samples, of which 2 were selected from clay-rich arroyos, 1 from a test pit, and 1 from backdirt at the Crane site. Twelve additional samples were initially collected as archaeomagnetic samples from clay-lined hearths at the Vegas Ruin, the Rock Jaw site (AZ U:3:407/2014), and the Crane site. These 16 samples were then compared to the ceramic thin-sections.

Petrographic thin-sections of the sherds and clay samples were prepared by Quality Thin Sections in Tucson. The thin-sections were taken from as shallow a depth as possible to yield a flat surface. The ceramic thin sections measured 6–8 cm^2 in area, and the archaeomagnetic thin-sections were 1–4 cm^2. The primary author conducted the petrographic analysis using a Nikon Optiphot-2 petrographic microscope. Inclusion sizes were determined by measuring a series of 10 grains using a graduated reticle built into one of the microscope optics and are described below in terms of the Wentworth Scale, a standard method of characterizing particle sizes in sedimentology (Folk 1974). The relevant size classes in the Wentworth Scale are very coarse sand (2–1 mm), coarse sand (1–0.5 mm), medium-sized sand (0.5–0.25 mm), fine sand (0.25–0.125 mm), very fine sand (0.125–0.0625 mm), and silt (0.0625–0.00391 mm). Silt is the smallest size category of optically identifiable minerals. Comparative charts (Matthew et al. 1991; Terry and Chilingar 1955) were used to estimate percentages of inclusions in the ceramic paste. Given the diversity of the inclusions that are present in ceramics, the comparative method for assessing the amount and size of materials found in ceramics has been found as useful for archaeological ceramic petrography as point counting (Mason 1995).

The petrofacies model has been used to interpret petrographic analyses of sand-tempered ceramics elsewhere in Tonto Basin, including the Slate Creek and Punkin Center sections of SR 188, immediately south of the current project area (Heidke and Miksa 2000; Vint and Heidke 2000:Figure P.2). Petrofacies, in this context, are "temper resource-procurement zones whose sand compositions are distinct from one another at a relevant scale of investigation" (Miksa and Heidke 1995:143). Miksa and Heidke (1995) summarized their theories and methods and described petrofacies defined for Tonto Basin. Several petrofacies in the upper Tonto Basin were later revised (Heidke and Miksa 2000).

Our data were not collected with the goal of making petrofacies assignments. Our research questions differed from those addressed by Miksa and Heidke; we were interested in the composition and texture of the paste and felt that binocular microscopic characterization to identify petrofacies (Miksa and Heidke 1995:175–176), although cost-effective, would not provide the relevant data. To enable some comparison with other studies in the area, tentative petrofacies assignments were made for the paste groups described below using the published petrofacies descriptions. We emphasize that these are estimates for descriptive purposes. Our methods are not intended to be a substitute for the methods outlined by Miksa and Heidke (1995).

Ceramic Thin-Section Descriptions

The ceramics from the Vegas Ruin and the Crane site are organized into four paste groups (Paste Groups A–D) (Tables 33 and 34). Paste Group A ceramics (22 sherds) had inclusions apparently derived only from weathered diabase. Paste Group B ceramics (6 sherds) were dominated by weathered diabase but also had significant amounts of other plutonic or metamorphic inclusions. Paste Group C contained two sherds dominated by metamorphic inclusions, such as biotite schist or quartzite. Paste Group D ceramics (25 sherds) were dominated by plutonic inclusions probably derived from weathered granite. Six sherds in Paste Group D also contained minor amounts of volcanic, metamorphic, and/or sedimentary inclusions.

Many of the samples from Paste Groups A and B might be assigned to the Armer, Cline, or Hackberry petrofacies

Table 33. SR 188–Cottonwood Creek Project Petrographic Samples, by Type and Paste Group Membership

Ceramic Type	Paste Group				Total
	A	B	C	D	
Brown corrugated	3	2	1	1	7
Brown plain	5	1	—	4	10
Red plain	—	1	1	17	19
Salado Red Corrugated	14	2	—	3	19
Total	22	6	2	25	55

(Miksa 1995:520–523; Miksa and Heidke 1995:Table 9.4), located to the east and southeast of the project area (Heidke and Miksa 2000:Figure 3.1). Both groups are dominated by diabase, a common inclusion type in Tonto Basin. The two samples in Paste Group C were difficult to assign to a petrofacies, based on our descriptions below.

Most of the samples in Paste Group D might be assigned to the Ash petrofacies (Miksa 1995:530; Miksa and Heidke 1995:Table 9.4), when inclusions are apparently only derived from granite, or to the Pinto or Wildcat–Poison Terrace petrofacies when volcanic, metamorphic, and/or sedimentary inclusions appear. The Ash petrofacies is located to the south and the Pinto and Wildcat–Poison Terrace petrofacies are in the lower Tonto Basin (Heidke and Miksa 2000:Figure 3.1). We are not arguing that these ceramics were manufactured in the lower Tonto Basin, however, because they may be more similar to materials available near the site (see "Comparison of Ceramic and Sediment Samples" below).

Paste Group A

Paste Group A consisted of 22 sherds containing diabase fragments and particles derived from weathered diabase. These inclusions were up to 35 percent of the ceramic paste. Isolated angular plagioclase grains appeared in many of these sherds. They ranged in size from silt to very fine or fine sand and made up 1–8 percent of the matrix. These grains were attributed to weathered diabase in the absence of untwinned alkali feldspar or rock fragments that might indicate another origin.

Diabase is an igneous rock similar in composition to basalts and gabbros and is intermediate in grain size. It has been classified both as a variety of the volcanic or extrusive rock basalt (Schumann 1993) and as a plutonic or intrusive rock similar to gabbro (Bates and Jackson 1984:137). Most diabases date to the Paleozoic and are termed paleobasalts (Schumann 1993:246, 248). The phenocrysts in diabase contained olivine, pyroxene, and/or plagioclase. The groundmass includes these minerals and may include quartz, hornblende, and biotite. Augite, one of the clinopyroxenes in the pyroxene group, is an important rock-forming mineral in basalts. Diabase outcrops over much of the Globe-Miami area and in the Salt River Canyon. It is compositionally homogeneous across the region, exhibiting only some slight textural variations within individual intrusions (Shride 1967).

Within the diabase in the Paste Group A sherds, extremely large crystals partially or completely enclose a range of randomly oriented smaller crystals. This is known as poikilitic texture (MacKenzie et al. 1982:33). One variant of poikilitic texture is ophitic texture, in which the enclosed crystals are elongate and are completely or partially enclosed. It may be termed subophitic texture when the crystals are only partially enclosed (MacKenzie et al. 1982:34). In the diabase, the plagioclase laths are partially or completely enclosed by olivine or pyroxene. The olivine and pyroxene displayed some degree of weathering in all of the Paste Group A sherds, although the extent of weathering varied. Diabase ultimately weathers to a reddish clay, so it is not surprising that many of the ceramics in Paste Group A had a dark reddish paste.

Catalog No. 3893, Brown Corrugated

The paste was medium reddish brown and contained inclusions derived from weathered subophitic diabase. These appeared as plagioclase contained by olivine or, more commonly, pyroxene. They ranged in size from very-fine- to medium-sized sand and accounted for about 20 percent of the ceramic paste. Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 3 percent of the ceramic paste.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Pyroxene grains also ranged from unweathered, to altered to iddingsite

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
					Paste Group A						
Brown corrugated	3893	Crane site	HT 255	medium reddish brown	23	diabase	VF-M	20	plutonic sediments	St-VF	3
Brown corrugated	4680	Vegas Ruin	TR 211	medium reddish brown	25	diabase	M-C	20	plutonic sediments	St-VF	5
Brown plain	2656	Vegas Ruin	Feature 6 west wall of room Feature 11	medium reddish brown	11	diabase	VF-M	8	plutonic sediments	St-VF	3
Brown plain	2733	Vegas Ruin	Feature 10 midden	medium reddish brown	33	diabase	F-C	28	plutonic sediments	St-VF	5
Brown plain	3186	Crane site	TP 12	medium reddish brown	23	diabase	VF-C	20	plutonic sediments	St-VF	3
Brown plain	4711	Vegas Ruin	SU 360	medium reddish brown	23	diabase	VF-C	20	plutonic sediments	St-VF	3
Brown plain	4764	Vegas Ruin	SU 443	medium reddish brown	23	diabase	VF-C	20			
Brown corrugated	2941	Vegas Ruin	Feature 49 burial fill	medium reddish brown	23	diabase	M-C	15	plutonic sediments	St-VF	8
Salado Red Corrugated	2526	Vegas Ruin	Feature 1 compound	medium brown	35	diabase	St-C	35			

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds (*continued*)

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
Paste Group A (*continued*)											
Salado Red Corrugated	2612	Vegas Ruin	Feature 5 north wall of Feature 1 compound	yellowish brown	20	diabase	VF-M	20			
Salado Red Corrugated	3205	Crane site	TP 12	medium reddish brown	18	diabase	VF-M	15	plutonic sediments	St-VF	3
Salado Red Corrugated	3207	Crane site	TP 12	dark brown to dark reddish brown	18	diabase	St-VC	15	plutonic sediments	St-VF	3
Salado Red Corrugated	3285	Vegas Ruin	Feature 99 pit structure	medium brown	30	diabase	St-VC	30			
Salado Red Corrugated	3438	Crane site	point-provenienced artifact	bright yellowish red	20	diabase	St-C	20			
Salado Red Corrugated	3792	Crane site	WT 72	medium brown	35	diabase	St-C	35			
Salado Red Corrugated	3906	Crane site	HT 260	medium brown	35	diabase	St-C	35			
Salado Red Corrugated	3907	Crane site	HT 260	medium reddish brown	4	plutonic sediments	St-F	3	diabase	F-C	1
Salado Red Corrugated	4671	Vegas Ruin	Feature 1 compound	medium reddish brown	15	diabase	M-VC	10	plutonic sediments	St-VF	3
Salado Red Corrugated	4673	Vegas Ruin	TR 213	very dark brown	35	plutonic sediments	St-VF	30	diabase	M-C	5

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds (*continued*)

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
					Paste Group A (*continued*)						
Salado Red Corrugated	4713	Vegas Ruin	SU 360	medium reddish brown	18	diabase	VF-M	15	plutonic sediments	St-VF	3
Salado Red Corrugated	4790	Vegas Ruin	SU 443	medium reddish brown	15	diabase	VF-M	15			
Salado Red Corrugated	2694	Vegas Ruin	Feature 10 midden	medium reddish brown	18	diabase	VF-M	15	plutonic sediments	St-VF	8
					Paste Group B						
Brown corrugated	2651	Vegas Ruin	Feature 9 rubble from west wall of Feature 1 compound	medium brown to medium reddish brown	45	diabase	St-C	45			
Brown corrugated	3861	Crane site	WT 64	medium reddish brown	26	diabase	St-VC	25	quartzite	M-VF	1
Brown plain	2551	Vegas Ruin	Feature 1 compound	reddish brown	35	diabase	St-C	35			
Red plain	2856	Vegas Ruin	Feature 34 pit structure	dark brown	40	diabase	St-C	40			
Salado Red Corrugated	3232	Crane site	TP 12	medium reddish brown	25	diabase	St-C	25	muscovite schist	M	trace
Salado Red Corrugated	3793	Crane site	WT 72	medium reddish brown	35	diabase	St-M	35	quartzite	C	trace

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds (*continued*)

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
					Paste Group C						
Brown corrugated	2650	Vegas Ruin	Feature 7 west wall of Feature 1 compound	dark brown	28	metamorphic sediments	F-VC	25	quartz sediments	St-F	3
Red plain	4908	Vegas Ruin	Feature 195 borrow pit	medium brown	25	plutonic sediments	VF-C	25			
					Paste Group D						
Brown corrugated	3899	Crane site	HT 260	dark brown	20	plutonic sediments	St-VC	20			
Brown plain	2493	Vegas Ruin	Feature 1 compound	medium brown	23	plutonic sediments	M-VC	20	plutonic sediments	St-VF	3
Brown plain	2588	Vegas Ruin	Feature 4 rubble from east wall of Feature 1 compound	medium brown	25	plutonic sediments	St-VC	15	diabase	M-C	10
Brown plain	2634	Vegas Ruin	Feature 3 south wall of Feature 1 compound	dark brown	35	plutonic sediments	St-VC	35			
Brown plain	4498	Vegas Ruin	Feature 1 compound	dark brown	30	plutonic sediments	St-M	30			
Red plain	2592	Vegas Ruin	Feature 5 north wall of Feature 1 compound	medium brown	45	plutonic sediments	St-C	45	sandstone	M	trace
Red plain	2619	Vegas Ruin	Feature 2 erosion-control ditch surface collection	medium reddish brown	18	plutonic sediments	F-C	15	plutonic sediments	St-VC	3
Red plain	2709	Vegas Ruin	Feature 10 midden	dark brown	35	plutonic sediments	St-VC	35			

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds (*continued*)

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
	Paste Group D (*continued*)										
Red plain	2767	Vegas Ruin	Feature 11 room	dark brown	30	plutonic sediments	M-VC	20	plutonic sediments	St-F	10
Red plain	2837	Vegas Ruin	Feature 19 pit structure	dark brown	30	plutonic sediments	St-VC	30			
Red plain	2857	Vegas Ruin	Feature 34 pit structure	medium reddish brown	23	plutonic sediments	M-VF	20	plutonic sediments	St-VF	3
Red plain	2919	Vegas Ruin	general site	dark brown	10	plutonic sediments	St-M	10			
Red plain	3196	Crane site	TP 12	very dark brown	35	plutonic sediments	St-C	35			
Red plain	3197	Crane site	TP 12	very dark brown	25	plutonic sediments	St-C	25			
Red plain	3221	Crane site	TP 12	dark brown	30	plutonic sediments	St-VC	30			
Red plain	3784	Crane site	WT 69	dark brown	30	plutonic sediments	St-VC	30			
Red plain	4510	Vegas Ruin	Feature 142 burial fill	dark brown	30	plutonic sediments	St-M	30			
Red plain	4528	Vegas Ruin	Feature 179 pit structure	medium brown	25	plutonic sediments	St-VC	25			
Red plain	4537	Vegas Ruin	Feature 182 burial fill	dark brown	35	plutonic sediments	St-C	35			
Red plain	4692	Vegas Ruin	general site	dark brown	40	plutonic sediments	St-C	40			
Red plain	4789	Vegas Ruin	SU 443	very dark brown	40	plutonic sediments	St-C	40			

Table 34. Paste Groups and Inclusions of Thin-Sectioned Sherds (*continued*)

Ceramic Ware and Type	Catalog No.	Site[a]	Context or Feature	Paste Color	Total Inclusions (%)	Primary Inclusions			Secondary Inclusions		
						Type	Size	Amount (%)	Type	Size	Amount (%)
	Paste Group D (*continued*)										
Red plain	4907	Vegas Ruin	Feature 195 borrow pit	medium reddish brown	18	plutonic sediments	F-C	15	plutonic sediments	St-VF	3
Salado Red Corrugated	2570	Vegas Ruin	Feature 1 compound	medium brown	40	plutonic sediments	St-C	40	volcanic sands	M	trace
Salado Red Corrugated	2571	Vegas Ruin	Feature 1 compound	medium reddish brown	11	plutonic sediments	VF-F	10	plutonic sediments	M	1
Salado Red Corrugated	4762	Vegas Ruin	SU 443	medium brown	30	plutonic sediments	St-C	30	basalt	M	trace

Key: C = Coarse; F = Fine; HT = hand trench; M = Medium; St = Silt; SU = stripping unit; TP = test pit; TR = trench; VC = Very coarse; VF = Very fine; WT = wall trench.
[a]Includes Vegas Ruin (405/2012) and the Crane site (410/2017).

(an iron-oxide-rich weathering product of olivine) along fractures and margins, to completely replaced by iddingsite. The final weathering products of the olivine and pyroxene grains were black opaque angular inclusions composed of clay minerals and hematite.

A trace amount of fine- to very-fine-sand-sized biotite was visible. More biotite may have been present but was indistinguishable from the highly weathered grains of pyroxene.

Catalog No. 2656, Brown Plain

Like Catalog No. 3893, the paste was medium reddish brown and contained inclusions derived from weathered subophitic diabase. These appeared as plagioclase contained by olivine or, more commonly, pyroxene. They ranged in size from very fine to medium-sized sand and accounted for about 8 percent of the matrix. Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 3 percent of the ceramic paste.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Pyroxene grains also ranged from unweathered, to altered to iddingsite along fractures and margins, to completely replaced by iddingsite. The final weathering products of the olivine and pyroxene grains were black opaque angular inclusions composed of clay minerals and hematite.

A trace amount of fine- to very-fine-sand-sized biotite was visible. More biotite may have been present but was indistinguishable from the highly weathered grains of pyroxene.

Catalog No. 2733, Brown Plain

The paste of this sherd was quite similar to other pastes dominated by weathered diabase in terms of color and the presence of silt- to fine-sand-sized fragments of plagioclase, accompanied by highly weathered pyroxene and brown biotite. Fragments of ophitic diabase made up about 20 percent of the medium reddish brown paste and ranged in size from fine to coarse sand. Another 5 percent was composed of silt- to very-fine-sand-sized plagioclase fragments. Fine- to medium-sand-sized black opaque inclusions represented highly weathered pyroxene or biotite and made up an additional 8 percent.

Catalog No. 4680, Brown Corrugated

The medium reddish brown paste was similar to the previous samples containing diabase in terms of paste color and the presence of silt- to fine-sand-sized fragments of plagioclase accompanied by highly weathered pyroxene and brown biotite. This sample contained about 20 percent subophitic to ophitic diabase fragments, ranging in size from medium-sized to coarse sand. Silt- to very-fine-sand-sized plagioclase fragments made up about 5 percent of the ceramic matrix. Fine- to medium-sand-sized black opaque inclusions represented highly weathered pyroxene or biotite and composed 3 percent of the matrix.

Catalog No. 4711, Brown Plain

Like Catalog No. 3893 (brown corrugated) and Catalog No. 2656 (brown plain), the paste was medium reddish brown and contained inclusions derived from weathered subophitic diabase. These appeared as plagioclase contained by olivine or, more commonly, pyroxene. They ranged in size from very fine to very coarse sand and accounted for about 20 percent of the matrix. Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 1 percent of the ceramic paste.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Olivine and pyroxene grains also ranged from unweathered, to altered to iddingsite along fractures and margins, to completely replaced by iddingsite. The final weathering products of the olivine and pyroxene grains were black opaque angular inclusions composed of clay minerals and hematite.

A trace amount of fine- to medium-sand-sized biotite was visible. More biotite may have been present but was indistinguishable from the highly weathered grains of olivine and pyroxene.

Catalog No. 4764, Brown Plain

The paste was medium reddish brown and contained inclusions derived from weathered diabase. This sample was almost identical to Catalog No. 4711 (brown plain) in terms of the color and the appearance of the diabase. The major difference between the two sherds was that the current specimen contained about 5 percent very-fine- to medium-sand-sized angular black opaque inclusions. The black inclusions most likely resulted from the weathering of the olivine, pyroxene, and/or biotite.

Catalog No. 3186, Brown Plain

Like Catalog No. 3893 (brown corrugated), Catalog No. 2656 (brown plain), and Catalog No. 4711 (brown plain), the paste was medium reddish brown and contained inclusions derived from weathered subophitic diabase. These appeared as plagioclase contained subophitically by olivine or, more commonly, pyroxene. They ranged in size from very fine to very coarse sand and accounted for about 20 percent of the matrix. Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 3 percent of the ceramic paste.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Olivine and pyroxene grains also ranged from unweathered, to altered to iddingsite along fractures and margins, to completely replaced by iddingsite. The final weathering products of the olivine and pyroxene grains were black opaque angular inclusions composed of clay minerals and hematite.

A trace amount of very-fine- to medium-sand-sized biotite was also visible.

Catalog No. 2941, Brown Corrugated

Like Catalog No. 4680, the medium reddish brown paste was similar to the previous samples containing diabase in terms of paste color and the presence of silt- to fine-sand-sized fragments of plagioclase accompanied by highly weathered olivine, pyroxene, and brown biotite. This sample contained about 15 percent subophitic to ophitic diabase fragments, ranging in size from medium-sized to coarse sand. Silt- to very-fine-sand-sized plagioclase fragments made up about 8 percent of the ceramic matrix. Fine- to medium-sand-sized black opaque inclusions represented highly weathered pyroxene or biotite and composed 3 percent of the matrix.

Catalog No. 2526, Salado Red Corrugated

The ceramic paste was medium brown and had a distinctly gritty appearance from silt-sized to coarse-sand-sized isolated mineral grains and rocks derived from weathered ophitic or subophitic diabase. The fragments of diabase and the isolated grains of plagioclase, olivine, and pyroxene derived from the diabase accounted for 35 percent of the ceramic paste.

The majority of the plagioclase, olivine, and pyroxene grains displayed a wide range of weathering textures and products. Less than 5 percent of these grains appeared unweathered. The plagioclase laths displayed varying degrees of alteration to sericite, paralleling their crystallographic axes and internal fractures. In a trace amount of the plagioclase laths, weathering had proceeded to the point of obscuring their optical characteristics. The grains of olivine and pyroxene displayed a similar range of weathering, with some grains crosscut by fracture zones composed of iddingsite and other grains that were completely replaced by iddingsite resulting in dark reddish inclusions. The final stage of pyroxene weathering resulted in black opaque inclusions, some of which maintained the angular morphology of the original mineral grain.

A trace amount of brown biotite, present as a component of rock fragments and as isolated books, was also present. The books of biotite were also highly weathered, either to hematite and clay minerals or to incipient kaolinite.

Catalog No. 2612, Salado Red Corrugated

The paste was a yellowish brown color and contained inclusions derived from weathered diabase. Plagioclase, olivine, and pyroxene minerals ranged in size from very fine- to medium-sized sand and accounted for about 20 percent of the matrix. A trace amount of fine- to very-fine-sand-sized biotite was also present.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Pyroxene grains also ranged from unweathered, to partially altered to iddingsite along fractures and margins, to completely replaced by iddingsite. Completely weathered pyroxene grains appeared as black opaque laths composed of clay minerals and hematite.

Catalog No. 2694, Salado Red Corrugated

The paste of this sherd was a medium reddish brown color. It was quite similar to Catalog No. 2656 (brown plain), in terms of paste color and the presence of silt- to fine-sand-sized fragments of plagioclase accompanied by highly weathered olivine or pyroxene and brown biotite. The fine-sand-sized mineral grains were less weathered than those in Catalog No. 2656. These small inclusions accounted for about 8 percent of the ceramic matrix.

The paste also contained larger fragments of ophitic diabase. These accounted for about 15 percent of the paste and ranged in size from medium-sized to very coarse sand. The diabase fragments appeared less weathered than in Catalog No. 2656. There were about 3 percent fine- to medium-sand-sized black opaque inclusions that represented highly weathered pyroxene or biotite.

Catalog No. 3285, Salado Red Corrugated

The medium brown paste includes 30 percent mineral grains and rock fragments derived from subophitic to ophitic diabase. The olivine, pyroxene, and plagioclase grains and diabase fragments ranged in size from silt to very coarse sand. Fine- to medium-sand-sized black opaque inclusions represented highly weathered olivine, pyroxene, and/or biotite. Most of the olivine and pyroxene grains had weathered to hematite and clay minerals.

Catalog No. 4671, Salado Red Corrugated

The medium reddish brown paste was similar to other samples containing diabase (Catalog Nos. 4680 and 2941) in terms of paste color and the presence of silt- to fine-sand-sized fragments of plagioclase accompanied by highly weathered pyroxene and brown biotite. This sample contained about 8 percent subophitic to ophitic diabase fragments, ranging in size from medium-sized to very coarse sand. Silt- to very-fine-sand-sized plagioclase fragments made up about 10 percent of the ceramic matrix. Fine- to medium-sand-sized black opaque inclusions represented highly weathered pyroxene or biotite and composed 5 percent of the matrix.

Catalog No. 4673, Salado Red Corrugated

Inclusions in the very dark brown paste were bimodally distributed in terms of size. Thirty percent of the paste consisted of plagioclase fragments ranging in size from silt to very fine sand, along with a trace amount of brown biotite. Medium- to very-coarse-sand-sized fragments of subophitic diabase made up an additional 5 percent. The olivine and pyroxene was partially weathered to black opaque inclusions contained between the plagioclase laths.

Catalog No. 4713, Salado Red Corrugated

The medium reddish brown paste contained inclusions derived from weathered diabase. These consisted of plagioclase grains contained subophitically by olivine or, more commonly, pyroxene. The fragments of these minerals ranged from very-fine- to medium-sand sized and accounted for about 15 percent of the matrix of the sherd. A single, very-coarse-sand-sized diabase fragment was also present. In this fragment, the weathered olivine contained the plagioclase poikilitically. A trace amount of fine- to very-fine-sand-sized biotite was also present.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Olivine and pyroxene grains also ranged from unweathered, to altered to iddingsite along fractures and margins, to completely replaced by iddingsite. The final weathering products of the olivine and pyroxene grains were black opaque angular inclusions composed of clay minerals and hematite. The black opaque angular inclusions accounted for about 3 percent of the inclusions in the paste. Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 3 percent of the ceramic paste.

Catalog No. 4790, Salado Red Corrugated

The paste was medium reddish brown and contained plagioclase, with only a trace amount of olivine still present, derived from highly weathered diabase. The inclusions ranged in size from very-fine- to medium-sized sand and accounted for about 15 percent of the matrix of the sherd. The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. Black opaque angular inclusions that represented weathered olivine and/or pyroxene accounted for about half of the inclusions in the paste.

Catalog No. 3205, Salado Red Corrugated

Like Catalog No. 3893 (brown corrugated), Catalog No. 2656 (brown plain), Catalog No. 4711 (brown plain), and Catalog No. 3186 (brown plain), the paste was medium reddish brown and contained inclusions derived from weathered subophitic diabase. They ranged in size from very fine to medium-sized sand and accounted for about 15 percent of the matrix. A trace amount of fine- to very-fine-sand-sized biotite was also visible.

The plagioclase laths ranged from unweathered grains to grains that were completely altered to kaolinite. No unaltered olivine or pyroxene grains remain. These grains had weathered to iddingsite or black opaque angular inclusions. The black opaque angular inclusions accounted for about 3 percent of the inclusions in the paste.

Silt- to very-fine-sand-sized grains of angular plagioclase were also present and made up an additional 3 percent of the ceramic paste. These grains were probably derived from weathered diabase.

Catalog No. 3207, Salado Red Corrugated

The paste of this sherd was dark brown to dark reddish brown and contained fragments of subophitic and poikilitic textured diabase. The majority of the inclusions were derived from diabase, including silt- to very-coarse-sand-sized fragments of plagioclase with lesser amounts of olivine and pyroxene. The fragments of diabase and the mineral grains derived from it accounted for about 15 percent of the ceramic paste and ranged in size from silt to coarse sand. An additional 3 percent of the paste was composed of fine- to medium-sand-sized black opaque inclusions. These black inclusions were the result of the weathering of grains of olivine and pyroxene, as similar black areas could be observed in the rock fragments.

Also present in the paste of this sherd were two rounded, fine-sand-sized quartz grains and a single, coarse-sand-sized, subrectangular void surrounded by a carbonaceous halo. This void was likely the result of the combustion of an accidental plant inclusion.

Catalog No. 3438, Salado Red Corrugated

The paste of this sherd was a bright yellowish red. The fragments of subophitic diabase in this sherd were highly weathered, more so than the diabase in most of the Paste Group A sherds. Inclusions ranged in size from silt to coarse sand, with the exception of a single, very-coarse-sand-sized fragment of subophitic olivine diabase. There was a greater amount of silt- to fine-sand-sized fragments of plagioclase and olivine, however. Virtually all of the isolated olivine grains had weathered to iddingsite. The pyroxene observed in previous samples was not present.

Catalog No. 3792, Salado Red Corrugated

The medium brown paste of this sherd contained about 35 percent fragments of weathered diabase. The fragments of diabase and the olivine and pyroxene grains ranged from silt- to coarse-sand sized; the smaller grains were more common. The plagioclase grains were frequently weathered to sericite and clay minerals, and the olivine and pyroxene were frequently weathered to iddingsite or to opaque black inclusions. About 3 percent silt- to fine-sand-sized brown biotite was also present.

Catalog No. 3906, Salado Red Corrugated

Like Catalog No. 3792 (Salado Red Corrugated), the medium brown paste of this sherd contained about 35 percent fragments of weathered diabase. The fragments of diabase and the olivine and pyroxene grains ranged from silt to coarse sand in size; the smaller grains were more common. Unlike Catalog No. 3792, however, the rock fragments and isolated mineral grains generally appeared unweathered.

Catalog No. 3907, Salado Red Corrugated

The major inclusions present in the medium reddish brown paste were silt- to very-fine-sand-sized subangular inclusions composed primarily of plagioclase. A trace amount of quartz may also have been present in the silt-sized fraction but was too small to identify optically. A trace amount of highly weathered fragments of diabase was also present. The diabase fragments and the isolated grains of plagioclase, olivine, and pyroxene ranged in size from fine- to medium-sized sand. The plagioclase within the diabase fragments had weathered to sericite and clay minerals. The olivine and pyroxene had weathered to iddingsite or opaque black angular inclusions.

Paste Group B

Inclusions from weathered diabase made up 20–45 percent of the paste in Paste Group B ceramics, producing a texture and composition similar to that of Paste Group A ceramics. Unlike Paste Group A ceramics, Paste Group B ceramics also contained up to 1 percent inclusions not derived from diabase. These included plutonic rocks, such as quartz monzonite or granite, and metamorphic rocks, such as quartzite and muscovite schist.

Catalog No. 2651, Brown Corrugated

The paste color ranged from medium brown to medium reddish brown. The paste contained 45 percent mineral grains weathered from diabase, ranging in size from silt to coarse sand. Almost all of the olivine and pyroxene grains had broken up and displayed a wide range of weathering stages. Weathering ranged from internal fracturing and the alteration of margins to the complete destruction of internal structures and alteration to iddingsite. The plagioclase laths were also highly weathered to sericite and clay minerals. Additional inclusions were fine-sand-sized, weathered, brown biotite and a single, medium-sand-sized fragment of inequigranular quartzite. Inequigranular rocks display conspicuous differences in grain sizes, and equigranular rocks contain grains of similar size.

Catalog No. 3861, Brown Corrugated

The paste of this sherd was a medium reddish brown color. Diabase grains and isolated minerals associated with diabase (such as olivine and pyroxene) accounted for about 20 percent of the ceramic paste and ranged in size from silt to very coarse sand. The isolated mineral grains ranged from unweathered to completely altered to iddingsite and clay minerals.

Angular fragments of very-fine-grained quartz monzonite (Bates and Jackson 1984:415) accounted for an additional 1 percent of the ceramic paste. This granitic rock was similar in appearance to quartzite, but the quartz grains were not rounded (as would be expected for sand grains in quartzite) and did not display undulose extinction (indicating they were not metamorphic). They ranged in size from medium-sized to very coarse sand.

Catalog No. 2551, Brown Plain

The paste of this sherd was a reddish brown color and was slightly birefringent (optically active). It contained about 35 percent fragments of ophitic or subophitic diabase composed of plagioclase, olivine, and pyroxene. The mineral grains and rock fragments ranged in size from very fine to coarse sand. The plagioclase, olivine, pyroxene, and trace biotite displayed a continuous range of weathering textures and degrees of alteration.

A single grain of plutonic origin was also present. The plutonic source was probably granite, which is dominated by quartz, alkali feldspars, and plagioclase feldspar (Schumann 1993:200). The rock fragment was subrounded, medium-sand sized, and characterized by granophyric intergrowths of quartz and alkali feldspar radiating from untwinned alkali feldspars. Granophyric texture is an igneous rock texture with irregular intergrowth of quartz and feldspar. The alkali feldspar was altered to sericite and clay minerals, in some cases obscuring the optical characteristics of the mineral inclusions.

Catalog No. 2856, Red Plain

The paste was dark brown and contained 40 percent highly weathered mineral grains and rock fragments derived from diabase. Virtually all of the olivine and pyroxene had weathered to dark reddish brown inclusions, which preserved the original crystallographic orientation of these minerals and resulted in an almost micaceous appearance. Alkali feldspar accounted for about 15 percent of the minerals present. The untwinned alkali feldspar was usually altered to sericite, often to the point of obscuring the optical characteristics of the mineral grain. Trace amounts of plagioclase and green-brown hornblende were present in rock fragments.

One percent of the ceramic paste was composed of plutonic inclusions, appearing as rounded, medium-sand-sized grains of quartz or aggregate masses of quartz and untwinned alkali feldspar. A single, very-coarse-sand-sized grain was composed of quartz and untwinned alkali feldspar, and the feldspar was heavily altered to sericite.

Catalog No. 3232, Salado Red Corrugated

The paste of this sherd was a medium reddish brown color. The paste contained about 25 percent fragments of diabase and mineral grains derived from the diabase. Black opaque inclusions made up an additional 3 percent of the ceramic paste. As in Catalog No. 3207 (Salado Red Corrugated, Paste Group A), the black inclusions most likely represented the weathering products of olivine and pyroxene.

Also present in the paste of this sherd was a single, medium-sand-sized fragment of muscovite schist.

Catalog No. 3793, Salado Red Corrugated

The paste of this sherd was a medium reddish brown color. Weathered inclusions derived from diabase accounted for about 35 percent of the ceramic paste and ranged in size from silt to medium-sized sand. These included highly weathered grains of olivine, pyroxene, and plagioclase and a few fragments of diabase. The olivine and pyroxene present in the paste had almost completely weathered to iddingsite and clay minerals.

A single, angular, medium-sand-sized fragment of very-fine-grained quartzite was also present in the paste of this sherd.

Paste Group C

Paste Group C includes two sherds dominated by metamorphic inclusions.

Catalog No. 2650, Brown Corrugated

The paste of this sherd was a dark brown color. Two types of inclusions were present in the paste of this sherd: rounded quartz grains and fragments of high-grade metamorphic rocks of variable composition and schistosity. The quartz grains were silt- to fine-sand sized and made up about 3 percent of the ceramic paste. Based on the undulose extinction of the isolated quartz grains, they were probably derived from a metamorphic source. Undulose extinction is uneven optical extinction. It is evidence for the deformation of the crystal through pressure and, therefore, characteristic of a metamorphic origin.

The metamorphic rock fragments made up about 25 percent of the ceramic matrix and ranged in size from fine to very coarse sand. Most were biotite schists characterized by segregated zones or pockets of highly deformed quartz and brown biotite. The biotite was often weathered, staining the rock fragments a faint reddish brown color. Higher grades of metamorphism included phyllite and mylonite. The mylonite usually contained sparse amount of biotite that weathered to hematite, staining the rock fragment a dark reddish brown. The higher metamorphic grades made up only about 10 percent of the rock fragments.

Catalog No. 4908, Red Plain

The medium brown paste contained about 25 percent very-fine- to coarse-sand-sized, subangular to rounded sands. The sands were composed primarily of very fine grained quartzite. Brown biotite accounted for about 1 percent of the ceramic paste. Trace amounts of basalt and biotite schist were also present, along with a single, medium-sand-sized grain of sparry limestone containing fragments of foraminifera.

Paste Group D

Paste Group D, with 25 samples, was the largest paste-composition group. These ceramics were dominated by plutonic inclusions that were probably derived from granite, as suggested by rock fragments composed of quartz, untwinned alkali feldspar, and, occasionally, plagioclase feldspar. One nearby source of plutonic rock was Ruin Granite, which outcrops to the north of the Salt River Canyon (Peterson 1962; Shride 1967).

Some variation was present within Paste Group D ceramics. Seventy-six percent of the sherds (n = 19) apparently contained only granitic inclusions. The remaining 6 sherds also contained minor amounts of volcanic, metamorphic, or sedimentary inclusions. All three rock types were mixed together in 3 sherds (Catalog Nos. 2588, 2570, and 4762), where basalt and sandstone appeared with quartzite or another metamorphic rock, such as biotite schist or gneiss. Diabase, which appeared in 1 sherd (Catalog No. 2588) as 10 percent of the paste, was similar to the diabase observed in sherds from Paste Groups A and B.

Catalog No. 3899, Brown Corrugated

The paste of this sherd was a dark brown color and contained inclusions from a plutonic source. The source was granite, as indicated by the presence of medium- to coarse-sand-sized rock fragments composed of quartz, untwinned alkali feldspar, and occasional plagioclase feldspar. Rock fragments and isolated grains of quartz, untwinned alkali feldspar, and plagioclase feldspar ranged in size from silt to very coarse sand and made up 20 percent of the ceramic paste. The untwinned feldspars fell along a continuum from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. Trace amounts of dark green biotite and epidote were also present.

Catalog No. 2493, Brown Plain

The medium brown paste contained isolated mineral grains derived from a plutonic source. The grain size distribution was bimodal. Angular medium- to very-coarse-sand-sized mineral grains accounted for 20 percent of the paste. Approximately 3 percent of the paste contained silt- to very fine-sand-sized subrounded grains of quartz, plagioclase, and untwinned alkali feldspar. Because of the small size of these fine particles, the percentage of each mineral grain could not be determined. A trace amount of brown biotite in the paste also fell into this size category.

The most common mineral, making up 50 percent of the grains, was the alkali feldspar microcline. The microcline usually displayed microperthitic intergrowths of albite of the patch and ribbon type. Quartz was poikilitically contained within one of the microcline grains. Quartz was also present as isolated mineral grains and was found in a slightly lesser amount than did microcline. Untwinned alkali feldspar was also present in the paste but accounted for only about 5 percent of the total inclusions. In general, the alkali feldspars in the paste appeared unweathered, but a trace amount displayed some alteration to sericite and clay minerals.

Catalog No. 2588, Brown Plain

The medium brown paste contained 25 percent isolated minerals and rock fragments ranging continuously in size from silt to very coarse sand. Rock fragments were in the minority, accounting for less than 1 percent of the ceramic paste.

Plutonic inclusions made up 15 percent of the paste. Two plutonic rock fragments were medium-sand in size and displayed micrographic intergrowth of untwinned alkali feldspar and quartz. In both, the alkali feldspar had been altered to sericite and clay minerals. Untwinned alkali feldspar was also present as isolated grains, along with trace amounts of microcline, muscovite, and epidote. The untwinned alkali feldspar ranged from unweathered to highly weathered, and a few grains had almost completely weathered to clay minerals, obscuring their optical characteristics. Biotite ranged from unweathered to reduced to black opaque inclusions.

Metamorphic rocks in the paste were quartzite, which was the most common type of rock fragment, and biotite gneiss. The quartz boundaries in the quartzite were sutured and the quartz grains displayed undulose extinction, indicating a metamorphic origin. Isolated quartz grains in the ceramic paste also exhibited undulose extinction. Biotite gneiss appeared as a single rounded grain.

One distinctive feature of this sherd was the appearance of medium- to coarse-sand-sized, dark reddish brown or black opaque inclusions, which made up 10 percent of the clay matrix. These opaque fragments represented highly weathered olivine and pyroxene grains. These were probably derived from diabase, as suggested by the association of two of the black inclusions with highly weathered laths of plagioclase.

There was one medium-sand-sized fragment of very-fine-grained basalt. The basalt was composed of andesine plagioclase that contained intergranular pyroxene and cubic magnetite. The pyroxene, except for the core of the fragment, had almost completely weathered to hematite and clay minerals.

Remaining nonplutonic inclusions were a medium-sand-sized, very-fine-grained, mature, grain-supported sandstone and a medium-sand-sized, weathered, plagioclase grain enclosing areas of clay minerals and hematite.

Catalog No. 2634, Brown Plain

Rock fragments and isolated grains of quartz, untwinned alkali feldspar, and plagioclases ranging in size from silt to very coarse sand made up 35 percent of the dark brown ceramic paste. The untwinned feldspar grains ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics. A trace amount of highly weathered biotite was also present.

Catalog No. 4498, Brown Plain

The dark brown, opaque paste contained isolated mineral grains from a plutonic source, ranging in size from silt to medium-sized sand. Untwinned alkali feldspar grains were 30 percent of the paste. About two-thirds of the untwinned alkali feldspar grains had weathered to the point of obscuring their optical characteristics. Quartz accounted for about 5 percent of the ceramic paste. Brown biotite accounted for an additional 1 percent of the ceramic paste. A trace amount of weathered plagioclase was also present.

Catalog No. 2592, Red Plain

The medium brown paste contained 45 percent isolated mineral grains and a trace amount of rock fragments. The isolated mineral grains were derived from a plutonic source, but one that was compositionally distinct from the source of Catalog No. 2588 (brown plain). In this sample, quartz was the dominant isolated mineral followed closely by untwinned alkali feldspar. The alkali feldspars ranged in appearance from unweathered to completely altered to sericite and clay minerals, obscuring their optical characteristics. Plagioclase was present at about one-third the amount of quartz or untwinned alkali feldspar. Microcline, green hornblende, and brown biotite were present in trace amounts. The mineral grains ranged continuously in size from silt to coarse sand.

There was a single, medium-sand-sized grain of well-sorted, very-fine-grained sandstone with brown clay cement in the paste.

Catalog No. 2619, Red Plain

The medium reddish brown paste had inclusions that were bimodally distributed by size. Silt- to very-fine sand-sized angular fragments of quartz and untwinned feldspar made up 3 percent of the paste. An additional 15 percent of the paste consisted of fine- to coarse-sand-sized inclusions from a plutonic source. The proportions of quartz and untwinned alkali feldspar were roughly equal. Microcline and plagioclase were present in about a 5:1 ratio with the quartz and untwinned alkali feldspar. The feldspars were generally unweathered, and only a trace amount of the feldspar grains appeared slightly kaolinized and altered to sericite. A trace amount of brown biotite was present in the paste.

A single, medium-sand-sized grain of weathered dolomitic limestone was also present.

Catalog No. 2709, Red Plain

Rock fragments and isolated fragments of quartz, untwinned alkali feldspar, and plagioclases made up 35 percent of the dark brown ceramic paste. The inclusions ranged in size from silt to very coarse sand and were derived from a plutonic source. The source was granite, as indicated by the presence of very-coarse-sand-sized rock fragments composed of quartz, untwinned alkali feldspar, and/or microcline and plagioclase. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the grains. A trace amount of biotite and epidote was present.

Catalog No. 2767, Red Plain

Subangular to subrounded plutonic inclusions accounted for about 30 percent of the dark brown paste. They ranged in size from silt to coarse sand and had a bimodal distribution of particle sizes. Silt- to very-fine-sand-sized isolated mineral grains accounted for about 10 percent of the inclusions present. An additional 20 percent of the paste contained medium- to very-coarse-sand-sized mineral grains and sparse fragments of plutonic rock. The minerals were similar in both size groups. Rock fragments, appearing in trace amounts, were composed primarily of medium-sand-sized grains of untwinned alkali feldspar and plagioclase, with or without quartz.

The dominant mineral present was alkali feldspar, which accounted for about two-thirds of the mineral grains present. Most alkali feldspar was untwinned. About 10 percent of the alkali feldspar grains were microcline, distinguished by its characteristic grid-twinning. A trace number of microcline grains contained rounded poikilitic quartz. About two-thirds of the untwinned alkali feldspar grains were highly altered to sericite and clay minerals, occasionally to the point of obscuring their optical characteristics.

Brown biotite was also present in the ceramic paste and appeared mostly as isolated grains but was also found in aggregate fragments with untwinned alkali feldspar. Much of the biotite in the paste had weathered to clay minerals, making it difficult to differentiate from the clay matrix because of the lack of visual contrast.

Quartz accounted for about 10 percent of the mineral inclusions. It was present primarily as isolated mineral grains but was occasionally found poikilitically within microcline. Plagioclase accounted for only 1 percent of the ceramic paste. Trace amounts of green biotite and epidote were also present.

Catalog No. 2837, Red Plain

The paste of this sherd was a dark brown color and contained inclusions from a plutonic source. The source was granite, as indicated by the presence of very-coarse-sand-sized rock fragments composed of quartz, untwinned alkali feldspar, and/or microcline and plagioclase. Rock fragments and isolated grains of quartz, untwinned alkali feldspar, and plagioclase feldspar ranged in size from silt to very coarse sand and made up 30 percent of the ceramic paste. The untwinned feldspars fell along a continuum from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains.

A trace amount of dark green biotite and epidote was present, along with a single rounded grain of pyroxene. Green hornblende appeared twice, once as a coarse-sand-sized isolated grain, and once as a component of a plutonic rock fragment composed of quartz and weathered, untwinned alkali feldspar.

Catalog No. 2857, Red Plain

The medium reddish brown paste contained isolated mineral grains derived from a plutonic source. Similar to Catalog No. 2493 (brown plain), the alkali feldspar microcline made up 50 percent of the mineral grains. The microcline usually displayed microperthitic intergrowths of albite of the patch and ribbon type. Quartz was poikilitically contained within one of the microcline grains. Quartz was also present as isolated mineral grains and was found in a slightly lesser amount than did microcline. Untwinned alkali feldspar was also present in the paste but accounted for only about 5 percent of the total inclusions. In general, the alkali feldspars in the paste appeared unweathered, but a trace amount displayed some alteration to sericite and clay minerals.

Plagioclase made up 1 percent of the paste and was usually altered to sericite. A trace amount of the laths of plagioclase contained untwinned alkali feldspar poikilitically. In general, the alkali feldspars appeared unweathered, although a trace amount displayed some alteration to sericite and clay minerals.

The grain size distribution was bimodal. Angular, medium- to very-coarse-sand-sized mineral grains accounted for 20 percent of the paste. Approximately 3 percent of the paste contained silt- to very-fine-sand-sized subrounded grains of quartz, plagioclase, and untwinned alkali feldspar. Because of the small size of these fine particles, the percentage of each mineral grain could not be determined. A trace amount of brown biotite in the paste also fell into this size category.

A single grain of an moderately well-sorted immature sandstone was also present. The sandstone had a dark brown clay cement.

Catalog No. 2919, Red Plain

The dark brown paste contained inclusions derived from a plutonic source. Quartz and untwinned alkali appeared primarily as isolated mineral grains and, occasionally, in rock fragments with both minerals. Quartz and untwinned alkali feldspar grains ranged in size from silt to medium-sized sand and each accounted for about 10 percent of the ceramic paste. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. A trace amount of plagioclase was also present.

Catalog No. 4510, Red Plain

The dark brown, opaque paste of this sherd was very similar to the paste of Catalog No. 4498 (brown plain) in terms of color and because it also contained 30 percent untwinned alkali feldspar. The untwinned alkali feldspar grains ranged in size from silt to medium-sized sand and most had weathered to sericite and clay minerals. Quartz made up 5 percent of the inclusions and fell into the same size range as the untwinned alkali feldspar. Trace amounts of plagioclase and brown biotite were also present.

Catalog No. 4528, Red Plain

The source of plutonic inclusions in the medium brown paste was granite, as indicated by the presence of very-coarse-sand-sized rock fragments composed of quartz, untwinned alkali feldspar and plagioclase feldspar. Rock fragments and isolated fragments of quartz, untwinned alkali feldspar and plagioclase ranged in size from silt to very coarse sand and made up 25 percent of the ceramic paste. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. A trace amount of biotite was present and a trace amount of green hornblende appeared as isolated mineral grains.

Catalog No. 4537, Red Plain

Rock fragments and isolated fragments of quartz, untwinned alkali feldspar and plagioclase ranged in size from silt to coarse sand and made up 35 percent of the dark brown ceramic paste. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. A trace amount of biotite and epidote was present. Green hornblende appeared once as a coarse-sand-sized isolated grain and once as a component of a plutonic rock fragment composed of quartz and weathered untwinned alkali feldspar.

Catalog No. 4692, Red Plain

The paste was dark brown and contained subangular to subrounded plutonic inclusions ranging in size from silt to coarse sand. Inclusions made up 40 percent of the paste. About two-thirds of the mineral grains were alkali feldspar, which was found most commonly in an untwinned form. About 10 percent of the alkali feldspar grains were microcline, distinguished by its characteristic grid-twinning. A trace number of microcline grains exhibited poikilitic texture and contained rounded quartz. About two-thirds of the untwinned alkali feldspar grains were highly altered to sericite and clay minerals, occasionally to the point of obscuring their optical characteristics.

Quartz accounted for about 10 percent of the mineral inclusions. Quartz was present primarily as isolated mineral grains or poikilitically within microcline. Brown biotite usually appeared as isolated grains but was also observed in aggregate fragments with untwinned alkali feldspar. Much of the biotite in the paste had weathered to clay minerals, which made it difficult to differentiate from the clay matrix because of the lack of visual contrast. Plagioclase was also present but accounted for only 1 percent of the ceramic paste. Trace amounts of green biotite and epidote were also present.

Catalog No. 4789, Red Plain

Inclusions in the very dark brown, opaque paste were virtually identical in types and quantities to plutonic minerals in Catalog No. 4692 (red plain) and probably came from the same source. This sample lacked the trace amount of epidote and green biotite observed in Catalog No. 4692, however.

Catalog No. 4907, Red Plain

The inclusions in the medium reddish brown paste had sizes that were bimodally distributed. Three percent of the paste consisted of angular fragments of quartz and untwinned feldspar, ranging in size from silt to very fine sand. Inclusions ranging in size from fine to very coarse sand made up an additional 15 percent. The mineral grains included roughly equal proportions of quartz and untwined alkali feldspar. Microcline and plagioclase were also present at about a 5:1 ratio with the quartz and untwinned alkali feldspar. The untwinned feldspar grains displayed a continuous degree of alteration from unweathered to completely altered to sericite and clay minerals, obscuring their optical characteristics. Brown biotite may have accounted for at least 10 percent of the mineral grains. It was difficult to distinguish from the paste because it was often silt sized and appeared as black opaque inclusions, having weathered to hematite and clay minerals.

Catalog No. 3196, Red Plain

The paste was very dark brown and opaque. Like the paste of Catalog No. 4692 (red plain), it contained subangular to subrounded plutonic inclusions ranging in size from silt to coarse sand. Inclusions made up 35 percent of the paste. About two-thirds of the mineral grains were alkali feldspar, which was found most commonly in an untwinned form. About 10 percent of the alkali feldspar grains were microcline, distinguished by its characteristic grid-twinning. A trace number of untwinned alkali feldspar and microcline grains exhibited poikilitic texture and contained rounded quartz. About two-thirds of the untwinned alkali feldspar grains were highly altered to sericite and clay minerals, occasionally to the point of obscuring their optical characteristics.

Quartz accounted for about 10 percent of the mineral inclusions. Quartz was present as isolated mineral grains, in rock fragments with untwinned alkali feldspar or poikilitically within microcline or untwinned alkali feldspar. Brown biotite usually appeared as isolated grains but was also observed in aggregate fragments with untwinned alkali feldspar. Much of the biotite in the paste had weathered to clay minerals, making it difficult to differentiate from the clay matrix because of the lack of visual contrast. Plagioclase was also present but accounted for only 1 percent of the ceramic paste.

Catalog No. 3197, Red Plain

The paste was very similar to that of Catalog No. 3196 (red plain) in terms of paste color and the presence of sands derived primarily from a plutonic source. The major difference was that the inclusions made up only 25 percent of the paste of this sample. The inclusions were also finer in size, ranging from silt to medium-sized sand.

Catalog No. 3221, Red Plain

Rock fragments and isolated grains of quartz, untwinned alkali feldspar and plagioclases ranged in size from silt to very coarse sand and made up 30 percent of the dark brown paste. The source of these plutonic inclusions was granite, as indicated by the presence of medium- to coarse-sand-sized rock fragments of quartz, untwinned alkali feldspar, and occasionally plagioclase feldspar. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. Trace amounts of dark green biotite and a single, medium-sand-sized grain of pyroxene were also present.

Catalog No. 3784, Red Plain

Like Catalog No. 3221 (red plain), rock fragments and isolated grains of quartz, untwinned alkali feldspar and plagioclases ranged in size from silt to very coarse sand and made up 30 percent of the dark brown paste. The source of these plutonic inclusions was granite, as indicated by the presence of medium- to coarse-sand-sized rock fragments composed of quartz, untwinned alkali feldspar, and plagioclase feldspar. The untwinned feldspars ranged continuously from unweathered to completely altered to sericite and clay minerals, obscuring the optical characteristics of the mineral grains. Trace amounts of dark green biotite, hornblende, and epidote also appeared in the ceramic paste.

One coarse-sand-sized and two medium-sand-sized voids surrounded by carbonaceous halos were also present. These were probably from plant materials that were accidently incorporated into the ceramic paste.

Catalog No. 2570, Salado Red Corrugated

Forty percent of the medium brown paste consisted of isolated mineral grains and rock fragments. Inclusions ranged in size from silt to very coarse sand. Rock fragments were derived from plutonic, volcanic, metamorphic, and sedimentary rocks.

A single plutonic rock fragment displayed micrographic texture. The angular fragment was coarse sand in size and characterized by the wedge-shaped intergrowth of untwinned alkali feldspar and quartz.

Volcanic rock fragments included one medium-sand-sized fragment of basalt and one coarse-sand-sized angular fragment of porphyritic andesite. The basalt fragment displayed a distinctive trachytic texture. Trachytic texture results from fine-grained feldspar laths that are aligned subparallel to the flow direction. The groundmass of the andesite was a cryptocrystalline mass of plagioclase weathered biotite and weathered biotite. Andesine plagioclase was contained porphyritically within the groundmass.

Metamorphic and sedimentary rock fragments included fine- to medium-grained quartzite; two pieces of submature sandstone; and a single, coarse-sized, rounded grain of biotite gneiss. A very-coarse-sized rock fragment consisting of two spherulites was also present. A spherulite is “a rounded crystallaria [crystal aggregate] in which the crystals radiate from a single point” (Brewer 1964:285).

Quartz accounted for 90 percent of the isolated mineral grains. Untwinned alkali feldspar appeared in rock fragments and as isolated mineral grains and made up 10 percent of the ceramic paste. Most of the alkali feldspar in both contexts had weathered, often obscuring its optical characteristics. Plagioclase was present in a trace amount. One medium-sand-sized aggregate, two fine-sand-sized grains of epidote, and two medium-sand-sized pyroxene grains were also present.

Catalog No. 2571, Salado Red Corrugated

The medium reddish brown paste contained about 11 percent angular grains of quartz and untwinned alkali feldspar in roughly equal amounts. The size distribution of these grains was bidmodal. Ten percent of the paste consisted of quartz and untwinned alkali feldspar grains ranging in size from very fine to fine sand. Another 1 percent consisted of medium-sand-sized grains. The paste also contained 1 percent brown biotite, ranging in size from silt to very fine sand.

Catalog No. 4762, Salado Red Corrugated

The medium brown paste contained 30 percent isolated mineral grains and a trace amount of volcanic, metamorphic, and sedimentary rock fragments. Rock fragments included two medium-sand-sized fragments of porphyritic basalt; two coarse-sand-sized fragments of weathered biotite schist; one medium-sand-sized and one coarse-sand-sized fragment of quartzite; and one very-coarse-sand-sized and one medium-sand-sized grain of well-sorted, very-fine-grained sandstone with brown clay cement.

Isolated mineral grains ranged continuously in size from silt to coarse sand and were consistent with a plutonic origin, probably granitic. Quartz was the dominant isolated mineral, followed closely by untwinned alkali feldspar. The alkali feldspars ranged from unweathered to completely altered o sericite and clay minerals, obscuring their optical characteristics. Plagioclase was present at about one-third the amount of quartz or untwinned alkali feldspar. Microcline, green hornblende, and brown biotite were present in trace amounts. One coarse-sized fragment of microcline contained micrographic intergrowths of quartz.

Discussion

The ceramic samples described above are similar to other analyzed ceramics in Tonto Basin. All but two of the 55 ceramic samples fell into diabase-dominated Paste Groups A and B or into granite-dominated Paste Group D. Most ceramics from the Roosevelt Platform Mound (RPM) study in the lower Tonto Basin were also tempered with granite, diabase, or a combination (Simon et al. 1998:100). Forty-five percent of the ceramic samples in this study belonged to Paste Group D, 40 percent were in Paste Group A, and 11 percent were in Paste Group B (see Table 33). Most of the ceramics (51 percent in Paste Groups A and B) were tempered with diabase.

Ceramic types were not equally distributed among the four paste groups. Salado Red Corrugated samples were almost entirely assigned to Paste Group A. Eighty-four percent of Salado Red Corrugated samples belonged to Paste Groups A or B and were tempered with diabase (see Table 33). Salado Red in the RPM was also "usually tempered with diabase" (Simon et al. 1998:100).

Inclusions in Paste Groups A and B, as noted above, might be assigned to the Armer, Cline, or Hackberry petrofacies. In their summary of temper patterns throughout Tonto Basin, Heidke and Miksa (2000:127) observed that in the early Classic period, "corrugated wares, especially the slipped corrugated types [such as Salado Red Corrugated], were generally tempered with Armer/Cline Petrofacies sand." Brown corrugated ceramics in this project were distributed across all four paste groups (see Table 33).

The red plain samples analyzed here almost all belong to Paste Group D. Most of these samples might be assigned to the Ash petrofacies, when inclusions are apparently only derived from granite, or to the Pinto or Wildcat-Poison Terrace petrofacies when volcanic, metamorphic, and/or sedimentary inclusions appear. Early Classic period plain and red wares "are generally tempered with Ash Petrofacies sand" (Heidke and Miksa 2000:127). Some of the brown plain ceramics in this project were in Paste Group D but more were in Paste Groups A and B (see Table 33).

The origin of the inclusions in these paste groups is debatable. A key assumption of the petrofacies model is that most of the inclusions were intentionally added as temper and were derived from stream sands (Miksa and Heidke 1995). In their analysis of lower Tonto Basin ceramics, Simon et al. (1998:100) suggested that "potters probably gathered temper materials from decomposing rock formations or near these freshly weathered sources, rather than from the extremely mixed sands of the Salt River and Tonto Creek and their primary tributaries." We propose a third possibility: at least some of the ceramics analyzed in our project were made from "self-tempered" or residual clays that contained abundant natural inclusions. Miksa and Heidke (1995:190–194) have addressed the problem of distinguishing between natural and added inclusions, and this issue is revisited below (see "Comparison of Ceramic and Sediment Samples" and "Conclusions").

Temper is related to thermal shock resistance and vessel wall strength (Bronitsky and Hamer 1986; Van Keuren et al. 1997), and ethnographically, potters among the Tohono O'odham (Fontana et al. 1962) and the Maricopa (Fernald 1973) adjusted the paste composition depending upon the vessel function. There was no clear relationship in this study, however, between paste group and vessel function as inferred from rim morphology (see Chapter 2, this volume). As Table 35 shows, most vessels fall into the largest paste composition groups, Paste Groups A and D, regardless of function. Vessels used for cooking, food preparation, and serving or eating tended to belong to Paste Group D, and liquid-carrier or liquid-storage vessels tended to belong to Paste Group A. This pattern may have been the result of the small sample size.

Sediment Sample Thin-Section Descriptions

Sixteen sediment samples were thin-sectioned for comparison with the ceramic samples (CS). Four samples (CS-1, CS-2, CS-3, and CS-4) were collected from the project area (Figure 27) for comparison with the ceramic samples. Twelve additional sediment samples for comparison came from unused archaeomagnetic samples from hearths.

Nonfeature Samples

Deposits were selected for sampling based on apparent high clay content. These samples were generally finer in texture than the ceramic samples discussed above, lacking large inclusions, although some of the inclusions they contained (such as the diabase and sandstone in CS-3) were compatible with the range of inclusions in the ceramics.

Two samples (CS-2 and CS-3) contained pedorelics, or papules (Brewer 1964:274–282), a relict soil feature not observed in any of the ceramics. Papules are redeposited indurated nodules of an older soil material, either a clay or

Table 35. Petrographic Paste Group Membership and Vessel Function

Vessel Function	Paste Group				Total
	A	B	C	D	
Cooking	2	—	—	2	4
Food preparation, serving, and eating	8	4	1	15	28
Food preparation or cooking	—	—	—	3	3
Liquid carrier or liquid storage	3	—	1	—	4
Liquid storage	9	2	—	5	16
Total	22	6	2	25	55

silty clay, or preserved portions of a previously existing soil horizon within a newly formed horizon. A few of the papules in CS-2 displayed distinct bedding, a result of their origin from a relict soil.

CS-1

CS-1 was collected from layer of clay-rich soil about 30 cm below the ground surface, exposed in an arroyo cut roughly 0.75 km north of Jakes Corner (see Figure 27).

The sediment was poorly sorted; areas composed almost completely of a very fine, slightly indurated "pure" clay were surrounded by areas with 3 percent silt- to very-fine-sand-sized brown biotite. The biotite-rich areas also contained trace amounts of quartz and plagioclase.

One coarse-sand-sized and two medium-sand-sized fragments of kaolinized tuff were also present. One of the medium-sand-sized tuff grains also contained about 5 percent highly weathered brown biotite, staining the tuff grain a reddish brown color.

CS-2

CS-2 was collected about 0.4 km to the west of the Vegas Ruin (see Figure 27) from a layer of clay-rich soil exposed in an arroyo cut about 40 cm below the ground surface. The layer was much finer in texture than the layers immediately above and below it.

The matrix was dominated by silt-sized particles. Subangular, isolated, fine-sand-sized grains of slightly weathered untwinned alkali feldspar made up 1 percent of the paste. One distinctive component of the clay matrix was the abundance of coarse-sand-sized rounded pedorelics or papules.

CS-3

CS-3 was collected from a test pit within Site AZ U:3:404/2011 (see Figure 27). Sediments at the site were colluvial and alluvial layers with only weak soil development.

One third of the matrix was made up of papules ranging in size from very fine to coarse sand. There was also a trace amount of silt- to very-fine-sand-sized rounded grains of quartz and brown biotite.

The sample also contained a trace amount of fine- to very-coarse-sand-sized fragments of olivine diabase, similar to diabase observed in Paste Groups A and B in the ceramic sample. The olivine diabase grains appeared unweathered, consistent with an origin from colluvium rather than a soil profile weathering in situ. Two medium-sized fragments of immature sandstone with brown clay cement were also present.

CS-4

CS-4 was collected from stripping backdirt at the Crane site (see Figure 27). Surface colluvium on the upper shoulder of the terrace spur at the Crane site exhibits weak soil development in the form of an A-Bk profile. Below this was buried soil with a buried argillic horizon (designated 2Btb1–2Bt2). These horizons were moderately to violently effervescent. Layers of colluvium appeared on the side slope.

The sediment sample contained 3 percent quartz, untwinned alkali feldspar, and brown biotite grains, ranging in size from silt to very fine sand. The alkali feldspar ranged from unweathered to highly altered to sericite and clay minerals. An additional 3 percent consisted of fine- to coarse-sand-sized mineral grains and rock fragments derived from a plutonic source. Two medium-sized grains of quartzite were also present.

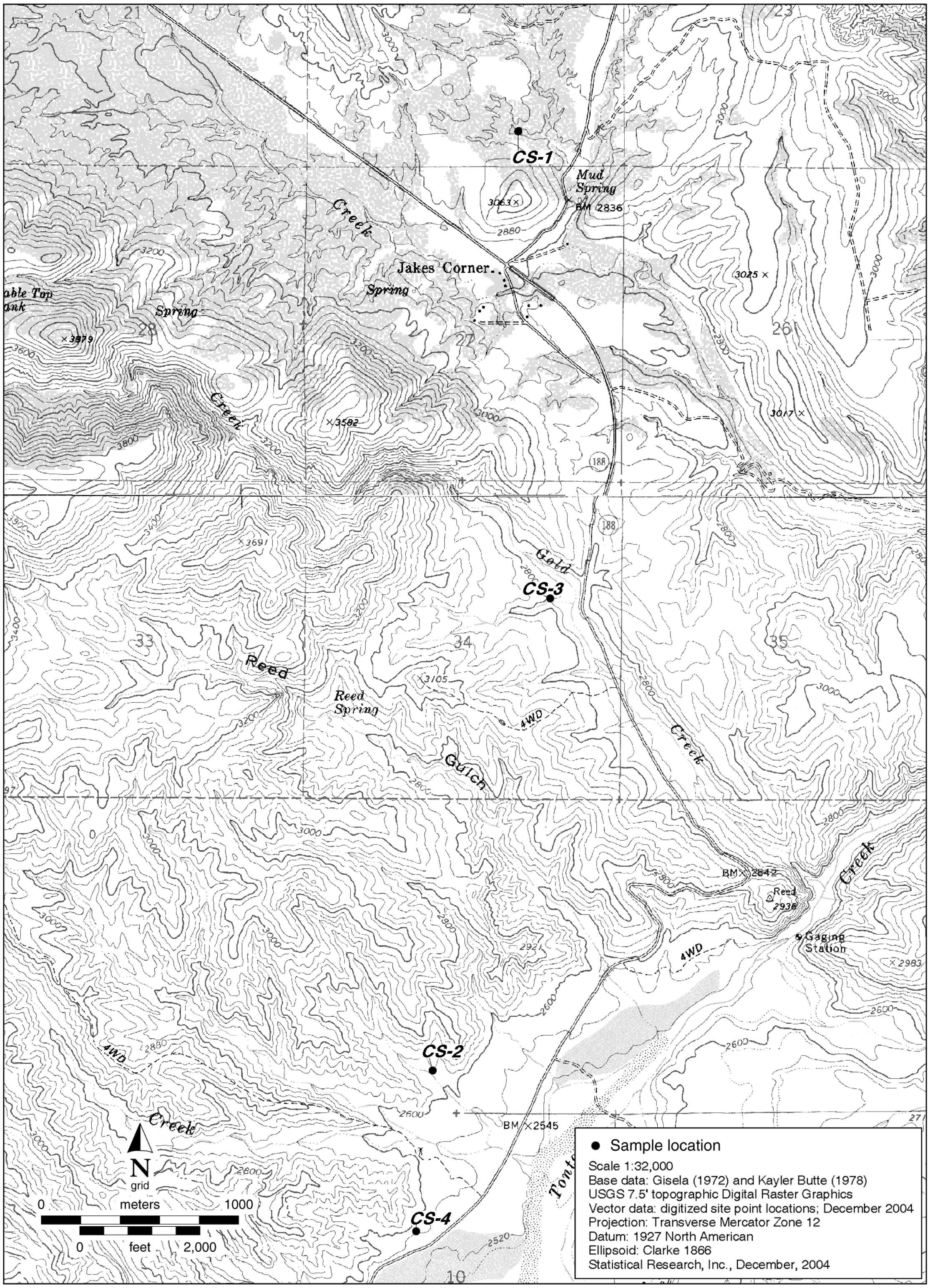

Figure 27. Locations of clay samples for the SR 188–Cottonwood Creek Project.

Archaeomagnetic Samples

Extra material from 12 archaeomagnetic samples (see Volume 1, Appendix A) was also thin-sectioned for comparison with the ceramics. These samples do not represent the sterile subsoil into which features were excavated but the clay linings added to hearths before use (William Deaver, personal communication 2003); thus these samples represent clays that were probably locally derived and used for a different purpose. The sediment below the clay lining was often added by house residents to fill a previous hearth so that a new hearth could be constructed in the same location. The 12 samples were collected from three sites: the Vegas Ruin, Rock Jaw site, and Crane site.

At the Vegas Ruin, nine samples were collected from Features 19, 34, 99, 179, and 11. Feature 19 was a Miami/Roosevelt phase pit structure with two hearths in the east-central area. The original hearth (19.04) was clay lined with a 5-cm-wide collar at the floor. It was cleaned out and filled with brown gravelly loam before the construction of a later hearth (19.01) within Feature 19.04. The later hearth was also clay lined but lacked a collar. The plaster was preserved only on the upper one-third of the hearth sides.

Feature 34 represented two Miami/Roosevelt phase pit structures, one built on top of the other, with a hearth for both structures in the east-central area. The original hearth (34.32) was an unlined basin with oxidized rim and walls. The earlier structure either collapsed or was dismantled, and a smaller adobe-walled pit structure was built on top. The hearth (34.01) for the second structure was built above Feature 34.32 and had a well-oxidized, 2–3-cm-thick layer of clay plaster.

Feature 99 was another Miami/Roosevelt phase pit structure with two hearths in the east-central area. The original hearth (99.25) was clay lined and well oxidized. A large oval pit was later dug above Feature 99.25, removing the upper portion, and filled with adobe. It was into this surface that the later hearth (Feature 99.01) was built. Feature 99.01 was lined with a 2–3-cm-thick layer of clay plaster that was well oxidized.

Feature 179 was another Miami/Roosevelt phase pit structure with a remodeled hearth in the east-central area. The archaeomagnetic sample was collected from the latest hearth (179.60), which had well plastered and well-oxidized sides. Remnants of two previous hearths were visible when Feature 179.60 was sectioned, although most of the previous hearths were removed by the construction of the latest hearth.

Features 11.1 and 11.2 were two hearths inside Feature 11, a rectangular cobble-adobe-foundation habitation room dating to the Miami/Roosevelt phase. The floor of Feature 11 was excavated into a silty clay loam with Stage I carbonate development. Both hearths were deep basin-shaped pits with a 2–3-cm-thick clay lining and were found at floor level within the eastern half of the house. Plaster was preserved on about two-thirds of the surface of each hearth. Archaeomagnetic dating indicated that these hearths were too late to be associated with the house occupation (William Deaver, personal communication, 2003).

Two samples were collected from Features 1 and 3 at the Rock Jaw site. Feature 1 was a pre-Classic house in a pit, with a hearth (Feature 1.01) in the west-central portion of the house. The hearth was plastered and had a 15-cm-wide collar. Feature 3 was a pit house constructed in the Feature 1 house pit and was superimposed on Feature 1. The hearth (Feature 3.02) was a plastered basin in the east-central portion of the house.

One sample was collected from Feature 30 at the Crane site, a Miami phase pit house with a formal hearth (Feature 30.01) with a large collar.

Vegas Ruin, Feature 19.01, Sample No. 2071

The medium brown sandy clay matrix contained about 40 percent rock fragments and isolated mineral grains. Isolated mineral grains accounted for about three-quarters of the inclusions. The isolated mineral grains consisted of rounded sands that were very fine to coarse in size and were composed of equal proportions of quartz and untwinned alkali feldspar. Fine- to very-fine biotite mica made up an additional 5 percent of the isolated minerals. The alkali feldspar grains ranged in appearance from unweathered to completely weathered to sericite and clay minerals. Trace amounts of black opaque inclusions ranged in size from fine- to very-fine sand. These grains probably represented weathered biotite.

Medium-to very-coarse-sized fragments of plutonic, volcanic, metamorphic, and sedimentary rock fragments were present in the clay matrix in roughly equal proportions. The plutonic rock fragments were characterized by the intergrowth of quartz and intwinned alkali feldspar. One very-coarse-sand-sized grain of microcline contained micrographic intergrowths of quartz and albite.

The volcanic rock fragments were primarily welded tuff with a brown, glassy groundmass containing laths of plagioclase and highly weathered brown biotite. One medium-sand-sized volcanic rock fragment consisted of a weathered groundmass of brownish glass with laths of pyroxene. Two fragments of volcanic chalcedony were also present in the clay sample.

The metamorphic rock fragments consisted of fine- to coarse-sand-sized books of brown biotite and one medium-sand-sized fragment of quartz mica schist. The sedimentary inclusions were medium- to coarse-sand-sized fragments of fine-grained sparry limestone.

Vegas Ruin, Feature 19.04, Sample No. 2078

The sample contained about 35 percent inclusions, consisting primarily of subangular to rounded grains of quartz and untwinned alkali feldspar. The quartz and alkali feldspar grains ranged from very fine to coarse in size. The alkali feldspar grains ranged from unweathered to completely altered to sericite and clay minerals. Very-fine to fine-sand-sized books of brown biotite made up 5 percent of the matrix.

Volcanic, metamorphic, and sedimentary rock fragments were also present in trace amounts. These were weathered fine- to medium-sand-sized inclusions of gray tuff, two very-coarse-sand-sized fragments of quartzite, two coarse-sand-sized fragments of quartz mica schist, and a single, medium-sand-sized, rounded fragment of sparry limestone.

Vegas Ruin, Feature 34.01, Sample No. 2072

Isolated mineral grains and rock fragments made up approximately one-third of the matrix. Most of these were plutonic inclusions. The isolated mineral grains ranged in size from silt to medium-sized sand and were composed of equal amounts of rounded quartz and untwinned alkali feldspar. The untwinned alkali feldspar grains ranged from unweathered to completely altered to sericite and clay minerals. Twenty percent of the isolated mineral grains were very-fine- to fine-sand-sized flakes of brown biotite. Trace amounts of very-fine- to fine-sand-sized black angular opaque inclusions were also present.

Rock fragments were volcanic, plutonic, and sedimentary in origin and ranged in size from medium-sized to very coarse sand. The most common rock type was gray silicified welded tuff found as rounded grains, some of which displayed vesicles. Also present were angular fragments of quartz and untwinned alkali feldspar; one very-coarse-sand-sized, rounded grain of sparry limestone; and one very-coarse-sand-sized rounded grain of well-sorted sandstone with coarse, crystalline calcite cement.

Vegas Ruin, Feature 34.32, Sample No. 2079

The matrix contained about 35 percent inclusions, both isolated mineral grains and rock fragments. Quartz and untwinned alkali feldspars were present in equal amounts, and the grains ranged in size from very fine to coarse sand. The alkali feldspar grains ranged from unweathered to completely weathered to sericite and clay minerals. About 5 percent of the matrix consisted of very-fine- to fine-sand-sized brown biotite. Very-fine- to fine-sand-sized black opaque inclusions made up 1 percent and probably represented weathered biotite.

Rock fragments were of volcanic, plutonic, and metamorphic origin. They were three coarse-sand-sized reddish fragments of welded tuff, one coarse-sand-sized rock fragment with equal amounts of untwinned alkali feldspar and quartz, one very-coarse-sand-sized fragment of fine-grained quartzite, and one fragment of quartz mica schist.

Vegas Ruin, Feature 99.01, Sample No. 2073

The medium brown matrix contained 40 percent inclusions, both isolated mineral grains and rock fragments. The isolated minerals were mostly silt- to medium-sand-sized rounded grains of quartz and untwinned alkali feldspar. The untwinned feldspar ranged from unweathered to completely altered to sericite and clay minerals. Very-fine- to fine-sand-sized books of biotite formed about 5 percent of the inclusions.

Rock fragments of volcanic, plutonic, and metamorphic origin were less than 1 percent of the matrix. The most common rock fragments were light gray volcanic tuff. Some of the tuff grains displayed vesicles, and one tuff grain contained brown biotite. A single, red, very-coarse-sand-sized, weathered volcanic rock was also present, along with one coarse-sand-sized fragment of quartzite and one very coarse plutonic grain of quartz and untwinned alkali feldspar.

Vegas Ruin, Feature 99.25, Sample No. 2081

Inclusions accounted for about 40 percent of the matrix and ranged in size from silt to coarse sand. Most inclusions were subangular to rounded isolated mineral grains, primarily equal amounts of quartz and untwinned alkali feldspar. One untwinned alkali feldspar grain displayed complex micrographic intergrowth with albite. About 5 percent of the matrix was very-fine- to fine-sand-sized brown biotite. Very-fine- to fine-sand-sized black opaque inclusions made up an additional 1 percent.

Volcanic, plutonic, and metamorphic rock fragments appeared in trace amounts. One medium-sand-sized fragment of very-fine-grained basalt had a groundmass of plagioclase with sparse intergranular olivine and augite. A coarse-sand-sized fragment of reddish brown volcanic tuff contained books of brown biotite, much of which had weathered to hematite and clay minerals. Two coarse-sand-sized angular plutonic rock fragments were composed primarily of untwinned alkali feldspar, quartz, and weathered brown biotite. A single very-coarse-sand-size fragment of biotite mica schist was also present.

Vegas Ruin, Feature 179.60, Sample No. 2074

The matrix contained about 60 percent inclusions, primarily subangular to rounded quartz and untwinned alkali feldspar grains. One of the untwinned alkali feldspar grains displayed complex micrographic intergrowth with quartz. Brown biotite accounted for about 5 percent of the isolated mineral grains.

Trace amounts of volcanic and metamorphic rock fragments were also present. Light gray volcanic tuff appeared and one fragment contained sparse, weathered, brown biotite. There was also one coarse-sand-sized fragment of quartz mica schist.

Vegas Ruin, Feature 11.1, Sample No. 2075

Fifty percent of the matrix consisted of angular to rounded isolated mineral grains and rock fragments. The isolated mineral grains were largely equal amounts of quartz and untwinned alkali feldspar. The alkali feldspar ranged from unweathered to altered to sericite and clay minerals. About 5 percent of the inclusions were very-fine- to fine-sized books of brown biotite. Single grains of zircon and pyroxene were also visible.

Rock fragments were volcanic and sedimentary in origin. There were three medium-sand-sized rounded grains of very-fine-grained trachytic basalt. One very-coarse-sand-sized fragment of submature sandstone was well sorted and supported by silica cement. A single, very-coarse-sand-sized grain was composed of laths of untwinned alkali feldspar and interstitial brown biotite.

Vegas Ruin, Feature 11.2, Sample No. 2082

The inclusions, which composed 30 percent of the matrix, were mostly subangular to rounded grains of quartz and untwinned alkali feldspar. The quartz and alkali feldspar grains ranged in size from very fine to coarse sand. The alkali feldspar grains ranged from unweathered to completely altered to sericite and clay minerals. One untwinned alkali feldspar grain displayed complex micrographic intergrowth with albite. Very-fine- to fine-sand-sized books of brown biotite made up about 5 percent of the matrix.

Volcanic rock fragments were present in trace amounts. A coarse-sand-sized fragment of reddish brown volcanic tuff contained books of brown biotite, many of which had weathered to hematite and clay minerals. There was also one medium-sand-sized fragment of highly weathered volcanic rock containing thin laths of plagioclase in a matrix of brown biotite.

Rock Jaw Site, Feature 3.02, Sample No. 2076

This matrix was 80 percent inclusions. The inclusions were mostly subangular to rounded grains of quartz and untwinned alkali feldspar, ranging in size from very fine to coarse sand. The alkali feldspar grains ranged from unweathered to completely altered to sericite and clay minerals. Trace amounts of untwinned alkali feldspar grains displayed complex micrographic intergrowth with albite or albite and quartz. About 5 percent of the matrix was very-fine- to fine-sized books of brown biotite. The biotite was often weathered to black angular inclusions.

Volcanic, metamorphic, and sedimentary rock fragments were present in trace amounts. Two coarse-sand-sized fragments of fine-grained basalt had a groundmass of brown glass containing abundant laths of plagioclase and cubic magnetite. One basalt grain contained intergranular augite. One very-coarse-sand-sized fragment of moderately well-sorted sandstone was grain supported with brown clay cement. Two coarse-sand-sized fragments of biotite mica schist were also present.

There was also a single, coarse-sand-sized fragment of wood. Its cell structure was visible as a series of brown rectangles.

Rock Jaw Site, Feature 1.01, Sample No. 2077

Inclusions made up 25 percent of the matrix and exhibited a bimodal size distribution. Inclusions ranging in size from silt to fine sand were 20 percent, including 15 percent quartz and untwinned alkali feldspar grains in equal amounts and 5 percent brown biotite.

An additional 5 percent was composed of inclusions ranging in size from coarse to very coarse sand. This group includes isolated grains of quartz and untwinned alkali feldspar in equal amounts, as well as volcanic, plutonic, and metamorphic rock fragments. One basalt grain had a black, glassy groundmass containing forked laths of plagioclase. Weathered pyroxene (possibly augite) was contained porphyritically within the basalt grain. The other basalt grain lacked the augite but otherwise had a similar texture. A single, coarse-sand-sized grain with both untwinned alkali feldspar and quartz was probably plutonic in origin. A very-coarse-sand-sized, medium-grained quartzite fragment contained grains with a strongly bedded orientation.

Two coarse-sized, rounded, dark red soil papules were also present in the soil matrix. Both had bedded textures.

Crane Site, Feature 30.01, Sample No. 2083

The yellowish brown matrix contained about 15 percent very-fine- to medium-sized-sand inclusions. The most common type of inclusions were weathered grains of untwinned alkali feldspar. About 5 percent of the inclusions were silt-sized to fine brown biotite grain, a trace amount of which had weathered to opaque angular inclusions. A trace amount of quartz was also present. The matrix also had one coarse-sand-sized gray fragment of welded tuff and two rounded soil papules.

Comparison of Ceramic and Sediment Samples

How similar are the archaeological ceramics to clay available in the area, and which inclusions seen in the ceramics might be natural inclusions in the raw clay? The 12 sediment samples were analyzed to answer these questions.

The four nonfeature samples contained only 1–6 percent inclusions and were much finer in texture than the ceramics, which contained between 18 and 45 percent inclusions. Two of them also contained papules, which were not observed in any of the ceramics. These samples, in their current, unprocessed state, are not similar to any of the archaeological ceramics.

The archaeomagnetic samples had between 15 and 80 percent inclusions. Most of these samples appeared to represent clay-rich sediments collected by site residents to line hearths, although some of the coarser samples may represent sediments underlying hearths. We recognize that these could have been processed clays that may have contained added materials; however they provided an additional source of nonceramic clays that were actually used by the prehistoric inhabitants of the project area. Of the 12 samples, 11 (all but Sample No. 2083) were dominated by isolated grains of quartz and untwinned alkali feldspar that was probably derived from granite, similar to isolated grains in the Paste Group D ceramic samples. These isolated grains were accompanied in all samples by trace amounts of volcanic, plutonic, metamorphic, and/or sedimentary rocks. Common inclusions included volcanic tuff (8 samples), mica schist (6 samples), and quartzite (4 samples); basalt, limestone, sandstone, and plutonic aggregates of quartz and untwinned alkali feldspar also were present. These fragments usually ranged in size from medium-sized to very coarse sand, although the largest inclusions in two samples (Sample Nos. 2074 and 2082) were coarse-sand sized. These archaeomagnetic samples were similar to some of the ceramics in Paste Group D (Catalog Nos. 2588, 2592, 2619, 2857, 2570, and 4762) that contained diverse rock fragments and provide insight into the prehistoric use of clays for ceramic and nonceramic purposes.

Conclusions

All but two of the 55 ceramic samples fell into diabase-dominated Paste Groups A and B or into granite-dominated Paste Group D. Red plain and Salado Red Corrugated pastes are similar to pastes of these types elsewhere in Tonto Basin. As observed by other authors, red plain ceramics are dominated by granitic inclusions, and Salado Red Corrugated vessels contained mostly diabase-derived inclusions (see Table 34).

Vessel function was not clearly related to paste-group membership. Most vessels fell into the largest paste composition groups, Paste Groups A and D, regardless of function (see Table 35). There was a slight tendency for vessels used for cooking, food preparation, and serving or eating to belong to Paste Group D and for liquid-carrier or liquid-storage vessels to belong to Paste Group A.

The archaeomagnetic samples described above are significant because they demonstrate that coarse and very coarse rock fragments, similar to those in some of the archaeological samples, are naturally present in sediments exploited by prehistoric residents of the area. It is unlikely that these sediments were processed or tempered before they were used for hearth linings. People may have used the same clay-rich sediments for multiple purposes, perhaps subjecting the sediment to extra processing before use in ceramic manufacture. Native potters in southern and central Arizona often collected inclusion-rich clay near their residence, cleaning or processing it prior to use (Table 36).

At least some of the Paste Group D ceramics were probably made by residents of Vegas Ruin, based on similarities between the archaeomagnetic samples and archaeological ceramics. The subset of Paste Group D most similar to the archaeomagnetic samples (ceramics with granitic inclusions and diverse rock fragments) were classified as brown ware, red plain, and Salado Red Corrugated, suggesting that some vessels of all three categories were made in the project area. These samples included all of the vessel functions seen in Paste Group D, representing almost all vessel functions (see Table 35).

This analysis demonstrates that prehistoric potters in the project area probably targeted inclusion-rich clays, like many of their historical-period counterparts below the Mogollon Rim. These potters lacked access to discrete layers of clay or shale in sedimentary formations, such as those used by the Acoma and Laguna (Dillingham and Elliot 1992) and Zuni (Stevenson 1904), and apparently did not rely on well-sorted alluvial clays.

In this situation, it becomes difficult for the archaeologist to

Table 36. Clay Procurement, Processing, and Tempering by Non-Puebloan Groups in the Southwest

Group (Dates of Fieldwork)	Description of Clay and Clay Source	Processing	Temper	Reference
Tohono O'odham (1958–1959)	The clay is "exposed beneath the topsoil."	"The potter then crushes the chunks of clay by pounding them on the ground with a stick. The pounded clay is further refined by sifting it into a can through a screen." Ground clay is mixed with water and then kept damp for 3–5 days before use.	Often, the clay has sufficient natural inclusions and requires no further temper. If it is used, temper is added to ground clay before the water is added. Tempering materials included horse manure, coarse sand, crushed sherd, and ground rock, including granite and schist. Temper may have only been used for certain vessel forms. For example, one potter added ground schist only to clay for water jars "to make the water cooler."	Fontana et al. (1962:55–57)
Pima (1901–1902)	"The common ware that is intended to be subjected to heat is generally made from clay obtained among the Skâsowalik hills, which lie on the southern border of the Gila River reservation. The material is a dry granular clay combined with quartz pebbles and feldspathic detritus . . . . Another well-known clay pit is situated on McClellan's branch, at the northeastern base of the Sacaton hills, whence a whitish clay is obtained. The villages about the Casa Blanca Ruin obtain clay from pits within a stone's throw of the ruin itself and from the river bottom near the village of Rso'tûk."	"[A] great part of the mass [from the Skâsowalik hills source] is sharp, angular stone, which must be winnowed out by hand in the shallow baskets . . . . The clay is thoroughly dried . . . by spreading it on blankets in the sun. It is then sifted to remove the larger particles of stone. It is next mixed with water and kneaded a few minutes, formed into lumps the size of the fist, and laid aside to 'ripen' over night."	"The tempering materials used in the clays last mentioned [McClellan's branch, near Casa Blanca Ruin, and from the river bottom near Rso'tûk] are sand and ground potsherds. The clay from the Skâsowalik hills is so coarse that it requires no tempering."	Russell (1975:124–126); photographs of "Skâsowalik hills clay pit" and "clay pit near the Gila" are Plate XVIa–b.
Pima (1938)			"According to my informant the Pimas have always used the sherd temper for pottery. She, Mrs. Annie Olin Jackson of Blackwater, said that her grandmother used it and nothing else, except for the large water ollas where they use sand or fine gravel."	Unpublished letter from David J. Jones, Casa Grande National Monument Park Ranger, to Nora Gladwin, dated April 17, 1938. Gila Pueblo archives, MS 15, Series 7, Folder 9.
Maricopa (1929–1932)	"The clay used for the [ceramic vessel] body was common adobe . . . available anywhere within a few yards of the house."	"It was dug out with a stick, spread in the sun until well-dried, and pounded fine on the metate."	"Fine sand was mixed with it . . . . Sherds from the ancient ruins were also pounded up in place of sand tempering."	Spier (1978:106)

Table 36. Clay Procurement, Processing, and Tempering by Non-Puebloan Groups in the Southwest (*continued*)

Group (Dates of Fieldwork)	Description of Clay and Clay Source	Processing	Temper	Reference
Maricopa (1972) (modern painted-ware production)	"Maricopa potters, in 1972, are reluctant to tell outsiders exactly where the clay they use is located. Old photographs of deposits only indicate that some are situated on level desert ground and others on slopes . . . . Before selecting a digging site the potter first tastes the clay. If it tastes salty she will not use it."	"The potter . . . fills a four-gallon galvanized bucket about two-thirds full with clay and then pounds it with a heavy, cylindrical rock . . . . The clay is then screened in order to remove coarse rock and clay particles."	None. "The potter prefers standard window screen [for screening clay] as it is small enough to allow only finely ground clay and rock crystals to sift through, the crystals serving as a natural temper in the paste."	Fernald (1973:13)
Maricopa (1972) (utilitarian wares; not produced in 1972)	For utilitarian vessels, "potters used a different clay, to which they added temper, and fired pots longer . . . . Ida Redbird called this clay [described by Spier] adobe and said it was different from the clay used for modern decorated wares."	'Techniques of manufacture for utilitarian wares were basically the same as those described for modern decorated vessels."	"Temper was mainly sand from nearby river beds, but ground up sherds were also used."	Fernald (1973:25)
Mojave (1902–1904)			"Clay is tempered with sandstone crushed on the metate . . . ." A sample of crushed and ground temper believed by Kroeber to be sandstone was later identified as granite.	Kroeber and Harner (1955:2)
Western Apache (unknown)	"You have to use a special kind of clay for making pots . . . . In Turnbull Mountain we used to get it at *i chish ke he* where springs are on the east side of the mountain . . . ." Other locations are listed only by Apache names. The clay was red.	"When we brought [the clay] back we ground it up on a metate. At the same time we ground up with the clay the broken pieces of prehistoric pottery from ruins. Also we mixed up a plant called *i sa bisl nal de he* which we ground up and put with the clay . . . . We stirred the clay and water together until it got soft and just right. Then we left it."	"When the clay is ready, you have to mix up ground pieces of pottery from a ruin. Also with the clay you have to mix certain plants. These *are hush si ta ha* and *i sa bial al de he*. You boil these up in water. Before boiling you have to peel the skin off *hush si ti ha.* Also you use old burnt mescal bean butts. These are sticky things and that is why they are good."	Quotes from informants A. P. and N. W. in Goodwin's unpublished field observations. Goodwin Papers, MS 17, Folder 40. Arizona State Museum, University of Arizona, Tucson. See also review by Whittlesey and Benaron (1998:176).
Northeastern and Western Yavapai (1932)	Northeastern Yavapai: "Clay, *ikonu'*, obtainable near Mayer, but not near Prescott; also found at site Adjustiteye near Jerome." Western Yavapai: "Red clay for pots obtained in many places."	Western Yavapai: "Lumps [in clay] mashed on metate."		Gifford 1932:280

sample discrete "clay sources," and the search for clay sources on the landscape requires assumptions about the raw materials that may not be accurate. Nonfeature samples were collected for this study based on assumptions that raw clay was fine textured and that most inclusions were intentionally added as temper. These assumptions were undermined by the discovery that natural inclusions in the archaeomagnetic samples were similar to the inclusions in some of the ceramics.

Systematic offsite clay sampling (e.g., Neff et al. 1992) is still likely to produce valuable data. We suggest that in addition to this activity, clay-rich materials from the site should be sampled. Clay hearth linings, for example, come from clay-rich sediments in the area known and used by the local residents. So does the adobe used in construction. Comparisons between these materials and archaeological ceramics may be most productive where ceramic technology is relatively expedient, and extensive grinding, winnowing, or levigation have not completely changed the composition of natural inclusions.

The conclusions drawn above about local ceramic manufacture should be further tested through chemical-compositional analysis, using a technique such as neutron activation analysis or ICPS. If the clays used for local ceramic manufacture are truly similar to those used for lining hearths and have had their composition only slightly changed by processing, then their chemical composition should be similar to that of hearth linings and the original source.

Another approach is to reanalyze the petrographic thin sections, collecting quantitative data on the weathering state of plagioclase feldspars. Miksa and Heidke (1995:190–194) have suggested that this indicates whether the bulk of the inclusions are natural inclusions or were added as sand temper. Plagioclase weathers rapidly, and heavily weathered feldspar was uncommon in sand samples, because it had been destroyed by transport. Sand samples, therefore, have relatively high ratios of moderately weathered plagioclase (10–90 percent weathered area) to heavily weathered plagioclase (over 90 percent weathered area) because of the low proportion of heavily weathered plagioclase. Residual clays, lacking the damaging effects of transport, should have more heavily weathered plagioclase and, therefore, lower ratios of moderately weathered to heavily weathered plagioclase. Miksa and Heidke found that the point-counted ceramic samples resembled sand in their plagioclase ratios, suggesting that most of the inclusions were added as sand.

Plagioclase weathered to sericite and clay minerals was noted in 13 (24 percent) of our 55 ceramic-sample descriptions, but we did not collect quantitative data on the frequency of different weathering stages within samples. It would be a valuable test of our hypothesis to record plagioclase weathering for the archaeomagnetic samples (which we argue are residual clays, rather than tempered alluvial clays) and for the ceramics most similar to those samples. This would indicate whether residual clays used by site residents actually have lower ratios of moderately to heavily weathered plagioclase, and whether the ratios in our ceramics resemble ratios in these clays.

CHAPTER 4

Lithic Analysis

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This chapter presents the analysis of flaked and ground stone artifacts recovered during the CCP. A total of 10,079 stone artifacts were collected during Phase 1 testing and Phase 2 data recovery, and 4,543 (45 percent) of these underwent detailed analysis (Table 37). In summary, a total of 4,026 flaked stone artifacts, 266 ground stone artifacts, 39 ornaments, and 213 other stone artifacts were analyzed. In doing this, we identified a variety of flaked stone, ground stone, and ornaments collected from the various contexts at the nine sites studied for this project. The primary purpose of this study was to contribute information concerning the project's major research issues regarding subsistence/settlement, trade and exchange, and demography in Tonto Basin (Ciolek-Torrello and Klucas 1999). Attempting to explain technology and the composition of stone industries are pervasive themes in regional artifact analyses, and this study is no exception. Through examining the stone artifacts from a site, we can address how they were made, used, and recycled. Such data can also be used to address a society's economy and technology (Nelson 1996).

The CCP artifacts were collected from specialized activity areas, field houses, small farmsteads, and compounds. Most of the site components reflect home-life in small Sedentary or early Classic period farming communities. Less than 200 lithic artifacts were collected from four of the sites examined (see Table 37). To a certain extent, the size of these collections limited our ability to study technology and site function. Five of the sites, however, contained collections large enough to allow a detailed examination of raw-material procurement and lithic technology. Relatively few diagnostic flaked stone tools were recovered from the project sites compared to debitage. However, the complete sequence of arrow-point production—from a retouched flake to a finished point—was represented from several burials at the Vegas Ruin (AZ U:3:405/2012). In contrast, broken and discarded ground stone artifacts were somewhat common. The use and discard of ground stone tools informed us about the use life of these tools. Similarly, documenting the sequence of projectile-point production provided insights into how projectile points were made, used, recycled, and deposited within small, rural communities.

This chapter is organized in five sections. Following this introduction, we briefly discuss several previous studies in Tonto Basin, followed by our research objectives. Then we describe our sample selection criteria and analytical methods. This is followed by a discussion of the results. Next we compare the lithic collections from each of the sites and interpret meaningful patterns. Finally, we present our conclusions and discuss avenues for future research.

Previous Regional Research

The research history of Tonto Basin is long and complex. For the purposes of this report, we will concentrate on a few of the projects conducted in recent years that are most relative to the research focus of the CCP. These include the TCAP, the Roosevelt Community Development Study (RCD), the SR 87–Sycamore Creek Project (SCP), the Roosevelt Rural Sites Study (RRSS), Archaeology of the Mazatzal Piedmont, and the Payson Archaeological Research Expedition (PARE) in Star Valley.

Tonto Creek Archaeological Project

Conducted by DAI, this project investigated 27 sites along SR 188 (Clark 2002). Components spanning the Archaic–Classic period interval were documented. The sites along SR 188 flank the highway and are located just south of the CCP project area.

Table 37. Stone Artifacts Analyzed from the CCP Sites

Artifact Type	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Flaked stone																				
Projectile point	3	0.4	1	0.7	—	—	67	4.6	—	—	3	0.7	—	—	—	—	5	0.7	79	1.7
Biface	2	0.3	—	—	—	—	2	0.1	—	—	3	0.7	1	0.2	—	—	1	0.1	9	0.2
Uniface	—	—	—	—	—	—	1	0.1	—	—	—	—	1	0.2	—	—	—	—	2	<0.1
Drill/perforator	1	0.1	—	—	—	—	3	0.2	—	—	2	0.5	2	0.3	—	—	1	0.1	9	0.2
Scraper	14	1.8	3	2.2	—	—	20	1.4	2	1.2	8	1.8	3	0.6	—	—	5	0.7	55	1.2
Chopper	7	0.9	2	1.5	—	—	—	—	1	0.6	1	0.2	11	1.7	—	—	—	—	22	0.5
Core	25	3.3	16	11.7	12	7.3	73	5.0	4	2.5	19	4.3	16	2.5	2	5.0	30	3.9	197	4.3
Tested cobble	3	0.4	2	1.5	1	0.6	9	0.6	1	0.6	3	0.7	7	1.1	1	2.5	—	—	27	0.6
Modified flake	110	14.5	31	22.6	1	0.6	48	3.3	25	15.4	37	8.4	64	10.0	9	22.5	23	3.0	348	7.7
Burin	—	—	—	—	—	—	9	0.6	—	—	—	—	—	—	—	—	—	—	9	0.2
Burin spall	—	—	—	—	—	—	2	0.1	—	—	—	—	—	—	—	—	—	—	2	<0.1
Debitage[a]	567	74.9	78	56.9	143	87.2	903	62.4	123	75.9	335	75.8	500	78.7	27	67.5	567	74.6	3,243	71.4
Spall	—	—	—	—	—	—	3	0.2	—	—	—	—	—	—	—	—	—	—	3	0.1
Tabular knife	—	—	—	—	—	—	6	0.4	—	—	3	0.7	9	1.4	1	2.5	2	0.3	21	0.5
Subtotal	732	96.7	133	97.1	157	95.7	1,146	79.3	156	96.3	414	93.7	614	96.7	40	100	634	83.4	4,026	88.6
Ground stone																				
Mano	10	1.3	1	0.7	4	2.4	73	5.0	2	1.2	8	1.8	5	0.8	—	—	43	5.7	146	3.2
Metate blank	—	—	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—	—	—	1	<0.1
Metate	4	0.5	—	—	1	0.6	40	2.8	1	0.6	4	0.9	2	0.3	—	—	26	3.4	78	1.7
Pestle blank	—	—	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—	—	—	1	<0.1
Hoe	—	—	—	—	—	—	2	0.1	—	—	1	0.2	—	—	—	—	6	0.8	9	0.2
Discoid	—	—	—	—	—	—	2	0.1	—	—	—	—	—	—	—	—	—	—	2	<0.1
Borer/reamer	—	—	—	—	—	—	—	—	1	0.6	—	—	—	—	—	—	—	—	1	<0.1

Table 37. Stone Artifacts Analyzed from the CCP Sites (*continued*)

Artifact Type	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
										Ground stone (*continued*)										
Axe	1	0.1	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—	1	0.1	3	0.1
Polishing stone	—	—	—	—	—	—	3	0.2	—	—	—	—	—	—	—	—	—	—	3	0.1
Shaft straightener	—	—	—	—	—	—	6	0.4	—	—	—	—	—	—	—	—	7	0.9	13	0.3
Indeterminate ground stone	1	0.1	—	—	—	—	6	0.4	—	—	—	—	1	0.2	—	—	1	0.1	9	0.2
Subtotal	16	2.1	1	0.7	5	3.0	135	9.3	4	2.5	13	2.9	8	1.3	—	—	84	11.1	266	5.9
										Ornament/special										
Awl	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.1	1	<0.1
Bead	—	—	—	—	—	—	5	0.3	—	—	2	0.5	—	—	—	—	—	—	7	0.2
Pendant	—	—	—	—	—	—	12	0.8	—	—	1	0.2	—	—	—	—	3	0.4	16	0.4
Pendant blank	1	0.1	—	—	—	—	6	0.4	—	—	—	—	1	0.2	—	—	1	0.1	9	0.2
Perforated disk	—	—	—	—	—	—	2	0.1	—	—	—	—	—	—	—	—	2	0.3	4	0.1
Ring	—	—	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—	1	0.1	2	<0.1
Subtotal	1	0.1	—	—	—	—	26	1.8	—	—	3	0.7	1	0.2	—	—	8	1.1	39	0.9
										Other										
Anvil	—	—	—	—	—	—	5	0.3	—	—	—	—	—	—	—	—	2	0.3	7	0.2
Hammer stone	6	0.8	3	2.2	2	1.2	128	8.8	2	1.2	12	2.7	7	1.1	—	—	27	3.6	187	4.1
Manuport	2	0.3	—	—	—	—	6	0.4	—	—	—	—	5	0.8	—	—	5	0.7	18	0.4
Subtotal	8	1.1	3	2.2	2	1.2	139	9.6	2	1.2	12	2.7	12	1.9	—	—	34	4.5	213	4.7
Total	757	100	137	100	164	100	1,446	100	162	100	442	100	635	100	40	100	760	100	4,543	100

Note: Subtotal percentages calculated using site total.
[a]Debitage includes both flakes and shatter.

A total of 24,000 stone artifacts were analyzed from the project sites (Sliva and Lyons 2002). Analysis focused on four research questions: (1) what technologies or industries were used at the sites, and what were the differences in the collections; (2) how were patterns of exchange and trade expressed in the lithic collections—mainly, were there specialized tools or exotic material types in the collections and were certain tools made from certain materials; (3) was it possible to attribute cultural affiliation on the basis of stylistic variability, and does this variability correspond with regional or temporal patterns; and (4) how could the stone artifacts be used to infer subsistence practices.

Many projectile points were recovered during the TCAP, and part of the analysis focused on the development of a chronologically sensitive projectile-point typology. Sliva and Lyons (2002) have reconsidered the argument that Archaic collections tend to be curated, whereas Formative collections are expedient. They concluded that this is an oversimplified argument and that lithic technology did not regress as ceramic technology flourished.

The Roosevelt Community Development Study

The RCD study examined 27 sites along the Salt River, near the modern shore of Theodore Roosevelt Lake and near Pinto Creek (Elson and Clark 1995). Collections from 19 of these sites underwent detailed analysis, and the stone artifacts from these sites were from components dating to A.D. 100–1350 (Lindeman 1995:Table 1.1). Four research questions were pursued: (1) from what contexts were debitage specimens representing expedient vs. formalized reduction strategies found; (2) what changes in reduction strategies, if any, occurred over time; (3) could lithic workshops be identified using the distribution of debitage, and if so, is there evidence of lithic specialists during the Roosevelt phase; and (4) could a projectile-point typology for the western Tonto Basin be constructed.

The methods used for the analysis of these collections was a combination of formal-tool classification and debitage analysis. The stages of core reduction were inferred using a mass analysis (Ahler 1989). A projectile-point typology was developed and the debitage analysis determined that multiple reduction strategies (flake core, bifacial, and bipolar) occurred at five of the project sites.

SR 87–Sycamore Creek Project

The SCP project examined 28 sites along SR 87. Most of the sites were pre-Classic or Classic period habitation sites (Vanderpot et al. 1999). The lithic analysis had four research goals: (1) to infer subsistence patterns using the presence of tool types of known function(s), (2) to use diagnostic artifacts to examine the chronology of the sites studied, (3) to identify patterns of mobility by examining raw-material procurement patterns, and (4) to identify the reduction strategies used at the sites by examining the recovered debitage.

This project conducted a technological analysis of the debitage and a functional analysis of the formed tools (Knoblock et al. 2003). Such an analysis required the use of individual flake analysis (IFA) to determine the technology that produced the debitage. This analytical method identified bifacial-core reduction, flake-core-reduction, bipolar-core-reduction, and pressure-flaking activities.

The Roosevelt Rural Sites Study

The RRSS examined 31 sites, 17 of which were intensively investigated (Ciolek-Torrello et al., eds. 1994). This included 6 farmsteads, 9 field houses, and 2 limited-activity sites. These sites contained components ranging from the Archaic to Classic period in age. Towner (1994) examined four research questions as part of the lithic analysis: (1) could the core-reduction strategies used at the various sites be identified; (2) how could raw-material procurement patterns be used to examine trade and exchange; (3) what changes in reduction strategies, if any, occurred over time; and (4) how could the stone artifacts be used to infer site function(s).

Towner (1994) applied IFA and mass analysis techniques to the debitage. The IFA analysis was technologically based using methods discussed by Crabtree (1972), Callahan (1979), and Flenniken (1978, 1981). Towner (1994) concluded that most of the lithic materials were local and that several reduction techniques occurred at most Formative period sites. He also concluded that IFA analysis is more informative when different reduction strategies occurred at a site and that this method was more suited to functional studies than to mass analysis techniques.

Archaeology of the Mazatzal Piedmont, Central Arizona

This project investigated 24 sites located along 12 km of SR 87. These sites were located between the Ord Mine Road and Rye. They contained components dating to the Archaic through historical periods (Ciolek-Torrello 1987). All of the sites were situated along the eastern slope of the Mazatzal Piedmont in a rich, arable environment. Fourteen prehistoric sites were intensively investigated, and it was determined that 2 were Archaic period camps, 3 contained Formative period courtyards, 9 were field houses, and 3 were prehistoric lithic scatters.

There were four research questions that this project investigated: (1) what reduction strategies (bifacial-core reduction vs. flake-core reduction) were used at the sites, (2) what were the raw-material procurement strategies, (3) what stages of core reduction and tool production were represented by the debitage, and (4) what function(s) did the different tool types serve. A combination of methods were used in this study. Tools underwent a functional analysis. The debitage was analyzed using the IFA methods developed by Chapman (1977) and White (1963). The intention was to identify the stages of core reduction through the observation of cortical material on the dorsal surface of the flakes. In simple terms, this research concluded that chert was more abundant at Archaic period sites and that Archaic period cores represent a greater investment of time and labor.

Star Valley: Payson Archaeological Research Expedition

PARE included 35 sites in Pine and Star Valleys near Payson, Arizona (Lindauer et al. 1991). These sites were located in valley bottom and upland zones. Previous soil studies indicated that the valley bottom contained deep, arable alluvium. Shallow, stony colluvium characterized the sediments encountered at the upland sites, which were often situated on steep slopes. Together, these attributes likely made the uplands a less desirable setting for agricultural activities.

The lithic analysis was conducted using technological and functional interpretations of the artifacts (Bradley 1991). Two research questions were pursued: (1) what raw materials were used for tools and (2) what was the method or methods of tool manufacture and use? They concluded that chert was the dominant raw material used in the collection, with high-quality chert used for curated tools, whereas poorer quality materials were used for more expedient tasks. It was also observed that the Star Valley sites used chert from both immediate geological sources and from sources up to 40 km away.

Interestingly, debitage representing early-stage core reduction formed less than 5 percent of the debitage recovered from individual sites. This indicates that cores were prepared away from these sites, possibly at the geological sources. A large number of projectile points (n = 511) were also analyzed. These points were used to develop a projectile-point typology that included nine distinct types. The authors cautioned, however, that the typology was meant as a general-pattern-recognition device rather than a chronological tool. They argued that the resharpening of projectile points may change their configuration (*sensu* Flenniken and Wilke 1989). They noted that the majority of the points recovered were a small triangular variety ubiquitous during the Formative period in the Southwest. They also examined the correlation of faunal remains and projectile points and concluded that the presence of projectile points did not necessarily represent hunting activities.

Analysis Objectives

Of the broad research themes defined by TNF (Effland and Macnider 1991; Wood et al. 1989), we selected subsistence/settlement, demography, and exchange/trade/commerce as those most appropriate given the available data. Our treatment plan (Ciolek-Torrello and Klucas 1999) and several other recent investigations in the region (see Volume 1; Clark 2002) include lithic data in their studies of regional chronology. Below, we briefly discuss how the lithic artifact collections can inform on these research themes and the specific questions that we explored as part of the CCP.

Raw-Material Procurement and Exchange

What stone was selected for tools, and where could it be obtained? The identification of lithic materials provides a data set from which we can examine the frequency of local and exotic tool stone use. To this end, we submitted five of the obsidian artifacts to Dr. M. Steven Shackley for X-Ray Fluorescence (XRF) analysis. We also assembled the necessary geologic maps and literature in order to identify the location and extent of workable local materials. Further, we examined the amount and type of cortex on specimens to determine if both outcrop and river-cobble lithic materials were being exploited. Together, we used these observations to evaluate whether raw materials were quarried from local outcrops, streambeds, or other sources. By doing so, we hoped to determine whether local or imported materials were preferred and what specific materials were sought.

The long-distance distribution of materials and finished products is the focus of our research into trade, exchange, and commerce. When a group is mobile, stone acquisition is often carried out concurrently with other tasks (embedding). When people are more permanently situated, however, they must either establish their villages near desirable rock sources, develop and maintain trading relationships to obtain material, or conduct material-gathering forays.

The products being exchanged and the direction of trade into or out of a region can be investigated. Several stone materials flowed across the Southwest, and argillite, turquoise, and obsidian are known to have moved through Tonto Basin. Trade patterns also differ chronologically. Bayman and Shackley (1999:836–845) have noted that Classic period Hohokam community centers acquired obsidian from a wider variety of sources at greater distances than previously noted. Such trade may reflect the need for specialists to obtain the raw material and craft specialists to produce the desired product. Palettes, stone censers, and projectile points may have been produced by specialists. If this was the case, then the presence of workshops or material caches can be anticipated (Doyel 1980; Haury 1976). Similarly, we wanted to identify what tools and ornaments were being imported partially finished and to determine whether only finished items were sought.

Subsistence and Settlement

The theme of subsistence and settlement explores the relationship between economic systems and land use. Lithic analysis addresses this theme by studying individual tools, tool kits, or industries. This research focuses on how tools were made, used, and where these activities occurred on site. Intersite comparison expands these analyses by identifying patterns in tool production and use at different kinds of sites, such as quarries, activity areas, camps, or villages.

In the Tonto Creek vicinity, several models of hunting/gathering and horticultural adaptation have been investigated by reviewing how tools were made, used, and recycled. For example, Dosh et al. (1987) studied the effect of group mobility on Archaic and Formative period stone tool collections. More generally, Parry and Kelly (1987) juxtaposed biface manufacture and tool curation with expedient flake-tool production methods. Huckell (1998) postulated that sites representing mobile Archaic period or more sedentary Formative period village life could be distinguished by identifying contexts where bifacial reduction or expedient flake-core technology was used.

Questions about plant collection and processing have also been investigated using stone artifacts. Knoblock et al. (2003:104–111) reviewed the distribution of tabular tools at sites along Sycamore Creek and found that these tools were concentrated at Kitty Joe Canyon, where agave was present. Interestingly, tabular tools were seldom noted at sites with roasting pits. This led them to suggest that tabular tools were closely linked to agave procurement and were used to extract, rather than prepare or cook, bulbs and leaves.

Other studies concerning Tonto Basin have used stone-artifact studies to help interpret subsistence tasks and settlement functions. For example, Rice and Ravesloot (1990:103–104) sought to understand village life and organization in pre-Classic and Classic period RPM sites. By comparing collections from the interior and exterior of rooms, they identified where tools were made or abandoned. Similarly, Sliva and Lyons (2002) recently analyzed floor deposits to infer the location of tool-making activities at pre-Classic and early Classic period sites. Both studies suggested that stone artifact manufacture migrated from within houses to courtyard areas over time.

The CCP treatment plan recognized that the highway ROW being investigated represented a more restricted research zone than other projects. Ciolek-Torrello and Klucas (1999:18) therefore directed subsistence/settlement research toward the issues of natural resource selection, agricultural dependence, and mobility and human-land relationships. The analysis of habitation sites normally results in the recovery of more tools and tool kits compared to more-limited-activity loci (Frison and Bradley 1980; Thomas 1973). Consequently, we relied on the identification of tool kits associated with subsistence activities (e.g., ground stone, projectile points, butchery tools, or agricultural tools) so that we could infer what resources were processed and perhaps their relative importance to the site's inhabitants. For example, projectile points are often assumed to have been used to hunt game, whereas tabular knives are thought to represent plant-food processing. By contrast, rounded manos and basin metates were used for hard-seed preparation, whereas trough metates and two-handed loaf manos are associated with the production of cornmeal. As such, we used the relative abundance and spatial distribution of such tools to infer what resources were used and where they were processed. Our treatment plan indicated that residue analysis would be conducted on select stone tools (Ciolek-Torrello and Klucas 1999:36). The main objective of this proposed residue analysis was the identification of *Agave* sp. residues on tabular tools, but we encountered very few tabular tools from good recovery contexts. Abundant evidence of *Agave* sp. use was documented in our flotation samples (see Chapter 7; Appendix D.1). Thus, we did not feel it was worthwhile to pursue residue analysis. Instead, we reallocated the funds for residue analysis to enhance our geochemical studies of recovered obsidian artifacts. As we had relatively little other evidence for regional exchange and interaction, we believed that this analysis would represent a better use of these funds.

Demography

The theme of demography includes issues relating to population, ethnicity, health/nutrition, and agricultural productivity. The number of stone artifacts from specific recovery contexts could be used to infer group size and combinations of or types of specific tools to attempt to infer gender-specific task areas. The discussions of demographic issues in the regional literature link tools, ornaments, and their system of manufacture to ethnicity. Such studies, like this one, use patterning in the shape and size of artifact classes (e.g., projectile points, metates, and palettes) to identify ethnically diagnostic ways of tool manufacture and use.

We also wanted to know if the stone tools from the CCP sites were similar to or distinct from those typically encountered at Hohokam, Mogollon, and Salado sites in other areas. For instance, several regional studies have considered ground stone tools as signatures of group identity (Greenwald 1988; Hoffman and Doyel 1985). The results of these studies suggested that the Hohokam villagers in the Gila/Salt basin used imported milling implements. We therefore wanted to know if the occupants of the CCP sites also imported milling implements or other kinds of artifacts or materials. Quartz and amethyst points and vesicular basalt ground stone have been viewed as ethnic markers (Knoblock et al. 2003). Sliva and Lyons (2002) pointed out that their collections from the Punkin Center vicinity along Tonto Creek did not reflect a standardized ground stone manufacturing system. This suggested to them that demographic questions could not be addressed with the ground stone artifact data. Greenwald (1988:218), summarizing data from the Tucson Aqueduct Project near Picacho, however, argued that vesicular basalt manos and trough metates were being centrally made and distributed to Hohokam villagers. Kamp and Whittaker (1999), in their work at Lizard Man Village, asserted that a cultural distinction may be expressed in projectile-point attributes. They noted that small triangular points, common throughout the Southwest, differ in the placement of the notches along their blades. Kamp and Whittaker (1999:83) also observed that triangular points with high notches (placed more than one-third of the length as measured from the base) seem to distinguish Sinaguan sites and those of other peoples throughout central Arizona. Longer points with low notches are more typical of Anasazi sites. Triangular points without notches seemingly characterize Classic period Hohokam and Salado sites (Sliva 1997:54–55).

Mortuary practices and ritual behaviors also figure prominently in the evaluation of ethnicity. A group may have practices similar to other groups; however, instances of imitation, alteration of elements, or use of local materials can occur. Like Pearson (1999:44), therefore, we recorded observations that could potentially be used to infer ethnicity, based on artifact morphology and recovery context(s). For example, stone artifacts are commonly found in pre-Classic and Classic period inhumations throughout Tonto Basin. As such, we wanted to know how these sumptuary goods compared with those from Hohokam, Mogollon, and Salado sites situated elsewhere.

Chronology

Sites along the alignment were thought to represent several different time periods (Ciolek-Torrello and Klucas 1999). Several artifact types are time sensitive and provide relative dates for activities occurring at a site. Unfortunately, "time sensitive" primarily refers to very broad temporal periods that often span several centuries, even millennia. Projectile points and ground stone artifacts can be used as "index fossils" for certain periods. These artifacts, however, may be retained as heirlooms, can be scavenged and reused, or can be imitations of atypical or nonlocal styles (Whittaker 1984:102).

Regional studies have used projectile points to indicate whether site activities date to the Archaic, Formative, or more-recent periods (Knoblock et al. 2003). Several authors have also asserted that abundant biface-reduction debris is usually not found at Formative period sites (Bernard-Shaw 1984; Ciolek-Torrello 1987; Hoffman and Doyel 1985; Sullivan and Rozen 1985). Furthermore, Rice (1998) has argued that Archaic period sites in Tonto Basin contain more curated flaked stone collections compared to those from Formative period sites. Following this reasoning, Archaic period collections should contain numerous biface reduction flakes and tools that have been intensively refurbished (i.e., curated), whereas Formative period collections should exhibit a paucity of biface-reduction debris and be replete with expedient-core-flake debitage.

For this analysis, we assumed that larger dart and spear points represent primarily Archaic period hunting complexes (Whittaker 1999:85), whereas small points represent bow-and-arrow technology. Although it is true that typical, small triangular arrow points were common in late prehistoric times, the date of their incorporation into the weapon system is still uncertain. Likewise, the timing of when larger points were rarely used or no longer made is unclear. Additionally, points made from materials that are difficult to work are often generalized or aberrant forms, which confuses rather than clarifies site dating. Reworking and resharpening alters projectile-point forms and makes it difficult to refine chronologies (Flenniken and Wilke 1989:155). In Tonto Basin, arguments have been made that projectile points can be used as chronological markers (Sliva and Lyons 2002). Redman's (1993:134) analysis, however, indicated that projectile points cannot be used to identify Formative periods of occupation. Concerning the protohistoric period, Whittaker (1984:101–102) has suggested that a concept of "small triangular point complex" could be used to identify sites dating to this intriguing interval. Given these differing conclusions, we hoped that the CCP project could be used to evaluate these ideas.

Technology

Technology is a society's interface with the environment. It facilitates or restricts the procurement of food, the construction of homes, the attainment of comfort, and the fulfillment of ritual needs. The concept of technology often implicitly directs stone-tool studies. Nelson (1996:185) has summarized this concept as "the relationship among strategies for manufacturing, manipulating (using, reusing, resharpening), and abandoning (losing, discarding) material items. It includes the actors' knowledge about, and behavior within, these domains." When stone artifact analysts discuss quarrying, reduction, use, and discard, they are describing technological behaviors.

Two lithic technologies are frequently encountered during artifact studies: flaked stone technology and ground stone technology. Generally, Formative period flaked stone technology focused on the reduction of flake cores and the production of tools from the cores or the debitage. Flaked-stone-artifact studies primarily emphasize a series of behaviors that constitute the procurement, reduction, and manufacture of tools (Bar-Yosef et al. 1992; Grace 1997). For example, Knoblock et al. (2003) recently completed an in-depth study of stone sources, including the selection and uses of these sources in the Sycamore Creek area.

In recent years, Southwestern flaked stone studies have presented a picture of prehistoric technology that may be described as the formal/expedient dichotomy (Sliva and Lyons 2002:488–489). Sedentism (i.e., Formative Southwest society) has become synonymous with a stone technology of expediency characterized by few formal tools, large quantities of utilized but unmodified flakes, and debitage representing simple flake-core reduction (Huckell 1989, 1998; Parry and Kelly 1987; Rice and Ravesloot 1990). Expedient industries typically had (1) flaking techniques that do not control flake form, (2) the use of flakes without retouching, and (3) selection of flake tools from debitage (Huckell 1989, 1998). Parry and Kelly (1987:287) have suggested that such expedient tools have important advantages over formal tools, including sharp working edges and lower production costs. Huckell (1998) has noted that structured and standardized tool production was found where making portable, generalized bifaces was a primary objective. As such, it appears that settled-village life made these tool forms largely unnecessary.

If the stone technology is expedient, then why invest effort in intensively studying these simple industries? Because, expediency may be more perceived than real. Expedient does not mean spontaneous, convenient, or makeshift. Rather, it can be defined as it is in *Webster's New World Dictionary*: "useful in obtaining a desired result." First, we must recognize that expedient production and expedient use are separate phenomena. The goal of a usable tool can be met in many ways. Producing tools on an ad-hoc basis minimally requires that workable stone be available where tasks are being completed. Several recent archaeological studies have demonstrated that expedient production occurs when stone material of good quality is available and need not be conserved (e.g., Andrefsky 1994). Uncontrolled flake-core reduction and selection of tools from among debitage have been documented at both temporary camps and permanent settlements near chert, obsidian, or other homogeneous, predictably fracturing rock sources (Bamforth 1990).

Methods

Most regional archaeological reports segregate the detailed analysis of diagnostic flaked, ground, and ornamental stone from the study of production artifacts (cores and debitage). Formal stone-artifact analyses focus on investigating tool and ornament function and age, often by reviewing attributes reflecting morphological variability or style.

There are numerous approaches to analyzing the often redundant byproducts of tool making, cores and debitage. Two generalized methods of debitage analysis are most prevalent: IFA and flake aggregate analysis (FAA). Some authors have discussed the analytical techniques used for IFA and FAA as competing methods for lithic analysis (Ahler 1989:86–87; Sullivan and Rozen 1985). Instead, they should be seen as complementary and suitable to particular research questions or samples.

Sample Selection Criteria

The purpose of the descriptive analysis was to identify and summarize the flaked and ground stone attribute patterns that would help us address project research questions. Recognizing patterns of manufacture and use relies upon making sufficient numbers of observations to see what characteristics frequently occur. Because the investigations did not extend beyond the project ROW, several sites produced very small collections that limited the number of observations that could be made. The site collections included specimens from surface and subsurface contexts. Four of nine sites produced fewer than 200 specimens. To maximize our information, we undertook an IFA approach for all the artifacts from sites with fewer than 700 specimens.

On the other hand, when a substantial number of artifacts was collected, as was the case at the Vegas Ruin and at the Crane site (AZ U:3:410/2017), a sampling program was started in accordance with the treatment plan (Ciolek-Torrello and Klucas 1999:36). Our sampling approach prioritized contexts that exhibited the best preservation and least disturbance, along with strong contexts, such as structures, sealed pits, structure floors, and outdoor-activity surfaces. Our treatment plan focused our analysis and sampling on the questions of settlement and subsistence practices, cultural affiliation and exchange, and chronology. To this end, all diagnostic artifacts from these sites were analyzed, along with all artifacts from screened feature contexts, 50 percent of the debitage gathered from nonfeature test-pit excavations, and all artifacts separated from flotation and wet-screen samples. The 50 percent sample from the test pits was selected by first size sorting the debitage using 2-, 1-, ½-, ¼-, and ⅛-inch screens. Based on material type, half of the specimens captured in each screen were then selected for analysis. This allowed us to intensively describe all diagnostic artifacts and at the same time still review enough of the debitage to allow for a technological study. This approach minimized the inspection of potentially redundant data from general contexts such as mechanical trenches, large middens, or surface sheet wash. As a result, 760 (28 percent) of the stone artifacts from the Crane site and 1,446 (34 percent) of the artifacts from the Vegas Ruin were analyzed, and laboratory inspection of the unanalyzed specimens indicates that the range of variability exhibited by the Vegas Ruin and Crane site collections was captured in the samples chosen for analysis.

Debitage Analysis

Individual Flake Analysis

IFA looks at each individual artifact and records its key attributes. This approach permits a researcher to identify specific production processes or techniques even when finished tools are absent from the sample. This method was developed in concert with experiments in lithic replication by Don Crabtree and Jeffery Flenniken (Plew et al. 1985) and was taught to several generations of lithic analysts that attended a flint knapping field school in southern Idaho (Yerkes and Kardulias 1993). This technique identifies the behavior behind the reduction of cores through identifying stages of core reduction and tool production (Collins 1975; Flenniken 1981). This is achieved by observing the attributes of the individual flakes and the amount of cortex present on them. For example, flakes removed from a flake core are recognizably different from flakes that were removed from a biface. Flake-core debitage is generally larger, seldom exhibits evidence of intensive platform preparation, lacks any appreciable longitudinal curvature, and has fewer flake scars. Biface reduction debitage is normally smaller in comparison, often exhibits evidence of intensive platform preparation and pronounced longitudinal curvature, and has a distinctive dorsal flake-scar pattern. By recording these kinds of observations, several studies have significantly increased our understanding of prehistoric lithic technologies (see Clark 1985; Cotterell and Kamminga 1990; Sheets 1975).

Flake Aggregate Analysis

FAA studies groups of artifacts having a common attribute, such as size, weight, or cortex amount. FAA provides a generalized estimate of what stoneworking activities, such as quarrying, initial reduction, or final shaping produced a given collection. Size sorting is a primary tactic of analysis and can even be mechanized by standard screening so that large artifact quantities can be sorted.

Ahler (1989) has noted that each system has advantages and constraints. IFA requires highly trained lithic analysts with an understanding of technologies being studied, whereas FAA is relatively quick and inexpensive. The FAA method provides questionable results when a collection is the end product of several distinct technologies. Each approach, therefore, should be used depending on the research questions being addressed and the context of the sample.

Ahler (1989) presented another method of FAA analysis that he termed mass aggregate analysis (MAA). Although not used in this study, Ahler's approach has proved most attractive to researchers dealing with large debitage collections. Ahler's method is to first sort a collection by lithic material type and then by cortex amount. Once this is done, the specimens are worked through nested screens. Then he compares the results with replicated reduction debris to see if his expectations were met. Ahler described his approach as studying the forest rather than the tree. Ahler designed his program to contrast archaeological data with an experimentally derived flake model to control two common aggregate analysis problems: raw material size variability and technologically mixed samples. His approach is useful for recognizing manufacturing steps at quarry sites or initial-reduction sites. Within the multicomponent sites that represent Southwest village life, a multiplicity of materials exists and unmixed collections are rare. In such a situation, Ahler's approach is too inclusive; it becomes difficult to identify just how or where tools were made. Ahler's system, therefore, is useful in restricted contexts, particularly if either the material or reduction stage is a constant (Morrow 1997:65–66).

Summary

There are strengths and weakness to both the IFA and MAA methods. Both approaches, as they are used in regional studies, can help identify certain reduction stages by either flake completeness or size and cortex. IFA or MAA, however, tell us little about final tool preparation, tool use, discard, or recycling. They also can be technique blind, treating a complete bipolar flake as if it were a complete biface-thinning flake. To paraphrase Ahler, we know the forest is there but cannot tell if oaks or piñons are present.

The IFA method can be effectively applied only by analysts trained in the identification of technologically meaningful attributes. Further, an analyst should have a hands-on understanding of the lithic materials used at the site(s) being analyzed. Certain geologic materials present limitations, such as the size or the consistency of the raw material. Such variables entered into the decisions made in prehistory about how to use those materials. Trained analysts can identify the behavior and strategies that were used to reduce cores and produce tools. Such data are valuable for identifying specialist activity areas, patterns of trade, and, possibly, relationships to other sites.

The MAA method also has its advantages and disadvantages. At first glance, MAA analysis does not require special training before it can be conducted. Most often this method is applied to collections of many thousands of artifacts. However, analysts should be skilled enough to separate different material types and different reduction strategies (e.g., bifacial-core reduction vs. flake-core reduction) before the debitage is processed. Commonly, collections are processed before any separations are conducted and mixed collections often create misleading patterns or overwhelm subtle patterns. For example, bipolar-reduction strategies can be totally missed if they are not separated out previous to processing. The conclusions that are reached using this method are generalizations that cannot be used to answer many specific behavioral questions.

Two specific examples of these approaches are found in regional studies: Sullivan and Rozen's (1985) debitage completeness model based on IFA and Ahler's (1989) MAA system based on FAA. The Sullivan and Rozen approach focuses particularly on artifact completeness and compares the relative frequency of flakes exhibiting similar bulbar, margin, and platform attributes among samples. Rozen developed the approach while working on the Arizona Electric Power Cooperative (AEPCO) transmission line collections and then, in conjunction with Sullivan, analyzed the Pitiful Flats assemblage from near Cibeque, Arizona. Sullivan and Rozen (1985:769) argued that higher frequencies of complete flakes (at their ceramic sites) were consistent with flake-core reduction rather than blank and preform production. Although their approach systematized debitage analysis by looking at flake completeness and breakage, its implications for assessing behavioral issues are unclear.

An experimental or theoretical understanding of what flake completeness actually measures, and how it relates to manufacturing techniques, needs to be developed. A major criticism of the Sullivan and Rozen approach is that stone-material characteristics greatly influence flake breakage not only during flake-blank and preform shaping but also during core reduction. The proper application of this method does not standardize the analytical method unless the analyst receives special training. When conducted correctly, such analyses can identify general patterns of core reduction. These data are often useful in general comparisons between sites.

Artifact Recording and Definitions

The CCP lithic analysis began by reviewing the collections, removing the nonartifactual stone, grouping the specimens by material, and then separating tools from debitage. This sorting process was necessary because it was not always clear what specimens were artifacts until their surfaces were inspected for retouching or other evidence of manufacture and use. Presorting within proveniences also facilitated selecting samples when analytic results from a provenience were ambiguous and additional observations were needed to better evaluate production, use, or disposal.

Artifact descriptions were recorded as a series of variables and their values and were entered into a master database. Variables were either morphological or stylistic attributes that distinguished how the artifacts were made and used and why they were discarded. Our data recording included provenience control information and material for all artifact categories. After this basic information was noted, we proceeded to record a series of observations depending upon whether the artifact was flaked, ground, or ornamental stone.

Here, we introduce the general artifact categories that were found and describe the variation seen. For the purpose of this analysis we defined a tool as any artifact that was deliberately manufactured, shaped, or modified through use. Tools included diagnostic artifacts, such as axes, and informal artifacts that were spontaneously used and had slightly damaged edges, such as edge-modified flakes. Because there is little consensus regarding the characteristics of many tools, we have provided general definitions along with a brief description summarizing materials and site provenience. We also briefly discuss the interpretive value of each artifact type as appropriate. Metric measurements were made of all tools. We describe the morphological categories first. These are followed by commonly occurring tool types. Less-common artifacts are not described here but are discussed in detail within the context of their discovery.

Flaked Stone Artifacts

Artifacts that were carefully formed, deliberately modified, and heavily edge-damaged, as well as flakes with just rounded, smoothed, or crushed margins, were considered tools. The tools were separated from the cores and the debitage. Morphological and stylistic characteristics such as striking-platform type, the presence of cortex, and the portion of the artifact were recorded.

Tools often have restricted size parameters beyond which they cannot function effectively as projectiles, drills, or cutting and scraping tools. Size is also a clue to hafting and is a measure of standardization. Consequently, the maximum dimensions of tools were recorded: length, measured perpendicular to the platform; width, measured parallel to the platform from margin to margin; and thickness, the distance from the bulbar to exterior face.

Projectile Points

This is likely the most recognizable class of lithic artifacts. Sites containing large numbers of projectile points may represent an intensive hunting pattern or a need for defensive weaponry. Projectile points recovered in association with faunal remains and butchery tools are often interpreted as being part of a hunting tool kit. Projectile points are typically classified based on the shape of their haft elements and metric measurements. In the CCP analysis, points were divided into two major groups: small triangular forms and large points (Kamp and Whittaker 1999:83; Whittaker 1984:101–102). This distinction separates spear and dart points, which usually measured more than 30 mm in length, from smaller arrow points. Projectile points were normally manufactured by selecting a noncortical flake blank and then either unifacially or bifacially pressure flaking the tool. Notches along the lateral margins aided in hafting the point to a wood, cane, or bone foreshaft. Several variables affect the configuration of projectile points, including the weapon system used (e.g., bow and arrow or atlatl and dart), haft elements, prey species, and the material used to make the projectile point.

Projectile points represent the pervasive hunting tools of the Tonto Basin region and may have also been used in warfare (Dart 1995; Sliva and Lyons 2002). In contrast to bifaces, points have completed hafts and were commonly finished by careful percussion or regular pressure flaking—often in a manner conditioned by cultural norms. A number of attempts have been made to formalize Arizona point typologies. A preliminary point typology was developed for Tonto Basin by Lindeman (1995) and by Sliva and Lyons (2002). These typologies are mostly concerned with arrow-point forms. Kamp and Whittaker (1999) have noted that serrated points occur most frequently with Cohonina sites and side-notched points occur most frequently at Anasazi sites. Justice (2002) has recently assembled a reference book of projectile points for the Southwest. This is a coarse reference in which major projectile-point types are discussed in terms of "clusters" or large groups of roughly similar types. Justice did what previous authors did not; he addressed projectile-point types from the Clovis to Pueblo periods.

Bifaces

A biface has flakes crossing two faces from prepared margins and lacks a haft element. A biface may be a preform for a projectile point, a knife, or cutting tool. Bifaces can also function as cores that were commonly used to transport fine-grained lithic materials such as obsidian. It has been argued that bifacial reduction is predominantly an Archaic period reduction strategy. The recovery of bifaces directly reflects technology, and large numbers of bifaces would suggest that bifacial reduction was an important economic activity.

Cores

A core is a nucleus from which flakes are removed in a patterned manner to produce a predictable result. The reduction of a core produces flakes that can be used as tools or used as blanks for tools. Cores are identified by platform types and the direction(s) that flakes were removed from the core. For this analysis, cores were identified by the technology that produced them (e.g., flake-core or bipolar reduction). Several styles of uniplanar and multiplanar cores are present in the project collection. Some cores had just one series of flakes removed and retained considerable cortex. Many of the multiplanar cores had been intensively reduced before being discarded. Bipolar cores were produced when small pebbles of fine-grained material were placed on an anvil and struck with a hammer stone. The force from the hammer and the anvil can have the effect of cleaving a pebble and producing usable flake blanks (Hayden 1980). By recording the platform attributes and the amount of cortex for the debitage and the cores, the observations from these different artifact types could be compared. Such comparisons can help to determine if specific raw materials were made into cores at a site or not. If the cores were produced away from the habitation area, this may signal differences in raw-material procurement, trade, or mobility.

Cores can be used to identify habitation sites. If a site was occupied for long periods of time then a higher frequency of exhausted cores should be observed compared to a temporary camp. Parry and Kelly (1987) have also argued that a sedentary lifeway is predisposed to flake-core-reduction strategies. A high frequency of flake cores could therefore characterize Formative period sites.

If any indication of how the original core had been reduced was present, we noted the attribute under the data category "industry." For example, shearing or a damaged distal end of a core was interpreted as indicating a bipolar reduction industry. Modification to tool margins, both the location and method of retouching or damage, were also noted. Additional tool-specific observations about hafts, heat treatment, and other seldom-occurring but notable technological characteristics were recorded in a "comments" field.

Choppers

Choppers are percussion-flaked cobbles or large flakes that often bear large flake scars that produce a low-angle unifacial or bifacial working margin. These tools were mostly made from basalt and, based on the use wear observed, they apparently represent a heavy-duty cutting tool. The presence of choppers provides an indication of heavy chopping tasks, such as field clearing or house construction. When they occur with other agricultural tools, they can be used to address questions of subsistence, resource selection, and agricultural dependence. As such, although the occurrence of a chopper alone does not answer any of these questions, when considered in the context of a site and the other tools recovered, the sum of these parts can address all of these questions.

Scrapers

Scrapers can be classified into a number of types, including side, end, side-and-end, or disk scrapers. Scrapers are most typically associated with hide-processing and woodworking activities. Steep edge angles and use wear are among the most common attributes of scrapers (see Keeley 1980; Morrow 1997). The relatively large size of many scrapers indicates they may also have functioned as a cutting or shaping tool. To record scrapers, the type of modification (e.g., end, side, side-and-end, thumbnail, or disk) and the rounding or damage of edges was noted. The number and frequency of scrapers from a site can be used to infer the importance of cutting and scraping tasks. Such inferences can be used to support or counter discussions concerning how perishable materials were worked and in what frequency.

Drills

A drill is used to perforate another object, and the bit is often pressure flaked to a fine, sharp point (Arnold 1987). Prehistoric people are known to have made drills from flake blanks (Slaughter et al. 1992), reworked projectile points (Rondeau 1996), and burin spalls. Drills are identified by distinctive wear patterns on and around their distal end, including rounding and abrasion that results in a small dimple in the distal end of the bit. Drills serve a specific function; however, this function can vary from drilling support beams in a structure to drilling small disk beads.

Tabular Tools

Tabular tools are tabular rock pieces that were percussion flaked or ground (or both) along one or more margins to create a functional tool. For tabular tools, we recorded the length, width, and thickness, along with the method of retouch (ground, chipped, or both). At least three probable uses have been postulated for tabular tools: as knives for plant (agave) harvesting (Bernard-Shaw 1984), as hoes for preparing fields and irrigation ditches (Irwin 1993), or as saws used for shell and ornament production (Copus 1993). Tabular tools were an important part of the prehistoric tool kit at regional sites, particularly in the Mazatzal Mountain vicinity (Knoblock et al. 2003). In Tonto Basin, they were often made from tabular schist or slate and had chipped, ground, or serrated margins.

Although the precise function of tabular tools is often ambiguous, most of the activities associated with these tools are likely related to subsistence pursuits. Tabular tools were, however, also used to make shell ornaments as discussed by Copus (1993), and the use of tabular tools for ornament manufacturing is a context-based interpretation. For example, Copus inferred tabular tools were used for ornament production based on the co-occurrence of shell ornament production debris and tabular tools in several recovery contexts at Shelltown and the Hind site. As such, tabular tools can be used to examine trade and exchange. It should be cautioned, however, that the presence of one tabular tool at a site does not address any of these questions well.

Modified Flakes

Modified flakes are informal tools that exhibit use wear or retouch along one or more margins. Modified flakes also show a wide range of variation. The most identifiable attribute is the treatment of the margins, which can be retouched, notched, or denticulated by direct percussion or pressure flaking. Generally, modified flakes are distinct from scrapers insofar as their edge angle is less steep and they are often smaller than scrapers. They are generalized tools that could have been used for several cutting tasks. Such tools, therefore, can be used to evaluate whether perishable materials were worked on site. As such, they can be used to infer subsistence and production activities.

Burins and Burin Spalls

Crabtree (1982:27) defined a burin as "a chisel-like implement derived from a flake or blade. . . . The specialized flake removed as a result of the burin break is called a burin blade or spall." The initial linear detachment effectively removes the margin of a flake, creating a spall that is triangular in cross section; if it is a trapezoidal spall, then it is a noninitial detachment. Burin spalls have been used on the California coast for the production of shell beads (Arnold 1991). At the site of Shelltown, chalcedony burin spalls were also recovered from shellworking contexts (Copus 1993:437).

In Archaic period contexts, burin spalls have been interpreted as boneworking tools. If the context can be established and use wear is apparent on the burin spall, then this tool type can be used to discuss questions of chronology. Later in time, burins are simply the flake from which burin spalls were produced. The burins themselves were not used, but the spalls were used as small drills for shell and stone ornaments. Hence, if large numbers of burin spalls are recovered that demonstrate use wear, and it appears that ornaments were produced on the site, then burin spalls could be used to examine trade and manufacturing technology.

Debitage

Debitage includes all unmodified artifacts made during core reduction, tool manufacture, or tool maintenance. The attributes of a flake include a platform, a bulb of force, and rings of force, all of which are produced as the flake is detached. Flakes can be removed from both cortical and noncortical platforms, often following ridges created from a prior flake detachment.

Observations for recording debitage include size, the technology that produced it (e.g., bifacial reduction or flake-core reduction); platform type (e.g., single faceted, multifaceted, ground, opposing, or crushed); distal termination (e.g., step, feather, hinge, overshot, or absent); portion of the flake (e.g., proximal, medial, distal, split, or complete), and material type.

Debitage can be used to address questions of resource selection, trade and commerce, and technology. For example, large amounts of shatter are commonly recovered from core-reduction loci. The frequency of raw materials in a debitage collection can be used to identify material preferences and trade. Identifying flake types allows for the identification of biface-reduction vs. flake-core industries. These observations are also useful in examining changes in lithic technology over time.

Ground Stone Artifacts

The ground stone analysis procedures focused on formal tools. We were particularly interested in the function(s) of specific tools and how they were made. Attributes of manufacture and use were recorded somewhat differently. The intensity of ground stone manufacture and use was ranked by recording two attributes: level of use and the number of utilized surfaces. These variables identified a series of morphological categories, ranging from the absence of formal shaping through intensively shaped to resharpened, and from a single, flat surface to multiple, concave, or convex use surfaces. Additional measurements also were made that noted, for example, the depth of metate surfaces or the size of bead perforations. These attributes were used to categorize ground stone artifacts into types and to make interpretations about their stage of production and intensity of use. Through the identification of these phenomena, we can identify settlements that may have relied on corn vs. other plant foods.

Metates

Metates are ground stone tools that are the stationary portion of a milling implement on which manos are used. Regionally, forms vary from large basins to flat slabs to trough shapes. For this analysis, metates were categorized based on their shape (e.g., basin, flat, concave, slab, or trough) and the kinds of use wear they exhibited (e.g., flaked to form, ground high points, and pecked surface). Adams (1999:492) has proposed that a metate's design was purposeful and reflects prehistoric processing techniques. People used basin metates to process oily seeds, whereas flat to concave forms were used to process soaked kernels. The trough metate, she argued, was a dry-corn grinding tool used for fine-flour processing. Metates are a powerful tool type for addressing research questions. Trough metates are commonly associated with the Formative period and specifically with corn processing. According to LeBlanc (1983), trough metates occur as part of the tool kit that was developed for a more sedentary agricultural lifeway. Many researchers have associated the use of trough metates with the domestication of corn (Ciolek-Torrello 1995; Martynec 1993). Therefore, the frequency with which trough metates occur at a site can be used to examine subsistence practices, including agricultural dependence. For example, if trough metates are numerous at the project sites, the occupants of these sites were likely dependent upon agricultural resources during the Formative period. As such, metates can also be used to address general chronological issues.

Manos

Manos are a category of hand stone that was deliberately shaped and used on a metate, normally to process plant foods. Adams (2002a) has suggested that mano shape is directly related to the type of metate it was used with. Seven forms were observed: irregular, loaf shaped, oval, rectangular, round, subrectangular, and unmodified. Most round manos were probably used in basin metates. Ovoid shapes functioned best on concave to flatter forms. Rectangular and subrectangular manos were often used with trough metates. Rectangular manos that were used in trough metates have distinctive use patterns on their ends: a ground facet develops from the mano coming in contact with the shoulder of the metate (Bartlett 1933; Kamp and Whittaker 1999; Knoblock et al. 2003). Further, Woodbury (1954) has argued that manos over 16 cm in length were two-handed manos used with trough metates. We also applied this length distinction when grinding facets were not observed on the distal ends of rectangular manos. Following Adams (2002a), our analysis also considered shape, the number of ground surfaces, and the amount of wear (e.g., flaked to form, ground highs, and pecked surface).

Axes

Axes are grooved with a wedge-shaped, ground bit. Axes were designed to be a hafted tool, and they were used for chopping wood as well as for shaping other tools, clearing brush, and possibly digging. Two forms often occur at regional sites—totally grooved and three-quarter grooved. For the purpose of this analysis, axes were identified by type according to the type of groove observed, and it was observed if the groove was accompanied by a raised ridge or not. It is unclear, however, if axes with these different attributes were used for different purposes.

Figure 28. Shaft straighteners from Feature 38 inhumation at the Crane site (410/2017).

Hoes

Woodbury (1954:166) described hoes as "tools shaped partly or wholly by grinding, with a broad blade that is relatively thin and sharp edged." Slaughter et al. (1992:94) has noted that this tool type demonstrates a "wide variety of form, size and manufacturing technique." It has been postulated that hoes functioned as agricultural tools (Fratt 1991; Haury 1976; Wheat 1955; Woodbury 1954). For our analysis, a hoe was identified as tabular material that had been flaked to form around the margins, was tanged or notched for hafting, and demonstrated rounding and/or grinding polish on the distal end. As a tool associated with agricultural activities, hoes can be used to discuss subsistence and agricultural activities.

Shaft Straighteners and Shaft Smoothers

There is some confusion about these artifact types. Unfortunately, the terms "shaft straightener" and "shaft smoother" are often used interchangeably. Shaft straighteners are made from a cobble of heat-resistant material. A U-shaped groove was worked into the material, and when the tool was heated, a dart or arrow shaft was applied to the groove to concentrate heat on the shaft and straighten it (Figure 28). Shaft smoothers or abraders were used to sand down shafts and the smooth the exterior of an arrow or dart. Flenniken and Ozbun (1988) have noted that V-shaped grooves were used in pairs as abraders to sand down shafts. When a shaft straightener is used, the action of heating and applying a wood or cane shaft to the groove produces a dark polish in the groove. The polish is a result of the vegetal materials reacting with heat. Such a polish will not accumulate in shaft abraders used to reduce shafts. To keep abraders working, the grooves are cleaned, resulting in a V-shaped groove. During our analysis, the shape of the groove and the presence of a dark stain or polish in the groove was used to identify shaft straighteners.

The presence of this artifact type is not particularly telling. As long as there have been projectiles, there have also been shafts that needed straightening. However, if several shaft straighteners are recovered from a single context at a site (e.g., a structure), this may indicate craft specialization.

Perforated Disks

Perforated disks are tabular stone disks that bear a central perforation. Artifacts with the same characteristics have also been made from clay or fragments of sherds (Adams 1996:18). These have frequently been identified as spindle whorls used in processing fiber and making textiles (Greenwald 1988; Wilcox 1978). If we accept the identification of perforated disks as spindle whorls, these artifacts represent the production of string from fibers. Most commonly, this occurred with cotton, which was an agricultural trade good. Perforated disks, therefore, can be used to evaluate economic relationships and agricultural dependence, but it is important to note that they may have served other purposes. For example, Judd (1954) and Ladd (1979) posited that whorls may have been used during ornament production as a weight for hand or pump drills. Similarly, perforated disks may have also been used as gaming pieces or personal adornments.

Polishing Stones

According to Adams (1996:32), polishing stones are "hand stones of a smooth surface texture involved in the final stages of manufacturing or production of other items." She noted that the surface texture changes with use, creating a smooth, often shiny, surface (Adams 1993). They are most frequently associated with pottery production, where they are thought to have been used to smooth coil joints and burnish green vessels before firing. The frequency with which polishing stones are observed may help us to understand ceramic production, trade, and settlement function. If a large number of polishing stones were recovered from a single feature, they may represent a workshop or specialist. It is important to note, however, that they may have also been used to burnish, shape, or polish other materials, such as soft stone or wood.

Borers

A borer is a tool used to enlarge an existing hole through grinding action. According to Copus (1993), these were most commonly made of schist or gneiss and were used to make shell ornaments. As such, borers can be used to examine craft specialization and trade. They can also inform on site function.

Ornaments

Ornaments include jewelry and ritual items that were produced for personal adornment or trade. Such objects served no functional purpose in the acquisition or processing of food resources. Beads were presumably strung or suspended on cordage. Jernigan (1978:33) has pointed out that disk beads are commonly recovered from Hohokam Colonial period contexts. Adams and Elson (1995:142) have noted an absence of ornaments from early ceramic period components. Adams (1996:29) has pointed out that when strung, pendants exhibit a broad, prominent surface.

Ornaments recovered during the CCP include beads, rings, and pendants. Recorded attributes include the shape of the specimen, location of perforation, type of perforation (conical, biconical, or straight), the size of the perforation, and any decorative features (e.g., incising). The type of perforation can indicate how the ornament was drilled or punched (from one side or both). The types of pendants identified include geomorphic, disk, oval, tabular, rectangular, triangular, and trapezoidal (examples shown in Figure 29). The types of beads include disk, tube, geomorphic, and cylindrical beads.

The raw materials used to make ornaments can also be used to discuss raw-material procurement patterns. People in Tonto Basin most often used red argillite to make ornaments, although black argillite, limestone, and other slightly metamorphosed sediments were also used. During the analysis of the ornaments, the occurrence of blanks for beads or pendants was noted. The blanks were recorded according to their shape (e.g., flat, oval, or unidentifiable). The occurrence of blanks at sites may indicate that beads or pendants were produced there, particularly if drills and grinding slabs are associated with the blanks.

Other Artifacts

Hammer Stones

Hammer stones are cobbles or pebbles that have been used to detach flakes from cores. The use wear is indicated by crushed or battered areas. Three types of hammer stones were observed in the CCP collection: those used for ground stone production, those used for flake stone reduction, and those used for bipolar reduction. Wedge-shaped forms have been associated with milling-implement percussion reduction (Schneider 1993), whereas small, fist-sized, battered cobbles and recycled cores are commonly associated with flake stone reduction. Bipolar reduction hammer stones frequently have a divet battered into a flat surface, just off center. Bipolar hammer stones are distinguished from anvils by size. Anvils are frequently stationary objects, whereas hammer stones are not. Hammer stones were distinguished by the type of reduction they were used for, the material type observed, and the location and type of battering. All hammer stones were measured using a digital caliper.

The identification of the different kinds of hammer stones (e.g., flaked stone vs. ground stone) can be used to discuss the intensity of flake-core reduction or the intensity of ground

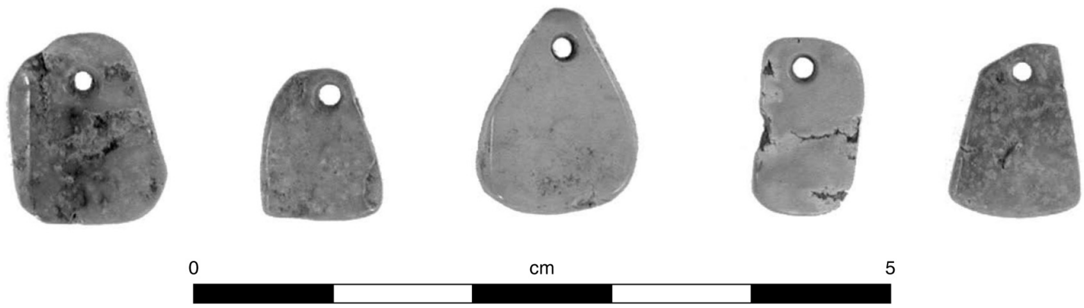

Figure 29. Turquoise pendants from Feature 181 inhumation at the Vegas Ruin (405/2012).

stone production or maintenance. If ground stone production is found to occur at our study sites, then these data can be used to discuss subsistence, resource selection, agricultural dependence, mobility, and technological organization. The hammer stone data should be used in concert with the core data to discuss the reduction strategies and, thus, the technological organization of these sites.

Anvils

Anvils are used to help fracture another rock during tool manufacture. As such, anvils are an integral part of bipolar reduction. Bipolar cores, which are often small pebbles of fine-grained material, were placed on an anvil and struck with a hammer stone (Flenniken 1981). The force from the hammer and the anvil can have the effect of cleaving a pebble and producing usable flakes. This force also has the result of creating a damaged area near the center of the artifact (Slaughter 1992). The attributes we recorded for anvils include the zone of battering, material type, and size.

The occurrence of anvil stones normally represents the reduction of small, and often high-quality, tool stone. Such behavior tells us that resources are being accessed immediately around the site and that the level of mobility is rather low. Further, the pattern of using small pebbles to produce tools argues against an established trade network of high-quality tool stone. It is important to note, however, that anvils may have also been used for other purposes, such as splitting wood or processing other plant materials.

Raw-Material Availability

Now that the artifact types have been defined, it is important to identify what materials were available locally vs. what must have been brought in from a considerable distance. The variety, accessibility, and suitability of the raw materials help us to understand the choices people had to make when they produced stone tools and ornaments. As such, we were interested in determining what materials were available in the project area.

The project area is situated in the transition between the Piedmont zone of the upper Tonto Basin and the floodplain of the lower Tonto Basin. Tonto Creek and its tributaries dissect this landscape and contain a variety of workable stone. The region's most prominent geologic feature is a ridge of Proterozoic bedrock, the Alder Group, which is exposed at Jakes Corner and separates the lower Tonto Basin from the upper Tonto Basin to the north (Richard 1999:3). The Alder Group consists of three formations: the Board Cabin, the Houdon, and the Bread Pan. Along with Quaternary gravel deposits along Tonto Creek and its drainages, these formations were likely the principal sources of workable stone in Tonto Basin throughout prehistory.

The definitions of the material types identified in this study are presented in Table 38. The cortical attributes of the CCP artifacts indicate that clasts from gravel deposits, streambeds, and colluvium were the principal sources of workable stone. The most abundant materials in the collection came from the Alder Group's Board Cabin Formation. Both flaked and ground stone tools were made from Board Cabin rocks. Dark volcanics, particularly basalt and andesite, some of which were metamorphosed into distinctive green to black basalt and metavolcanics, appear to have been particularly favored. The darker stones, particularly the basalt and metasiltstone, are fine-textured, homogeneous, and appear to be enriched with quartz. All these attributes improve the flakeability of the stones (Whittaker 1994:12–14). Some of the Board Cabin material is porphyritic, but because of its higher silica content, it was used nevertheless. Where magma contacted siltstones and claystones, the sedimentary deposits were metamorphosed into metasiltstones and argillites. The argillite present in Board Cabin was used to make ornaments and an argillite ring fragment from the Vegas Ruin may have been made from this local material. This argillite occurs near AZ O:15:41/583

Table 38. Material Descriptions

Material	Description
Andesite	Aphanitic (fine-grained from fast cooling) volcanic medium to dark gray color. Typically, it has phenocrysts (crystals formed during cooling) of quartz and feldspar.
Basalt	Aphanitic volcanic dark gray to black color. Typically, it is free of macroscopic phenocrysts.
Breccia	A rock composed of angular fragments of other rock.
Chalcedony	Translucent crypto-crystalline from precipitate, hot-springs silicate, fibrous mineral, often with a globular (botryoidal) form; can be banded.
Chert	Microcrystalline quartz from bedded silicate sediments; generally light opaque colors from white to brown and gray. Superior flaking quality.
Conglomerate	A rock consisting of rounded clasts of other rocks cemented together within a finer matrix.
Dacite	A light colored volcanic rock of coarse-grained texture.
Fused shale	Metamorphosed siliceous shale having a glassy texture.
Gneiss	A coarse-grained, banded, schistose rock; often a metamorphosed granitic.
Granitic	Coarsely crystalline (porphyritic) igneous rock formed underground (a plutonic).
Jasper	A red to yellow brown microcrystalline quartz separated by distinctive color.
Limestone	A massive, fine-textured rock containing at least 80% calcium or magnesium carbonates.
Metavolcanic	A volcanic rock transformed under heat or pressure; groundmass may be fine, however; transformed phenocrysts should be present.
Metasediment	A sedimentary rock such as clay stone transformed by heat or pressure.
Mudstone	An indurated (cemented) mud, sedimentary rock consisting primarily of clay and silt-sized particles.
Obsidian	A volcanic glass.
Porphyries	A volcanic rock with a large quantity of phenocrysts within a groundmass.
Quartz	A clear, hard (Mohs hardness 7) mineral composed of quartz (SiO_2), with a hexagonal crystal structure.
Quartzite	A metamorphosed sandstone.
Rhyolite	Aphanitic volcanic of light gray to pink color. Reddish brown rocks, occasionally with small phenocrysts, can be included.
Sandstone	A cemented or compacted sedimentary rock composed primarily of quartz grains.
Shale	Fine-textured, indurated, and laminated sedimentary rock.
Siltstone	A fine-grained, clastic sedimentary rock.
Slate	Fine-grained metamorphic rock retaining well-developed fissility (cleavage).
Vesicular basalt	A dark volcanic having many small cavities.
Volcanic	An igneous rock from a magma source that is rapidly cooled; color or mineralogy is unclear, making further typing difficult.
Unknown	Material that cannot be identified because of burning, adhesive coating, or other surface conditions.

Note: After Huckell (1998).

and AZ O:15:103/2061, at the northern end of the project area.

The second Alder Group that was used aboriginally is the Houdon Formation, whose upper member contains very dense, gray to purple quartzites. These quartzites were commonly used to make hammer stones and ground stone artifacts. Both phyllite and schist are also found in the metamorphosed units of the Houdon Formation. Metates were made from the schist and notched tools from the phyllite. The Houdon Formation's lower member contains a distinctive conglomerate with small jasper pebbles that was also selected as a material for metates. The quartzite within the Bread Pan Formation of the Alder Group was also exploited by prehistoric people. Fine-textured white quartzite that occurs as cobbles in the drainages was used to make flaked stone tools.

The Quaternary gravel deposits that flank the west side of Tonto Creek contain detritus from local outcrops and alluvial clasts brought downstream from the upper Tonto Basin and Mogollon Rim. A wide variety of materials occur as gravels, including chalcedony, chert, and jasper. These cryptocrystalline minerals are often a preferred flaked stone material, but the specimens available in the gravels are of variable quality. Small gas pockets, also known as "vugs," and crystal veinlets and a thick cortical rind are characteristics of these specimens. Most of these rocks were made into either small scrapers or bifaces. The fracture properties of chalcedony and chert can be improved by heat treatment, which also imparts a lustrous sheen to the outer surface of the material. Heat-treated chert and chalcedony flakes, bifaces, and points appear as mortuary paraphernalia at some project sites.

The Quaternary gravels are also a source of granitic rock and gneiss. Both large and small cobbles were used to make manos and metates, respectively. Larger cobbles were also used to construct compound walls. Volcanic tuff and limestone cobbles were also present among the gravels. These were also part of the ground stone industry, although their coarser textures promoted their use as smoothing and abrading tools rather than as milling equipment. Small limestone pebbles were occasionally shaped into ornaments. A red-and-purple, very-fine-textured metasandstone appears in some Quaternary gravel deposits. This material has a more predictable fracture than the local quartzites and was apparently preferred by toolmakers at AZ U:3:406/2013. Quartz cobbles round out the suite of usable materials found in the gravels. Quartz primarily was a flaked stone source rock.

Two additional geologic units supplied limited quantities of material. The Precambrian Red Rock Group's rhyolite, which also occurs as a metarhyolite, was selectively used for flaked and ground stone manufacture. The material outcrops upslope and to the west of the project sites but could be collected in drainages. Rhyolite was a major flaked stone material at AZ U:3:404/2011. The Apache Group outcrops to the east of the project area and is a source of light-colored sandstone. It occurs as cobbles and could have been collected in drainages feeding Tonto Creek. Both manos and metates were made from this material.

The prevalence and variety of locally available stones contrasts with the scarcity of the nonlocal materials: obsidian, a talcose schist that is possibly soapstone (steatite), and argillite. Small amounts of obsidian from two sites, the Rock Jaw site (AZ U:3:407/2014) and the Crane site, were submitted for XRF analysis. All of the obsidian recovered from the Rock Jaw site was identified as Government Mountain obsidian (Appendix B.1). The small amount of obsidian recovered from the Crane site was identified as originating at the Superior obsidian source. Soapstone is found in the Sierra Ancha and this may have been the rock source for the two pieces of broken material we found at the Vegas Ruin. There is red argillite that occurs as ornaments. Argillite figures prominently in the regional exchange system and was made into jewelry, such as beads and pendants, and ritual objects. An excellent source called the Del Rio, lying north of Prescott in the Chino Valley, has been recognized since the 1930s. This and several other red argillite sources have been mapped within the Proterozoic Mazatzal quartzite. A not-too-distant locality where outcrops and float were mined has been identified at Deer Creek near Rye (Elson and Gunderson 1992:439–440). If the inhabitants of the CCP sites made items from argillite that was not obtained from Jakes Corner, the Deer Creek could be where the red-bead and pendant material from the project sites was obtained.

Recovery Contexts

Here, the data recovered from each site are presented in the general terms of flaked stone, ground stone, ornaments, and "other" stone artifacts (see Table 37). We will present a description of the collection from each site and the frequency with which these materials were recovered. When relevant, the methods of data recovery and variety of excavation contexts are also briefly discussed.

AZ O:15:41/583

A total of 757 stone artifacts were recovered from Site 41/583 (see Table 37), and 301 of these were collected from the site surface (Tables 39 and 40). We hoped that the diagnostic artifacts would help determine if this site was contemporary with nearby Ushklish Ruin (Haas 1971). Diagnostic artifacts (190) formed 25 percent of the collection. Many of the surface artifacts were distributed just north of the Feature 1 *horno*, but few of these were burnt.

Many different materials were found in small quantities; however, as at other nearby sites, basalt predominated, forming nearly half of the site collection (Table 41). Artifacts

Table 39. Small Flaked Stone Collections from Various CCP Sites

Context	Projectile Point		Biface		Uniface		Drill/ Perforator		Scraper		Chopper		Core Tool		Tested Cobble		Modified Flake		Debitage		Tabular Knife		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Site 41/583																								
Surface	1	0.1	1	0.1	—	—	—	—	8	1.1	7	1.0	12	1.6	2	0.3	58	7.9	205	28.0	—	—	294	40.2
Stripping units	—	—	1	0.1	—	—	—	—	—	—	—	—	7	1.0	1	0.1	4	0.5	25	3.4	—	—	38	5.2
Test pits	—	—	—	—	—	—	—	—	6	0.8	—	—	1	0.1	—	—	22	3.0	89	12.2	—	—	118	16.1
Horno F 1	2	0.3	—	—	—	—	1	0.1	—	—	—	—	5	0.7	—	—	26	3.6	248	33.9	—	—	282	38.5
Subtotal	3	0.4	2	0.3	—	—	1	0.1	14	1.9	7	1.0	25	3.4	3	0.4	110	15.0	567	77.5	—	—	732	100
Site 103/2061																								
Surface	1	0.8	—	—	—	—	—	—	3	2.3	2	1.5	16	12.0	2	1.5	30	22.6	69	51.9	—	—	123	92.5
Test pits	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.8	9	6.8	—	—	10	7.5
Subtotal	1	0.8	—	—	—	—	—	—	3	2.3	2	1.5	16	12.0	2	1.5	31	23.3	78	58.6	—	—	133	100
Site 404/2011																								
Surface	—	—	—	—	—	—	—	—	—	—	—	—	1	0.6	—	—	—	—	18	11.5	—	—	19	12.1
Test pits	—	—	—	—	—	—	—	—	—	—	—	—	3	1.9	—	—	—	—	30	19.1	—	—	33	21.0
Wall trenches	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	12.7	—	—	20	12.7
Room F 1	—	—	—	—	—	—	—	—	—	—	—	—	4	2.5	1	0.6	1	0.6	38	24.2	—	—	44	28.0
Extramural space F 2	—	—	—	—	—	—	—	—	—	—	—	—	4	2.5	—	—	—	—	37	23.6	—	—	41	26.1
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	12	7.6	1	0.6	1	0.6	143	91.1	—	—	157	100
Site 406/2013																								
Surface	—	—	—	—	—	—	—	—	2	1.3	1	0.6	4	2.6	1	0.6	25	16.1	123	78.8	—	—	156	100
Site 408/2015																								
Surface	—	—	—	—	1	0.2	1	0.2	1	0.2	4	0.6	7	1.1	3	0.5	33	5.3	165	26.7	4	0.6	219	35.5
Test pits	—	—	—	—	—	—	—	—	—	—	3	0.5	1	0.2	2	0.3	12	1.9	142	23.0	1	0.2	161	26.1
Trenches	—	—	—	—	—	—	—	—	1	0.2	—	—	3	0.5	—	—	1	0.2	5	0.8	—	—	10	1.6
Wall trenches	—	—	—	—	—	—	—	—	—	—	—	—	2	0.2	1	0.2	2	0.3	12	1.9	1	0.2	18	2.9

Table 39. Small Flaked Stone Collections from Various CCP Sites (*continued*)

Context	Projectile Point		Biface		Uniface		Drill/ Perforator		Scraper		Chopper		Core Tool		Tested Cobble		Modified Flake		Debitage		Tabular Knife		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	Site 408/2015 (*continued*)																							
Nonfeature	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	—	—	8	1.3	—	—	9	1.5
Hearth F 10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	1	0.2
Burial F 8	—	—	1	0.2	—	—	—	—	—	—	2	0.3	—	1.0	1	0.2	12	1.9	124	20.1	3	0.5	143	23.1
Midden F 9	—	—	—	—	—	—	1	0.2	2	0.3	2	0.3	2	0.8	—	—	4	0.6	41	6.6	—	—	52	8.4
Rock alignment F 1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	0.5	—	—	3	0.5
Pit F 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	1	0.2
Subtotal	—	—	1	0.2	1	0.2	2	0.3	4	0.6	11	1.8	16	2.6	7	1.1	64	10.4	502	81.4	9	1.5	617	100
	Site 409/2016																							
Surface	—	—	—	—	—	—	—	—	—	—	—	—	2	5.0	1	2.5	9	22.5	27	67.5	1	2.5	40	100
Total	4	0.2	3	0.2	1	0.1	3	0.2	23	1.3	21	1.1	75	4.1	15	0.8	240	13.1	1,440	78.5	10	0.5	1,835	100

Note: Subtotal percentages calculated using site total.
Key: F = feature.

Table 40. Small Ground Stone Collections from Various CCP Sites

Context	Mano		Metate		Axe		Borer/Reamer		Hoe		Indeterminate Fragment		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
							Site 41/583							
Surface	3	18.8	2	12.5	1	6.3	—	—	—	—	1	6.3	7	43.8
Stripping units	3	18.8	—	—	—	—	—	—	—	—	—	—	3	18.8
Horno F 1	4	25.0	2	12.5	—	—	—	—	—	—	—	—	6	37.5
Subtotal	10	62.5	4	25.0	1	6.3	—	—	—	—	1	6.3	16	100
							Site 103/2061							
Surface	1	100	—	—	—	—	—	—	—	—	—	—	1	100
							Site 404/2011							
Nonfeature	1	20.0	—	—	—	—	—	—	—	—	—	—	1	20.0
Room F 1	2	40.0	1	20.0	—	—	—	—	—	—	—	—	3	60.0
Extramural space F 2	1	20.0	—	—	—	—	—	—	—	—	—	—	1	20.0
Subtotal	4	80.0	1	20.0	—	—	—	—	—	—	—	—	5	100
							Site 406/2013							
Surface	2	50.0	1	25.0	—	—	1	25.0	—	—	—	—	4	100
							Rock Jaw site (407/2014)							
Surface	2	14.3	—	—	—	—	—	—	1	7.1	—	—	3	21.4
Features	6	42.9	4	28.6	—	—	—	—	1	7.1	—	—	11	78.6
Subtotal	8	57.1	4	28.6	—	—	—	—	2	14.3	—	—	14	100
							Site 408/2015							
Surface	1	12.5	2	28.6	—	—	—	—	—	—	1	12.5	4	50.0
Burial F 8	3	37.5	—	—	—	—	—	—	—	—	—	—	3	37.5
Midden F 9	1	12.5	—	—	—	—	—	—	—	—	—	—	1	12.5
Subtotal	5	62.5	2	25.0	—	—	—	—	—	—	1	12.5	8	100
Total	30	62.5	12	25.0	1	2.1	1	2.1	2	4.2	2	4.2	48	100

Note: Subtotal percentages calculated using site total.
Key: F = feature.

made from metavolcanic materials, chert, chalcedony, and jasper were present, but there were surprisingly few artifacts made from quartzite or metasediment. Chert and jasper were the most frequently used fine-grained materials recovered from the site, and these materials were used to make projectile points, bifaces, and drills. The basalt, quartzite, and metasediment are available as float on site and in outcrops to the east, but we were not able to identify the source location(s) of the chert and jasper.

Flaked Stone Artifacts

Projectile Points

Three projectile points were recovered during our investigations at Site 41/583 (Appendix B.2, Table B.2.1). Two were generalized side-notched forms, and one was a small, long, triangular, serrated type commonly found at pre-Classic and Classic period Hohokam and Salado sites. A basalt side-

Table 41. Number of Artifact Types from Site 41/583, by Material Type

Artifact Type	Igneous							Sedimentary	Metamorphic						Cryptocrystalline Silicate			Mineral			Total
	Basalt	Rhyolite	Granite	Andesite	Porphyritic Andesite	Breccia	Indeterminate Igneous	Sandstone	Quartzite	Schist	Meta-sediment	Metavolcanic	Porphyritic Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	Quartz	Argillite	Hematite	
Flaked stone																					
Projectile point	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	3
Biface	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	2
Drill/perforator	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Scraper	5	1	—	—	—	—	—	1	—	—	—	3	—	—	—	—	3	1	—	—	14
Chopper	6	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	7
Core	9	—	—	—	—	—	1	3	—	—	1	3	2	1	—	3	2	—	—	—	25
Tested cobble	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	3
Modified flake	45	5	—	3	3	—	1	5	2	1	12	15	5	3	2	2	6	—	—	—	110
Debitage	274	12	—	20	7	2	1	12	12	—	12	79	36	10	10	57	23	—	—	—	567
Subtotal	341	18	0	23	10	2	3	22	14	1	25	101	44	14	13	66	34	1	—	—	732
Ground stone																					
Mano	—	—	6	—	—	—	—	—	2	—	—	—	—	2	—	—	—	—	—	—	10
Metate	—	—	2	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	4
Axe	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Indeterminate ground stone	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Subtotal	1	—	8	—	—	—	1	—	3	—	—	—	—	3	—	—	—	—	—	—	16
Other																					
Pendant blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Hammer stone	4	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	6
Manuport	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2
Subtotal	4	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	1	2	9
Total	345	18	8	23	10	2	4	24	17	1	25	101	44	17	13	66	34	1	1	2	757

notched point was recovered from a flotation sample gathered from the Feature 1 *horno* (Figure 30n). It was made on a percussion flake that had been bifacially pressure flaked and then notched. An impact fracture removed its tip and a break at one of the notches removed part of the base. The point had a fire-induced pot-lid fracture on one face. This material would not benefit from heat treatment, so the thermal pot-lid fracture was likely the result of its being in the *horno*. The distance of the notches from the base places this projectile point within the low-notched category established by Kamp and Whittaker (1999:84) and the Sedentary Side-notched type as defined by Sliva (1997:54).

The second projectile point was a chert side-notch point that was produced by pressure flaking a percussion-flake blank to shape. Pressure notches were placed 4.6 mm above the slightly concave base, identifying it as a low-side notched form, and because of its overall size, it was assigned to the small category. It was recovered from the site surface.

The third point was triangular and made from a heat-treated chalcedony flake. The entire surface was pressure flaked, then it was notched, and its lateral margins were serrated. Its base converged slightly, and it had been thinned for hafting. It was also recovered from the Feature 1 *horno* (see Figure 30f).

Bifaces

Two bifaces were found (see Tables 37 and 39). One was made from chert, the other from a porphyritic metavolcanic material. The chert biface was made from the distal segment of a percussion-and-pressure retouched flake. It may be a point preform, however, it was larger than necessary for a small triangular point. It appears to have broken during manufacture and was discarded. The second biface represented the early stage of manufacture and was roughly percussion shaped. Cortex remained on its margins. Several step fractures (manufacturing mistakes) along one edge may have led to its discard.

Drills

A chert burin spall, made from a flake, seems to have functioned as a drill. It had been retouched along one, slightly crushed margin. It was only 19.8 mm long, 6.1 mm wide, and 4.8 mm thick. It was found in the basal fill of the Feature 1 *horno* (see Table 39). Burin spalls have been associated with ornament production at the Hohokam sites of Shelltown and the Hind site in southwestern Arizona (Copus 1993:437), and Martynec (1993:300) has noted that chalcedony is hard enough to drill though turquoise.

Scrapers

Fourteen scrapers were recovered from this site (Table B.2.2; see Table 39). The scrapers had regular, serially retouched margins, and all but 2 were worked on both their sides and ends. Only 3 complete examples were collected, and these were similar in size to many of the broken specimens. Five of them were made of basalt, and they were just slightly larger than the others. Three jasper and 3 metavolcanic scrapers were also recovered, along with single scrapers made of quartz, rhyolite, and metasandstone.

The size of the average scraper was relatively large, at 50.0 mm long, 50.0 mm wide, and 15.7 mm thick. All of the scrapers were recovered from the vicinity of Test Pit (TP) 2 in the central portion of the site. These scrapers may represent deliberate "curation"; their intensively straightened margins resulted from multiple resharpening events.

Choppers

Seven irregularly percussion-shaped choppers were collected from the surface, but none was recovered from buried contexts (see Tables 37 and 39). Six were made from green or dark gray basalt available on or surrounding the site, and the seventh was a reddish brown metasandstone. The basalt choppers were made from colluvial cobbles and were often casually shaped, whereas the metasandstone chopper was made from a large flake. Of these, only three were complete specimens. The others had broken and one of these had been slightly reused as a hammer stone. The length of broken choppers was measured on the axis that did not include the break. Complete choppers were 95.5 mm long on average, whereas the broken choppers were 84.7 mm long on average.

Modified Flakes

Modified flakes formed 15 percent of this site's flaked stone collection—the third highest percentage among the project sites. Modified flakes were recovered from all recovery contexts at Site 41/583. These modified flakes were made from basalt, metarhyolite, and a distinctive, reddish brown metasandstone. Several different types of modified flakes were encountered. About 25 percent of them were notched flakes, whereas the others were less regularly formed and had either irregular percussion-retouched, pressure-retouched, crushed, or rounded margins. The edge modifications were quite variable and likely represented the expedient use of flakes made from local materials. However, the flakes that were used were not necessarily made expediently. For instance, less than 20 percent of them were cortical, and more than 30 percent had faceted platforms. As such, they appear to have been interior flakes detached from cores with

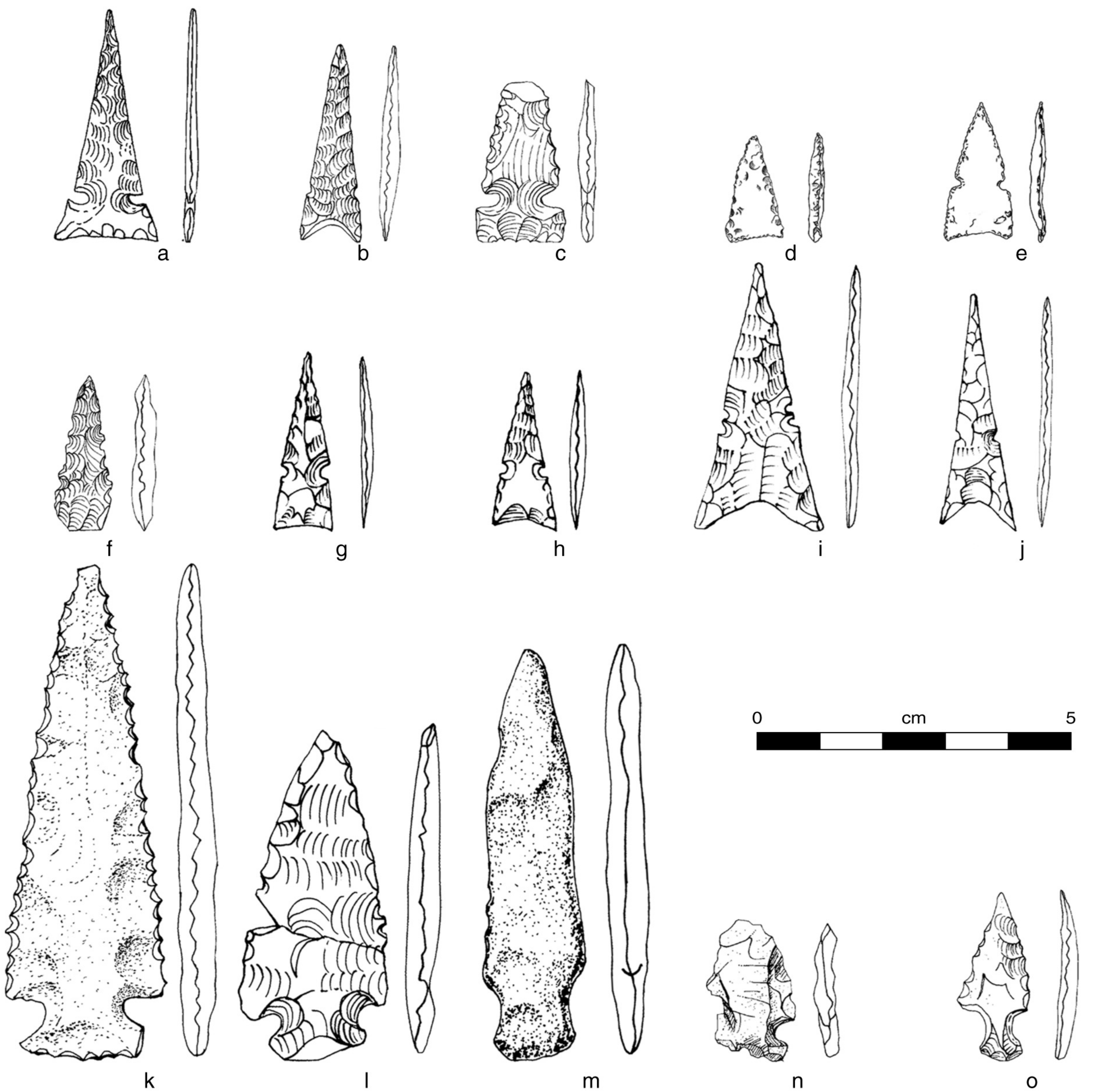

Figure 30. Projectile points from the SR 188–Cottonwood Creek Project: (*a*) Sedentary Side-Notched point from the Feature 30 pit structure, Crane site (410/2017); (*b*) Sedentary Side-Notched point from the Feature 19 pit structure, Vegas Ruin (405/2012); (*c*) Sedentary Side-Notched point from the Feature 1 pit structure, Rock Jaw site (407/2014); (*d*) Classic Triangular point from the Feature 1 compound, Vegas Ruin; (*e*) Classic Side-Notched point from the Feature 11 room, Vegas Ruin; (*f*) Colonial Barbed point from the Feature 1 *horno*, Site 41/583; (*g*) Sedentary Side-Notched point from the Feature 33 inhumation, Vegas Ruin; (*h*) Sedentary Side-Notched point from the Feature 33 inhumation, Vegas Ruin; (*i*) Classic Side-Notched point from the Feature 12 inhumation, Vegas Ruin; (*j*) Sedentary Side-Notched point from the Feature 12 inhumation, Vegas Ruin; (*k*) San Pedro point from the Feature 137 inhumation, Vegas Ruin; (*l*) Elko point from the Feature 4 wall rubble, Vegas Ruin; (*m*) San Pedro point from the Feature 4 structure, Crane site; (*n*) indeterminate basalt point from the Feature 1 *horno*, Site 41/583; and (*o*) indeterminate chert point from the Feature 1 pit structure, Rock Jaw site.

prepared platforms. Thirty-eight of the modified flakes were complete, and they were 42.7 long, 43.4 wide, and 14.5 mm thick on average. The maximum length was 80.3 mm and the minimum length was 7.2 mm. Overall, these dimensions indicate that flakes slightly wider than long were often selected as tool blanks.

Cores and Tested Cobbles

We collected 25 cores and 3 tested cobbles from Site 41/583 (see Tables 37 and 39). Seventy-two percent of the cores were complete or nearly complete, whereas the remainder were core fragments. Some cores bore only a few flake scars, whereas others were intensively reduced. Basalt was the most common core material, followed by chert and metasandstone. Cores made of jasper, metavolcanics, and metasediments were also present.

Three different reduction strategies were used to reduce cores at this site: single-direction reduction (60 percent), multidirectional reduction (32 percent), and bidirectional reduction (8 percent). The multidirectional cores, at this and other sites, often developed as a cobble that was reduced, first unidirectionally then multidirectionally. Flake removal was nonpatterned, and relatively large flakes were made. Two bidirectional cores were worked from a beveled edge, and one basalt core could have been a blank for an axe. Manufacturing mistakes (step fractures and breakage) often led to core discard. The complete cores averaged 66.6 mm in maximum dimension. Over 70 percent had little or no cortex on their surfaces, and only 32 percent had cortical platforms.

Three tested cobbles were also collected. One of them was a 57.3 mm diameter chert cobble that was unsuccessfully battered in an attempt to remove the cortex. It is unclear why a large metarhyolite (82.9 mm) and basalt (93.1 mm) cobble were rejected. About half of the cores and tested cobbles were found on the surface. Most of the other specimens were collected from the Feature 1 *horno* or from the mechanical stripping units that surrounded it.

Debitage

The debitage from Site 41/583 consisted of 567 specimens, of which only 27 percent were complete flakes (see Tables 37 and 39). These complete flakes were relatively small and were 30 mm long and 31.8 mm wide on average. The rest of the collection consisted of similar-sized medial or distal flake fragments, and the occasional piece of angular shatter. Interestingly, only 3.4 percent (n = 19) of the flakes were completely cortical. This suggests that the debitage represents late-stage reduction activities. Only 5.8 percent (n = 22) of the flakes were removed from bifaces, and the remainder were best interpreted as flake-core-reduction debris. No evidence of bipolar reduction was encountered.

In general, the debitage represents the reduction of local basalt and basalt cobbles after most of the cortex had been removed. A concentration of 3 basalt cores, 1 tested cobble, and 14 flakes was collected from surface Collection Unit (CU) 2. Thirteen basalt flakes were also found in the first level of TP 4, which was excavated in the center of this collection unit. These flakes could not be refitted to the core, but they do represent the only identified flaked stone concentration from the site. This concentration likely represents a small activity area at which a limited amount of core reduction took place.

Ground Stone Artifacts

Axes

A damaged three-quarter-groove axe was found on the surface (Figure 31). Like many other large artifacts, the tool started out as a green basalt cobble that had been shaped carefully by flaking, pecking, and grinding, as well as by use. Because of bit damage that occurred during use, it was reworked at its proximal end by pecking and grinding. This unfortunately led to a fracture that caused it to be discarded, because it could no longer be easily hafted. It was 143.4 mm long, 66.4 mm wide, and 42.1 mm thick.

Manos

We recovered 10 manos; in contrast to the other sites, more than half of these were made from granitic cobbles (see Table 40). Most were fragments; however, 6 of the manos could still be confidently typed. One-half of the manos recovered were oval, 1 was loaf shaped, and 1 was round. The remainder were indeterminate fragments. The complete manos were 127.5 long, 86.3 mm wide, and 40.4 mm thick on average. Eight of the manos or mano fragments were from the vicinity of the *horno*.

Metates

Four metate fragments, all of different materials, were collected (see Table 40). Three of these were from basin metates, and the fourth was from a slab metate. Three had some use wear on their grinding surfaces, but only one had been resharpened by pecking. Additionally, two fragments showed some wear on their outer surface likely from rubbing against the ground during use. Two parts of a large, granitic, basin-shaped metate, which could not be refitted, were collected on the surface. Both parts had been pecked to resharpen their

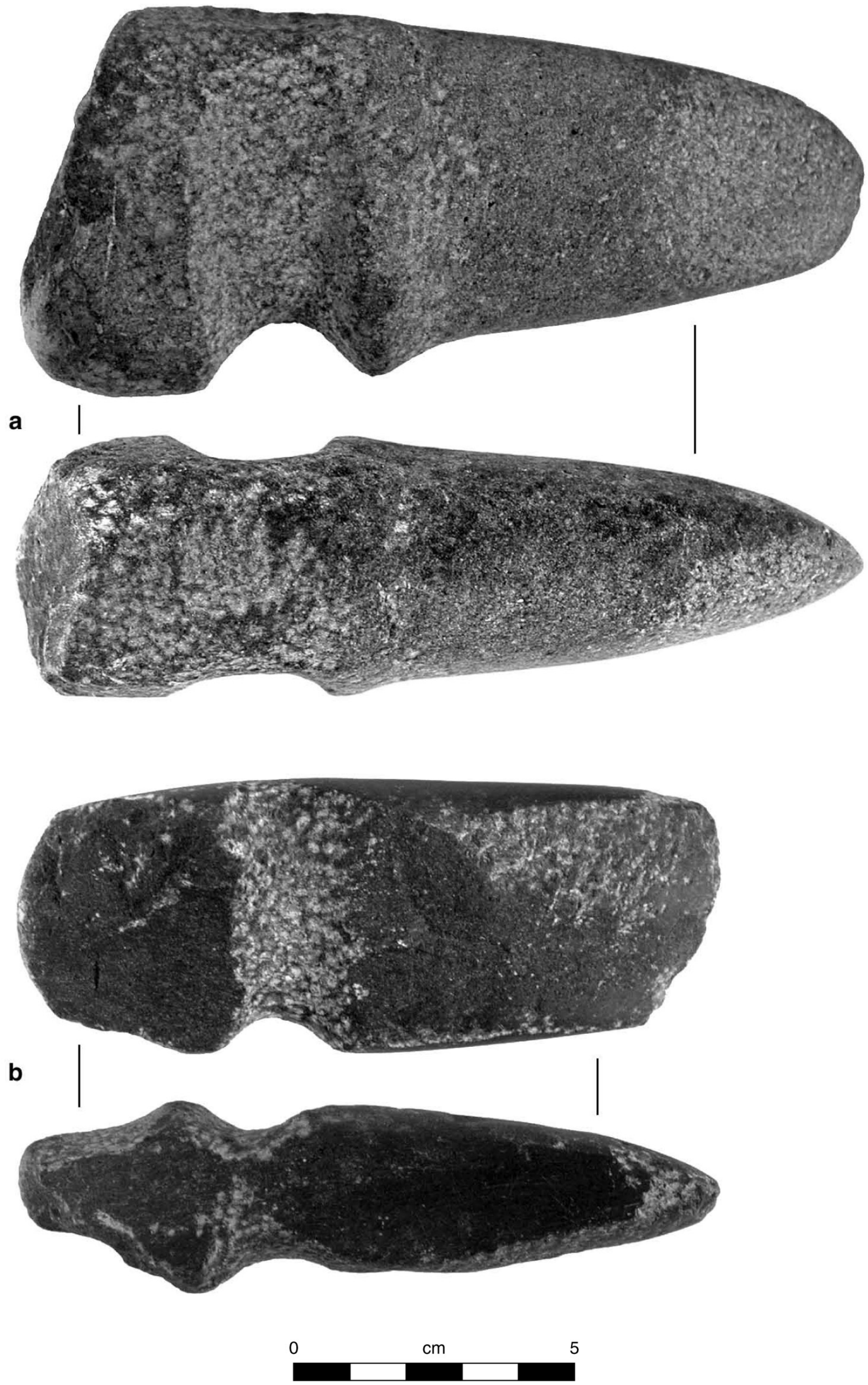

Figure 31. Three-quarter-groove axes from (*a*) Site 41/583 and (*b*) the Crane site (410/2017).

surface. A complete, gray, basalt, flat to convex metate was found in Feature 3. The mano types recovered were consistent with the types of metates recovered from this site.

Other Artifacts

Hammer Stones

Only six hammer stones were collected, even though numerous cores and considerable debitage was recovered. They were generally large, measuring 92.4 mm long, 80.9 mm wide, and 64.2 mm thick on average. Hammer stones were collected from all recovery contexts at this site (Table 42).

Artifact Distribution

Feature 1

A large *horno* was identified at the northwestern end of the site. Nearly 40 percent of the lithic artifacts from this site were recovered from this feature (see Tables 39 and 40). This feature was largely constructed of burnt cobbles and ash deposits. Three manos and two metates were recovered from this context. It appears that fragments of ground stone materials were being recycled as rocks to line the *horno* feature. Nearly 25 percent of the modified flakes were recovered from the *horno*, most likely this represents the discard of exhausted tools into the *horno* when a particular activity was finished. The only drill recovered from this site was recovered from the *horno*. One indeterminate basalt projectile point that exhibited evidence of temperature stresses and one chert Colonial barbed arrow point were also recovered from this context. The artifacts recovered from this feature appear to represent recycling and the disposal of exhausted tools.

Summary

Stone artifacts from Site 41/583 were most numerous in CU 2, TP 11, or from within or nearby the Feature 1 *horno* (see Tables 39 and 40). The artifact concentration from CU 2 represented, in part, the detachment of flakes from several basalt cores. Some flakes were briefly used and then abandoned. In addition, tools representing both seed-processing and scraping/cutting activities were abandoned at this small task area. Near the *horno*, the flaked and ground stone tools that had been discarded became incorporated into the rake out or in-filling of the *horno*. Many scrapers were found on the surface in this area, TP 11, and in the mechanically stripped area surrounding the *horno*. Their distribution likely represents several activity areas associated with the preparation of food, either before or after it entered the *horno*.

The site lies just west of the Board Cabin outcrop that contains the basalts and some of the metavolcanics used to make the scrapers and much of the debitage from this site. Float from the outcrop is present in colluvial deposits east of the ROW. Nevertheless, little evidence for assaying material, quarrying, and initially shaping cores was observed. Instead, most cores and debitage specimens were noncortical, indicating that final flake production and tool use were the prominent activities that created the stone artifact concentrations marked by the scrapers and debitage.

We found two points that often appear at ceramic period sites in central Arizona as well as a Colonial Barbed point, a type that frequently occurs in pre-Classic Hohokam sites throughout southern and central Arizona. Three-quarter-groove axes, though never common, are often associated with ceramic period habitation sites, such as nearby Ushklish Ruin. The axe recovered from Site 51/483 was likely used by the site inhabitants to collect firewood to fuel the Feature 1 *horno*. The manos and metates from this site were the ubiquitous basin and flat-concave forms that have little or no temporal significance. Overall, the stone tools that were left behind and the activities that they represent were consistent with interpreting Site 41/583 as a work area associated with Ushklish Ruin or other nearby sites.

AZ O:15:103/2061

This site was previously reported as a low-density artifact scatter that contained an Archaic period projectile point (Hoffman 1991:36). Hoffman collected the point and, after a cursory examination, suggested that the point might be a reworked Pinto (Archaic) style made from Hardscrabble Mesa dacite. One purpose of our analysis, therefore, was to evaluate whether the lithics could represent an early occupation of the surrounding Hardt Creek area. To this end, in accord with our data recovery plan (Ciolek-Torrello and Klucas 1999:27), SRI conducted a surface collection, excavated two test pits, and dug a trench across the site. These efforts resulted in the collection of 1 ground stone artifact, 133 pieces of flaked stone, and 3 hammer stones (see Tables 37, 39, and 40). Despite the small quantity of artifacts recovered during the Site 103/2061 investigations, the quantity of diagnostic tools was considerable, representing 30 percent of the recovered artifacts.

The stone artifacts from this site were made from 14 raw materials (Table 43). Basalt, rhyolite, and metavolcanics, which also include porphyritic metavolcanic, occurred most frequently. Together, chert, chalcedony, and jasper constituted almost 15 percent of the site collection. Other identified

Table 42. Number of Anvils, Hammer Stones, and Manuports Recovered, by Site

Context	Artifact Type			Total
	Anvil	Hammer Stone	Manuport	
	Site 41/583			
Surface	—	5	—	5
Horno F 1	—	1	2	3
Subtotal	—	6	2	8
	Site 103/2061			
Surface	—	3	—	3
Subtotal	—	3	—	3
	Site 404/2011			
Room F 1	—	1	—	1
Extramural space F 2	—	1	—	1
Subtotal	—	2	—	2
	Vegas Ruin (405/2012)			
Surface	—	6	—	6
Stripping units	1	33	—	34
Test pits	—	6	—	6
Adobe-lined pit F 59	—	1	—	1
Burial plot F 221	—	2	—	2
Burial F 21	—	2	1	3
Burial F 103	—	1	—	1
Burial F 106	—	1	—	1
Burial F 137	—	—	4	4
Burial F 220	—	1	—	1
Compound F 1	2	24	—	26
Midden F 10	—	5	—	5
Pit F 107	—	1	—	1
Pit F 176	—	—	1	1
Pit structure F 19	—	9	—	9
Pit structure F 34	1	7	—	8
Pit structure F 99	1	4	—	5
Pit structure F179	—	5	—	5
Pit/hearth F 162	—	2	—	2
Rubble F 4	—	3	—	3
Slab-lined pit F 134	—	1	—	1
Room F 11	—	9	—	9
Wall F 6	—	1	—	1
Wall F 8	—	4	—	4
Subtotal	5	128	6	139

Table 42. Number of Anvils, Hammer Stones, and Manuports Recovered, by Site (*continued*)

Context	Artifact Type			Total
	Anvil	Hammer Stone	Manuport	
	Site 406/2013			
Surface	—	2	—	2
	Rock Jaw site (407/2014)			
Surface	—	7	—	7
Pit F 12	—	1	—	1
Pit structure F 1	—	4	—	4
Subtotal	—	12	—	12
	Site 408/2015			
Surface	—	2	3	5
Burial F 8	—	3	1	4
Rock alignment F 1	—	2	1	3
Subtotal	—	7	5	12
	Crane site (410/2017)			
Surface	1	4	1	6
Stripping units	—	1	—	1
Test pits	—	—	2	2
Granary F 31	—	1	—	1
Burial F 21	—	2	—	2
Midden F 1	—	7	2	9
Pit structure F 30	—	3	—	3
Cobble concentration F 17	—	2	—	2
Structure F 4	—	2	—	2
Structure F 6	1	1	—	2
Structure F 19	—	2	—	2
Possible structure F 26	—	1	—	1
Cobble alignment Feature 11	—	1	—	1
Subtotal	2	27	5	34
Total	7	187	18	212

Key: F = feature.

materials included andesite, argillite, metamorphic, metasediment, quartz, and quartzite. The sources of the chert, chalcedony, and jasper are unclear, but the other identified materials were present as colluvial cobbles and natural outcrops in the area surrounding the site.

Flaked Stone Artifacts

Projectile Points

The projectile point collected by Hoffman (1991:36) was forwarded to SRI for our analysis. The point was a small, black, almost complete notched form. Originally, it was described as made of Hardscabble Mesa dacite; however, it appeared too dark to be dacite, which is a light-colored extrusive rock. When viewed microscopically, it was made from a fine-textured mudstone. The point also appeared not to have been reworked as initially thought. Instead, it was a late-stage percussion flake that was pressure worked along its margins to a semi-triangular shape. Notches were then placed on either side about one-third of the way up. An impact fracture had blunted its tip. Its simple, pressure-flaked form placed it within the small-triangular-point group. It did not illustrate the bifacial percussion reduction and stemmed haft that was typical of Pinto points (Amsden 1935; Harrington 1957). Instead, it seems to be an atypical small, triangular-notched arrow point.

Scrapers

There were three scrapers among the diagnostic flaked tools (see Tables 39 and B.2.2), including a basalt side scraper, a metavolcanic side scraper, and a chert end scraper. The basalt scraper had a carefully crafted concave edge and was smaller than the metavolcanic scraper. The chert scraper was an end scraper that was fashioned by pressure flaking the flake's terminus. This tool had the luster that can sometimes been observed when a flake has been heat treated.

Choppers

Two percussion-flaked choppers were collected (see Table 39, where choppers were included with "Core Tools"). Made from small cobbles, one was made of porphyritic andesite and the other from basalt. The porphyritic andesite chopper was complete and was 131.2 mm long, 93.4 mm wide, and 46.2 mm thick. The basalt chopper had been split lengthwise and was 96.3 mm long, 49.8 mm wide, and 39.8 mm thick. Both choppers were patinated, suggesting that they could be Archaic period tools. However, they were similar to other cobble choppers found during the project, so the patination may simply reflect mineralogical responses to local environmental conditions.

Modified Flakes

Thirty-one modified flakes made from a variety of materials were collected (see Table 39). Basalt flakes were the most commonly modified, followed by those made from rhyolite, andesite, mudstone, chert, jasper, and metamorphic materials. Four notched flakes were included among the modified flakes. Margins on the other specimens had been percussion retouched, pressure retouched, crushed, and/or rounded.

The diversity of this tool type is illustrated by the variability of retouch observed. Retouch was observed on all margins, including the platform. Retouch was used to shape or resharpen the flake edges. Nine of the modified flakes retained considerable cortex. Cortical platforms occurred with the same frequency. Eleven unbroken specimens were 41.2 mm long, 29.7 mm wide, and 14.9 mm thick on average. This suggests that long, narrow flakes were selected as blanks. The maximum tool length observed was 66.8 mm and the minimum length observed was 14 mm.

Overall, the modified flakes from Site 103/2061 were of moderate size, were made of many different material types, and were likely used to accomplish many different tasks. Modified flakes constituted 23 percent of the site collection. At other project sites, modified flakes appear to have been mainly interior flakes with cortical platforms that were used and then resharpened. This site demonstrated the same pattern. Flake type was not dependent on the material being reduced. Cortical and multifaceted platforms were observed for chert and metarhyolite flakes. This relatively high frequency indicates that the working of perishable materials was an important site activity. It is likely that these modified flakes were used to work plant materials and process carcasses.

Cores

Sixteen cores and 2 tested cobbles were found (see Table 39). The cores were both complete (n = 8) and fragmentary (n = 8); some had only a few flake scars, whereas others were totally reduced. Eight different materials were observed among the cores and tested cobbles. Three types of cores were present: unidirectional (n = 7), multidirectional (n = 4), and bipolar (n = 3). Two cores were too fragmentary to type. The multidirectional cores developed from unidirectional forms as the material was reduced. Flake removal was unstructured, and the goal of reduction seems to have been the removal of large flakes. The reduction of bidirectional cores involved the removal of flakes from two platforms, creating a beveled edge. Two of the bidirectional cores were

Table 43. Number of Stone Artifacts from Site 103/2061, by Material Type

Artifact Type	Igneous				Sedimentary	Metamorphic					Cryptocrystalline Silicate			Mineral	Total
	Basalt	Rhyolite	Andesite	Porphyritic Andesite	Mudstone	Quartzite	Meta-sedimentary	Metavolcanic	Porphyritic Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	Quartz	
Flaked stone															
Projectile point	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
Scraper	1	—	—	—	—	—	—	1	—	—	—	1	—	—	3
Chopper	1	—	—	1	—	—	—	—	—	—	—	—	—	—	2
Core	5	—	—	—	—	—	2	—	4	—	2	1	1	1	16
Tested cobble	—	—	—	—	—	—	1	—	—	—	—	—	1	—	2
Modified flake	11	7	1	—	1	—	—	1	3	—	—	4	3	—	31
Debitage	31	4	1	2	—	2	3	7	19	2	2	4	1	—	78
Subtotal	49	11	2	3	2	2	6	9	26	2	4	10	6	1	133
Ground stone															
Mano	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Other															
Hammer stone	1	—	—	—	—	1	1	—	—	—	—	—	—	—	3
Total	50	11	2	3	2	4	7	9	26	2	4	10	6	1	137

large and regular enough to have been blanks for choppers or axes. Reduction mishaps, such as step fractures and breakage, led to core discard. Overall, it appears that the cores from this site were extensively reduced. For example, more than half of the cores bore little or no cortex and 12 had noncortical platforms.

Two tested cobbles were also collected. These included one 63-mm-long piece of jasper and one 75-mm-long metasedimentary cobble. The jasper piece had crystal-filled cavities, which made it difficult to work and led to its rejection. It is unclear why the metasedimentary cobble was not reduced further; however, we noted that both tested cobbles were smaller than most of the cores. It is possible, therefore, that these cobbles were rejected because better materials became available.

Debitage

Debitage from this site consisted of 78 specimens (see Tables 37 and 39). About two-thirds of the flakes were fragments, and lengthwise splitting seems to have been a common occurrence, accounting for 39 percent of the flakes. The debitage represented the reduction of various materials, but basalt dominated the collection. Nearly 90 percent of the debitage was noncortical, and nearly half of the flakes had faceted platforms. This indicates that the flakes likely represent mid- to late-stage core-reduction activities. The early stage of core reduction, therefore, appears to have occurred elsewhere and very little initial percussion—the shaping of cores and cortex removal—occurred at the site.

The complete flakes were 39.9 mm long on average, including five bifacial-thinning flakes, but none of these flakes represented late-stage bifacial reduction. Several pieces of porphyritic andesite debitage and a porphyritic andesite core were also present. Debitage from the porphyritic andesite core included four pieces of shatter and five small flake fragments, but none of these could be conjoined with the core. Given that this core and debitage did not conjoin, several flake blanks may have been struck from this core and used elsewhere.

Ground Stone Artifacts

Manos

One oval mano fragment was collected from the site surface (see Table 40). It represented about two-thirds of a quartzite mano that was considerably worn, with smooth surfaces.

Other Artifacts

Hammer Stones

Three hammer stones were recovered (see Table 42). Surprisingly, the hammers stones had battered, wedge-shaped bits typical of ground stone production. Basalt, quartzite, and metasedimentary cobbles were used for these hammers. They were 80.0 mm long, 70 mm wide, and 47.1 mm thick on average, and they were 72.4–89.4 in maximum dimension.

Summary

Site 103/2061 was previously described as a sparse lithic scatter with a possible Archaic period component. The projectile point that suggested this interpretation cannot be readily ascribed to the Archaic period, as its size, shape, and manufacturing characteristics were within the parameters of the small triangular-point group (Whittaker 1984).

Cores representing more-intensive, systematic reduction were also found. No bifacial cores, however, were recovered. Huckell (1998) has noted that bifacial techniques characterize Archaic period lithic technology in the Southwest. Another common characteristic of Archaic period collections is the presence of tools made from nonlocal material. This is thought to be a consequence of greater mobility; but except for the chert, jasper, and chalcedony, the collection from Site 103/2061 consisted largely of local materials (see Table 43). Overall, the cores and raw-material frequencies at this site compared best with a Formative period technology and lifeway.

Only a few diagnostic tools, informal tools, and debitage specimens were sparsely distributed within the project ROW at Site 103/2061 (see Tables 37, 39, and 40). With such a small collection, it is difficult to infer what other activities, with the possible exception of random discard, contributed to the formation of this site. The tools we found appear to have been abandoned after breaking during use. Only one concentration of a core, flakes, and shatter—representing core reduction and flake-blank production from a single porphyritic-metavolcanic core—was identified. The debitage represented occasional flake-blank production, and most of the product was taken elsewhere. The debitage attributes differed from those observed at nearby sites, but the sample size was small and may not represent the overall pattern of reduction at this site. One stoneworker's individual behavior, working four or five different cores in a manner the toolmaker had decided was appropriate for local materials, could be responsible for the differences we documented.

AZ U:3:404/2011

A total of 164 lithic artifacts were collected from this site (see Table 37). These included 157 flaked stone artifacts, 5 ground stone artifacts, and 2 hammer stones (see Tables 39, 40, and 42). All of these artifacts were analyzed. Few diagnostic artifacts were found in the field house (Feature 1) and the attached enclosure (Feature 2). Most of the site collection was from the general-site surface, including 1 modified flake and 5 ground stone artifacts. Debitage composed 91 percent of the site collection. Basalt, rhyolite, and quartzite were most commonly utilized. Chert, chalcedony, and jasper artifacts formed less than 10 percent of the collection; the remainder was composed of artifacts made from a wide variety of igneous or metamorphic materials (Table 44). The Feature 1 field-house collection contained a relatively high frequency of rhyolite, a material that was uncommon at all of the other project sites with the exception of the Vegas Ruin. This may reflect a greater abundance of rhyolite in nearby Gold Creek. Conversely, the rhyolite frequency may have resulted from the small sample size, with the amounts being skewed by a single stone-working event.

Flaked Stone Artifacts

Modified Flake

One modified chert flake was recovered from the Feature 1 field house (see Table 39). It was 59.2 mm long, 48.3 mm wide, 20.7 mm thick, and was made on a partially cortical flake.

Cores

Twelve cores and 1 tested cobble were recovered (see Table 39). The cores were made from six different materials, including mudstone (n = 1), basalt (n = 2), rhyolite (n = 3), chert (n = 1), jasper (n = 1), and quartzite (n = 4). The tested cobble appeared to be white quartz, but the toolmaker's single flake detachment did not remove the thick cortex and expose the material's interior, so this is a tentative identification. Nine cores were flaked unidirectionally, had cortical platforms, and mostly cortical faces. The smallest of these was a worked chert pebble, whereas the largest were quartzite and basalt cobbles. Chert, chalcedony, and jasper pebbles like those used to manufacture the small core can be found in nearby Gold Creek. The small size of these pebbles, however, limited the reduction strategies to bipolar or percussion-splitting. Furthermore, the small size of these pebbles limited the size of the flakes that could be produced. Only two cores had multiple flake series removed from several platforms (multidirectional). Together, these cores represented the production of flakes for tool blanks. Cores were found in two key proveniences. Three were found inside the Feature 1 field house along with a hammer stone. Four other cores and one hammer stone were recovered from the adjoining Feature 2. The other specimens were distributed across the general-site surface.

Debitage

The debitage from this site consisted of 143 specimens (see Tables 37 and 39). All of them appear to have been produced during flake-core reduction. Nearly 40 percent of the debitage was made of basalt (predominately the darker basalt) and a little over 15 percent from rhyolite (see Table 44). Quartzite was used as often as rhyolite, but the other identified materials were apparently only seldom used. About two-thirds of the debitage was cortical, and about 30 percent of the flakes had cortical platforms. This suggests that the primary and secondary stages of core reduction occurred frequently on site.

There were 82 complete flakes that measured 38.8 mm long on average and ranged between 89.2 and 13.2 mm in maximum dimension. The cores were considerably larger and were 78 mm long on average; therefore, they likely yielded much larger flakes than those collected. This suggests that tool blanks were produced on site and then transported elsewhere. Smaller decortication flakes were found near the Feature 1 field house. CU 44, located to the south of the field house, produced 24 pieces of debitage and 3 cores. The density of artifacts in this area appears to indicate a work area or toss zone.

Ground Stone Artifacts

Manos

All four of the recovered manos (see Table 40) were made of granitic material and were unifacially worn. They were 161–180 mm long, and two of them were rectangular and exhibited trough wear on both ends. Another of the manos was round in plan view and was heavily used on one surface. The remaining mano was an unshaped cobble that was heavily worn on one surface. These different types of manos indicate that a variety of plant-food processing techniques may have been used at this site.

Table 44. Number of Stone Artifacts from Site 404/2011, by Material Type

Artifact Type	Igneous					Sedimentary			Metamorphic				Cryptocrystalline Silicate			Total
	Basalt	Rhyolite	Granite	Andesite	Indeterminate Igneous	Mudstone	Siltstone	Conglomerate	Quartzite	Meta-sedimentary	Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	
Flaked stone																
Core	2	3	—	—	—	1	—	—	4	—	—	—	—	1	1	12
Tested cobble	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Modified flake	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Debitage	58	23	—	1	1	1	4	—	20	7	9	2	4	6	7	143
Subtotal	60	26	—	1	1	2	4	—	25	7	9	2	4	8	8	157
Ground stone																
Mano	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	4
Metate	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Subtotal	—	—	4	—	—	—	—	1	—	—	—	—	—	—	—	5
Other																
Hammer stone	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	2
Total	60	26	4	1	1	2	4	1	26	8	9	2	4	8	8	164

Metates

A complete trough metate that was 490 mm long, 460 mm wide, and 90 mm thick was recovered from the fill of the Feature 1 field house. It was made from a local conglomerate that has distinctive jasper inclusions, but we were unable to locate the geologic source of this distinctive material.

Other Artifacts

Hammer Stones

Two hammer stones were recovered (see Table 42). The size and shape of both is consistent with hammer stones used for the reduction of flake cores. One was collected from the fill of the Feature 1 field house. The other was a recycled metasediment core that was recovered from Feature 2.

Summary

Many of the stone artifacts from Site 404/2011 were from the Feature 1 field house and the adjoining Feature 2 (see Tables 39 and 40). The excavation of the Feature 1 field house recovered almost 30 percent of the collection from this site. Most of the flakes from the field house were complete, and the frequency of complete flakes and the variety of lithic materials from this feature suggest that flake blanks were collected and stored inside it. Furthermore, the flake fragments from the feature suggest that some reduction may have occurred within the structure.

The artifacts from Feature 2 included 4 cores, 1 hammer stone, 37 flakes, and 1 mano. These artifacts constitute 26 percent of the site lithic collection. Most of the flakes from Feature 2 were complete and were made from many different materials. They likely represented a reduction area. This inference was also supported by the presence of a hammer stone and several partially reduced cores from the same context.

Ground stone artifacts from this site had been intensively used and resharpened. The ground stone implements found within the Feature 1 field house were likely cached there by the site's last inhabitants. Artifacts from the fill of the field house were either intentionally discarded or cached for later use. Given that most of the tools were still usable, it is unlikely that they represented a disposal event. As such, they appear to have been cached items.

The Vegas Ruin (AZ U:3:405/2012)

Excavators identified three occupational episodes at the Vegas Ruin (see Volume 1, Chapter 5). The earliest period of occupation was identified as an activity area associated with four large roasting features. These roasting pits were situated beneath calcic soil, suggesting they dated to the Archaic period (see Volume 1). The second occupational context was associated with jacal-walled pit structures typical of the pre-Classic–Classic period transition in Tonto Basin (Shelley and Ciolek-Torrello 1994). The last occupation of the site included the construction of a cobble-adobe-foundation compound that was partially exposed at the surface.

A total of 4,274 stone artifacts were recovered from the Vegas Ruin, and this collection was sampled for analysis purposes in an attempt to reduce the amount of potentially redundant data. This sample consisted of 1,146 flaked stone artifacts, 135 ground stone artifacts, 26 ornaments, and 139 "other" stone artifacts (see Table 37). Together, these 1,446 artifacts constitute 33.8 percent of the site collection (Table 45). The 1,446 artifacts selected for analysis included all of the recovered diagnostic artifacts, all artifacts from controlled feature excavations and wet-screen and flotation samples, and a 50 percent sample of the debitage specimens recovered from test-pit excavations. The 50 percent sampling of the test-pit debitage involved sorting the specimens through a series of nested screens (2-, 1-, ½-, and ¼-inch) and gathering half of the specimens from each screen fraction. This was done to minimize the inspection of potentially redundant data, because it was clear during the test-pit excavations and during the nested screening that the collection consisted exclusively of relatively large, flake-core-reduction debris. As such, this sampling strategy still allowed us to address our questions concerning prehistoric stone technology, chronology, and cultural affiliation, as outlined in our data recovery plan (Ciolek-Torrello and Klucas 1999:39).

The flaked stone tools included projectile points, cores, bifaces, modified flakes, scrapers, burins, burin spalls, drills, tabular knives, and tested cobbles. Ground stone artifacts included manos, metates, a metate preform, hoes, polishing stones, an axe, a shaft straightener, a pestle blank, and a stone disk. The recovered ornaments included pendants, pendant blanks, beads, disks, perforated disks, and a ring. Hammer stones, discussed under "other artifacts," could be associated with flaked stone production, ground stone production, or bipolar reduction. Anvils are also discussed under other artifacts.

Flaked Stone Artifacts

Projectile Points

The vast majority (about 85 percent) of projectile points recovered from CCP sites were from the Vegas Ruin (see Table 37; examples shown in Figure 30), and approximately

Table 45. Flaked Stone Artifact Distribution at Vegas Ruin (405/2012)

Context	Projectile Point	Biface	Uniface	Drill/ Perforator	Scraper	Core	Tested Cobble	Modified Flake	Burin	Burin Spall	Debitage	Spall	Tabular Knife	Total
							Nonfeature							
Surface	1	—	—	—	—	1	—	—	—	—	—	—	—	2
Stripping units	—	1	1	—	8	15	—	10	1	—	7	—	1	44
Test pits	1	—	—	—	3	7	—	2	2	—	77	2	—	94
Wall trenches	1	—	—	1	—	2	—	—	—	—	—	—	—	4
Subtotal	3	1	1	1	11	25	—	12	3	—	84	2	1	144
							Feature							
Adobe-lined pit F 56	—	—	—	—	—	—	—	—	—	—	2	—	—	2
Adobe-lined pit F 189	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Borrow pit F 22	—	—	—	—	—	—	—	—	—	—	11	—	—	11
Borrow pit F 195	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Burial plot F 221	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Burial plot F 223	—	—	—	—	—	—	—	—	—	—	4	—	—	4
Burial F 12	6	—	—	—	—	1	—	—	—	—	2	—	—	9
Burial F 14	2	—	—	—	—	—	—	—	—	—	—	—	—	2
Burial F 21	—	—	—	—	—	—	—	1	—	—	20	—	—	21
Burial F 33	16	—	—	—	—	—	—	—	1	—	—	—	—	17
Burial F 49	1	—	—	—	—	—	—	1	—	—	19	—	—	21
Burial F 101	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Burial F 102	1	—	—	—	—	—	—	—	—	—	1	—	—	2
Burial F 103	1	—	—	—	—	—	—	—	—	—	6	—	—	7
Burial F 106	—	—	—	—	—	—	—	—	—	—	2	—	—	2
Burial F 137	24	—	—	—	1	4	—	11	—	1	8	—	—	49
Burial F 140	1	—	—	—	—	—	—	—	—	—	2	—	—	3
Burial F 141	—	—	—	—	—	—	1	—	—	—	5	—	—	6
Burial F 144	—	—	—	—	—	—	—	—	—	—	2	—	—	2

Table 45. Flaked Stone Artifact Distribution at Vegas Ruin (405/2012) (*continued*)

Context	Projectile Point	Biface	Uniface	Drill/ Perforator	Scraper	Core	Tested Cobble	Modified Flake	Burin	Burin Spall	Debitage	Spall	Tabular Knife	Total
	Feature (*continued*)													
Burial F 145	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Burial F 146	—	—	—	—	—	—	1	—	—	—	3	—	—	4
Burial F 164	—	—	—	1	—	—	—	—	—	—	2	—	—	3
Burial F 168	—	—	—	—	—	2	—	—	—	—	2	—	—	4
Burial F 181	—	—	—	—	—	—	—	—	—	—	4	1	—	5
Burial F 196	2	—	—	—	—	—	—	—	—	—	—	—	—	2
Burial F 207	—	—	—	—	—	—	1	—	—	—	3	—	—	4
Burial F 220	—	—	—	—	—	1	—	—	—	—	10	—	—	11
Compound F 1	1	—	—	—	5	14	—	11	—	—	—	—	—	31
Midden F 10	—	1	—	1	—	9	3	6	—	1	336	—	—	357
Partially enclosed space F 54	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Pit F 63	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Pit F 158	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Pit structure F 19	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fill	1	—	—	—	—	1	—	1	1	—	38	—	1	43
Floor	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Hearth F 19.1	—	—	—	—	—	—	—	1	—	—	2	—	—	3
Hearth F 19.4	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Pit structure F 34	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fill	—	—	—	—	—	3	2	2	1	—	49	—	—	57
Floor	—	—	—	—	—	2	—	—	—	—	—	—	—	2
Hearth F 34.32	—	—	—	—	—	—	—	—	—	—	4	—	—	4
Pit structure F 99	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fill	1	—	—	—	—	1	—	—	—	—	7	—	—	9
Hearth F 99.25	—	—	—	—	—	—	—	—	—	—	1	—	—	1

Table 45. Flaked Stone Artifact Distribution at Vegas Ruin (405/2012) (*continued*)

Context	Projectile Point	Biface	Uniface	Drill/ Perforator	Scraper	Core	Tested Cobble	Modified Flake	Burin	Burin Spall	Debitage	Spall	Tabular Knife	Total
	Feature (*continued*)													
Pit structure F 179	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fill	2	1	—	—	—	3	—	2	—	—	100	—	—	108
Floor	—	—	—	—	—	—	—	—	—	—	6	—	—	6
Pit F 179.62	—	—	—	—	—	—	—	—	—	—	9	—	—	9
Roasting pit F 154	—	—	—	—	—	—	—	—	—	—	21	—	—	21
Roasting pit F 162	—	—	—	—	—	—	—	—	—	—	5	—	—	5
Roasting pit F 15	—	—	—	—	—	—	—	—	—	—	10	—	—	10
Roasting pit F 16	—	—	—	—	—	—	—	—	—	—	8	—	—	8
Roasting pit F 132	—	—	—	—	—	—	—	—	—	—	32	—	—	32
Roasting pit F 183	—	—	—	—	—	—	—	—	—	—	7	—	—	7
Roasting pit F 159	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Roasting pit F 180	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Room F 11	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fill	2	—	—	—	3	3	1	—	2	—	51	—	2	64
Floor	—	—	—	—	—	2	—	—	—	—	2	—	—	4
Hearth F 11.1	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Hearth F 11.2	—	—	—	—	—	—	—	—	—	—	3	—	—	3
Subtotal	64	2	—	2	9	48	9	36	—	—	819	—	4	1,002
Total	67	3	1	3	20	73	9	48	9	2	903	3	5	1,146

Key: F = feature.

Note: Measurements provided were taken from all analyzed artifacts.

one-third of these were recovered from a single burial (Feature 137). A total of 67 projectile points was recovered and identified types included single examples of San Pedro and Elko Corner-notched dart points and a variety of Formative period arrow-point styles (see Table B.2.1). Originally defined by Sayles and Antevs (1941), San Pedro points are common throughout southern and central Arizona, and they are a diagnostic artifact of the Cochise Culture of southeastern Arizona. Elko Corner-notched points generally have a more northerly distribution and were made over a significantly longer period of time. These points are best interpreted as heirlooms that were collected and brought to the site. Alternatively, the presence of both San Pedro and Elko Corner-notched types suggests that people familiar with these two projectile point technologies were affiliated with the occupants of the Vegas Ruin. This is unlikely, however, given that the majority of the projectile points recovered were Formative period bow-and-arrow forms.

The Formative period projectile points from the Vegas Ruin consisted entirely of Sedentary and Classic period styles. Following Sliva's (1997) classification, Sedentary Side-notched (46.3 percent) and Classic Side-notched (32.8 percent) were the most commonly recovered point styles at the Vegas Ruin. Only one early Classic Side-notched point was recovered; however, a variety of other arrow-point styles were included in the collection. These included Classic Concave-base Triangular, Classic Serrated, and Classic Triangular. Most of these arrow points were intentionally placed in burials—24 were interred with burial Feature 137 alone—or recovered from the fill of pit structures and rooms (see Table B.2.1).

Fine-grained materials were most often used to make the projectile points (Table 46). Chert was observed most frequently (78 percent), followed by chalcedony (12 percent), basalt (5 percent), jasper (3 percent), and quartzite and quartz (1 percent each). Differential surface luster on 15 percent of the points indicated that the flakes blanks had been heat treated before point manufacture.

Bifaces

One percussion-flaked, basalt biface fragment was recovered from the Vegas Ruin. It was broken during the reduction process. Biface reduction is not commonly associated with Formative period technologies. The proximal portion of a bifacial jasper knife was also recovered from a test pit placed in the Feature 10 midden.

Cores

A total of 73 cores were recovered from various contexts at the Vegas Ruin (see Table 45). Three different types of cores were recognized: bipolar cores (13 percent), unidirectional cores (27 percent), and multidirectional cores (60 percent). The materials utilized for single-direction-flake cores were basalt (60 percent), rhyolite (25 percent), chert (10 percent), and quartzite (5 percent). Multidirectional flake cores were made of basalt (37 percent), rhyolite (30 percent), chert (21 percent), metasandstone (7 percent), and quartzite (5 percent). Bidirectional-flake cores were made from finer-grained materials such as chert (86 percent) and rhyolite (14 percent). Finally, obsidian marekanites, "Apache tears," were the only specimens that underwent bipolar reduction. This indicates a desire to access even small amounts of high-quality tool stone.

It was assumed that some of these core types actually represented stages of the reduction sequence. If so, it is reasonable to assume that unidirectional cores may represent an earlier stage of reduction when compared to multidirectional cores. In order to evaluate this possibility, the average size of these core types was determined. Bipolar cores were the smallest cores, with an average length of 16.1 mm. On average, the unidirectional cores were 71.1 mm long, the bidirectional cores were 41.5 mm long, and the multidirectional cores were 73.9 mm long. The relatively large size of the multidirectional cores does not support the notion that they represented the later stages of core reduction.

Scrapers

Twenty scrapers were recovered from the Vegas Ruin (see Tables 37 and 45). All of the scrapers were made from durable, coarse-grained materials. Rhyolite was a particularly preferred material, accounting for 40 percent (n = 8) of the scrapers, followed by basalt (25 percent), chert (20 percent), siltstone (5 percent), quartzite (5 percent), and metasandstone (5 percent). The collection included four types of scraper. Denticulate scrapers occurred most frequently (30 percent), followed by end scrapers and side-and-end scrapers (25 percent each), and side scrapers (20 percent). Scrapers varied between 34.2 and 110.0 cm in length and 17.4 to 75.0 mm in width. Side scrapers and side-and-end scrapers were both 69 mm in length on average. The average length of end scrapers was slightly smaller at 61.8 mm and denticulate scrapers were the smallest at 58.9 mm in length.

Modified Flakes

Forty-eight modified flakes were included in the analyzed samples from the Vegas Ruin (see Table 45). These included nine types of tools, including pressure modified (23 percent), unifacially retouched (19 percent), bifacially retouched (19 percent), notched (8 percent), denticulate (6 percent), and edge utilized (25 percent). Materials used to make these tools included chert (50 percent), rhyolite (21 percent), basalt (21 percent), metasandstone (4 percent), and chalcedony (4 percent). Nearly all of the pressure-modified flakes were made from chert flakes, and most of these (80 percent) were heat treated before they were pressure flaked.

The different types of modified flakes have similar average lengths; the only difference noted was that the average length of notched (40.1 mm) and denticulate (31.9 mm) flakes were the smallest. The remainder of the modified-flake types were very similar in length, being about 50–57 mm long on average. These measurements may record the length at which these tools were no longer easily used.

Drills

Excavations at the Vegas Ruin yielded three drills (see Table 45). Two were bifacially flaked; the other was made from a burin spall, and each of them was likely used for different tasks. One of the bifacially flaked drills was likely not hafted and was used to drill relatively large holes, whereas the other bifacially flaked drill had an acute tip likely used to make small perforations. The burin spall could have only made small perforations. The bifacial drill was made from quartz, and the burin-spall drill was made from chert.

Burins and Burin Spalls

Nine burins and two burin spalls were recovered from the Vegas Ruin (see Table 37). Eight of the burins were intact, and they measured 47.4 mm long on average. They were made from chert (34 percent) and basalt, quartzite, and rhyolite (all 22 percent). The selection of these materials focused on fine-grained materials with a relatively high silica content. One chert and one basalt burin spall were also recovered. The basalt specimen was complete, but only the distal end of the chert specimen was recovered. The recovery of burins and burin spalls indicates a need for small tools such as drills. These kinds of tools may reflect ornament production. Interestingly, one of the burins was placed in the Feature 101 burial, whereas one of the burin spalls was placed in the Feature 137 burial. The other burins or burin spalls were recovered from secondary fill deposits found in rooms, pit structures, or the Feature 10 midden.

Debitage

Debitage dominated the Vegas Ruin flaked stone collection (n = 903) (see Table 37). Most of the flakes represented flake-core reduction (78 percent), followed by bifacial reduction (3 percent) and ground stone debitage (1 percent). The remaining specimens could not be confidently assigned to a reduction industry. The flake-core reduction used a wide range of materials; the most frequently observed was basalt, followed by chert, rhyolite, and quartzite (see Table 46). Bifacial reduction seemingly focused on the use of chert (44 percent), quartz (36 percent), chalcedony (12 percent), and small amounts of jasper and white quartz (4 percent each). Debitage was found in practically all of the features and recovery contexts at the Vegas Ruin. It was most plentiful in the Feature 10 midden, followed by the fill of the Feature 19, 34, and 179 pit structures and the Feature 11 cobble-adobe-foundation room. Debitage was only rarely recovered from floor contexts or from burial fill (see Table 45).

Tabular Knives

Six tabular knives were recovered from the Vegas Ruin, including two from the Feature 19 pit structure and two from the Feature 11 room (Table B.2.3). One of those recovered from Feature 19 was made from a piece of tabular rhyolite. The other three were made from a gray schist. All of them exhibited continuous unifacial or bifacial retouch along at least one working margin. The rhyolite specimens from Feature 19 rested in direct contact with the structure floor and may have represented de facto refuse. The other specimens were recovered from the upper fill of the features from which they were collected.

Ground Stone Artifacts

A total of 136 ground stone artifacts were recovered, including manos, metates, hammer stones, ground stone production debitage, polishing stones, perforated stone disks, blanks, an anvil, an axe, a shaft straightener and some indeterminate fragments (Table 47; see Table 37).

Manos

The Vegas Ruin contained 73 manos, including loaf, oval, and indeterminate types (Table 48). The loaf manos were nearly twice as numerous as the other mano types. Given their relatively large size (i.e., two-handed) and the fact that they consistently exhibited end wear, they were likely used with the relatively large number of trough metates found at the site. The oval manos were small, lacked end wear, and were most likely used with basin or slab metates. A wide range of materials were used to make the loaf manos, but granite (32 percent), metavolcanic materials (22 percent), and rhyolite (16 percent) were used the most often (see Table 46). Other identified loaf-mano materials included conglomerate (9 percent), sandstone (6 percent), quartzite (6 percent), basalt (3 percent), volcanic tuff (3 percent), and andesite (3 percent). A similar range of materials was used for the oval

Table 46. Number and Percentage of Different Artifact Types from Vegas Ruin (405/2012), by Material Type

Artifact Type	Igneous														Sedimentary										Metamorphic														Cryptocrystalline Silicate						Mineral										Total (n)
	Obsidian		Basalt		Rhyolite		Granite		Andesite		Porphyritic Andesite		Volcanic Tuff		Limestone		Sandstone		Siltstone		Conglomerate		Indeterminate Sedimentary		Quartzite		Schist		Metasandstone		Metasediment		Metavolcanic		Porphyritic Metavolcanic		Indeterminate Metamorphic		Chalcedony		Jasper		Quartz		Hematite		Argillite		Steatite		Steatite		Turquoise		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Flaked stone																																																							
Projectile point	—	—	3	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1.5	—	—	—	—	—	—	—	—	—	—	—	—	8	11.9	52	77.6	2	3.0	1	1.5	—	—	—	—	—	—	—	—	67
Biface	—	—	2	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Uniface	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Drill/perforator	—	—	1	33.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	33.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	33.3	—	—	—	—	—	—	—	—	—	—	—	—	3
Scraper	—	—	5	25.0	8	40.0	—	—	—	—	—	—	—	—	—	—	—	—	1	5.0	—	—	—	—	—	—	—	—	1	5.0	—	—	—	—	—	—	—	—	—	—	4	20.0	—	—	1	5.0	—	—	—	—	—	—	—	—	20
Core	2	2.7	28	38.4	19	14.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	4.1	—	—	—	—	—	—	—	—	—	—	18	24.7	—	—	3	4.1	—	—	—	—	—	—	—	—	73
Tested cobble	—	—	2	22.2	1	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	22.2	—	—	—	—	—	—	—	—	—	—	4	44.4	—	—	—	—	—	—	—	—	—	—	—	—	9
Modified flake	—	—	10	20.8	10	7.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	4.2	—	—	—	—	—	—	—	—	2	4.2	24	50.0	—	—	—	—	—	—	—	—	—	—	—	—	48
Burin	—	—	2	22.2	2	22.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	33.3	—	—	2	22.2	—	—	—	—	—	—	—	—	9
Burin spall	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	—	—	2
Debitage	—	—	439	48.6	94	69.6	—	—	29	3.2	—	—	—	—	1	0.1	5	0.6	2	0.2	—	—	—	—	21	2.3	—	—	10	1.1	12	1.3	1	0.1	1	0.1	—	—	28	3.1	166	18.4	10	76.9	84	9.3	—	—	—	—	—	—	—	—	903
Spall	—	—	1	33.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	66.7	—	—	—	—	—	—	—	—	—	—	—	—	3
Tabular knife	—	—	—	—	1	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	66.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	7.7	—	—	—	—	—	—	—	—	—	—	6
Subtotal	2	0.2	495	43.2	135	11.8	—	—	29	2.5	—	—	—	—	1	0.1	5	0.4	3	0.3	—	—	—	—	23	2.0	4	0.3	18	1.6	12	1.0	1	0.1	1	0.1	—	—	38	3.3	275	24.0	13	1.1	91	7.9	—	—	—	—	—	—	—	—	1,146
Ground stone																																																							
Mano	—	—	6	8.2	8	11.0	24	32.9	1	1.4	1	1.4	1	1.4	—	—	8	11.0	1	1.4	5	6.8	—	—	—	—	—	—	—	—	1	1.4	7	9.6	—	—	—	—	—	—	—	—	—	—	10	13.7	—	—	—	—	—	—	—	—	73
Metate blank	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Metate	—	—	—	—	2	5.0	12	30.0	—	—	—	—	—	—	—	—	9	22.5	—	—	11	27.5	—	—	—	—	1	2.5	1	2.5	—	—	—	—	—	—	1	2.5	—	—	—	—	—	—	3	7.5	—	—	—	—	—	—	—	—	40
Pestle blank	—	—	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Hoe	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Discoid	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	1	50.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Axe	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Polishing stone	—	—	1	33.3	—	—	2	66.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Shaft straightener	—	—	—	—	1	16.7	—	—	—	—	—	—	1	16.7	1	16.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	50.0	—	—	6
Indeterminate ground stone	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	50.0	—	—	—	—	1	16.7	—	—	—	—	2	33.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Subtotal	—	—	9	6.7	12	8.9	39	28.9	1	0.7	1	0.7	2	1.5	5	3.7	17	12.6	1	0.7	17	12.6	—	—	—	—	4	3.0	1	0.7	1	0.7	8	5.9	—	—	1	0.7	—	—	—	—	—	—	13	9.6	—	—	—	—	3	2.2	—	—	135
Ornament																																																							
Bead	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	20.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	20.0	1	20.0	2	40.0	5
Pendant	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	33.3	—	—	8	66.7	12

Table 46. Number and Percentage of Different Artifact Types from Vegas Ruin (405/2012), by Material Type (*continued*)

Artifact Type	Igneous														Sedimentary										Metamorphic														Cryptocrystalline Silicate						Mineral										Total (n)
	Obsidian		Basalt		Rhyolite		Granite		Andesite		Porphyritic Andesite		Volcanic Tuff		Limestone		Sandstone		Siltstone		Conglomerate		Indeterminate Sedimentary		Quartzite		Schist		Metasandstone		Metasediment		Metavolcanic		Porphyritic Metavolcanic		Indeterminate Metamorphic		Chalcedony		Jasper		Quartz		Hematite		Argillite		Steatite		Steatite		Turquoise		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Ornament (*continued*)																																																							
Pendant blank	—	—	—	—	1	16.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	66.7	—	—	—	—	6
Perforated disk	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Ring	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	100	—	—	—	—	1
Subtotal	—	—	—	—	1	3.8	—	—	—	—	—	—	—	—	1	3.8	—	—	—	—	—	—	—	—	—	—	3	11.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	38.5	1	3.8	10	38.5	26
																																		—	—	—	—	—	—															
Other																																																							
Anvil	—	—	2	40.0	1	20.0	—	—	—	—	—	—	—	—	—	—	1	20.0	1	20.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Hammer stone	—	—	73	57.0	20	15.6	4	3.1	—	—	—	—	—	—	1	0.8	4	3.1	—	—			1	0.1	4	3.13	—	—	2	1.6	—	—	2	1.6	—	—	—	—	—	—	1	0.8	—	—	16	11.7	—	—	—	—	—	—	—	—	128
Manuport	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	—	—	—	—	1	16.7	3	50.0	—	—	1	16.7	—	—	6
Subtotal	—	—	75	53.6	21	15.0	4	2.9	—	—	—	—	—	—	1	0.7	5	3.6	1	0.7	—	—	1	0.8	4	2.9	—	—	2	1.4	—	—	2	1.4	—	—	—	—	1	0.7	1	0.7	—	—	17	4.3	3	2.1	—	—	1	0.7	—	—	139
Total	2	0.1	579	40.0	169	11.7	43	3.0	30	2.1	1	0.1	2	0.1	8	0.6	27	1.9	5	0.3	17	1.2	1	0.1	27	1.9	11	0.8	21	1.5	13	0.9	11	0.8	1	0.1	1	0.1	39	2.7	276	19.1	13	0.9	121	8.4	3	0.2	10	0.7	5	0.3	10	0.7	1,446

Note: Measurements provided were taken from all analyzed artifacts. Subtotal percentages calculated per artifact-class total.

Table 47. Ground Stone Artifact Distribution at Vegas Ruin (405/2012)

Context	Mano		Metate		Metate Blank		Pestle Blank		Axe		Discoid		Hoe		Polishing Stone		Shaft Straightener		Indeterminate Fragment		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
											Nonfeature											
Surface	10	13.7	9	22.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19	14.1
Stripping units	13	17.7	7	17.5	—	—	1	100	—	—	—	—	1	50.0	2	66.7	1	16.7	—	—	25	18.5
Test pits	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	—	—	2	1.5
Wall trenches	1	1.4	1	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	33.3	4	3.0
Subtotal	25	34.2	17	42.5	—	—	1	100	—	—	—	—	1	50.0	2	66.7	2	33.3	2	33.3	50	37.0
											Feature											
Adobe-lined pit F 171	—	—	1	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Borrow pit F 22	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Borrow pit F 195	1	1.4	2	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	2.2
Erosion-control ditch F2	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Burial F 21	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Burial F 33	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Burial F 49	—	—	1	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Burial F 103	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Burial F 137	1	1.4	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	2	33.3	4	3.0
Compound F 1	12	16.3	11	27.5	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	1	16.7	25	18.5
Midden F 10	2	2.7	—	—	—	—	—	—	—	—	2	100	—	—	—	—	1	16.7	1	16.7	6	4.4
Pit F 70	—	—	1	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Pit F107	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Cache F 130	2	2.7	1	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	2.2
Pit structure F 19																						
Structural debris	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Floor	3	4.1	2	5.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	3.7

Table 47. Ground Stone Artifact Distribution at Vegas Ruin (405/2012) (*continued*)

Context	Mano		Metate		Metate Blank		Pestle Blank		Axe		Discoid		Hoe		Polishing Stone		Shaft Straightener		Indeterminate Fragment		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Feature (*continued*)																						
Pit structure F 34																						
Fill	3	4.1	—	—	—	—	—	—	1	100	—	—	—	—	1	33.3	—	—	—	—	5	3.7
Floor	4	5.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	3.0
Pit F 34.2	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Pit structure F 99																						
Fill	2	2.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1.5
Floor	—	—	—	—	—	—	—	—	—	—	—	—	1	50.0	—	—	—	—	—	—	1	0.7
Posthole F 99.35	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.7
Pit structure F 179																						
Fill	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	—	—	1	0.7
Floor	2	2.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1.5
Slab-lined pit F 134	2	2.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1.5
Room F 11																						
Fill	1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	16.7	—	—	2	1.5
Structural debris	1	1.4	2	5.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	2.2
Floor	3	4.1	2	5.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	3.7
Subtotal	48	65.8	23	57.5	1	100	—	—	1	100	2	100	1	50.0	1	33.3	4	66.7	4	66.7	85	63.0
Total	73	100	40	100	1	100	2	100	1	100	2	100	2	100	3	100	6	100	6	100	135	100

Note: Percentages calculated by artifact type.
Key: F = feature.

Table 48. Number and Percentage of Ground Stone Milling Implements from the CCP Sites, by Type

Milling Implement Type	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Oval mano	6	42.9	1	100	1	20.0	22	19.1	—	—	2	16.7	1	14.3	11	15.9	44	19.5
Loaf mano	1	7.1	—	—	2	40.0	38	33.0	1	33.3	5	41.7	1	14.3	19	27.5	67	29.6
Ind. mano	3	21.4	—	—	1	20.0	13	11.3	1	33.3	1	8.3	3	42.9	13	18.8	35	15.5
Basin metate	4	28.6	—	—	—	—	6	5.2	1	33.3	1	8.3	—	—	5	7.2	17	7.5
Slab metate	—	—	—	—	—	—	5	4.3	—	—	1	8.3	—	—	4	5.8	10	4.4
Trough metate	—	—	—	—	1	20.0	23	20.0	—	—	—	—	2	28.6	8	11.6	34	15.0
Metate blank	—	—	—	—	—	—	1	0.9	—	—	—	—	—	—	—	—	1	0.4
Indeterminate metate	—	—	—	—	—	—	6	5.2	—	—	2	16.7	—	—	9	13.0	17	7.5
Pestle blank	—	—	—	—	—	—	1	0.9	—	—	—	—	—	—	—	—	1	0.4
Total	14	100	1	100	5	100	115	100	3	100	12	100	7	100	69	100	226	100

and indeterminate manos, including granite (35 percent), sandstone (22 percent), quartzite (18 percent), as well as andesite basalt conglomerate, metasedimentary, and siltstone (all 5 percent each). The majority of these materials were coarse grained and would have made efficient grinding tools. Regardless of type, granite was the preferred mano material.

Metates

Trough metates were the most numerous type of metate at the Vegas Ruin, followed by basin and slab metates (see Tables 46–48). The remainder were fragments of metates that could not be typed. It is important to note, however, that slab, basin, and trough metates could grade into one another during their use life. No complete basin metates were recovered, but rhyolite was used to make all of them. The complete slab metates were 230 mm long, 141 mm wide, and 56 mm thick on average. Slab metate fragments from the Vegas Ruin were made from either granite or metasandstone. The trough metates were the largest, measuring 411 mm long, 287 mm wide, and 107 mm thick on average. These trough metates were made from the widest range of materials, including conglomerate (43 percent), granite (26 percent), quartzite (9 percent), sandstone (9 percent), as well as rhyolite, schist, and metasediment (4 percent each).

There is a distinction here: sandstone was used most frequently with metates for one-handed manos (e.g., slab and basin); it was used much less frequently with trough metates. The preference for material types is most likely a reflection of the demands placed on the metate during use. Nearly half of the trough metates had portions of the trough border flaked away. Large percussion flakes were detached using the interior surface of the trough border as a platform. Only remnant borders remained in some cases. The trough borders were not removed to produce a different kind of metate, as they were not reused. The trough may have been removed once it became too deep to efficiently use, or the trough may have been adjusted for the size of the manos that were to be used.

Hoes

One metavolcanic and one basalt hoe were recovered (see Table 47). The metavolcanic hoe was nearly complete, whereas only a fragment of the basalt specimen was recovered. The nearly complete example was 226 mm long, 100.2 mm wide, and 31.5 mm thick. The fragment was heavily damaged and appeared to have broken during use.

Ground Stone Blanks

Two artifacts were recovered that were flaked and pecked to form but not used (see Table 47). These included a rhyolite metate blank and one granite pestle blank. Because the intended form could be identified and no use wear was evident, these specimens were classified as blanks.

Polishing Stones

Two granite and one basalt polishing stone were recovered from the Vegas Ruin (see Table 47). One of the granite and the basalt specimens may have been used to work hides. They exhibited a dull polish on their outermost surfaces only, and this kind of wear is often the result of working soft, pliable materials. These possible “hide stones” were 73 mm long, 62 mm wide, and 31 mm thick on average. The other granite specimen was highly polished on one surface and may have been a burnishing tool used to produce pottery. It was 43 mm long, 34 mm wide, and 30 mm thick. It is important to note that a highly polished surface can also develop on a stone used repeatedly to work hides or burnish pottery over a prolonged period. As such, our identification of these artifacts as hide-working stone or burnishing tools is speculative and based solely on the macroscopic condition of the artifacts themselves.

Discoids

Two perforated stone discoids were recovered (see Table 47). Both were from the general-site surface, and one was made from limestone and one from schist.

Axes

A single three-quarter-groove axe was recovered from the Vegas Ruin (see Table 47; Figure 31). A wide range of functions have been assigned to stone axes, ranging from cutting wood to clearing fields (Mills 1993) to digging clay (Haury 1945). They have also been thought to have served as hammers for the production of metates or masonry blocks (Hough 1918; Russell 1908; Woodbury 1954). The axe from the Vegas Ruin was made from basalt with a three-quarter groove. It exhibited heavy battering and flaking, as though the axe was being rejuvenated or in the process of being made.

Shaft Straighteners and Smoothers

Six shaft straighteners were present in the Vegas Ruin collection (see Table 47). All of them were fire affected and had a single U-shaped groove. Half of them were made from steatite, and the remainder from limestone, volcanic tuff, or rhyolite. Soapstone tolerates repeated heating and cooling well. To function as a straightener, these tools would have been heated and then an arrow shaft would have been applied to the heated stone. Three of the shaft straighteners were complete, and they were 94 mm long, 64 mm wide, and 47 mm thick on average. Use polish was noted in the grooves.

Other Artifacts

Hammer Stones

A total of 128 hammer stones were recovered from the Vegas Ruin, and they were the second most numerous artifact type in the site collection (see Tables 37 and 42). Three types of hammer stones were observed: flaked stone (55 percent), ground stone (28 percent), and indeterminate specimens (17 percent). Most of the flaked stone hammer stones were basalt. Rhyolite, quartzite, sandstone, granite, chert and an unknown sedimentary material were used to make the other flaked stone hammer stones. They ranged in length from 34.5 mm to 118.8 mm. The relatively large number of hammer stones from the Vegas Ruin indicates that the reduction of cores and the maintenance (or production) of ground stone tools were important site activities.

An angular, chisel-shaped working end distinguished the ground stone type of hammer stone. These hammer stones possess flaked wedge-shaped impact zones. Schneider (1993) has maintained that this design was deliberate, to concentrate the blow of the hammer stone on a pestle or metate preform. As with the Vegas Ruin specimens, the bits of such hammer stones were heavily battered and easily recognizable. Nearly all of the hammer stones used to fashion ground stone implements were complete, and they measured 419 mm long, 79 mm wide, and 51 mm thick on average. Lengths ranged from 60.7 mm to 242.0 mm. Basalt (58 percent) and quartzite (11 percent) were the favored material for hammer stones used to make or maintain ground stone implements. Other materials used to make ground stone hammers included rhyolite, quartz, metavolcanic materials, granite, and limestone.

Anvils

Five anvils were included in the sample analyzed from the Vegas Ruin (see Table 42). Among these was a single pottery anvil recovered from the fill of the Feature 34 pit structure. Potter's anvils were used in conjunction with paddles to shape clay during the production of pottery. Made of basalt, the specimen from the Vegas Ruin was 65.9 mm long, 48.7 mm wide, and 42.8 mm thick.

The other four anvils appeared to have been used in concert with a percussor, probably during core reduction. They exhibited concentrated battering on their planar surface. One of these was from the fill of the Feature 99 pit structure, two were incorporated into the Feature 1 compound walls, and another was recovered during mechanical stripping. The presence of these anvils suggests that bipolar reduction was a frequently used method of reduction.

Ornaments

Ornaments from the Vegas Ruin included beads, pendants and pendant blanks, and a ring (Table B.2.4; Figures 32, 33–35, and 36). The beads were made from steatite, argillite, or turquoise. They were recovered from five burials, one pit structure, and one roasting pit. All of them were complete. Beads made from steatite and argillite were tubular, whereas those made of turquoise were either geomorphic or disk shaped. Turquoise and argillite were the favored materials used to make pendants. Most of the pendants were associated with burials; only two were recovered from a pit structure and

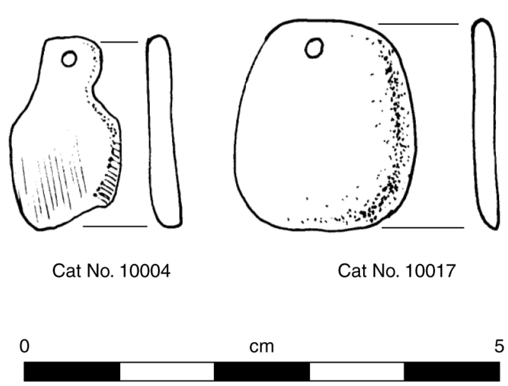

Figure 32. Turquoise pendants from the Feature 220 inhumation, Vegas Ruin (405/2012).

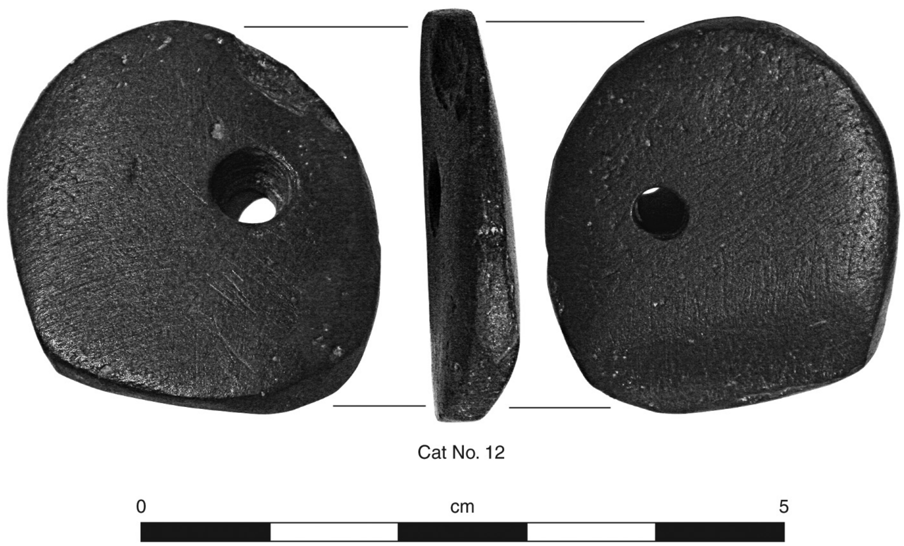

Figure 33. Irregular argillite pendant from the Feature 106 inhumation, Vegas Ruin (405/2012).

Figure 34. Steatite bead from the Feature 137 inhumation, Vegas Ruin (405/2012).

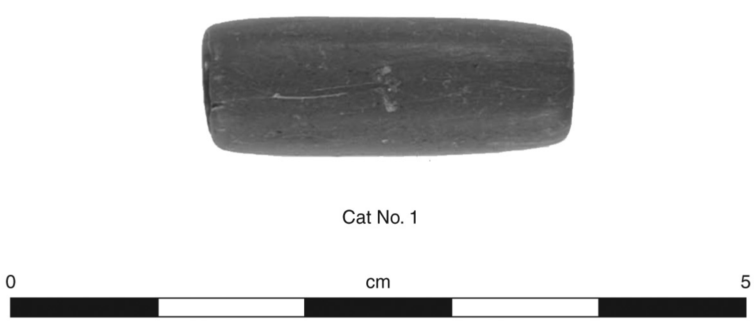

Figure 35. Red argillite tube bead from the Feature 146 inhumation, Vegas Ruin (405/2012).

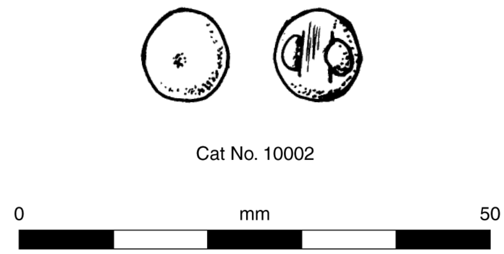

Figure 36. Turquoise bead from the Feature 196 inhumation, Vegas Ruin (405/2012).

one each from the Feature 22 and 97 borrow pits. The pendant shapes included rectangular, trapezoidal, oval, and geomorphic. Five pendant blanks were also recovered: four were made from argillite and one was made of schist. Pendant blanks were recovered from Feature 136, the Feature 1 compound, and from pit structures. A D-shaped argillite ring fragment was recovered from the Feature 10 midden. It appears to have been about 18 mm in diameter and was well polished, likely from being worn.

Summary

Excavations at the Vegas Ruin resulted in the collection of 4,274 stone artifacts—the largest and most diverse collection among the project sites. Of these, 1,446 artifacts underwent detailed analysis. The 67 projectile points gathered from the Vegas Ruin, particularly the numerous Sedentary Side-notched arrow points, suggest that it was occupied during the pre-Classic–Classic period transition. Most of these arrow points were associated with burials. Ground stone artifacts formed a significant portion of the stone tool collection and it appears that plant-food processing was an important site activity. In particular, the prevalence of trough metates and loaf manos suggests that the milling of maize was a frequent activity. An elaborate ornament industry, represented by beads, pendants, and a ring, was also encountered. These ornaments were made from turquoise, perhaps locally obtained, and argillite, which may have also been acquired locally.

Bifacial and flake-core technologies were used at the Vegas Ruin. Biface reduction most frequently relied on heat-treated chert and chalcedony flake blanks driven from locally available nodules. A great deal of skill was required to make the recovered projectile points, many of which were remarkably uniform in their size and shape. This suggests that projectile point manufacture was a specialized-craft activity. The other cutting, scraping, and chopping implements at the Vegas Ruin were fashioned from local materials using a flake-core-reduction strategy. Large, often retouched, partially cortical flakes made from durable quartzite and basalt were most commonly used to work perishable materials. These modified flakes, along with the relatively large number of scrapers and choppers, indicate that perishable materials were routinely worked on site.

AZ U:3:406/2013

This site was initially recorded as a multilocus artifact scatter (Hoffman 1991:43). The surface of the site was collected (Figure 37), and no subsurface deposits were identified (see Volume 1). Our data recovery resulted in the collection of 162 stone artifacts (see Table 37). All of the artifacts collected were analyzed. The flaked stone artifacts recovered included 4 core tools, 123 pieces of debitage, 25 modified flakes, 2 scrapers, and 1 tested cobble (see Table 39). The ground stone artifacts included 2 manos, 1 metate, and 1 borer (see Table 40). Two hammer stones were also collected (see Table 42). Basalt was the most common material used, followed by quartzite, a red siltstone, and metavolcanic materials (Table 49). Other artifacts were occasionally made of andesite, gneiss, metavolcanic, quartz, rhyolite, and shale. High-quality tool stone such as chert, chalcedony, and jasper were rare, representing only 11 percent of the site collection.

Flaked Stone Artifacts

Choppers

One green, basalt flake chopper (length 136 mm) was recovered from the general-site surface. It was bifacially flaked and bore a heavily damaged working margin.

Scrapers

Two scrapers made from percussion-retouched flakes were recovered from the site surface (see Tables 39 and B.2.2). One

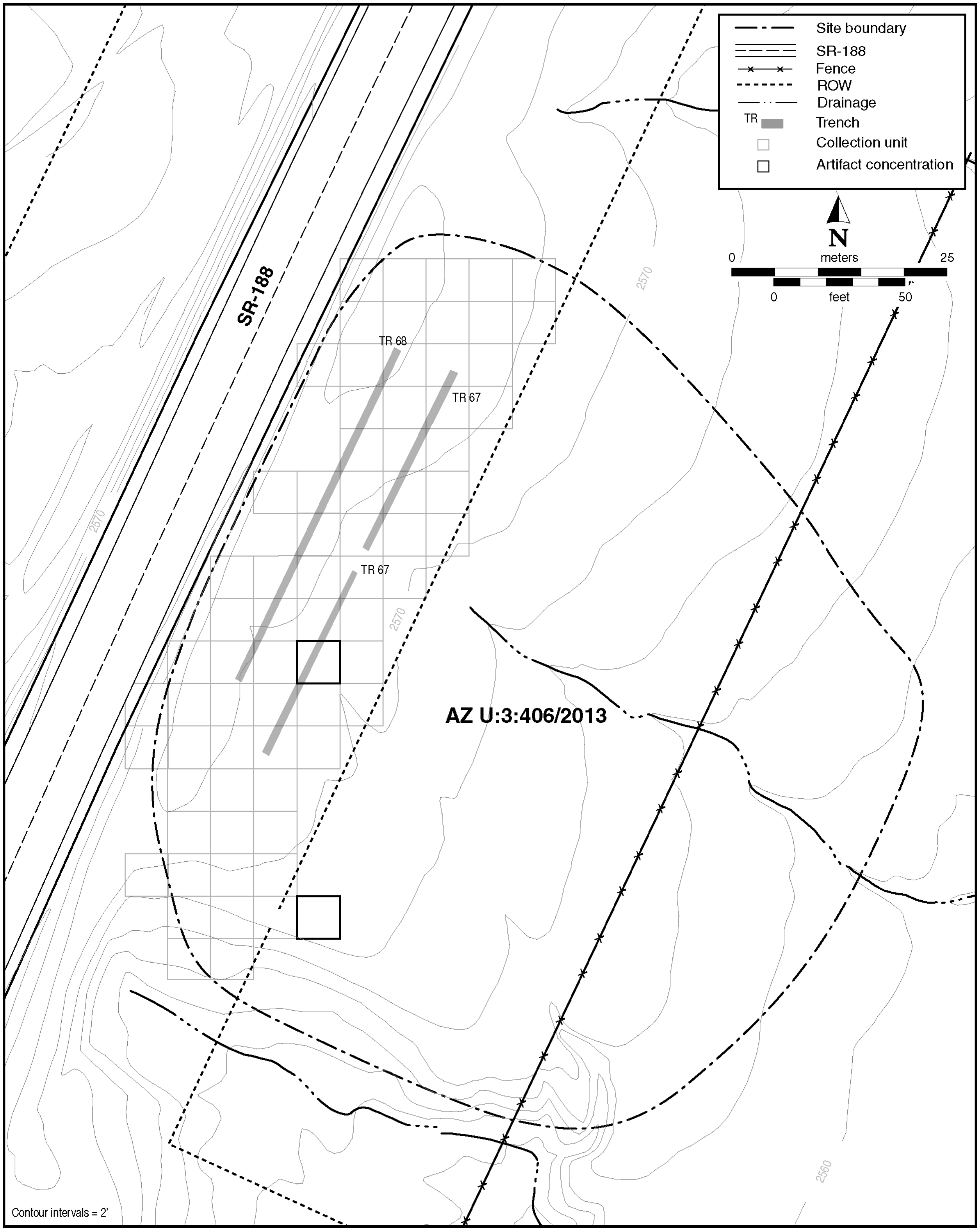

Figure 37. Location of artifact concentrations at Site 406/2013.

Table 49. Number of Stone Artifact Types from Site 406/2013, by Material Type

Artifact Type	Igneous				Sedimentary		Metamorphic						Cryptocrystalline Silicate			Mineral		Total
	Basalt	Rhyolite	Andesite	Porphyritic Andesite	Sandstone	Siltstone	Quartzite	Shale	Metasedimentary	Metavolcanic	Porphyritic Metavolcanic	Gneiss	Chalcedony	Chert	Jasper	Quartz	Chlorite	
Flaked stone																		
Scraper	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2
Chopper	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Core	—	—	—	—	—	1	1	—	2	—	—	—	—	—	—	—	—	4
Tested cobble	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Modified flake	8	2	—	—	2	2	2	—	2	3	—	1	1	1	1	—	—	25
Debitage	52	1	2	1	5	12	10	2	8	11	1	—	1	12	1	3	1	123
Subtotal	62	3	2	1	7	15	14	2	12	14	1	1	2	14	2	3	1	156
Ground stone																		
Mano	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	2
Metate	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Borer/reamer	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Subtotal	1	—	—	—	1	—	1	—	—	—	—	1	—	—	—	—	—	4
Other																		
Hammer stone	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	2
Total	63	3	2	2	8	15	16	2	12	14	1	2	2	14	2	3	1	162

of these was made from a large, basalt flake that was retouched along one steep-angle working margin and also notched along another margin. The other was made from a smaller chert flake and exhibited continuous retouch along one low-angle working margin.

Modified Flakes

Fifteen percent of the site collection consisted of modified flakes, six of which exhibited notches (see Tables 37 and 39). The others exhibited either irregular-percussion retouch or use wear that resulted from the crushing or rounding of the flake edge. Modification occurred most frequently on the lateral and distal margins. Flakes were retouched to sharpen margins that were irregularly shaped or dulled from use. Basalt, quartzite, siltstone, chert, and metavolcanic materials were most commonly used to make scrapers. A wide variety of other materials were also used but to a lesser extent. Very little cortex was observed on the dorsal surfaces of these tools, yet a little over half of them bear cortical platforms. This indicates that the modified flakes were the result of early-stage flake-core reduction. The complete specimens were 52 mm long, 50 mm wide, and 15 mm thick on average, with their length ranging between 90 and 22.5 mm.

Cores and Tested Cobbles

Four cores and one tested cobble were also included in the collection (see Tables 37 and 39). Two of the cores were made from a red metasediment, one from siltstone, and one from a purple quartzite. The red metasedimentary and siltstone cores displayed a systematic approach to reduction. A flat cortical surface was selected as a platform, and flakes were driven from this surface until it was no longer possible to make the large flakes that were the toolmaker's objective. The largest metasediment cores were 100–110 mm in diameter, whereas the siltstone core was 80 mm in diameter. The quartzite core was made from split cobble, measuring 55 mm in diameter, from which several large flakes were then removed. Made of quartzite, the tested cobble had two flake scars terminating in step fractures. These step fractures impeded the further reduction of this small cobble, which likely led to it being discarded.

Debitage

The debitage from this site consisted of 123 specimens, more than 40 percent of which were made of basalt (see Tables 37, 39, and 49). Chert, metavolcanic materials, quartzite, and siltstone were other materials commonly reduced on site. Nearly 80 percent of the debitage had little or no cortex, but over one-half of the flakes had cortical platforms. The flakes, therefore, represent later-stage reduction using elongated cobble cores, where a cortical platform was maintained until the core was exhausted. This same pattern was observed among the modified flakes. Together, this suggests that previously reduced flake cores or large-flake blanks were brought to the site and then further reduced. Nearly 40 percent of the flakes were split from platform to terminus. This could be one reason that these flakes were rejected as tool blanks. Flakes that were split from the platform to the distal terminus were commonly produced from hard-hammer reduction. The frequency of this reduction "error" indicates that late-stage cores were reduced at this site. There were just 34 complete flakes, and they were 37.6 mm long on average, ranging from 12.6 to 73 mm in length. The flake fragments were only 25.5 mm long on average.

Ground Stone Artifacts

Borers

A considerably worn borer made from a basalt flake was recovered from the site surface (see Table 40). It had a heavily abraded bit and was recovered from the site surface.

Manos

Two mano fragments were recovered from this site (see Tables 40 and 48). One was an irregularly shaped quartzite mano that was 150 mm long. It appeared that the grinding surface was being resharpened when it broke. The other was a sandstone loaf mano that exhibited intensive end wear, indicating it was used with a trough metate.

Metates

The final ground stone artifact was a basin metate fragment made from a gneiss boulder (see Tables 40 and 48). It maximum dimension was 235 mm, and it was recovered from the site surface.

Other Artifacts

Hammer Stones

Two hammer stones, including a small quartzite cobble and a small andesite cobble, were recovered from the site surface (see Table 42). Both were complete and exhibited intensive end battering.

Summary

Only three collection units from this site contained more than 10 artifacts; however, when combined with several adjacent units, they probably represent small work areas. One concentration located around CU 24 contained 30 artifacts, and a second concentration located 25 m south (see Figure 37) contained 32 artifacts. The first area contained 2 edge-modified flakes and 28 pieces of debitage. The second area contained 1 scraper, 6 modified flakes, 2 cores, 24 debitage specimens, and 1 broken metate fragment. Both areas had cores and debitage made from several different materials. These concentrations may represent multiple reduction episodes or disposal events. The analysis of the debitage and modified-flake tools indicated that late-stage core reduction and ground stone maintenance occurred at this site. It is likely that the concentrations observed were the result of these behaviors.

The Rock Jaw Site (AZ U:3:407/2014)

The Rock Jaw site was initially characterized as a low-density artifact scatter (Hoffman 1991). Surface collections at the site resulted in the collection of 258 stone artifacts; mechanical stripping resulted in the collection of 2 additional stone artifacts. Excavations yielded an additional 154 artifacts, 137 of which were from the Feature 1 and Feature 3 pit houses. In all, 414 stone artifacts were collected from this site, and all of these were analyzed (Tables 50 and 51; see Table 37). Much of our analysis of these specimens focused on determining if the assemblage from one pit house differed from the assemblage in the other pit house and how these artifacts differed from those collected from the surface. We did this in order to better understand if the stone technology used at this site differed between intramural and extramural spaces or occupational episodes. As such, our examination of the Rock Jaw site lithic collection was tailored to address the overall project goals of understanding tool function, occupational duration, and subsistence (Ciolek-Torrello and Klucas 1999:39).

Twenty-four stone tools were included among the artifacts recovered from the structures. These included projectile points, bifaces, scrapers, tabular tools, modified flakes, a chopper, manos, and metates. Tested cobbles and hammer stones were the only stone tools recovered from the site surface. Debitage accounted for the remaining 80 percent of the site collection. Basalt was used to make 35.5 percent of these artifacts (Table 52). Other commonly used materials included metasandstone, chert, and quartzite. The presence of nonlocal obsidian distinguished this site, whereas the relatively high frequency of metasandstone was similar to what we encountered at Site 406/2013 directly across the roadway. In the following discussion, we present the information about the stone artifacts and then summarize our results by contrasting what was discovered on the surface with what was recovered from the Feature 1 and 3 pit structures.

Flaked Stone Artifacts

Projectile Points

Three projectile points, two of chert and one of obsidian, were found (see Tables 52 and B.2.1). The obsidian and one of the chert points resembled the small, triangular, late prehistoric points typically found in central Arizona. These points were manufactured on small, noncortical flakes by pressure flaking. This retouch straightened the margins and flattened the faces. The points were finished by transverse-parallel pressure flaking. Pressure-flaked notches were then placed along the lateral margin to complete the haft (Whittaker 1984). The obsidian point broke through its notches and was 21.3 mm long, 10.1 mm wide, and 3.1 mm thick. A recent impact fracture removed the tip from the chert point, which was 25.6 mm long, 14.1 mm wide, and 3.9 mm thick. According to Yellen (1977:808), once tools are hafted, these tools and their fragments will accumulate where retooling takes place. The recovery of the distal portion of the obsidian point may then suggest that retooling occurred at this site.

The small, chert, side-notched point (see Figure 30c) appears to have been heat treated. Its notches were situated 6 mm above the point base. Points with higher notches, often located one-third up the margin from the base, are more common in central Arizona (Whittaker 1999:83). Both side-notched forms found at the Rock Jaw site were more carefully and intensively pressure-flaked than most examples of these points (Whittaker 1984:110–119, 1999:83–87).

The second chert point was a corner-notched form with an extended base (see Figure 30o). This specimen appears to have been intensively worked using percussion and then finished using pressure flaking. The extended base was shaped through deep pressure notches placed in the corners of the point preform. This is an uncommon point style, and its affiliations are unclear. Although its extended base is similar to Formative period corner-notch styles, it was, nevertheless, smaller. The point was larger than the other side-notched points, yet still qualified as a small point. It was 27.0 mm long, 12.5 mm wide, and 4.3 mm long.

Bifaces

Three bifaces, two from the site surface and one from the Feature 1 pit house, were recovered. Those from the surface were made from chert and metasandstone. The metasandstone biface had been shaped using percussion, and it

Table 50. Flaked Stone Artifact Distribution at the Rock Jaw Site (407/2014)

Context	Projectile Point	Biface	Drill/ Perforator	Scraper	Chopper	Core	Tested Cobble	Modified Flake	Debitage	Tabular Knife	Hoe	Total
						Nonfeature						
Surface	—	2	1	5	1	15	2	29	200	2	1	258
Stripping units	—	—	—	—	—	2	—	—	—	—	—	2
Subtotal	—	2	1	5	1	17	2	29	200	2	1	260
						Feature						
Hearth F 4	—	—	—	—	—	—	—	—	2	—	—	2
Hearth F 13	—	—	—	1	—	—	—	—	2	—	—	2
Pit F 12	—	—	—	—	—	—	—	—	2	—	—	2
Pit structure F 1												
Cultural	—	—	—	—	—	—	—	—	7	—	—	7
Fill	—	—	—	—	—	—	—	—	1	—	—	1
Floor	1	—	—	—	—	—	1	—	5	—	—	7
Mixed	—	—	—	—	—	—	—	1	9	—	—	10
Roof fall	1	1	—	2	—	—	—	—	41	1	—	46
Floor groove F 1.75	—	—	—	—	—	1	—	—	—	—	—	1
Posthole F 1.15	—	—	—	—	—	—	—	—	3	—	—	3
Posthole F 1.13	—	—	—	—	—	—	—	—	1	—	—	1
Posthole F 1.14	—	—	—	—	—	—	—	—	2	—	—	2
Posthole F 1.19	—	—	—	—	—	—	—	1	—	—	—	1
Posthole F 1.43	—	—	—	—	—	—	—	2	1	—	—	3
Posthole F 1.47	—	—	—	—	—	—	—	—	2	—	—	2
Posthole F 1.59	—	—	—	—	—	—	—	—	1	—	—	1
Posthole F 1.67	—	—	—	—	—	—	—	—	1	—	—	1
Pit structure F 3												
Fill	—	—	—	—	—	1	—	1	39	—	—	41
Floor	1	—	1	—	—	—	—	—	6	—	—	8
Floor groove F 3.3	—	—	—	—	—	—	—	—	1	—	—	1
Posthole F 3.6	—	—	—	—	—	—	—	—	1	—	—	1
Pit F 2	—	—	—	—	—	—	—	3	8	—	—	11
Subtotal	3	1	1	3	—	2	1	8	135	1	—	154
Total	3	3	2	8	1	19	3	37	335	3	1	414

Key: F = feature.

Table 51. Ground Stone Artifact Distribution at the Rock Jaw Site (407/2014)

Context	Mano		Metate		Hoe		Total	
	n	%	n	%	n	%	n	%
	Nonfeature							
Surface	1	12.5	1	25.0	1	100	3	23.1
Stripping units	1	12.5	—	—	—	—	1	7.7
Subtotal	2	25.0	1	25.0	1	100	4	30.8
	Feature							
Feature 1								
Floor	5	62.5	1	25.0	—	—	6	46.2
Posthole F 1.14	—	—	1	25.0	—	—	1	7.7
F 3 Floor	1	12.5	1	25.0	—	—	2	15.4
Subtotal	6	75.0	3	75.0	—	—	9	69.2
Total	8	100	4	100	1	100	13	100

Key: F = feature.

exhibited a perverse fracture, an indication that it broke during the reduction process. The Feature 1 chert biface was an elongate ovoid that had been extensively pressure retouched. It was 51.3 mm long, 31.9 mm wide, 6.5 mm thick, and appeared to be a point preform.

Choppers

A single andesite chopper was recovered from the site surface. One margin was bifacially retouched, producing an axe-like edge. It was 119.9 mm long, 98.9 mm wide, and 32.0 mm thick.

Cores

Nineteen cores and 3 tested cobbles were also recovered (see Tables 37 and 52). Unidirectional and multidirectional cores were included in the collection, and basalt was the most common core material at the site. Made from stream cobbles, the unidirectional cores often exhibited cortical platforms and margins. The flakes produced from these cores were nearly identical, and the face of the cores often only had one flake scar. Several cortical platforms characterized the multidirectional cores. These multiple platforms were the result of the stoneworker maximizing the potential size of flakes by selecting new platforms. Multidirectional flake removal also tends to avoid prior mistakes, particularly step fractures. Complete cores averaged 83.1 in their greatest dimension and ranged from 108.9 to 61.3 mm.

Two metasandstone and one quartzite tested cobble were also recovered. All only had one or two flakes detached. They were 81–87 mm in diameter and represented material prospects likely collected from nearby drainages.

Scrapers

The Rock Jaw site contained eight scrapers (see Tables 52 and B.2.2). All of them were large, retouched flakes with little or no cortex; five of them possessed steep, retouched, working margins. Three of them were made of basalt, three from quartz, and one from a metavolcanic material. Five of them were collected from the site surface and two were from a mixed stratum within the Feature 1 pit structure.

Drills

Two tools were classified as drills or perforators (see Tables 50 and 52). Each of them had an acute, retouched bit. One tool, which was recovered from the site surface, was made from a quartzite flake and was 43.3 mm long; its bit exhibited extensive crushing. The other tool was from the Feature 3 pit structure and was less worn, 30 mm long, and was made from a retouched rhyolite flake.

Table 52. Number of Stone Artifact Types from the Rock Jaw Site (407/2014), by Material Type

Artifact Type	Igneous							Sedimentary	Metamorphic							Cryptocrystalline Silicate			Mineral		Total
	Obsidian	Basalt	Rhyolite	Granite	Andesite	Porphyritic Andesite	Indeterminate Igneous	Sandstone	Quartzite	Schist	Metasediment	Metavolcanic	Porphyritic Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	Argillite	Turquoise	
Flaked stone																					
Projectile point	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	3
Biface	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	—	—	3
Drill/perforator	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
Scraper	—	3	—	—	—	—	—	—	—	—	—	1	—	—	—	3	1	—	—	8
Chopper	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Core	—	9	2	—	—	1	—	2	3	—	—	1	—	—	—	1	—	—	—	19
Tested cobble	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	3
Modified flake	—	11	2	—	3	1	—	8	6	—	2	1	1	—	1	1	—	—	—	37
Debitage	2	122	10	—	15	2	—	47	28	—	8	15	2	—	13	60	11	—	—	335
Tabular knife	—	1		—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	3
Subtotal	3	146	15	—	19	4	—	61	39	1	10	18	3	—	14	69	12	—	—	414
Ground stone																					
Mano	—	—	—	1	—	—	—	4	1	—	—	1	—	1	—	—	—	—	—	8
Metate	—	1	—	2	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	4
Hoe	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
Subtotal	—	1	—	3	—	—	—	5	1	—	1	1	—	1	—	—	—	—	—	13
Ornament																					
Ornament	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	1	3
Other																					
Hammer stone	—	10	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	12
Total	3	157	15	4	19	4	1	66	41	1	11	19	3	1	14	69	12	1	1	442

Tabular Tools

Three tabular tools were collected (Figure 38; see Tables 50 and B.2.3). All of them were percussion retouched or heavily crushed along their working margins. The sturdiest knife was made from a tabular piece of basalt. A series of percussion flakes was removed from its distal margin, and it was 133.7 mm long, 82.8 mm wide, and 25.3 mm thick. The second knife was a serrated piece of metasandstone measuring 99.3 mm long, 29.7 mm wide, and 14.8 mm thick. The other tabular tool was a schist fragment and was 17.9 mm long, 33.2 mm wide, and 10.2 mm thick. One of its margins had been crushed along its length.

Modified Flakes

A total of 37 modified flakes were recovered from the Rock Jaw site (see Tables 37 and 50). Nine of these were notched flakes. The others exhibited irregular percussion retouch, crushing, or rounding along at least one working margin. The retouching commonly occurred on the distal, lateral, and combined distal-lateral margins. People used 11 different materials for modified flakes at the Rock Jaw site (see Table 52). The most commonly used materials were basalt, metasandstone, and quartzite. Flakes of andesite, rhyolite, chalcedony, chert, obsidian, and metavolcanic materials were also used. Thirty percent of the modified flakes were partially cortical, and 62 percent of them possessed cortical platforms. It appears that these modified flakes were made from local cobbles, and 15 of them were complete. These complete specimens were 54 mm long, 47 mm wide, and 15 mm thick on average. The maximum recorded length was 94.8 mm and the minimum was 25.6 mm.

Debitage

Debitage from the Rock Jaw site consisted of 335 specimens (see Tables 37, 50, and 52). Nearly all of them appeared to have been produced during the reduction of generalized flake cores. Basalt was the most commonly used material, followed by chert and metasandstone. A variety of other materials, including obsidian, were also represented. Eighty-four percent of the debitage was noncortical and 74 percent of the flakes had natural platforms. This pattern is expected when a core is reduced in a sequential manner. In this manner of core reduction, the first flake detachment creates the template for all of the following detachments. These cores were usually reduced perpendicular to their long axis, and only a single flake scar was often observed on their face. Each flake that was detached was a mirror image of the previous flake. No bipolar-reduction debris was encountered, but 6 percent of the debitage consisted of bifacial-thinning flakes, and about one-half of these were produced during the pressure thinning of a biface, likely during point production. Two obsidian flakes were also found. One of these was partially cortical, which suggests that an obsidian core may have been reduced on site.

The complete flakes (n = 162) were 43 mm long on average, but the individual flakes ranged from 12.7 to 105 mm in length. This wide range of flake sizes reflects the diversity of the materials brought to the site and the range of reduction stages that occurred there. Metamorphic flakes were larger but more often fragments. The chert flakes were often smaller. Interestingly, the basalt cores were surprisingly large, almost twice the mean size of the complete basalt flakes. The small size of the debitage recovered, when compared to the size of the cores, indicates that the debitage we recovered was produced during core reduction but was rejected as being too small for tool blanks.

Ground Stone Artifacts

Excavators collected 13 ground stone artifacts from the Rock Jaw site. These included 8 manos, 4 metates, and 1 hoe (see Tables 37, 48, and 51).

Manos

Four of the manos were rectangular, two were oval, one was loaf-shaped, and one was a fragment too small to confidently classify. These manos were made from metasandstone, quartzite, granite, and an indeterminate metamorphic material. At least three appeared to have been resharpened and five had heavily worn and polished use facets. The rectangular manos exhibited trough wear, and three of them were made from sandstone and one from granite. The oval manos were made from much harder materials, such as quartzite and metamorphic rock. Differences in the hardness of the lithic materials used for the different mano types suggests they had a clearly different function. The complete manos ranged from 235 to 180 mm in length, 129.2 to 86.5 mm in width, and 64.1 to 54.5 mm in thickness.

Metates

Four metates, or fragments thereof, were recovered. Two of these were made of granite, one from metasediment, and one from basalt. Two parts of a large, granitic, basin-shaped metate were collected from the site surface. These fragments did not conjoin, but they were treated as representing a single specimen. Both fragments were pecked to resharpen their surface, and the metate possibly broke during resharpening. A complete, gray, basalt metate was found in the Feature 3 pit house. It had a stepped, 70-by-120-mm, central polished area, and in overall dimensions was 270 mm long, 129.2 mm wide,

Figure 38. Examples of tabular tools from the SR 188–Cottonwood Creek Project sites: (*a*) schist knife recovered during mechanical stripping at the Vegas Ruin (405/2012); (*b*) basalt knife from the Feature 8 inhumation, Site 408/2015; (*c*) rhyolite knife from Feature 19 pit structure, Vegas Ruin (405/2012); and (*d*) schist knife from the Feature 8 inhumation, Site 408/2015.

and 54.5 mm thick. The steplike area may have been an incipient ridge that develops on trough metates (Adams 1999). One bifacially worn slab metate fragment made of metasediment was recovered from the Feature 1 pit house. A complete granite metate was also recovered from the Feature 1 pit house. It was 1,390 mm long, 700 mm wide, 620 mm thick, and had a single ground surface.

Hoes

Excavators collected a hoe from the general-site surface. It was made from a large metasandstone flake that had been retouched on one end. Square in shape, it was 118 mm long, 82 mm wide, and 29.4 mm thick.

Other Artifacts

Ornaments

Beads

Two beads were recovered from our investigations at the Rock Jaw site (see Tables 37 and B.2.4). One was a cylinder bead, and the other was a tube bead. The tube bead was made from argillite, but the material used for the cylinder bead could not be identified. Both of these beads had been drilled biconically and were ground to shape. Both were recovered from the structures. The tube bead was recovered from Feature 1, and the cylinder bead was recovered from Feature 3.

Pendants

A single turquoise pendant was recovered. This specimen was triangular in plan view and was conically drilled near the apex of the triangle. This pendant was recovered during the excavation of Feature 3.

Hammer Stones

Ten basalt, 1 quartzite, and 1 granitic hammer stone were included in the collection (see Table 42). One of the basalt hammer stones had a wedge-shaped bit. These kinds of bits were often associated with ground stone production. The other basalt hammer stones, however, were battered cobbles that were used for flake-core reduction. On average, they were 87.8 long, 74.5 mm wide, and 55.5 mm thick. Sixty percent of the hammer stones were from the site surface. The others were recovered from the fill of the Feature 1 pit structure and Feature 12 pits.

Artifact Distribution

Two clusters of artifacts were found in a 5-by-10-m area at the site (Figure 39). Here, 45 artifacts were recovered (10 percent of the total collected), including scrapers, edge-modified flakes, cores, debitage and a hammer stone. One group consisted of metasandstone artifacts, including 2 edge-modified flakes, 1 core, and 5 flakes that were expediently manufactured, used, and discarded. The other group of artifacts, which were all made from basalt, consisted of 13 flakes, 2 scrapers, and 1 edge-modified flake. Additionally, several chert and jasper flakes were found. The grouping of these artifacts suggests that a small work area was located east and south of the pit house features.

Over one-third of the collection was recovered from the superimposed Feature 1 and 3 pit structures (see Volume 1). Lithic artifacts were recovered from the fill and floor of Feature 1 (see Tables 50 and 51). The fill contained 1 bead, 1 biface, 1 core, 4 hammer stones, 1 tabular knife, 5 manos, 2 metates, 3 modified flakes, 2 projectile points, 1 scraper, 1 tested cobble, and 52 flakes. One modified flake, 1 pendant, 1 scraper, and 22 flakes were found in the floor context. The projectile points consisted of the small, chert, side-notched point and the corner-notched point described previously. Excavators collected 54 lithic artifacts from Feature 3, equally distributed between the floor and fill contexts. The fill contained 1 bead, 1 obsidian projectile point fragment, 1 core, 1 mano, 1 complete basalt metate, 1 modified flake, 1 perforator, and 20 pieces of debitage. The metate may represent an incipient trough form.

Summary

The Rock Jaw site contained a relatively large number of diagnostic tools, and the Feature 1 and Feature 3 pit houses represent some of the least-disturbed contexts encountered during this project (see Tables 37, 50, and 51). Our stone-artifact analysis indicated that large-flake tools were being made, maintained, and used. The ground stone artifacts represented seed-grinding activities, and the recovery of arrow points and bifaces indicated that projectiles were being made and maintained on site.

Only four surface artifacts were waterworn, and little evidence of postdepositional damage was noted. It is possible, therefore, to compare the artifacts from the surface with those from the pit houses. Many of the modified flakes and scrapers rested on the site surface, along with most of the cores and much of the large, early-stage debitage made of igneous materials.

The structures yielded all of the projectile points and more than 70 percent of the ground stone artifacts. Tools that took time to make, such as points, or tools that were used in final food preparation, such as manos and metates, were concentrated in the fill and on the floor of the houses.

The maker(s) of the chert and obsidian points were highly skilled. The skill of the flint knappers stands apart from the more-simply made, small, triangular side-notch points found at the nearby Vegas Ruin and the Crane site. It is possible that the toolmakers collected their own materials. The presence of cortical and noncortical flakes of obsidian and chert indicated that the cores that produced those flakes were likely produced and reduced at this site. Furthermore, chert flakes from all stages of reduction, many of which were heat treated, were also recovered from this site.

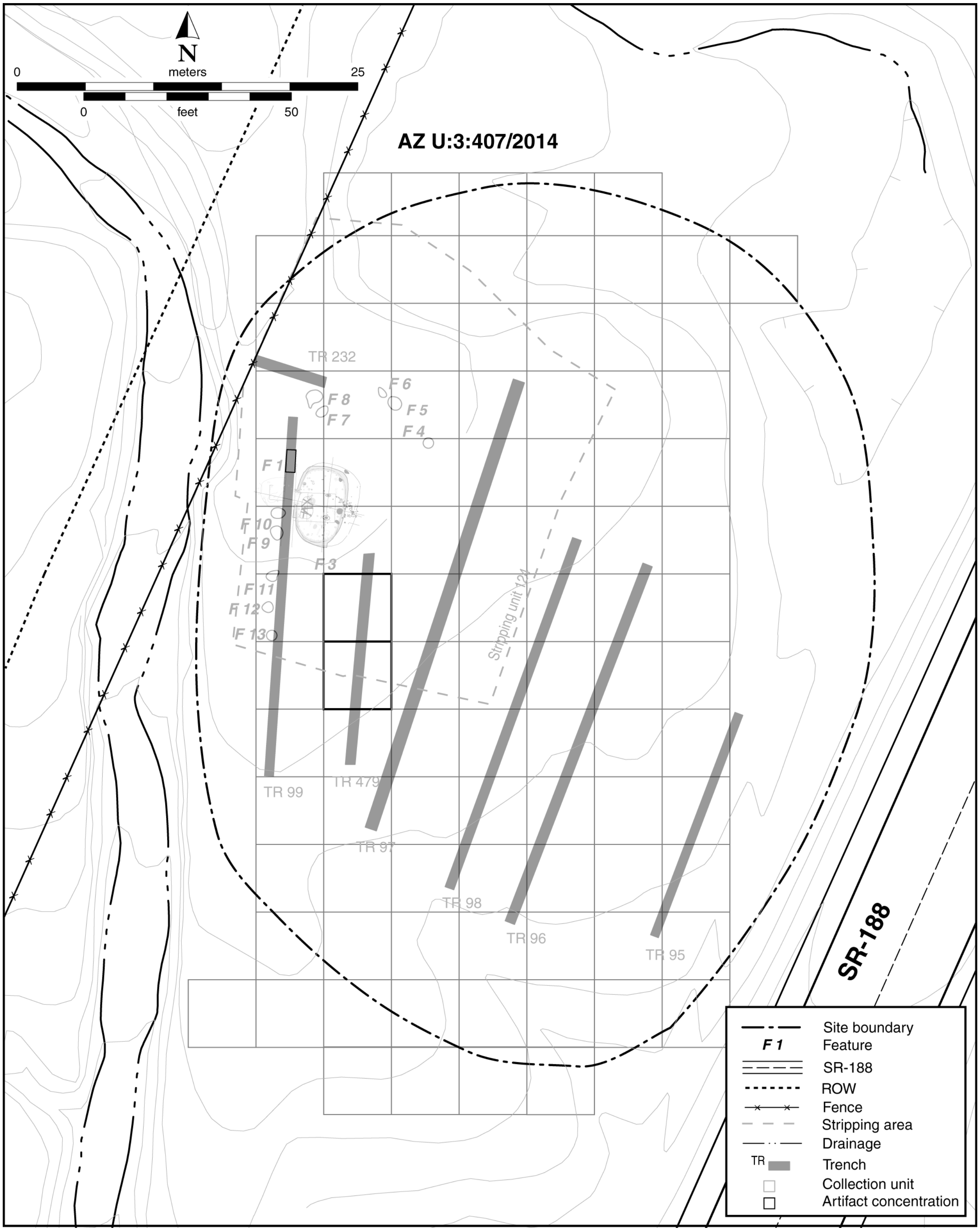

Figure 39. Location of artifact concentrations at the Rock Jaw site (407/2014).

AZ U:3:408/2015

A total of 635 stone artifacts were collected from AZ U:3:408/2015 (see Tables 37, 39, and 40). These included 614 flaked stone artifacts, 8 ground stone artifacts, 1 ornament, and 12 other artifacts. All of the recovered artifacts were analyzed. Identified flaked stone tools included bifaces, choppers, cores, drills, tabular tools, modified flakes, and scrapers. Manos and metates were also recovered, along with 1 pendant blank.

Flaked Stone Artifacts

Bifaces

A leaf-shaped jasper biface was interred along with the Feature 8 burial. It was likely a projectile-point preform and appeared to have been heat treated.

Choppers

Eleven choppers were collected from Site 408/2015 (see Table 39). On average, complete specimens were 92.9 mm long, 76.1 mm wide, and 29.8 mm thick. They were made of basalt, quartzite, and andesite.

Cores and Tested Cobbles

Three different types of cores were included among the 16 cores recovered from this site (see Tables 37 and 39). These included uniplanar cores (63 percent), multiplanar flake cores (31 percent), and bipolar cores (6 percent). It is possible that these core types represented the different stages of core reduction. For example, uniplanar cores might represent early-stage reduction, whereas multiplanar cores may represent late-stage reduction. The size of the cores, however, did not support this inference. Uniplanar cores were not significantly larger than their multiplanar counterparts, and the bipolar cores were the smallest, because they were made from small nodules. If these different core types did represent stages of reduction then the difference in core sizes should be greater. As such, the different core types likely resulted from reducing differently shaped and sized cobbles. Half of the cores were made of basalt (Table 53). Chert was also used, along with equal amounts of andesite, argillite, chalcedony, metavolcanic, rhyolite, and sandstone.

Seven tested cobbles were also found. Two of these were basalt, whereas the others were made of chert, metasediment, quartz, quartzite, or rhyolite.

Drills

Two chert drill fragments were recovered from this site (see Table 39). One was a bifacially flaked bit fragment. The other was intact and was 43.7 mm long, 37.1 mm wide, and 16 mm thick. Both drills exhibited use wear along their bits.

Tabular Tools

Nine tabular tool fragments were identified during analysis (see Tables 37, 39, and B.2.3). They were made from tabular schist, basalt, or rhyolite. Three of them were recovered from the fill of the Feature 8 inhumation, three from the site surface, one from a test pit, and two from walls associated with the Feature 1 structure.

Modified Flakes

Sixty-four modified flakes were included in the project collection (see Tables 37 and 39). Seventy-five percent of these were edge utilized and 25 percent of them were intentionally notched flakes. The edge-utilized flakes were 47.9 mm long, 46.1 mm wide, and 14.9 mm thick on average. The notched flakes were about the same size and were 63.2 mm long, 47.1 mm wide, and 14.5 mm thick on average. These differences in size may reflect different tool functions. The materials most often used to make these tools included basalt, quartzite, and chert, although a variety of other materials were also used (see Table 53).

Scrapers

The site collection included three scrapers (see Table B.2.2). One of these was made of basalt and was collected during mechanical trenching. The other two scrapers, one made from basalt and one from rhyolite, were collected from the Feature 9 midden. Together, they were 71.2 mm long, 70.4 mm wide, and 20.1 mm thick on average.

Debitage

The debitage from this site consisted of 500 specimens (see Tables 37 and 39). The majority of the debitage collected from this site was recovered from surface-collection units and from backhoe trenches. The largest single debitage concentration was encountered in the fill of the Feature 8 burial, and smaller concentrations were recovered from the Feature 9 midden and the Feature 1 structure (see Table 39). Ninety-five percent of these specimens were produced during the percussion reduction of flake cores. Four percent resulted

Table 53. Number of Stone Artifact Types from Site 408/2015, by Material Type

Artifact Type	Igneous							Sedimentary			Metamorphic						Cryptocrystalline Silicate			Mineral			Total
	Basalt	Vesicular Basalt	Rhyolite	Granite	Andesite	Porphyritic Andesite	Indeterminate Igneous	Limestone	Sandstone	Siltstone	Quartzite	Schist	Phyllite	Metasediment	Metavolcanic	Porphyritic Metavolcanic	Chalcedony	Chert	Jasper	Crystal Quartz	Quartz	Argillite	
Flaked stone																							
Biface	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Uniface	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Drill/perforator	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	2
Scraper	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Chopper	7	—	—	—	—	1	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	11
Core	8	—	1	—	1	—	—	—	1	—	—	—	—	—	1	—	1	2	—	—	—	1	16
Tested cobble	2	—	1	—	—	—	—	—	—	—	1	—	—	1	—	—	—	1	—	—	1	—	7
Modified flake	25	—	5	—	—	—	—	—	4	2	9	—	1	5	2	—	1	7	3	—	—	—	64
Debitage	249	—	17	—	19	6	1	2	32	4	16	—	—	17	16	6	19	71	23	—	1	1	500
Tabular knife	2	—	1	—	—	—	—	—	—	—	1	5	—	—	—	—	—	—	—	—	—	—	9
Subtotal	295	—	26	—	20	7	1	2	37	6	30	5	1	23	19	6	21	84	27	—	2	2	614
Ground stone																							
Mano	—	—	—	3	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	5
Metate	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Indeterminate	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Subtotal	—	1	—	3	—	—	—	—	2	—	—	1	—	—	1	—	—	—	—	—	—	—	8
Ornament																							
Ornament	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1

Table 53. Number of Stone Artifact Types from Site 408/2015, by Material Type (*continued*)

Artifact Type	Igneous							Sedimentary			Metamorphic						Cryptocrystalline Silicate			Mineral			Total
	Basalt	Vesicular Basalt	Rhyolite	Granite	Andesite	Porphyritic Andesite	Indeterminate Igneous	Limestone	Sandstone	Siltstone	Quartzite	Schist	Phyllite	Metasediment	Metavolcanic	Porphyritic Metavolcanic	Chalcedony	Chert	Jasper	Crystal Quartz	Quartz	Argillite	
Other																							
Hammer stone	3	—	—	1	1	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	7
Manuport	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	1	—	1	5
Subtotal	3	—	—	1	1	—	—	—	—	—	1	—	3	—	1	—	—	—	—	1	—	1	12
Total	298	1	26	4	21	7	1	2	39	6	31	6	4	23	21	6	21	84	27	1	2	4	635

from pressure-reduction activities. The method of manufacture used to make the other flakes could not be determined.

Forty-one percent of the flakes were cortical. This relatively high frequency of cortical flakes suggests that early-stage core reduction occurred on site. The complete flakes (n = 156) were 33.3 mm long on average, ranging from 8.1 to 72.4 mm. The average maximum length of the cores (72 mm) was substantially larger. At least some of the flakes, however, equaled the average size of cores, suggesting that large flakes were sometimes produced and used as tool blanks in this collection dominated by early-stage core reduction.

Ground Stone Artifacts

Metates

Two trough metate fragments were recovered from the surface of Site 408/2015 (see Tables 40 and 48). One of them was made from vesicular basalt and the other from sandstone (see Table 53). No other metates were encountered during mitigation.

Manos

Small, indeterminate fragments represented two of the five recovered manos (see Tables 40 and 48). One of the three larger fragments was classified as an oval mano. The other was an irregular mano. Materials used to make manos at Site 408/2015 included granite, sandstone, and metavolcanics (see Table 53). Because of the fragmentary nature of these artifacts, an average size is not meaningful.

Indeterminate Fragments

One indeterminate basalt ground stone fragment was recovered from the site surface. It was moderately ground on one flat surface and was fire cracked. It could represent either a metate or a mano (see Table 37).

Other Artifacts

Ornaments

Pendants

A complete argillite pendant blank was recovered from the wall of the Feature 1 structure (see Table B.2.4). It was ground to shape and then lightly incised on one surface, but it was not perforated. It was 46.9 mm long, 23.7 mm wide, and 5.2 mm thick.

Hammer Stones

The Site 408/2015 collection included seven hammer stones (see Table 42). Six appear to have been used for flaked stone reduction, and one was a hammer stone used for ground stone production. The flaked stone hammer stones were 90.6 mm long, 69.5 mm wide, and 49.4 mm thick on average. Three of the flaked stone hammers were recycled cores that exhibited extensive battering. The single ground stone hammer stone was 180 mm long, 109 mm wide, and 57.4 mm thick. The ground stone hammer was produced from recycling a bifacial mano as a hammer stone.

For hammer stones, it appears that recycling site debris (e.g., discarded cores and manos) was more attractive than procuring a stone to specifically conduct the task. Three flaked stone hammer stones were basalt, one was quartzite, one was granite, and one was metavolcanic. All of the basalt hammers were recycled cores. These hammers may also have functioned to resharpen grinding surfaces at the site. The ground stone hammer stone was made from an andesite cobble.

Manuports

Five manuports were recovered from this site (see Table 42). These included one clear quartz crystal from the site surface, two small tabular pieces of phyllite from the wall of Feature 1, and two tabular pieces of argillite from the Feature 8 inhumation. The quartz crystal had been worked along a single ariss, whereas the phyllite and argillite specimens appeared to be unworked.

Summary

Excavators gathered the fourth largest collection of stone artifacts from Site 408/2015. Most of the stone artifacts were collected from the site surface, test pits in the general-site area, the Feature 8 burial fill, and the Feature 9 midden. Debitage was the most numerous artifact type, followed by modified flakes. Cores, choppers, and scrapers were also recovered. Ground stone artifacts included five manos and two metates. Cores were fairly numerous, and core reduction, plant-food processing, and the working of perishable materials appear to have been important site activities. No evidence of biface reduction was encountered. Flake-core reduction dominated the flaked stone industry.

AZ U:3:409/2016

AZ U:3:409/2016 was a low-density lithic scatter located east of the new alignment. A surface collection grid of 58 5-by-5-m collection units was established and artifacts within these units were collected (see Volume 1). A backhoe trench was excavated to identify subsurface features, but none was found. Only 40 flaked stone artifacts were collected from this site (see Tables 37 and 39). Twenty collection units contained artifacts. Quantities were very light, with the greatest being just 6 artifacts per 5-m collection unit, and the average being about 2 specimens per unit. One hundred percent of this collection was analyzed. The artifacts displayed no apparent road-related damage; however, 8 percent of the artifacts were tumbled (waterworn) and probably had not been discarded where they were found. The goal of this analysis was to determine which activities produced the artifacts recovered and to see if they were similar or contemporary with those from the nearby Crane site, situated to the south.

The collection consisted of 2 cores, 1 tested cobble, 9 modified flakes, 27 flakes, and 1 tabular knife. These artifacts were primarily made from chert and chalcedony, metavolcanic materials, or basalt (Table 54). Other materials used to make the artifacts collected from this site included quartzite, rhyolite, schist, sandstone, and indeterminate metamorphic rocks.

Flaked Stone Artifacts

Modified Flakes

Nine modified flakes were the most numerous stone tools recovered from Site 409/2016 (see Tables 37 and 39). One was a metavolcanic flake that was wider than it was long and which exhibited an elongated percussion notch. It was the largest tool collected from this site. The other modified flakes exhibited irregular retouch along their lateral margins or distal edge. Percussion flaking was used to straighten the edges of two flakes, and only one specimen was pressure flaked. All of the modified flakes were broken. It appears, therefore, that these artifacts may have been discarded as they broke.

Cores

Two green basalt cores and one tested cobble were also collected (see Table 39). One of the cores was uniplanar and had several flakes removed from its cortical platform. A significant step fracture appears to have led to its discard. The second core was reduced in a more systematic way. Two platforms were established by removing cortical flakes. These platforms were then used to detach flakes in two directions. The tested cobble was made of red metasandstone and was 80 mm long. Two flakes had been detached to assay the cobble.

Debitage

The debitage consisted of 27 flakes (see Table 39). Chert and basalt, along with chalcedony, accounted for most of the flakes (see Table 54). Metavolcanic materials accounted for the next most frequently used material, followed by small amounts of quartzite, rhyolite, and metamorphic rocks. Only two complete flakes were noted, nearly 70 percent of the debitage had little or no cortex, and only about one-half of the flakes possessed platforms. These medial and distal flake fragments were 35.6 mm long on average. One chalcedony flake had been heat treated, whereas a chert bifacial-thinning flake was tumbled. These flakes indicated that some bifacial thinning occurred on site.

Summary

Informal tools and debitage were sparsely distributed within the alignment at Site 409/2016 (see Tables 37 and 39). Not only was the artifact distribution sparse, no concentrations of cores, flakes, or tools were identified. With so few artifacts, it is impossible to interpret what activity, except possibly random discard, contributed to this site. The artifacts could simply represent the occasional flake or tool abandoned during a task in an area that was peripheral to a larger site, such as the nearby Crane site.

The Crane Site (AZ U:3:410/2017)

The Crane site was initially described as a Classic period habitation (see Volume 1; Hoffman 1991). Excavated features included rooms, burials, granary pedestals, a pit house, and a midden. A total of 2,752 lithic artifacts were collected and 760 of these were analyzed, including 634 flaked stone and 84 ground stone artifacts, 8 ornaments, and 34 other artifacts (Tables 55 and 56; see Table 37). The 760 artifacts analyzed accounted for only 27.6 percent of the collection; however, this sample represents all diagnostic stone artifacts recovered from the site surface, feature excavations, flotation and wet-screen samples, and test-pit excavations. Nearly all of the unanalyzed portion of the collection consisted of debitage from the Feature 1 midden excavation, particularly specimens that were judgmentally sampled during the mechanical stripping of this feature. We determined, therefore, that we could accurately characterize the stone artifacts

Table 54. Number and Percentage of Flaked Stone Artifact Types from Site 409/2016, by Material Type

Artifact Type	Igneous				Sedimentary		Metamorphic										Cryptocrystalline Silicate				Total (n)
	Basalt		Rhyolite		Sandstone		Quartzite		Schist		Metavolcanic		Porphyritic Metavolcanic		Indeterminate Metamorphic		Chalcedony		Chert		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Core	2	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Tested cobble	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Modified flake	2	22.2	—	—	—	—	1	11.1	—	—	1	11.1	1	11.1	—	—	1	11.1	3	33.3	9
Debitage	6	22.2	2	7.4	—	—	1	3.7	—	—	4	14.9	2	7.4	1	3.7	5	18.5	6	22.2	27
Tabular knife	—	—	—	—	—	—	—	—	1	100	—	—	—	—	—	—	—	—	—	—	1
Total	10	25.0	2	7.4	1	2.5	2	5.0	1	2.5	5	12.5	3	7.5	1	2.5	6	15.0	9	22.5	40

Table 55. Flaked Stone Artifact Distribution at the Crane Site (410/2017)

Context	Projectile Point		Biface		Drill/Perforator		Scraper		Core		Modified Flake		Debitage		Tabular Knife		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Nonfeature																		
Surface	—	—	—	—	—	—	—	—	—	—	—	—	3	0.5	—	—	3	0.5
Hand trenches	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	1	0.2
Test pits	1	20.0	1	100	—	—	—	—	11	36.7	2	8.7	62	11.1	—	—	77	12.1
General site	—	—	—	—	—	—	—	—	—	—	—	—	3	0.5	—	—	3	0.5
Subtotal	1	20.0	1	100	—	—	—	—	11	36.7	2	8.7	69	11.8	—	—	84	13.2
Feature																		
Granary F 24	—	—	—	—	—	—	1	20.0	—	—	—	—	11	1.9	—	—	12	1.9
Hearth F 13	—	—	—	—	—	—	—	—	—	—	—	—	2	0.4	—	—	2	0.3
Burial F 21	—	—	—	—	—	—	—	—	—	—	—	—	6	1.1	—	—	6	0.9
Burial F 25	—	—	—	—	—	—	—	—	2	6.7	2	8.7	27	4.8	—	—	31	4.9
Burial F 35	—	—	—	—	—	—	—	—	—	—	—	—	4	0.7	—	—	4	0.6
Burial F 38	1	20.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2
Burial F 40	—	—	—	—	—	—	1	20.0	—	—	—	—	1	0.2	—	—	2	0.3
Midden F 13	—	—	—	—	—	—	3	60.0	11	36.7	6	26.1	131	23.1	—	—	151	23.8
Pit structure F 30	1	20.0	—	—	—	—	—	—	—	—	—	—	23	4.0	—	—	24	3.8
Pit F 37	—	—	—	—	—	—	—	—	—	—	—	—	3	0.5	—	—	3	0.5
Cobble concentration F17	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	2	100	3	0.5
Structure F 2																		
Fill	—	—	—	—	—	—	—	—	2	6.7	1	4.3	80	14.1	—	—	83	13.1
Mixed	—	—	—	—	—	—	—	—	1	3.3	5	21.7	5	0.9	—	—	11	1.7
Overburden	1	20.0	—	—	—	—	—	—	—	—	—	—	26	4.6	—	—	27	4.3
Structure F 3	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	1	0.2
Structure F 4																		
Fill	1	20.0	—	—	1	100	—	—	2	6.7	—	—	74	13.0	—	—	78	12.3

Table 55. Flaked Stone Artifact Distribution at the Crane Site (410/2017) (*continued*)

Context	Projectile Point		Biface		Drill/Perforator		Scraper		Core		Modified Flake		Debitage		Tabular Knife		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Feature (*continued*)																		
Floor	—	—	—	—	—	—	—	—	1	3.3	—	—	4	0.7	—	—	5	0.8
Overburden	—	—	—	—	—	—	—	—	—	—	3	13.0	14	2.5			17	2.7
Structure F 6	—	—	—	—	—	—	—	—	—	—	2	8.7	36	6.3	—	—	38	6.0
Structure F 19	—	—	—	—	—	—	—	—	—	—	2	8.7	11	1.9	—	—	13	2.0
Possible structure F 26	—	—	—	—	—	—	—	—	—	—	—	—	38	6.7	—	—	38	6.0
Subtotal	4	60.0			1	100	5	100	19	63.3	21	91.3	501	88.2	2	100	553	87.1
Total	5	100	1	100	1	100	5	100	30	100	23	100	567	100	2	100	634	100

Note: Percentages calculated by artifact type.
Key: F = feature.

Table 56. Ground Stone Artifact Distribution at the Crane Site (410/2017)

Context	Mano		Metate		Hoe		Axe		Shaft Straightener		Indeterminate Ground Stone		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	Nonfeature													
Surface	18	41.9	9	34.6	2	33.3	—	—	3	42.9	1	100	33	39.3
Hand trenches	2	4.7	—	—	—	—	—	—	—	—	—	—	2	2.4
Stripping units	5	11.6	2	7.7	—	—	—	—	—	—	—	—	7	8.3
Test pits	4	9.3	4	15.4	—	—	—	—	1	14.3			9	10.7
Trenches	3	7.0	—	—	1	16.7	—	—	—	—	—	—	4	4.8
Wall trenches	—	—	5	19.2	—	—	—	—	—	—	—	—	5	6.0
Subtotal	32	74.4	20	76.9	3	50.0	—	—	4	57.1	1	100	60	71.4
	Feature													
Granary F 31	3	7.0	—	—	—	—	—	—	—	—	—	—	3	3.6
Hearth F 13	—	—	1	3.8	—	—	—	—	—	—	—	—	1	1.2
Burial F 33	2	4.7	—	—	—	—	—	—	—	—	—	—	2	2.4
Burial F 38	—	—	—	—	—	—	—	—	2	28.6	—	—	2	2.4
Midden F 13	1	2.3	—	—	—	—	—	—	—	—	—	—	1	1.2
Pit structure F 30														
Fill	—	—	1	3.8	—	—	—	—	—	—	—	—	1	1.2
Floor	2	4.7	—	—	—	—	—	—	—	—	—	—	2	2.4
Cobble concentration F 17	—	—	1	3.8	—	—	1	100	—	—	—	—	2	2.4
Structure F 4	2	4.7	—	—	1	16.7	—	—	—	—	—	—	3	3.6
Structure F 6														
Fill	—	—	—	—	2	33.3	—	—	—	—	—	—	2	2.4
Floor	1	2.3	1	3.8	—	—	—	—	1	14.3	—	—	3	3.6
Structure F 19	—	—	2	7.7	—	—	—	—	—	—	—	—	2	2.4
Subtotal	11	25.6	6	23.1	3	50.0	1	100	3	42.9	—	—	24	28.6
Total	43	100	26	100	6	100	1	100	7	100	1	100	84	100

Note: Percentages calculated by artifact type.
Key: F = feature.

from the midden by analyzing 50 percent of the stone artifacts recovered from the 2-by-2-m unit used to sample it. Analyzing additional midden specimens would have most likely resulted in redundant data representing a generalized flake-core-reduction technology, a phenomenon characteristic of the Formative period that is already well documented (e.g., Parry and Kelly 1987).

A wide variety of lithic materials were used at this site (Table 57). Most represented only a very small percentage of the materials used. As at other sites, basalt was one of the most commonly used materials and was the dominant material type for the debitage, modified flakes, and hammer stones. Chert, chalcedony, and jasper were used rarely—mainly for projectile points. Quartzite was the only other material used with any significant frequency.

Flaked Stone Artifacts

Projectile Points

Chert arrow points, a point blank, and a metasandstone dart point were recovered from the Crane site (see Tables 55 and B.2.1; Figure 30). All of the arrow points conform with Whittaker's (1984) small-triangular-point category. The point blank was shaped by percussion and early-stage pressure work before it broke during production. One of the chert arrow points lacked its tip. The areas of this point that have been pressure flaked had a more lustrous surface than the nonpressure-flaked areas. This is an indication that the flake used to make the point was heat treated. The curvature and configuration of the piece indicated that this flake was detached from a biface. Furthermore, the pressure flakes that traveled across the surface of this point did so in a "left-handed" manner. The second arrow point was a small triangular chert point with high-side notches. This point was mostly formed by percussion shaping the flake. Pressure flaking was used to notch and finish the point. The third arrow point was a low side-notched specimen recovered from the Feature 30 pit house. Its curvature and remnant percussion scars indicated that it was made from a bifacial-thinning flake. The final arrow point was a high side-notched form from the Feature 38 inhumation. The Archaic period dart point, which was from the fill of the Feature 4 structure, was made from arcosic sandstone and resembled a San Pedro dart point (see Figure 30m). It likely represented a recycled point that was brought to the site.

Scrapers

Five scrapers representing four different types were recovered from this site (see Tables 55 and B.2.2). These included two thumbnail scrapers, one unifacial scraper, one end scraper, and one scraper made from a large percussion flake. Three of these scrapers were recovered from the Feature 13 midden. A complete thumbnail scraper was recovered from Feature 40 burial and the remaining scraper was recovered from the excavation of TP 3.

Tabular Tools

Two tabular tools were recovered from this site (see Tables 55 and B.2.3). One was complete; the other was a fragment. Both were made from schist, were retouched, and were associated with the Feature 17 cobble concentration. It has been argued that tabular tools are associated with agave processing. Tabular tools were encountered by Knoblock et al. (2003) as part of the SCP and by Irwin (1993) at the Pine Creek Project, and these tools were likely used for agave processing.

Modified Flakes

Twenty-three modified flakes were recovered from the Crane site. They were collected from across the site, but the majority were from wall trenches, test pits, and feature excavations (see Table 55). Most of the flakes were made from basalt, chert, or quartzite (see Table 57). Several different types of modified flakes were found. Six had notches worked into their margins. The remainder had percussion retouch, pressure retouch, or battering or margin rounding (sometimes a combination of the above). The majority of the modified flakes were made from local materials, and only two had prepared platforms. This suggests that many of them were struck from informal cores. Most of the modified flakes had little or no cortex. This lack of cortex, coupled with the simple platforms, suggests that these modified flakes were struck from late-stage flake cores.

Debitage

Debitage comprised 75 percent of the stone artifacts recovered from the Crane site (see Table 55). This debitage consisted of 561 flakes and 7 pieces of shatter. Flake-core reduction (92 percent), followed by bifacial reduction (2 percent), ground stone debitage (less than 1 percent), and flakes not assignable to reduction category (6 percent) characterize the analyzed collection. Flake core reduction focused on a wide range of materials, and the most frequently used was basalt (44 percent). The remaining materials most often used included chert, jasper, chalcedony, metasediment, and quartzite, each of which accounted for 5–6 percent of the analyzed specimens. Bifacial reduction focused exclusively on chert, jasper, and chalcedony.

Table 57. Number of Stone Artifact Types from the Crane Site (410/2017), by Material Type

Artifact Type	Igneous						Sedimentary				Metamorphic					Cryptocrystalline Silicate			Mineral					Total
	Obsidian	Basalt	Rhyolite	Granite	Andesite	Indeterminate Igneous	Limestone	Sandstone	Siltstone	Conglomerate	Quartzite	Schist	Metasediment	Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	Quartz	Argillite	Hematite	Turquoise	Steatite	
Flaked stone																								
Projectile point	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	5
Biface	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Drill/perforator	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
Scraper	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	—	—	—	—	—	—	5
Core	1	10	5	—	1	—	—	—	—	—	3	—	—	—	—	1	9	—	—	—	—	—	—	30
Modified flake	—	11	—	—	—	—	—	—	—	2	5	1	1	—	—	—	2	1	—	—	—	—	—	23
Debitage	1	324	27	—	7	—	—	1	1	4	51	—	3	4	1	21	110	9	2	1	—	—	—	567
Tabular knife	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	2
Subtotal	2	346	32	—	8	—	—	2	1	6	60	4	4	4	1	22	129	10	2	1	—	—	—	634
Ground stone																								
Mano	—	1	—	5	—	1	—	10	—	3	14	—	—	9	—	—	—	—	—	—	—	—	—	43
Metate	—	—	1	14	—	—	—	4	—	2	4	—	1	—	—	—	—	—	—	—	—	—	—	26
Hoe	—	1	—	—	—	—	—	—	—	1	1	3	—	—	—	—	—	—	—	—	—	—	—	6
Axe	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Shaft straightener	—	—	—	—	—	—	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	7
Indeterminate ground stone	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Subtotal	—	3	1	20	—	1	5	15	—	6	19	3	1	9	—	—	—	—	—	—	—	—	1	84

Table 57. Number of Stone Artifact Types from the Crane Site (410/2017), by Material Type (*continued*)

Artifact Type	Igneous						Sedimentary				Metamorphic					Cryptocrystalline Silicate			Mineral					Total
	Obsidian	Basalt	Rhyolite	Granite	Andesite	Indeterminate Igneous	Limestone	Sandstone	Siltstone	Conglomerate	Quartzite	Schist	Metasediment	Metavolcanic	Indeterminate Metamorphic	Chalcedony	Chert	Jasper	Quartz	Argillite	Hematite	Turquoise	Steatite	
Ornament/special																								
Ornament/special	—	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—	—	—	—	3	—	2	—	8
Other																								
Anvil	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Hammer stone	—	14	—	1	—	—	—	—	—	1	7	—	—	3	—	—	1	—	—	—	—	—	—	27
Manuport	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3	—	5
Subtotal	—	14	—	1	—	—	—	2	—	1	7	—	—	3	—	—	1	—	—	—	2	3	—	34
Total	2	363	33	21	8	1	5	19	2	13	86	9	5	16	1	22	130	10	2	4	2	5	1	760

Overall, the Crane site debitage represents a persistent use of percussion techniques using a variety of local materials to produce usable flakes and flake tools. The ground stone debitage also indicates onsite manufacture of ground stone artifacts. Biface reduction was seldom done; when it was, it was focused on the production of bifaces using a combination of percussion and pressure techniques. Biface production appears to have been focused on projectile point manufacture.

Ground Stone Artifacts

Five types of ground stone artifacts were recovered from the Crane site, including axe (n = 1), manos (n = 43), metates (n = 26), shaft straighteners (n = 7), and hoes (n = 6) (see Tables 37, 48, and 56).

Manos

The manos were most often made from quartzite and sandstone. Other materials used included basalt, conglomerate, granite, and metavolcanics. More than half of the manos recovered were complete. Identified mano types included irregular, loaf, oval, rectangular, and round. Loaf manos were encountered most frequently, followed by the indeterminate and oval types. Manos were recovered across the site from all contexts investigated. Loaf manos are commonly associated with trough metates, and the large number of them from this site indicates that corn processing was an important site activity (Bartlett 1933; Eddy 1964; Greenwald 1990; Haury 1976).

Metates

Five different metate types were encountered during this analysis. At the Vegas Ruin, trough metates occurred most frequently, followed by basin and slab metates. Two natural boulders with ground surfaces were also noted at the site. Only four of the metates were complete. The frequency of trough metates in this collection indicates that corn processing was an important site activity. About 75 percent of the metates were recovered from the site surface or during the excavations of test pits, trenches, or stripping units (see Table 56). Metates were also encountered as parts of the Feature 31 granary pedestal, within the Feature 33 inhumation, and in structures.

Half of the metates were made from granite and the other half were made from quartzite, sandstone, conglomerate, rhyolite, and metasedimentary stone. All of these materials were locally available, and granite appears to have been the preferred metate material.

Hoes

Six hoes, the most from any project site, were recovered from the Crane site (see Tables 37 and 56). Schist was the most frequently used material, followed by equal portions of basalt, conglomerate, and quartzite. Half of the hoes were recovered from the interior of structures. Two were recovered from Feature 6 and one from Feature 4. The two hoes from Feature 6 were both fragments and may have resulted from the repair or discard of a broken tool in this space. The one hoe from Feature 4 was complete and may represent the discard or loss of this tool. Hoes are considered agricultural tools for the preparation and maintenance of fields and irrigation ditches (Irwin 1993). Their presence at the Crane site, therefore, suggests strongly that field preparation, planting, and maintenance were important activities for the site inhabitants. Interestingly, three times as many hoes were recovered from the Crane site than were recovered from the Vegas Ruin, where nearly twice as many stone artifacts were collected.

Shaft Straighteners

Seven shaft straighteners were included in the site collection (see Table 56). They were rectangular in plan view, plano-concave in cross section, and exhibited single, striated, longitudinal grooves. One was made of steatite and was directly associated with the Feature 38 inhumation. Another shaft straightener made of sandstone was also recovered from Feature 38. All of the other specimens were made from limestone. Two of these were point located and collected from the general-site surface. Another rested on the floor of the Feature 6 structure, one was judgmentally sampled during the excavation of Stripping Unit (SU) 509, and another was collected from TP 32. This is a much larger number of shaft straighteners than was found at any other project site, and the reason for this is unclear. Perhaps one or more specialists were making arrow shafts at this site.

Axes

A stone axe was recovered from Feature 17, which was situated next to the Feature 31 pit structure (see Table 56). It exhibited a three-quarter ridged groove axe and was made from basalt. The bit was battered and had been resharpened.

Other Artifacts

Hammer Stones

Twenty-seven hammer stones were collected from the Crane site (see Table 42). Two different types of hammer stones were observed: hammer stones for flake-core reduction and hammer stones for ground stone production. Schneider (1993) has observed large quartzite cobbles with battered, wedge-shaped bits at a ground stone production quarry in southwestern Arizona. Half of the hammer stones observed in this collection was identified as ground stone production hammer stones. The average length of a flake stone hammer stone was 8 cm, whereas the average length of a ground stone hammer stone was 16 cm. Eighteen of the hammer stones were recovered from features, and only in the midden context were ground stone and flake stone hammers recovered together. The segregation of these types indicates that these hammers were used for different tasks.

Ornaments

Eight ornaments were recovered from the Crane site. A complete zoomorphic or anthropomorphic pendant made of siltstone was recovered from TP 274 (Figure 40). It is roughly rectangular with a large hole drilled through the center; all of the edges are carved. An oval turquoise pendant was also recovered from an inhumation (Feature 39) (Figure 41) and a square turquoise pendant was recovered from the pit structure Feature 30. An argillite pendant blank and argillite ring fragment were recovered from nonfeature contexts along with two perforated disks made of schist.

Summary

The Crane site contained the second largest collection of stone artifacts encountered during this project. Debitage and ground stone artifacts dominated the site collection. The occupants of the Crane site relied on locally available materials to meet their stone-tool needs. Nonlocal materials were rarely used. These nonlocal materials included obsidian from the Superior source (see Appendix B.1), turquoise, and perhaps argillite. The large percentage of ground stone artifacts at the Crane site, many of which were trough metates and loaf manos, suggests that maize was an important dietary staple. The presence of numerous basin and slab metates, however, also indicates that a variety of other plant taxa were processed on site. As such, the ground stone collection seemingly represents a rather varied vegetal diet.

The debitage from the Crane site indicates that flake-core reduction was the prominent flaked stone industry. The large number of cores associated with this debitage indicates that core reduction was an important site activity. One of the apparent goals of this industry was the production of usable flakes, many of which had been minimally retouched. Scrapers and choppers were relatively rare. Whether this reflects sampling error is unclear, but perishable materials were certainly worked frequently on site.

Arrow-point types recovered from the Crane site included Sedentary Side-notched, Classic Side-notched, and Classic Concave-base Triangular types. The relatively large number of Classic period point forms suggests that the Crane site was primarily occupied during the early Classic period. One large San Pedro–like point was recovered from a Classic period structure. This point appears to be an heirloom that was brought to the site.

Research Issues Revisited

Raw-Material Procurement

It appears that the occupants of the project sites relied almost entirely on locally available materials to meet their stone-tool needs. The only definite exceptions to this pattern in the flaked stone collection were occasional obsidian artifacts from the Vegas Ruin, the Crane site, and the Rock Jaw site (Table 58). Obsidian artifacts at the Vegas Ruin included two bipolar cores made from small marekanites. Those from the Crane site consisted of another small bipolar core, which was made from obsidian obtained from the Superior source to the south, and a small pressure flake. One obsidian projectile point and two flakes were collected from the Rock Jaw site. All three of these specimens were made from Government Mountain obsidian from northwestern Arizona. Appendix B.1 contains the results of Dr. M. Steven Shackley's XRF analysis of most of these artifacts.

Ground stone artifacts in the collection made from nonlocal materials included a vesicular basalt trough metate from Site 408/2015 (see Tables 40 and 53). Vesicular basalt metates and manos are a common component of Hohokam ground stone collections. Compared to other materials, however, ground stone artifacts made from vesicular basalt were only rarely used by the Formative period occupants of Tonto Basin (Adams 1995:Table 2.2, 2002a:Tables 10.8 and 10.9). Interestingly, vesicular basalt was commonly used as a ground stone material at the sites investigated by SRI as part of the SCP (Knoblock et al. 2003:Table 36), just to the south of Tonto Basin, where vesicular basalt can be obtained within 20 km of the SCP sites.

Nonlocal materials used to make ornaments recovered from the project sites included turquoise, argillite, and steatite (see Tables 58 and B.2.4). The geologic provenance of the turquoise is unclear, but turquoise artifacts are occasionally recovered from sites in Tonto Basin. Turquoise artifacts were recovered from burial contexts at the Vegas Ruin. They were

Figure 40. Five views of a siltstone pendant from a nonfeature context (Test Pit 274), Crane site (410/2017).

Figure 41. Turquoise pendant from the Feature 39 inhumation, Crane site (410/2017).

also discovered in a burial at the Crane site. Other contexts that included turquoise were pit structures at the Vegas Ruin and the Crane site, along with the midden at the Crane site. Argillite is locally available near Punkin Center, but it is unclear whether this is the source of the argillite artifacts recovered from the project sites. Similarly, it is also unclear if steatite was procured locally or obtained from nonlocal sources. Argillite artifacts were most commonly recovered from burials and pit structures at the Vegas Ruin. They were also associated with a burial at Site 408/2015, a large *horno* at Site 41/583, and structures at the Crane site.

Overall, locally available aphanitic basalt (and rhyolite) and quartzite were the most commonly used materials at the project sites (see Table 58). Being locally abundant and durable, basalt and quartzite were used to make most of the cutting and scraping tools. If debitage is eliminated, the frequency of quartzite tools almost equals that of basalt tools. Metavolcanic and metasedimentary materials, along with quartzite, were also frequently used. Projectile-point manufacture relied primarily on chert. Chalcedony, jasper, and other materials were occasionally used. The chert used to make the points recovered from the sites is a beige-colored material with small light gray inclusions. This chert was routinely heat treated, and a thin, light brown cortex covered several of the chert cores and heat-treated flake blanks. The chert nodules used to make these cores and flake blanks seem to have ranged between 5 and 20 mm in diameter. A lack of a thick, crenulated cortex on the cortical chert artifacts suggests that they were not collected from Tonto Creek. This kind of cortex normally characterizes stream-tumbled clasts. Rather, the thin, smooth cortex on the chert artifacts suggests that they were likely collected from nearby outcrops or colluvial deposits.

Granite was the preferred ground stone material. Sandstone, quartzite, conglomerate, and metavolcanic materials were also commonly used. Cobbles suitable for ground stone production were common in the project area, particularly in and along nearby Tonto Creek and its major tributaries.

Table 58. Stone Artifact Materials from the CCP Sites

Material	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Igneous																				
Obsidian	—	—	—	—	—	—	2	0.1	—	—	3	0.7	—	—	—	—	2	0.3	7	0.2
Basalt	346	45.7	50	36.5	60	36.6	579	40.0	63	38.9	157	35.5	298	46.9	10	25.0	363	47.8	1,926	42.4
Vesicular basalt	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	—	—	1	<0.1
Rhyolite	18	2.4	11	8.0	26	15.9	168	11.6	3	1.9	15	3.4	26	4.1	2	5.0	33	4.3	302	6.6
Granite	8	1.1	—	—	4	2.4	43	3.0	—	—	4	0.9	4	0.6	—	—	21	2.8	84	1.8
Andesite	23	3.0	2	1.5	1	0.6	30	2.1	2	1.2	19	4.3	21	3.3	—	—	8	1.1	106	2.3
Porphyritic andesite	10	1.3	3	2.2	—	—	1	0.1	2	1.2	4	0.9	7	1.1	—	—	—	—	27	0.6
Breccia	2	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	<0.1
Volcanic tuff	—	—	—	—	—	—	2	0.1	—	—	—	—	—	—	—	—	—	—	2	<0.1
Indeterminate igneous	4	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	0.1
Subtotal	411	54.3	66	48.2	91	55.5	825	57.1	70	43.2	202	45.7	357	56.2	12	30.0	427	56.2	2,461	54.2
Sedimentary																				
Limestone	—	—	—	—	—	—	8	0.6	—	—	—	—	2	0.3	—	—	5	0.7	15	0.3
Sandstone	24	3.2	—	—	—	—	27	1.9	10	6.2	66	14.9	39	6.1	1	2.5	19	2.5	186	4.1
Shale	—	—	—	—	—	—	—	—	2	1.2	—	—	—	—	—	—	—	—	2	<0.1
Siltstone	—	—	—	—	4	2.4	5	0.3	15	9.3	—	—	6	0.9	—	—	2	0.3	32	0.7
Mudstone	—	—	2	1.5	2	1.2	—	—	—	—	—	—	—	—	—	—	—	—	4	0.1
Conglomerate	—	—	—	—	1	0.6	17	1.2	—	—	—	—	—	—	—	—	13	1.7	31	0.7
Indeterminate sedimentary	—	—	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—	—	—	1	<0.1
Subtotal	24	3.2	2	1.5	7	4.3	58	4	27	16.7	66	14.9	47	7.4	1	2.5	39	5.1	271	6

Table 58. Stone Artifact Materials from the CCP Sites (*continued*)

Material	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Metamorphic																				
Gneiss	—	—	—	—	—	—	—	—	2	1.2	—	—	—	—	—	—	—	—	2	<0.1
Quartzite	17	2.2	4	2.9	26	15.9	121	8.4	16	9.9	41	9.3	31	4.9	2	5.0	86	11.3	344	7.6
Schist	1	0.1	—	—	—	—	11	0.8	—	—	1	0.2	6	0.9	1	2.5	9	1.2	29	0.6
Phyllite	—	—	—	—	—	—	—	—	—	—	—	—	4	0.6	—	—	—	—	4	0.1
Metasandstone	—	—	—	—	—	—	21	1.5	—	—	—	—	—	—	—	—	—	—	21	0.5
Metasediment	25	3.3	7	5.1	8	4.9	13	0.9	10	6.2	11	2.5	23	3.6	—	—	5	0.7	102	2.2
Metavolcanic	101	13.3	9	6.6	9	5.5	11	0.8	14	8.6	19	4.3	21	3.3	5	12.5	16	2.1	205	4.5
Porphyritic metavolcanic	44	5.8	26	19.0	—	—	1	0.1	1	0.6	3	0.7	6	0.9	3	7.5	—	—	84	1.8
Indeterminate metamorphic	17	2.2	2	1.5	2	1.2	1	0.1	—	—	1	0.2	—	—	1	2.5	1	0.1	25	0.6
Subtotal	205	27.1	48	35	45	27.4	179	12.4	43	26.5	76	17.2	91	14.3	12	30	117	15.4	816	18
Cryptocrystalline silicate																				
Chalcedony	13	1.7	4	2.9	4	2.4	39	2.7	2	1.2	14	3.2	21	3.3	6	15.0	22	2.9	125	2.8
Chert	66	8.7	10	7.3	8	4.9	276	19.1	14	8.6	69	15.6	84	13.2	9	22.5	130	17.1	666	14.7
Jasper	34	4.5	6	4.4	8	4.9	13	0.9	2	1.2	12	2.7	27	4.3	—	—	10	1.3	112	2.5
Subtotal	113	14.9	20	14.6	20	12.2	328	22.7	18	11.1	95	21.5	132	20.8	15	37.5	162	21.3	903	19.9
Mineral																				
Crystal quartz	—	—	—	—	—	—	—	—	—	—	—	—	1	0.2	—	—	—	—	1	<0.1
Quartz	1	0.1	1	0.7	—	—	28	1.9	3	1.9	—	—	2	0.3	—	—	1	0.1	36	0.8
White quartz	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.1	1	<0.1
Argillite	1	0.1	—	—	—	—	10	0.7	—	—	1	0.2	4	0.6	—	—	4	0.5	20	0.4
Chlorite	—	—	—	—	—	—	—	—	1	0.6	—	—	—	—	—	—	—	—	1	<0.1

Table 58. Stone Artifact Materials from the CCP Sites (*continued*)

Material	Site 41/583		Site 103/2061		Site 404/2011		Vegas Ruin (405/2012)		Site 406/2013		Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016		Crane Site (410/2017)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Mineral (*continued*)																				
Hematite	2	0.3	—	—	—	—	3	0.2	—	—	—	—	—	—	—	—	2	0.3	7	0.2
Turquoise	—	—	—	—	—	—	10	0.7	—	—	1	0.2	—	—	—	—	5	0.7	16	0.4
Steatite	—	—	—	—	—	—	5	0.3	—	—	—	—	—	—	—	—	1	0.1	6	0.1
Subtotal	4	0.5	1	0.7	—	—	56	3.9	4	2.5	2	0.5	7	1.1	—	—	14	1.8	88	1.9
Unidentified																				
Unidentified	—	—	—	—	1	0.6	—	—	—	—	1	0.2	1	0.2			1	0.1	4	0.1
Total	757	100	137	100	164	100	1,446	100	162	100	442	100	635	100	40	100	760	100	4,543	100

Note: The subtotal percentages were calculated using site total.

Tabular knives were most often made from local schist. Basalt and rhyolite were other preferred materials, followed by sandstone and quartzite. The use of schist in making tabular knives was a common prehistoric practice throughout southern and central Arizona. Schist was the primary material used to make the tabular knives recovered during the TCAP (Adams 2002b:Table 10.14). Tabular rhyolite, however, was the dominant material encountered during the SR 87 project along Sycamore Creek (Knoblock et al. 2003). The large number of tabular rhyolite knives at the Sycamore Creek sites is likely a consequence of rhyolite being available nearby.

Chronology and Demography

Projectile points were the most time-sensitive artifacts in the project lithic collection, represented by a total of 79 recovered specimens (see Tables 37 and B.2.1; examples shown in Figure 30). Most of these projectile points were recovered from burial contexts at the Vegas Ruin. Their placement in burials allows an assessment of stylistic variability during the pre-Classic–Classic period transition. Here, the point styles in the CCP collection are compared with those from the nearby TCAP (Sliva and Lyons 2002) and the SCP (Knoblock et al. 2003).

Archaic period dart points were recovered from Site 103/2061, the Vegas Ruin, and the Crane site. The point from Site 103/2061 had been extensively reworked and may have been brought to the site during the Formative period. Alternatively, it may represent an Archaic period component. The large San Pedro point (see Figure 30k) from the Vegas Ruin was recovered from burial Feature 137, where it accompanied 23 arrow points. The Elko Corner-notched point was collected from a buried rock scatter (see Figure 30l). A heavily worn stemmed point, here classified as cf. San Pedro, was recovered from the fill of the Feature 4 structure at the Crane site (see Figure 30m). One margin and face of this point were heavily eroded, likely by water. As such, this point may have been collected from nearby Tonto Creek and brought to the site during the early Classic period. Though these Archaic period points appear to have been gathered by Formative period peoples, they nonetheless represent Archaic period use of the project area. They were the only stone artifacts recovered in the course this project that were made during this poorly understood period.

Two of the three projectile points recovered from both the Rock Jaw site and Site 41/583 were indeterminate. These points cannot be placed in the extant Tonto Basin point typology proposed by Sliva and Lyons (2002). These points had relatively wide triangular blades with concave bases and broad, upward-angled side notches placed just above the base (see Figure 30n, o). At Site 41/583, they may represent the introduction of the bow-and-arrow weapon system or a Mogollon influence or presence in the project area (Whittaker 1984). Two indeterminate points were recovered from the Vegas Ruin, and one was recovered from Site 103/2061.

Sedentary Side-notched arrow points were the most numerous type at the Vegas Ruin, followed by Classic Side-notched, which together comprised 3 of the 5 projectile points at the Crane site (Table 59). One might take this evidence to suggest that the Crane site was occupied later than the Vegas Ruin. However, the small number of arrow points recovered from the Crane site, and the fact that practically all of Tonto Basin point types co-occurred within the Vegas Ruin burials, makes it impractical to order these sites temporally based on the projectile points alone. We do know that the proposed Tonto Basin Classic Side-notched, Classic Triangular, and Classic Concave-base Triangular types discussed by Silva and Lyons represented about 43 percent of the projectile points recovered from the Vegas Ruin. These point types, however, were recovered along with numerous Sedentary Side-notched points and a Colonial Stemmed Shouldered point from the Feature 137 burial. This admixture of point styles in burial contexts at the Vegas Ruin suggests that the site may have been occupied during a period of stylistic and technological transition. We feel it is important to note, however, that the arrow points recovered from the CCP sites also represent forms commonly recovered from Hohokam sites in the Phoenix Basin (Bernard-Shaw 1988; Gladwin et al. 1965), the Tucson Basin (Dart 1995; Kelly 1978), and the Little Colorado Region (Reid 1982; Tagg 1994). As such, they seemingly represent a technological complex used throughout much of Arizona between about A.D. 900 and 1350.

Subsistence

The stone tools at the project sites indicate that plant-food processing was a primary subsistence activity. Ground stone artifacts were particularly numerous at the Vegas Ruin and the Crane site (see Table 37). Almost equal proportions of flaked and ground stone tools were found at these sites (Table 60). The relatively high proportion of ground stone tools distinguishes these two habitation sites from the smaller habitation sites and limited-activity sites investigated during the CCP, which contained approximately 6–55 flaked stone tools for every ground stone tool. Trough metates and loaf manos were most commonly encountered at the two larger habitation sites. These kinds of ground stone tools were most often associated with corn processing. The large numbers of these artifacts at the Vegas Ruin and the Crane site suggest, therefore, that agricultural products were a dietary staple. There seems to be consistency in the proportions of manos to metates. Six of the seven sites with these ground stone tools exhibited ratios between 1.6 and 2.5 manos to each metate.

Table 59. Number and Percentage of Projectile-Point Types from the CCP Sites

Projectile-Point Type	Site 41/583		Site 103/2061		Vegas Ruin (405/2012)		Rock Jaw Site (407/2014)		Crane Site (410/2017)		Total (n)
	n	%	n	%	n	%	n	%	n	%	
Classic Serrated	—	—	—	—	1	1.5	—	—	—	—	1
Classic Concave-base Triangular	—	—	—	—	4	6.0	—	—	1	20.0	5
Classic Side-notched	—	—	—	—	22	32.8	—	—	2	40.0	24
Classic Triangular	—	—	—	—	3	4.5	—	—	—	—	3
Early Classic Side-notched	—	—	—	—	1	1.5	—	—	—	—	1
Sedentary Side-notched	—	—	—	—	31	46.3	1	33.3	1	20.0	33
Colonial Barbed	1	33.3	—	—	—	—	—	—	—	—	1
Colonial Stemmed Shouldered	—	—	—	—	1	1.5	—	—	—	—	1
Indeterminate arrow point	2	66.7	—	—	2	3.0	2	66.7	—	—	6
cf. San Pedro	—	—	—	—	—	—	—	—	1	20.0	1
San Pedro	—	—	—	—	1	1.5	—	—	—	—	1
Elko Corner-notched	—	—	—	—	1	1.5	—	—	—	—	1
Indeterminate dart point	—	—	1	100	—	—	—	—	—	—	1
Total	3	100	1	100	67	100	3	100	5	100	79

Table 60. Ratios of Certain Artifact Types from the CCP Sites

Site	Artifact Ratio[a]			
	Flaked Stone Tool to Ground Stone	Manos to Metates	Debitage to Cores	Debitage to Modified Flakes
41/583	10.3:1	2.5:1	23:1	5:1
103/2061	55:1		5:1	5:1
404/2011	2.8:1	4:1	12:1	143:1
Vegas Ruin (405/2012)	1.8:1	1.8:1	39:1	59:1
406/2013	8.3:1	2:1	31:1	5:1
Rock Jaw site (407/2014)	6.1:1	2:1	17:1	17:1
408/2015	14.3:1	2.5:1	31:1	8:1
409/2016			14:1	3:1
Crane site (410/2017)	0.8:1	1.6:1	66:1	87:1

[a] Ratios for the Vegas Ruin (405/2012) and the Crane site (410/2017) calculated using the total number of tools and debitage recovered rather than the number of analyzed samples.

Interestingly, the Crane site contained a much higher proportion of basin and slab metates compared to the Vegas Ruin (see Table 48). This could indicate that a greater variety of plant foods, particularly native taxa, were routinely processed at this site. Basin and slab metates and oval manos were also recovered from the Vegas Ruin but in much lower frequencies than the trough metates and loaf manos. By contrast, basin metates and oval manos dominated the ground stone collection from Site 41/583. This indicates that the people who used the large *horno* at this site had different plant-food processing needs compared to the residents of the Vegas Ruin and the Crane site.

Tabular tools were most numerous at Site 408/2015. They were also recovered from the larger habitation sites (see Table B.2.3). Tabular tools have often been associated with agave processing, but none was recovered from Site 41/583, which contained a large *horno*—a feature type that was often used to process agave prehistorically (Fish et al. 1992). The tabular tools at the Vegas Ruin and the Rock Jaw site were recovered from the surface or from secondary deposits. Three tabular tools were recovered from an infant burial at Site 408/2015. Tabular tools were also recovered from the surface and two from a rock pile at the Crane site. Overall, tabular tools were relatively rare at the project sites. This may suggest that agave did not figure prominently in the subsistence system.

Projectile points were recovered from five of the nine project sites (see Tables 37, 59, and B.2.1). The vast majority of the projectile points recovered from all nine sites were interred with burials at the Vegas Ruin, with over 20 recovered from a single burial. Together, the projectile points represent about 10 percent of the flaked stone tools recovered during this project. As such, they were a fairly common tool type. This suggests that hunting was an important subsistence activity, particularly for the occupants of the Vegas Ruin; however, the recovery of the majority of these points from burial contexts suggest they also had a very important ritual function as well.

Scraping and cutting tools were the most numerous kinds of tools in the collection. Modified flakes were particularly common. Many of these flakes exhibited low-angle working margins that were often retouched. As such, they would have made suitable cutting tools. The ratios of debitage to modified flakes across the project sites vary significantly; a ratio of less than 8:1 characterized most of the project sites. Only one modified flake was found at Site 404/2011, in association with a small field house. The Vegas Ruin and the Crane site also contained relatively few modified flakes compared to the other project sites. Surprisingly, Site 409/2016 contained a surprisingly high proportion of modified flakes, given the smaller size of the total collection from that site. Whether modified flakes served the same purposes as tabular knives at this site is unclear, but plant-food processing was clearly an important activity at Site 409/2016, which may represent an activity loci associated with the occupation of the nearby Crane site. Scrapers were most commonly recovered from Site 41/583, the Rock Jaw site, and the Vegas Ruin (see Tables 37 and B.2.2). These scrapers were significantly larger than the modified flakes and tended to have working margins with significantly steeper working margins. As such, they were more suited for working tougher materials. Large choppers were also recovered, and they were particularly numerous at Sites 41/583 and 408/2015. Overall, the large numbers of cutting, scraping, and chopping tools at many of the project sites represents an industry devoted to working perishable materials. Many of these perishable materials were likely foodstuffs, although these tools were also most certainly used to make textiles, to work wood and bone, and to build and maintain structures.

Technology

Generally, a flake-core technology reliant upon locally available materials characterizes the flaked stone technology used at the CCP sites. Coarser-grained volcanic materials, such as basalt and rhyolite, were most often selected for the production of utilitarian flake tools, scrapers, and choppers. The durability and relative ubiquity of these materials likely guided their selection for these purposes. This reliance on a flake-core technology, however, did not exclude biface reduction and manufacture. Bifaces were made during all periods of occupation represented at the project sites. Biface reduction focused on making projectile points, particularly small chert arrow points, during the occupation of the Vegas Ruin.

The ratio of cores to debitage among the project sites is presented in Table 60. This ratio can be used to infer some of the reduction activities at a site, with a greater number of cores signaling a greater amount of core reduction. Sites 103/2061, 404/2011, 409/2016, and the Rock Jaw site contained proportionately more cores compared to debitage among the project sites, whereas Sites 41/583, 406/2013, 408/2015, the Vegas Ruin, and the Crane site contained relatively few cores compared to debitage. The large number of cores at some of the CCP sites may indicate that not only core reduction but also material testing occurred there more often. It is also possible that the focus of reduction at sites such as Sites 103/2061, 404/2011, and 409/2016 was the production of usable flake blanks that were taken to other locations, such as nearby Ushklish Ruin or the Crane site. The relatively small number of cores recovered from Site 41/583, the Vegas Ruin, and the Crane site may indicate that more-intensive core reduction occurred at these sites. It appears that the intensity of core reduction at the other project sites falls somewhere in between these two modes of reduction. That is, core reduction was still an important activity at these sites, but that they may not have been as intensively reduced.

Evaluating the metric attributes of the cores recovered from the project sites provides a proxy for evaluating differences in core-reduction intensity. Table 61 lists the mean metric data for the cores and core tools recovered from the project sites. Interestingly, no significant differences distinguish the sites based on the types and sizes of cores they contained. The debitage-to-core ratios in Table 60, however, do suggest differences in the reduction activities at the sites. For example, the Vegas Ruin and Crane site stand out from all the others in terms of the high proportion of cores to other flaked stone tools and high proportions of debitage to cores. This evidence suggests more-intensive core-reduction activities at these two sites. By contrast, Sites 103/2061, 404/2011, and the Rock Jaw site contain relatively high proportions of cores to other flaked stone tools and relatively low proportions of debitage. These three sites appear to be areas of high-frequency core-reduction activity but at a much lower intensity. Alternatively, flakes may have been removed from these sites and taken to other locations. Site 41/583, 406/2013, and 408/2015 represent a third group with relatively few cores but moderate to high proportions of debitage, suggesting that core reduction was of intermediate intensity at these sites. Alternatively, flake blanks may have been brought to these sites from other locations. Finally, Site 409/2016 had low proportions of cores and debitage, suggesting very little core reduction took place at this site.

Inspecting the attributes of the debitage collected from the project sites is yet another way to examine patterns of reduction. Table 62 lists the amount of cortex on complete flakes from the project sites. Completely cortical early-stage flakes were most numerous at Site 103/2061 and least numerous at Site 41/583. The low number of flakes from Site 103/2061 may explain its large number of cortical flakes. Alternatively, early-stage core reduction may have been an important, if not primary, site activity. The large number of cortical flakes at Site 41/583 coincides with the relatively large number of cores recovered there. As such, it appears that core reduction was an important activity at Site 41/583. The Vegas Ruin, the Crane site, the Rock Jaw site, and Site 408/2015 have nearly equal amounts of completely and partially cortical flakes. This suggests that the range of reduction activities at these three sites was very similar. The fairly even number of cortical and noncortical flakes at these habitation sites suggests that early-stage through late-stage reduction routinely took place at these sites. Such a range of reduction activities is to be expected at a habitation site where people routinely reduced cores and made and maintained flaked stone tools. The debitage from Sites 404/2011 and 406/2013 primarily represents early- and mid-stage reduction activities.

Platform morphology can also be used to evaluate reduction stage and strategy. Table 63 lists the number of proximal flakes bearing different platform types collected from each site. Cortical platforms were often the most numerous from the project sites. Flakes with cortical platforms are often produced during either core reduction or when large flake blanks are fashioned into tools. Plain platforms tended to be the second most numerous, and they likely represent later-stage core reduction and tool manufacturing activities. Multifaceted

Table 61. Metric Attributes of Cores and Core Tools Recovered from the CCP Sites

Site	Length (L)			Width (W)			Thickness (T)			Average (L+W+T)/3	Total Number of Cores and Core Tools
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum		
41/583	26.8	66.9	103.0	20.2	50.9	99.7	14.2	33.6	63.0	50.5	35
103/2061	30.2	67.1	131.2	22.2	52.2	97.5	11.5	36.8	78.0	52.0	20
404/2011	34.5	54.9	92.5	32.7	69.1	103.6	22.1	65.9	102.5	63.3	13
Vegas Ruin (405/2012)	12.8	69.7	211.0	10.7	62.2	160.0	5.0	46.2	94.5	59.4	82
406/2013	53.6	94.4	136.2	45.0	77.6	102.0	37.5	55.6	68.3	75.9	6
Rock Jaw site (407/2014)	39.6	94.2	340.0	7.3	76.6	330.5	26.8	49.8	80.5	73.5	23
408/2015	17.2	80.6	120.0	18.4	66.3	102.7	14.4	39.0	76.6	62.0	34
409/2016	79.4	96.6	118.7	58.7	74.5	87.2	36.8	50.7	67.3	73.9	3
Crane site (410/2017)	10.4	41.2	75.9	5.3	56.5	87.0	3.4	47.4	77.9	48.4	30

Table 62. Amount of Cortex on Complete Flakes from the CCP Sites

Site	Cortex amount (%)								Total (n)
	0		1–49		50–99		100		
	n	%	n	%	n	%	n	%	
41/583	94	66.2	34	23.9	9	6.3	5	3.5	142
103/2061	12	63.2	2	10.5	1	5.3	4	21.1	19
404/2011	22	27.2	35	43.2	18	22.2	6	7.4	81
Vegas Ruin (405/2012)	300	55.9	125	23.2	58	10.8	54	10.0	537
406/2013	13	39.4	15	45.5	4	12.1	1	3.0	33
Rock Jaw site (407/2014)	80	50.0	53	33.1	10	6.3	17	10.6	160
408/2015	75	48.1	47	30.1	15	9.6	19	12.2	156
409/2016	5	83.3	1	16.7	—	—	—	—	6
Crane site (410/2017)	146	50.2	82	28.2	34	11.7	29	10.0	291
Total	747	100	394	100	149	100	135	100	1,425

Table 63. Number and Percentage of Flakes with Different Platforms from the CCP Sites

Site	Cortical		Plain		Multifaceted		Dihedral		Crushed		Total (n)
	n	%	n	%	n	%	n	%	n	%	
41/583	69	40.1	72	41.9	31	18.0	—	—	—	—	172
103/2061	21	42.0	20	40.0	8	16.0	1	2.0	—	—	50
404/2011	40	37.7	46	43.4	20	18.9	—	—	—	—	106
Vegas Ruin (405/2012)	333	48.5	185	27.0	151	22.0	1	0.1	16	2.3	686
406/2013	44	55.0	30	37.5	5	6.3	1	1.3	—	—	80
Rock Jaw site (407/2014)	54	60.7	22	24.7	13	14.6	—	—	—	—	89
408/2015	137	61.7	61	27.5	21	9.5	3	1.4	—	—	222
409/2016	7	43.8	5	31.3	4	25.0	—	—	—	—	16
Crane site (410/2017)	207	54.6	125	33.0	45	11.9	—	—	2	0.5	379
Total	912	50.7	566	31.4	298	16.6	6	0.3	18	1.0	1,800

platforms were slightly more numerous at the Vegas Ruin when compared to the other project sites. Many of the flakes with multifaceted platforms were chert biface-reduction flakes, likely produced during arrow-point production. Platform faceting signals a greater amount of effort on behalf of the prehistoric flint knapper. Faceting is performed in order to create and strengthen a platform prior to flake detachment. Platform faceting is also an integral component of bifacial reduction. As such, the presence of flakes made from fine-grained materials, such as chert or obsidian, along with multifaceted platforms likely represent biface manufacture. These same flakes also often bear numerous dorsal scars and a pronounced longitudinal curvature. Together, these attributes suggest bifacial reduction. At sites like the Vegas Ruin, the focus of bifacial reduction was arrow-point production. Multifaceted platforms were also present at many of the project sites, but these flakes were larger, bear few dorsal flake scars, and they seem to represent flake-core reduction activities.

We also wanted to know if the reduction activities that took place within structures differed from those that took place elsewhere. To this end, debitage was sorted from a series of fine-screened (1-mm mesh) sediment samples collected from the near-floor fill and floor of pit structures, rooms, and middens. The Vegas Ruin, the Crane site, and the Rock Jaw site were the only places where these comparisons could be meaningfully made. This is because only samples from these sites yielded a sufficient number of complete flakes. Complete flakes were used because cortex amount and size cannot be accurately recorded for incomplete flakes. At the Vegas Ruin, a total of 177 complete flakes from the midden and 192 complete flakes from structures and rooms were sorted from the wet-screen samples. Interestingly, there was no significant difference between the amount of dorsal cortex and size of the flakes recovered from these two contexts (Figures 42 and 43). That is, based on cortex and size, the flakes from near-floor fill and the floors of rooms and structures were nearly indistinguishable from the midden specimens. Similarly, flakes sorted from the wet-screen samples collected from the Crane site midden were also remarkably similar to those recovered from the various intramural and extramural contexts at the Vegas Ruin (Figures 44 and 45). Flakes from the pit structures at the Rock Jaw site tended to be somewhat smaller than those from the Vegas Ruin and the Crane site, but the frequency of dorsal cortex was essentially the same (Figures 46 and 47).

Overall, the complete flakes from the middens, structures, and rooms at these three sites appear to represent secondary refuse. No differences in reduction stage distinguish these contexts. This does not necessarily mean, however, that different reduction activities did not take place within structures and rooms when compared to extramural areas. Tool manufacture and repair may have routinely taken place within structures near hearths, but the resulting debris was likely gathered and disposed of elsewhere. As such, in the absence of de facto refuse, we can conclude little concerning the loci of core reduction vs. tool manufacture and repair.

Patterning does exist among the sites when the percentages of complete cortical flakes made of different materials are compared. Table 64 lists the percentage of complete flakes made of different materials from the project sites that were either partially or completely cortical. Only the most-abundant materials are listed. For example, the Vegas Ruin and the Crane site contained remarkably similar percentages of cortical flakes made of the same materials. Except for igneous materials, the percentages calculated for the Rock Jaw site also closely correspond to the Vegas Ruin and the Crane site. This suggests that similar reduction strategies were used at these sites and that different materials underwent many of the same reduction processes. The largest percentages of cortical flakes, regardless of material, were recovered from Sites 404/2011, 406/2013, and 408/2015. It appears, therefore, that core reduction and tool manufacture, rather than late-stage tool manufacture or repair, occurred more often at these sites. Again, different materials appear to have undergone very similar reduction trajectories, at least when cortex amount is used to gauge reduction stage.

Conclusions

The CCP included the analysis of 4,545 stone artifacts gathered from nine sites. Most of this collection was gathered from the Vegas Ruin, the Crane site, the Rock Jaw site, and Site 41/583 (see Table 37). Prehistoric people relied on locally available materials to meet their stone-tool needs. Nonlocal materials, such as obsidian, turquoise, steatite, and, perhaps, argillite, were used only occasionally. Argillite, which was easily accessible to prehistoric residents of the CCP area in the upper Tonto Basin, was also used for the manufacture of ornaments. Turquoise, steatite, and schist were also used to make ornaments, primarily pendants, as well as the small numbers of beads and rings that were found. Surprisingly, ornaments were recovered from a great variety of features: 12 were recovered from burials, 12 from structures, and 13 from other features and nonfeature contexts.

Only a small amount of obsidian was recovered from the CCP sites. This included a broken projectile point and two flakes from the Rock Jaw site, two bipolar cores from the Vegas Ruin, and a bipolar remnant core and flake from the Crane site. The three artifacts from the Rock Jaw site and the two from the Crane site were submitted to Dr. M. Steven Shackley for XRF analysis. Only four of the five specimens could be sourced. This analysis indicated that all three of the Rock Jaw site artifacts were derived from the distant Government Mountain source near Flagstaff, whereas the one from the Crane site came from the Superior source in the

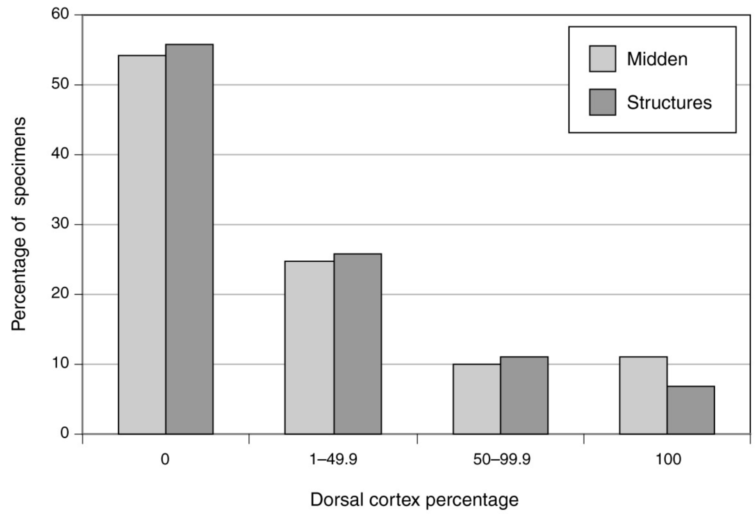

Figure 42. Cortex amount on complete flakes from the floor and near-floor fill of pit structures and rooms at Vegas Ruin (405/2012) compared to specimens from the midden.

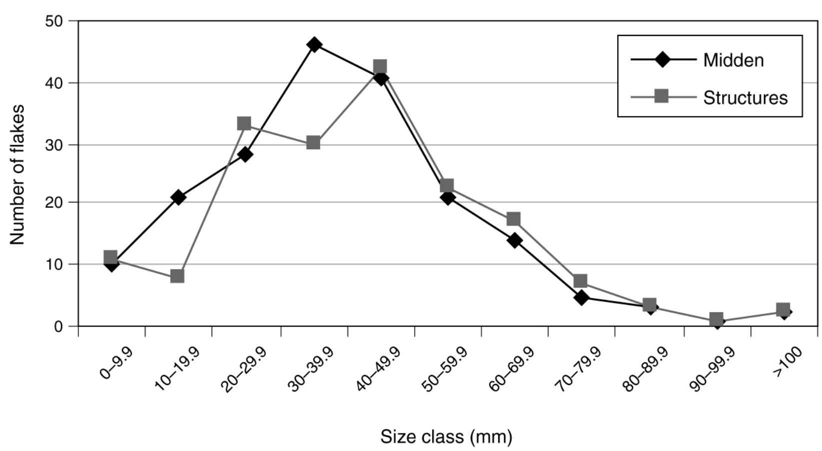

Figure 43. Size of complete flakes recovered from the floor and near-floor fill of pit structures and rooms at Vegas Ruin (405/2012) compared to specimens from the midden.

Globe-Miami highlands at the southern end of Tonto Basin (see Appendix B.1). This pattern of obsidian use, however, is typical of Tonto Basin lithic collections.

Projectile points were most numerous in burial contexts at the Vegas Ruin, particularly in Features 33 and 137. Projectile-point manufacture relied on heat-treated chert and chalcedony. Heat-treated flakes of these materials were also often encountered, along with projectile points and cores of the same materials in burial contexts. The types of projectile points recovered from the CCP sites are quite similar to those defined as part of the TCAP (Sliva and Lyons 2002). Sedentary Side-notched and Classic Side-notched points were the most numerous types in the CCP collection. Several Archaic period dart points were also recovered. One of these may represent an Archaic period occupation at Site 103/2061. The others appear to be heirlooms, owing to their presence in Formative period structures or burials, and were collected from the Crane site and the Vegas Ruin (see Tables 55 and

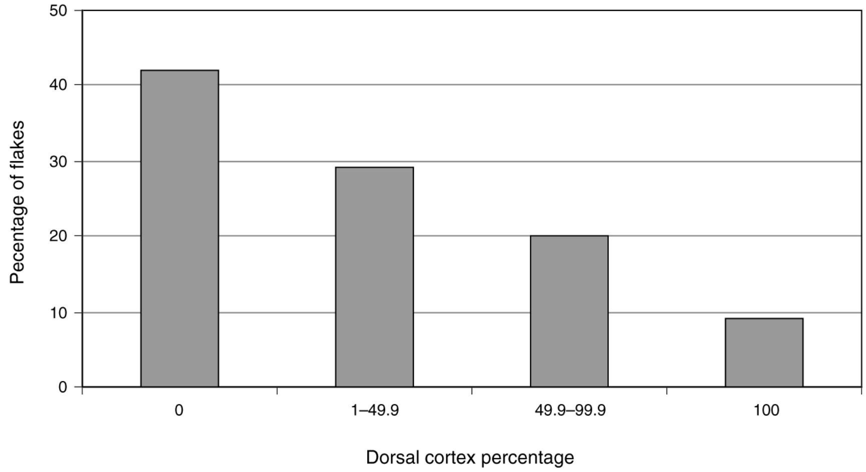

Figure 44. Cortex amount on complete flakes from the Crane site (410/2017) midden.

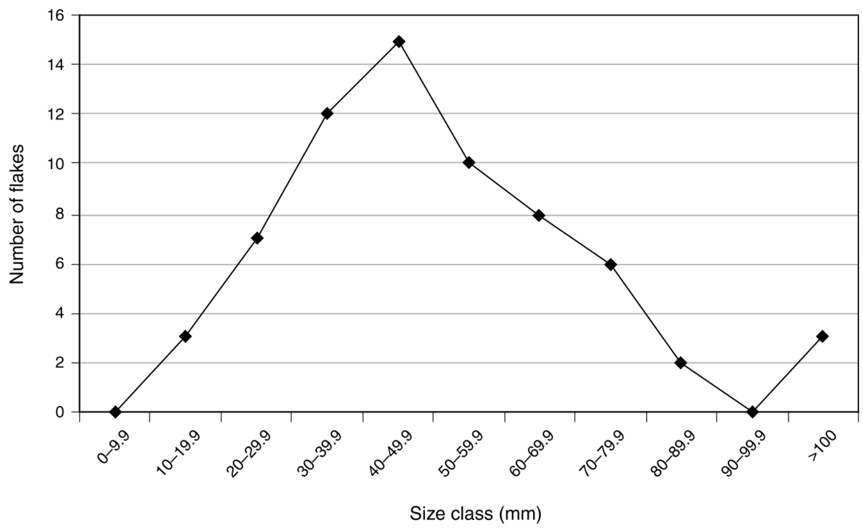

Figure 45. Size of complete flakes recovered from the Crane site (410/2017) midden.

B.2.1). The large numbers of projectile points recovered from the habitation sites suggests that hunting was an important component of the subsistence economy.

The large relative percentages of ground stone artifacts at the habitation sites indicate that plant-food processing was an important, if not primary, activity. Trough metates and loaf manos were among the most numerous of the ground stone artifacts at these sites. Maize processing, therefore, appears to have been particularly important. As such, it appears that the occupants of the Vegas Ruin and the Crane site relied intensively on agricultural foodstuffs, particularly maize. A variety of other plant foods also appear to have been important, as suggested by the many basin and slab metates that were also recovered from these sites. Overall, although maize processing was certainly emphasized, a wide variety of plant foods were also routinely sought and used.

Scrapers, choppers, and modified flakes were among the most numerous tools at the project sites. These implements represent an industry oriented toward the working of perishable materials. They were made using a flake-core-reduction strategy that focused on the production of large, usable flakes. Biface reduction was also practiced but was oriented toward making projectile points. Flake-core debitage dominated the project collection and appears to be a diagnostic characteristic

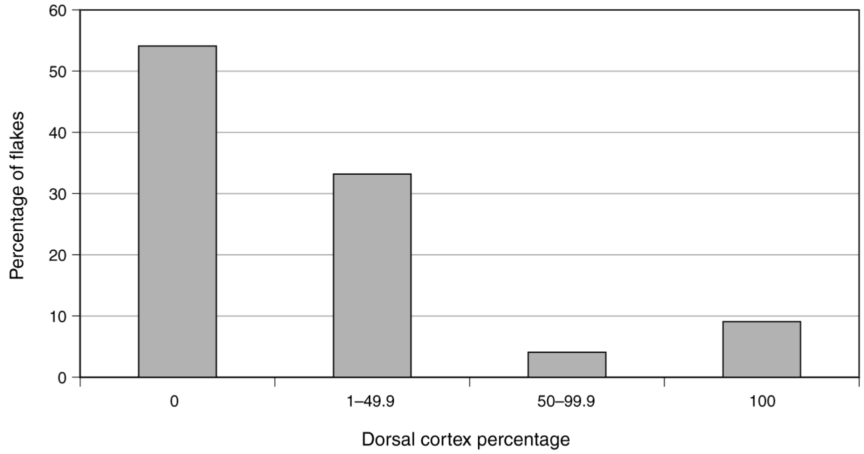

Figure 46. Cortex amount on complete flakes from pit structures at the Rock Jaw site (407/2014).

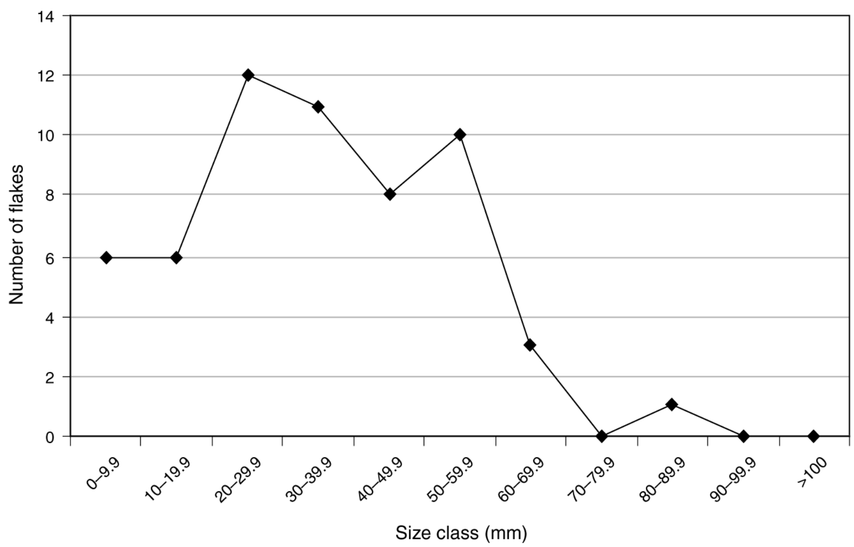

Figure 47. Complete flakes from pit structures at the Rock Jaw site (407/2014).

of Formative period collections from Tonto Basin.

Comparing debitage specimens collected from trash deposits, near-floor fill deposits, and from structure floors failed to identify significant differences. That is, the size and amount of cortex on complete flakes from these contexts is essentially the same. This suggests that the activities that produced the analyzed specimens were the basically the same or that the near-floor fill deposits were replete with secondary refuse. As such, we were unable to identify whether different reduction activities occurred within structures compared to surrounding areas.

Overall, the stone artifacts from the CCP sites suggest that the population was agriculturally dependent and relied almost entirely on local materials to meet their stone-tool needs. Most of the diagnostic tools in the collection were from burial contexts. The projectile points recovered from the habitation sites suggest that the sites were occupied during the pre-Classic–Classic period transition. A greater number of stone

Table 64. Percentage of Complete Cortical Flakes out of Total Flakes at the CCP Sites, by Material Type

Material	Site 41/583	Site 103/2061	Site 404/2011	Vegas Ruin (405/2012)	Site 406/2013	Rock Jaw Site (407/2014)	Site 408/2015	Site 409/2016	Crane Site (410/2017)
Igneous									
Basalt	40.3	50.0	70.0	44.6	70.6	52.2	52.2	50.0	48.5
Rhyolite	33.8	—	74.0	44.1	—	47.5	51.7	—	49.3
Andesite	—	—	100	58.8	100	50.0	50.0	—	100
Metamorphic									
Quartzite	—	50.0	70.2	42.4	59.3	46.4	51.4	—	48.9
Metasediment	38.5	55.6	66.7	42.3	71.4	43.4	52.3	—	46.7
Metavolcanic	35.5	—	65.1	42.4		45.9	51.9	—	47.2
Sedimentary									
Sandstone	34.3	—	—	44.1	60.7	50.0	51.3	—	49.5
Siltstone	—	—	71.4	—	60.6	—	51.9	—	49.7
Cryptocrystalline silicate									
Chalcedony	39.7	—	—	43.3		49.3	—	—	48.3
Chert	36.2	57.1	68.8	41.7	68.4	42.5	53.9	—	46.4
Jasper	36.0	—	66.7	41.4		43.1	52.9	—	46.9

artifacts and artifact types distinguishes the habitation sites from other nearby limited-activity locales. The kinds of projectile points, ground stone implements, and ornaments from the project sites were either the same or very similar to those recovered from throughout Tonto Basin. As such, the CCP stone artifact collection represents a suite of activities that characterize the pre-Classic–Classic period transition.

CHAPTER 5

Vertebrate Faunal Analysis

Robert M. Wegener

Introduction

The CCP's excavation efforts yielded a collection of 2,999 faunal specimens representing all five vertebrate classes and a minimum of 32 taxa (Table 65 provides a concordance of scientific and common names). Mammal remains dominated this collection, which was distributed among six prehistoric sites that primarily date to the pre-Classic–Classic period transition or the poorly understood Miami phase (A.D. 1150–1250). This chapter presents the results of a study of these vertebrate faunal remains. These results are then compared to those presented by previous researchers who have analyzed collections from Tonto Basin, surrounding upland locales, and the Salt-Gila-Verde region.

Data collection and compilation focused on identifying the taxa present in the CCP sample, evaluating the presence of butchering or food-processing patterns, and detecting temporal changes in the use, or perhaps availability, of faunal resources. If temporal variability was identified, then I examined whether it could be explained as the result of cultural practices or changes in the surrounding environment(s). Cultural practices of particular interest included changes in prey selection through time, the possible relationships between settlement history and the availability of faunal resources, and human-land relationships. An examination of these topics provided insight concerning the subsistence practices and the environment inhabited by the occupants of the project sites.

I begin this chapter by listing selected projects that have been conducted in Tonto Basin, surrounding upland locales, and the Salt-Gila-Verde region. These projects provide the comparative data used to investigate regional faunal procurement patterns, a primary objective of this analysis. Next, I describe the methods of specimen identification and analysis employed during the CCP. I provide descriptions of the identified taxa and discuss aspects of their life history and known ethnographic importance. I present detailed descriptions of the contexts in which the CCP faunal specimens were recovered. The resulting taxonomic and distributional data are then used to pursue and interpret prehistoric butchery, transport, and processing patterns, along with identified disposal practices and identified taphonomic processes. A project summary is then developed, which is followed by a compilation of previous research and a summary of multiregional trends.

Previous Research

Data compiled by Cameron (1998), recently presented by Waters (2002), and provided in this study indicate that archaeologists have recovered over 50,000 faunal specimens from over 120 prehistoric sites in Tonto Basin. Sites containing these remains have been interpreted as habitations, limited-activity loci, and ceremonial sites (see tables in Cameron [1998] and Waters [2002]. Projects in Tonto Basin that produced large collections used for comparative purposes in this study include the Ash Creek Project (Rice 1985), the Rye Creek Archaeological Project (RCAP) (Elson and Craig 1992), the RRSS (Ciolek-Torrello et al., eds. 1994), the FLEX Tonto Basin Project (Cameron 1997c), the RPM (Rice 1998), the RCD (Elson and Clark 1995), and the TCAP (Clark 2000).

Like James (1995), I was also interested in potential differences in faunal exploitation between sites located in Tonto Basin vs. those situated in the surrounding uplands and the nearby Salt-Gila River Basin. Several projects in the uplands surrounding the Theodore Roosevelt Lake region produced relatively large faunal collections. These upland projects include the Miami Wash Project (Doyel 1978), the Ord Mine Project (Ciolek-Torrello 1987), the Cholla Project (Reid 1982), the Pine Creek Project (Green 1990), and the SCP

Table 65. Scientific and Common Names of Identified Taxa

Taxon	Common Name
Fish	
Cyprinidae size	minnows
Amphibians	
cf. *Bufo* spp.	toads
Reptiles	
Testudines	tortoises and turtles
cf. *Kinosternon* spp.	mud turtles
cf. *Gopherus agassizii*	desert tortoise
Serpentes	snakes
Crotalus spp.	rattlesnakes
Birds	
Aves (eggshell)	birds
Lophortyx spp.	quail
Mammals	
Leporidae	rabbits and hares
Sylvilagus spp.	cottontails
Lepus californicus	black-tailed jackrabbit
Lepus cf. *alleni*	antelope jackrabbit
Rodentia	rodents
Ammospermophilus spp.	antelope ground squirrels
Thomomys spp.	pocket gophers
Muridae/Heteromyidae	mice, rats, voles
Perognathus spp.	pocket mice
Neotoma spp.	wood rats
Peromyscus spp.	white-footed mice
Carnivora	carnivores
Canidae	dogs
Canis spp.	dogs, coyotes, and wolves
Urocyon cf. *cinereoargenteus*	gray fox
Felidae	
Lynx rufus	bobcat
Artiodactyla	even-toed hoofed animals
Odocoileus spp.	deer
Odocoileus cf. *hemionus*	mule deer
Bos taurus	domestic cow

Table 65. Scientific and Common Names of Identified Taxa (*continued*)

Taxon	Common Name
Indeterminate mammals	
Mouse to squirrel size	
Squirrel size	
Squirrel to rabbit size	
Rabbit size	
Rabbit to coyote size	
Coyote to deer size	
Deer size	

(Klucas et al. 2002). The same Salt-Gila region collections used by James (1995:149–154, Table 20.27) are used in this analysis and include Las Colinas (Szuter 1989), Pueblo Grande (James 1994), Verde Bridge (at La Escuela Cuba [James 1992]), and Water Users (James 1991). In addition, faunal remains collected as part of SRI's research along the Lower Verde River (Shelley and Cairns 1998) were also incorporated. Faunal analysts have used these collections to investigate not only prehistoric subsistence patterns but also to assess site function, the presence of redistribution networks, paleoenvironmental fluctuations, and, more recently, issues of cultural affiliation.

Methods

In the field, faunal specimens were typically recovered by ¼-inch mesh screening. Some faunal bone was collected in grab-samples, and a few features were screened through ⅛-inch mesh. The overwhelming majority of the CCP faunal specimens (number of identified specimens [NISP] = 2,439, or 81.3 percent of the project total) was recovered from 4-liter flotation samples. It should be noted that virtually all of the smaller bones, including fish, birds, squirrel- to rabbit-sized mammals, and rodents, were recovered by flotation and not screening. The impact of our recovery techniques on this analysis will be discussed throughout the chapter.

All 2,999 faunal specimens in the CCP sample were identified and analyzed (Table 66). Data collection included the recording of 11 physical attributes for each specimen. All information characterizing each specimen was entered in a Microsoft Access database, in which specimens were assigned unique catalog numbers. The following discussions provide descriptions of the attributes recorded excluding provenience data. Provenience data were gathered from database tables stored in the CCP master database.

Identifications were made using a variety of available literature (Brown and Gustafson 1990; Gilbert 1973; Gilbert et al. 1985; Gustafson n.d.; Olsen 1968, 1973, 1979; Zweifel 1994) and the comparative collections housed in the zooarchaeology laboratory of the ASM. All identifications were made to the lowest taxonomic classification possible (e.g., genus or species). With highly fragmented remains, an assignment to a size class was all that was often possible. Such specimens were assigned to animal-size categories similar to those devised by Thomas (1969:393). The criteria used to place a specimen in a size class included bone thickness, relative size, and relative shape. The classification is as follows: (1) animals weighing less than 100 g (e.g., meadow mouse and pocket gopher), (2) animals weighing between 100 and 700 g (e.g., squirrel and chipmunk), (3) animals weighing between 700 g and 5 kg (e.g., cottontail rabbit and marmot), (4) animals weighing between 5 and 25 kg (e.g., coyote and bobcat), (5) animals weighing more than 25 kg (e.g., antelope, deer, and mountain sheep), and (6) indeterminate. Severe splintering can make it difficult to accurately assign a specimen even to a size class; a coding of "indeterminate" characterizes such specimens. Small pieces of cancellous bone received the same coding. At times, placing a specimen in a single category seemed unfounded, and such specimens were coded as representing one of several possible animal-size categories (e.g., size class 2–3, squirrel- to rabbit-sized animal).

The NISP represents the primary analytical measure used in this analysis. Following Grayson (1984:16), a specimen is defined as "a bone or tooth, or fragment thereof" and every individual specimen is included in the calculation of the NISP. In this approach, conjoining fragments are given an NISP value of 1. Eight NISP categories were recorded. Each specimen represents a single value (NISP = 1) in only one of

Table 66. Number and Percentage of Identified Specimens Assigned to Each Taxon from Each Site

Taxon	Site 41/583		Site 103/2061		Vegas Ruin (405/2012)		Rock Jaw Site (407/2014)		Site 408/2015		Crane Site (410/2017)		NISP Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Fish														
Cyprinidae	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Amphibians														
cf. *Bufo* spp.	—	—	—	—	8	0.3	—	—	—	—	—	—	8	0.3
Reptiles														
Testudines	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
cf. *Kinosternon* spp.	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
cf. *Gopherus agassizii*	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Serpentes	—	—	—	—	4	0.2	—	—	—	—	—	—	4	0.1
cf. *Crotalus* spp.	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Crotalus spp.	—	—	—	—	—	—	—	—	—	—	1	0.5	1	<0.1
Birds														
Aves (eggshell)	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
cf. *Lophortyx* spp.	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
Lophortyx spp.	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Mammals														
Leporidae	9	4.3	—	—	26	1.1	1	2.0	2	2.7	8	4.0	46	1.5
Sylvilagus spp.	2	0.9	1	100	27	1.1	—	—	—	—	3	1.5	33	1.1
Lepus californicus	1	0.5	—	—	67	2.7	—	—	1	1.4	7	3.5	76	2.5
Rodentia	7	3.3	—	—	6	0.2	1	2.0	—	—	5	2.5	19	0.6
Ammospermophilus spp.	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
Thomomys spp.	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Muridae/Heteromyidae	7	3.3	—	—	20	0.8	—	—	1	1.4	16	7.9	44	1.5
Perognathus spp.	1	0.5	—	—	3	0.1	—	—	—	—	—	—	4	0.1
Neotoma spp.	2	0.9	—	—	4	0.2	—	—	—	—	1	0.5	7	0.2

Table 66. Number and Percentage of Identified Specimens Assigned to Each Taxon from Each Site (*continued*)

Taxon	Site 41/583		Site 103/2061		Vegas Ruin (405/2012)		Rock Jaw Site (407/2014)		Site 408/2015		Crane Site (410/2017)		NISP Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Peromyscus spp.	2	0.9	—	—	1	<0.1	—	—	—	—	—	—	3	0.1
Carnivora	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
Canidae	—	—	—	—	—	—	—	—	1	1.4	—	—	1	<0.1
Urocyon cf. *cinereoargenteus*	—	—	—	—	3	0.1	—	—	—	—	—	—	3	0.1
Canis spp.	—	—	—	—	1	<0.1	1	2.0	3	4.1	—	—	5	0.2
Lynx cf. *rufus*	—	—	—	—	2	0.1	—	—	—	—	—	—	2	0.1
Artiodactyla	9	4.3	—	—	87	3.5	1	2.0	16	21.6	2	1.0	115	3.8
cf. *Odocoileus* spp.	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
Odocoileus spp.	1	0.5	—	—	26	1.1	1	2.0	3	4.1	1	0.5	32	1.1
Odocoileus cf. *hemionus*	—	—	—	—	1	<0.1	—	—	—	—	—	—	1	<0.1
Bos taurus	—	—	—	—	—	—	—	—	—	—	3	1.5	3	0.1
Indeterminate mammals														
Mouse to squirrel size	—	—	—	—	25	1.0	—	—	—	—	—	—	25	0.8
Squirrel size	—	—	—	—	—	—	—	—	—	—	1	0.5	1	<0.1
Squirrel to rabbit size	80	37.9	—	—	1,140	46.3	—	—	—	—	28	13.9	1,248	41.6
Rabbit size	73	34.6	—	—	562	22.8	35	71.4	13	17.6	79	39.1	762	25.4
Rabbit to coyote size	2	0.9	—	—	15	0.6	—	—	—	—	—	—	17	0.6
Coyote to deer size	—	—	—	—	242	9.8	1	2.0	4	5.4	1	0.5	248	8.3
Deer size	3	1.4	—	—	37	1.5	5	10.2	18	24.3	14	6.9	77	2.6
Unidentifiable mammals	12	5.7	—	—	137	5.6	3	6.1	12	16.2	32	15.8	196	6.5
Total	211	100	1	100	2,462	100	49	100	74	100	202	100	2,999	100

Key: NISP = number of identified specimens.

these NISP categories. NISP/end characterizes postcranial bone fragments possessing articular ends. Bone shafts and shaft fragments lacking articular ends were classified as NISP/shaft. NISP/flat characterizes fragments from flat bones, such as cranial elements and scapulae. Whole bones received a coding of NISP/whole. Teeth and tooth fragments were identified as NISP/teeth enamel. Similarly, antler and horn were classified as NISP/antler-horn, turtle shell as NISP/turtle-shell, and eggshell as NISP/eggshell. Summarizing these categories for a specific taxon and unit of analysis (e.g., feature or site) produced the NISP total. This allowed for a comparison of sites, features, and strata based on the taxa represented, the degree of fragmentation, and the condition of the specimen (e.g., size and burning).

The osteological name (e.g., femur) of each skeletal element was recorded. Recording element information would allow for the calculation of the minimum number of individuals (MNI) per taxon. Specimens were identified as being left, right, or axial, whenever possible. The anatomical orientation (e.g., distal or proximal) and location (e.g., lower thoracic limb) of each identified specimen or skeletal element also was recorded. For instance, a distal humerus fragment from the upper thoracic limb or a second maxillary premolar from the head might have been specified.

Although the recorded element information would allow for the calculation of MNI, I decided not to calculate the MNI for several reasons. First, MNI values tend to exaggerate the importance of rare taxa and undervalue the importance of common taxa (Lyman 2008:46). Second, because the Vegas Ruin (AZ U:3:405/2012) and the Crane site (AZ U:3:410/2017) are multicomponent sites, it was sometimes unclear which (particularly extramural) features dated to which time period. Because MNI is not simply additive, it would be difficult to calculate for large, complex sites such as these (Lyman 2008:45). Furthermore, because MNI values are minimums, we could not calculate the relative importance of one species over another as a ratio or percentage. Because of these shortcomings and other serious problems inherent with MNI (Grayson 1984), I instead relied on NISP.

The age of the animal at the time of death is often used to determine the season in which people dispatched them. Epiphyseal fusion, along with tooth eruption and occlusal surface wear, are the most commonly used criteria. Four age categories—fetal, juvenile, adult, and indeterminate—were used to describe the age of the individual specimens.

All specimens were classified as being unaltered, charred, or calcined. Bones and bone fragments lacking macroscopic color evidence of exposure to fire were classified as unaltered. Bones blacken between 400°C and 500°C and become calcined at temperatures exceeding 600°C–700°C (Buikstra and Swegle 1989:255). Shipman et al. (1984:308–313) have placed sheep and goat mandibles and astragali in a kiln for 4 hours and documented several color stages. Bone heated between 300°C and 500°C is mostly blackened but can appear yellowish red and red to purple. Intensely heated bones (>600˚C) become purplish blue and blue. When completely incinerated, or calcined, bone becomes bluish white or gray in color. Here, blackened specimens were classified as charred, and calcined specimens were those with gray, blue-gray, white, and, occasionally, buff-colored surfaces, indicating almost complete incineration.

Seven ordinal categories were used to characterize the maximum dimension, measured with a template, of each specimen. The categories are as follows: less than 5 mm, 5–15 mm, 15–25 mm, 25–35 mm, 35–50 mm, 50–100 mm, and greater than 100 mm in size. Recording specimen size allows for an assessment of the degree of fragmentation between taxa, features, time periods, and sites. Such information can provide useful insights concerning butchery and cooking practices.

One of five weathering stages was used to describe each specimen. These stages are defined in Table 67. The stages defined by Andrews (1990) were used for small mammal remains, and those defined by Behrensmeyer (1978) were used for large-mammal remains. Behrensmeyer (1978:150, 153) defined bone weathering as "the process by which the original microscopic organic and inorganic components of bone are separated from each other and destroyed by physical and chemical agents … which is a part of the normal process of nutrient recycling in and on soils." Three biological factors largely guide the rate of bone weathering: bone density, size of the bone, and fluctuations in temperature and moisture. Patterns in weathering data can aid in the interpretation of refuse-disposal practices and the history of site formation.

Individual specimens were assigned to 1 of 11 skeletal regions. Any cranial element, including the mandible, was identified as being from the head. Horn and antler were coded together. Cervical, thoracic, lumbar, and caudal vertebrae, as well as the innominates, were coded as axial. The thoracic and pelvic limbs were divided into upper and lower regions at the elbow and knee. Carpals, tarsals, metapodials, and phalanges were coded as feet. Long-bone fragments lacking landmarks that allowed for the identification of a specific element (e.g., femur) were assigned to the appendicular category. Small, cancellous bone fragments received a coding of indeterminate.

Results

The following discussions describe the identified taxa, the condition of the specimens, and their distribution within the CCP sites. Faunal remains were collected from six of the nine prehistoric sites investigated: AZ O:15:41/583, AZ O:15:103/2061, the Vegas Ruin, the Rock Jaw site (AZ U:3:407/2014), AZ U:3:408/2015, and the Crane site.

Table 67. Weathering Stages in Large and Small Mammals

Weathering Stage	Large Mammals: Description	Large Mammals: Years since Death	Small Mammals: Description	Small Mammals: Years since Death
0	Greasy; no cracking or flaking; perhaps with skin or ligament/soft tissue attached (marrow edible, bone still moist).	0–1	No modification.	0–2
I	Cracking parallel to fiber structure (longitudinal); articular surfaces perhaps with mosaic cracking of covering tissue and bone (split lines begin to form, low moisture, marrow is inedible).	0–3	Slight splitting of bone parallel to fiber structure; chipping of teeth and splitting of dentine.	1–5
II	Flaking of outer surface (exfoliation); cracks are present; crack edge is angular (marrow decays, split lines well developed).	2–6	More-extensive splitting but little flaking; chipping and splitting of teeth leading to loss of parts of crown.	3–5+
III	Rough, homogeneously altered compact bone resulting in fibrous texture; weathering penetrates a maximum of 1–1.5 mm; crack edges are rounded.	4–15	Deep splitting and some loss of deep segments or "flakes" between splits; extensive splitting of teeth.	4–5+
IV	Coarsely fibrous and rough surface; splinters of bone loose on surface, with weathering penetrating inner cavities; open cracks.	6–15		
V	Bone falling apart *in situ*; large splinters present; bone material very fragile.	6–15		

Note: Weathering stages for large mammals are after Behrensmeyer (1978) and small mammals are after Andrews (1990). Additions to large mammal descriptions are from Johnson (1985) are in parentheses. Adapted from Lyman (1994:Table 9.1).

Identified Taxa

Analysis of the CCP fauna resulted in the identification of 2,999 specimens, which represented 5 vertebrate classes and 32 taxa identified beyond the level of vertebrate order (see Table 66). Mammal remains were the most numerous specimens recovered, followed by 12 reptile bone fragments, 8 toad specimens, and 2 fish centra. Small, minimally identifiable bone splinters were most common. These specimens could only be assigned to an animal-size class. Squirrel- to rabbit-sized and rabbit-sized specimens dominated the collection. Specimens so fragmented that they could not be confidently assigned to an animal-size class were considered unidentifiable. Unidentifiable specimens (n = 196) accounted for 6.5 percent of the collection.

Fish

Two small (<3 mm), precaudal centrums represented the only fish remains in the collection. Both specimens were unburnt and were recovered in flotation samples collected from features at the Vegas Ruin. Each specimen was captured while water-screening these flotation samples through 1-mm mesh. One specimen was collected from a cobble-adobe-foundation room (Feature 11), and the other was collected from a roasting pit (Feature 132). These fish vertebrae were from minnows (cf. Cyprinidae) that, when alive, would have measured less than 15 cm in length and were likely caught in nearby Tonto Creek.

Amphibians

Seven pleurocentral vertebrae were recovered from a pit structure (Feature 179) at the Vegas Ruin (see Table 66). The size and shape of these vertebrae compared most favorably with those of a small toad (*Bufo* spp.). These vertebrae conjoined, represented one individual, were unburnt, and were considered intrusive. Another *Bufo* specimen was recovered from a burial at the Vegas Ruin, Feature 207.

When present, amphibian bones represented a small component of Late Archaic and Formative period sites (Szuter 1991:142). All amphibian taxa are somewhat dependent on surface water for reproduction (Lowe 1980), and prehistoric irrigation activities would have provided an ideal habitat for these animals (Szuter 1991:142).

Reptiles

Specimens representing two reptilian orders and at least five taxa were recovered (see Table 66). A small carapace fragment recovered from a pit structure (Feature 179) at the Vegas Ruin was assigned to the order Testudines. This specimen was root-etched and unburnt.

Sonoran mud turtle (*Kinosternon* spp.) remains (see Table 66) consisted of a plastron fragment from a burial (Feature 49) and a carapace fragment from a pit structure (Feature 179) at the Vegas Ruin. Both of these mud turtle specimens were unburnt, measured 15–25 mm in size, and exhibited Stage I weathering. Adult Sonoran mud turtles can grow to be 165 mm (6½ inches) long. They are essentially water dwellers that live in springs, creeks, ponds, and intermittent streams. These creatures normally inhabit oak to piñon-juniper woodlands but are occasionally found in desert and grassland areas. Sonoran mud turtles rely on invertebrate prey, such as crustaceans, insects, and worms, but they will also scavenge. Females lay two to nine eggs between May and September (Ivanyi et al. 2000:544).

Desert tortoise (*Gopherus agassizii*) carapace fragments (see Table 66) were found only at the Vegas Ruin. Both specimens were unburnt. One specimen consisted of 77 carapace fragments collected during the excavation of a burial (Feature 137). These fragments were from a small adult tortoise and likely represented the remains of a tortoiseshell rattle. Another carapace fragment was recovered during the excavation of a pit structure (Feature 179). Adult desert tortoises can reach 35.5 cm (14 inches) in length. They are primarily herbivores but will occasionally eat carrion, insects, rocks, bones, and soil (Ivanyi et al. 2000:546). Desert tortoises build burrows in hillsides and beneath boulders—often exploiting the prior excavations of other animals, particularly those of ground squirrels (Lowe 1964:159). Mating takes place during the summer, and females can retain viable sperm in the cloaca for a minimum of 2 years before laying their eggs in late June or early July. Ages can be estimated using the annual rings on the epidermal scutes, but desert tortoises may not grow during especially severe years (Ivanyi et al. 2000:547). Tortoiseshell fragments are commonly recovered from prehistoric sites, and desert tortoises were likely used in prehistory for their shells and meat (Szuter 1991:143).

Snake remains were recovered only from the Vegas Ruin and the Crane site (see Table 66). Two fragmentary vertebrae from the Vegas Ruin, one from an infant burial (Feature 220) and another from a composite burial (Feature 216), could be identified as snakes. Both these specimens were unburnt, hardly weathered, and were likely intrusive to these features. A similarly preserved rattlesnake (*Crotalus* spp.) vertebra was also recovered from the infant burial, Feature 220. Another rattlesnake vertebra was recovered from burial Feature 172. The only reptilian specimen collected from the Crane site was a rattlesnake vertebra collected from a flotation sample (PD 346) taken from a cobble-adobe-foundation wall (Feature 6). The rattlesnake remains collected from these sites were likely intrusive, because none of the specimens was charred, and all were hardly weathered. Additionally, rattlesnakes routinely enter rodent burrows in search of food.

Birds

Avian remains are by far the most diverse class of animal remains, in terms of richness, recovered from Hohokam sites. Bird bones have been found at over 70 sites, and over 50 taxonomic groups have been identified (Szuter 1991:72–74, 115). Bird remains formed a small component of the CCP collection (NISP = 4, or 0.1 percent of the project NISP total), and they were only encountered at the Vegas Ruin (see Table 66). One small (<5 mm), unburnt eggshell fragment was recovered from a flotation sample removed from a cobble-adobe-foundation room (Feature 11). A pit structure (Feature 179) contained an unburnt, distal right quail femur and calcined, distal left quail humerus. An unburnt, left distal quail humerus was recovered from the fill of a burial (Feature 145). The context and condition of these bird remains suggest that they represent prehistoric subsistence remains.

Mammals

Mammal remains (NISP = 2,973, or 99.1 percent of the project NISP total) numerically dominated the project collection (see Table 66). The condition of these specimens, however, precluded accurate taxonomic identifications, and 2,378 specimens could only be assigned to an animal-size class. Analysis resulted in 399 mammalian specimens that were identifiable beyond the level of vertebrate order. Among these, specimens representing small mammals—particularly leporids and medium-sized artiodactyls, such as deer—were the most numerous. In fact, lagomorph (NISP = 155) and artiodactyl (NISP = 152) specimens were represented in essentially equal numbers. A far greater number of indeterminate rabbit-sized bone fragments (NISP = 762) were recovered, however, when compared to indeterminate deer-sized remains (NISP = 77). Rodent remains, followed by carnivore remains, were the next most numerous mammalian specimens.

Rabbits and Hares

Identified lagomorph taxa included cottontails (*Sylvilagus* spp.), black-tailed jackrabbits (*Lepus californicus*), and, possibly, antelope jackrabbits (*Lepus* cf. *alleni*) (see Table 66). Cottontails are small animals, weighing 0.45–0.9 kg (1–2 pounds) (Merlin and Siminski 2000:493) that prefer rocky hill and canyon country, where they rest in rocky crevices and thick brush during the day. Cottontail newborns are very small, somewhat helpless, and require cover for protection and several weeks of growth before leaving the form (i.e., "nest"). Jackrabbits are much larger, weighing up to 3.6 kg (8 pounds) and stand just under 0.6 m (2 feet) tall. Female black-tailed jackrabbits give birth to precocial (independent at birth) offspring in open, fur-lined burrows. The young are hopping about in a few days—an adaptation to open environments. Growth is rapid and young reach their parents' weight in only 10 weeks (Zeveloff 1988:98–99). Antelope jackrabbits are one of the largest hares in North America. Adults typically weigh 4.5 kg (9–10 pounds) and often exceed 0.6 m (2 feet) in height. Cottontails and jackrabbits can potentially breed all year throughout southern and central Arizona (Hoffmeister 1986:137, 142) and, thus, immature specimens are of little use as indicators of seasonality.

Ethnographically, the horticulturalists of the Southwest employed a myriad of techniques when hunting rabbits. The Havasupai (Spier 1928:113), Maricopa (Spier 1933:67), Zuni (Cushing 1920:591–592), and Tewa (Parsons 1929:133) skewered hiding cottontails with sticks. Tohono O'odham and Tarahumara hunters dispatched jackrabbits with bows and arrows (Castetter and Underhill 1935:42; Lumholtz 1912:11). Traps were used by the Maricopa (Spier 1933:37). The Tohono O'odham (Densmore 1929:180), Tarahumara (Bennet and Zingg 1976:115; Pennington 1963:90), and Seri (McGee 1898:197) also simply ran the animals down. Communal rabbit drives, entailing the use of nets, were held by all these groups, as well as by the Navajo, Hopi, Pima, Yavapai, Walapai, and Mohave (Rea 1998:136; Spier 1928:121). Ceremony was often associated with communal hunts. The Tewa (Parsons 1929:135) held a Katchina dance before a hunt, and the Zuni would hunt after the corn harvest as a means of giving thanks (Stevenson 1904:442).

Rodents

Although 19 specimens could be identified only as representing rodent remains, six rodent taxa were identified beyond the level of vertebrate order (see Table 66). Specimens assigned to the Muridae/Heteromyidae category (NISP = 44) dominated the rodent portion of the collection. Antelope ground squirrel (*Ammospermophilus* spp.) was represented by a single element. These small squirrels, which are adapted to the arid environment, range throughout the low deserts of Arizona and northwestern Sonora. Antelope ground squirrels prefer rocky foothill habitats. For food, they rely on the fruits of chollas, prickly pear and barrel cacti, grass seeds, mesquite beans, insects, and, occasionally, mice. Adults can reach 230 mm (9 inches) in length and can weigh up to 125 g (4.5 ounces) (Cockrum and Petryszyn 1998:50). The young are born in an underground, fur-lined nest chamber in February or March.

Four pocket-mouse (*Perognathus* spp.) bones were also recovered. Pocket mice are nocturnal, burrowing animals with external fur-lined cheek pouches used to carry seeds, their primary food source. Pocket mice grow to 100 mm (4 inches) in length and commonly weigh 8 g (0.3 ounces) (Cockrum and Petryszyn 1998:74). Many species have been identified, and pocket mice thrive in a variety of habitats ranging from sandy, open creosote flats to rocky slopes and lava flows. They are solitary creatures that defend small territories and are known to fight each other. Two litters of three to six young are born each summer.

Pocket gopher (*Thomomys* spp.) remains were relatively rare (NISP = 2). Rarely seen aboveground, these fossorial creatures are found throughout Arizona wherever soft soils are present. At least 41 subspecies are reported for Arizona (Cockrum 1960). Pocket gophers are highly specialized burrow dwellers and their skeletal remains should nearly always be considered intrusive when found in archaeological deposits. Adults typically grow to 240 mm (9.5 inches) in length and weigh 190 g (6.7 ounces) on average (Cockrum and Petryszyn 1998:72). They feed on roots and bulbs, although they occasionally pull whole plants into their burrows. Normally, a single individual inhabits a tunnel system, which may have 20 or more mounds on the surface. Two litters of 2–10 young are typically born each year.

Often called packrats, wood rats (*Neotoma* spp.) live in a variety of habitats, and wood-rat bones (NISP = 7) constituted less than 1 percent of the collection. Wood rats are best known for the houses they construct of sticks, cactus parts, animal dung, and modern-day trash. They normally build these houses near the base of a prickly pear cactus, mesquite tree, hackberry bush, or between boulders. Adults can grow to be 375 mm (15 inches) long and weigh 180 g (6.3 ounces) on average (Cockrum and Petryszyn 1998:92). Wood rats are solitary and forage at night on mesquite beans, palo verde seeds, annual forbs, and cacti. They occasionally eat insects or other meat (Merlin and Siminski 2000:506). Wood rats are described in the ethnographic literature as a favored food of aboriginal peoples of the Southwest (Castetter and Bell 1942; Castetter and Underhill 1935; Whitman 1940) and the desert regions of California and the Great Basin (Steward 1938).

White-footed mice (*Peromyscus leucopus*) inhabit virtually every conceivable North American habitat, but only three identifiable specimens were recovered for this project. They are low on the vertebrate food chain and exhibit a terrific fecundity. These mice are small creatures that can reach 180 mm (7.1 inches) in length and weigh only 28 g (1 ounce) on average. With a gestation period of only 28 days, females can produce 8–10 litters a year (Cockrum and Petryszyn 1998:84; Merlin and Siminski 2000:505). Their diet consists primarily of fungi, berries, fruits, small nuts, and seeds, although they also hunt insects and other arthropods. No ethnographic evidence exists concerning the use of these prolific creatures as food among the aboriginal peoples of southern and central Arizona (Rea 1998:175).

Carnivores

Carnivore remains constituted a minor component of the project collection (see Table 66). Elements representing either coyote (*Canis latrans*) or domestic dog (*Canis familiaris*) were recovered, along with bobcat (*Lynx rufus*) and gray fox (*Urocyon cinereoargenteus*) bone fragments. A small tooth fragment was tentatively assigned to the order Carnivora.

Five specimens represented either coyote or domestic dog. A central figure in many Native American myths and legends, the coyote is remarkably intelligent, incredibly adaptable, and serves as a contemporary symbol of the American West. Adult desert coyotes are 1.2 m (47 inches) long and weigh 10.5 kg (23 pounds) on average (Cockrum and Petryszyn 1998:112; Merlin and Siminski 2000:474). In springtime, females give birth to a litter of up to 11 pups in the shelter of underground dens. They are omnivores, eating anything from cactus fruit and mesquite beans to road-killed carrion. They hunt rodents, rabbits, birds, snakes, and insects, particularly grasshoppers and crickets.

Two bones representing a bobcat were recovered. Adult bobcats average 940 mm (37 inches) in length and weigh 7–10 kg (15–22 pounds) (Cockrum and Petryszyn 1998:158; Phillips and Comus 2000:484). Female bobcats normally give birth to two altricial young in April or May; however, a litter may be born during any month of the year. Bobcats are primarily active at night, when they ambush rodents and rabbits. They defend a home range only a few square miles in size. Bobcat pelts were prized by the Pima (Rea 1998:231), and quivers made from complete bobcat skins have been documented (Russell 1908:Plate 13). Rea's (1998:232) informants also indicated that bobcats were eaten by the Tohono O'odham.

Three articulated gray fox (*U. cinereoargenteus*) foot bones were included in the collection. Adult gray foxes average 940 mm (37 inches) in length and 3.8 kg (8.4 pounds) in weight (Cockrum and Petryszyn 1998:120). They are largely nocturnal, and they are more secretive than the Red fox (*Vulpes vulpes*). Gray foxes inhabit a wide range of habitats, including deserts, open forests, and scrub from sea level to 2,800 m (9,000 feet) AMSL. They routinely climb tress, and they are the only North American canid with genuine climbing abilities. Gray foxes are capable of climbing the limbless trunks of 50-foot trees (Zeveloff 1988:256). Gray foxes are omnivorous and their diet consists of berries, fruits, nuts, insects, birds, and especially small mammals. Rodents and leporids are their preferred prey. At 10 months in age, females produce litters of 2–5 altricial young in June or July. Within 4 months, the young can forage on their own. A family unit, consisting of the parents and their young, commonly maintains a distinct home range centered on a den located in hollowed logs, beneath boulders, or in crevices.

Artiodactyls

Artiodactyl remains accounted for a little over 5 percent of the project collection (NISP = 152). Identified artiodactyl taxa included indeterminate medium-sized artiodactyls, deer, and domestic cow. Specimens identifiable solely as medium-sized artiodactyl were the most numerous and likely represented deer; however, they lacked the necessary diagnostic landmarks. The domestic cow remains are discussed in detail as part of the Crane site fauna.

Two species of deer—mule deer (*Odocoileus hemionus*) and white-tailed deer (*O. virginianus*)—inhabit the study area. The range and habitat preferences of each species overlap, but specific differences in foraging preferences and water requirements characterize each species. At times, they will also interbreed. Adult deer measure 1.6 m (63 inches) in length on average and can weigh as much 150 kg (350 pounds) (Cockrum and Petryszyn 1998:164–165). Does give birth to one or two precocial young from mid-June to mid-July. Mule deer primarily inhabit lower foothills and brushy canyons, where they feed mostly on shrubs and twigs but also eat some grasses and herbs. White-tailed deer range higher in the mountains, in grasslands, meadows, and particularly in oak woodlands. Their food consists of green plants, acorns, and some brush and twigs. Unlike white-tailed deer, mule deer are not dependent on standing water and can subsist for 3 days without drinking (Wallmo 1981:29). Mule deer are better adapted to both arid conditions and fluctuations in effective annual precipitation. Both species spend most of their life in small areas measuring 1–2 square miles; however, these areas are located in seasonal ranges that include mountainous fawning areas occupied in the late spring and foothill and valley locations in early winter (Merlin and Siminski 2000:490).

The ethnographic record indicates that peoples pursued artiodactyls in a variety of ways and artiodactyl hunting was often preceded by elaborate rituals involving dance and song, purification acts, and taboos (Densmore 1929:210; Laski 1958:20; Spier 1928:290, 1933:69; Whitman 1940:402). Hunting artiodactyls was a more complex activity among peoples documented in the ethnographic record, when compared to the hunting of smaller animals, like rabbits. Traps, snares, and pitfalls were often used (Harrington 1916:79; Lumholtz 1894:448, 1902:248). Small groups of one to three hunters would simply run the animal down (Bennet and Zingg 1976:113; Pennington 1963:101) or stalk them, imitating their behavior and appearance with the use of skins, antlers, and horns (Castetter and Underhill 1935:40–41; Spier 1928:147), and then dispatch them with a bow and arrow. People also pursued large mammals, particularly deer and pronghorn, communally, by driving them toward brush wing traps (Arkush 1995; Bennet and Zingg 1976:367; Densmore 1929:36; Parsons 1929:135; Underhill 1946:96). Artiodactyl carcasses required more time to process, primarily because they are large, but also because they provided hides, sinews, and workable bones. The distribution of these animal products, particularly the meat, was often formal and involved communal distribution among village residents; specific body segments were reserved for particular individuals as well (Szuter 1991:27). Artiodactyl bones received special treatment among the Tohono O'odham and Akimel O'odham (Szuter 1991:27). Castetter and Underhill (1935:41) and Castetter and Bell (1942:67) discovered that early Spanish accounts described middens of deer antlers and bighorn sheep horns, and that bones and horns were placed near waterholes. The head and lower-leg bones provided the necessary materials for headdresses and bone tools.

Indeterminate Mammals and Unidentifiable Remains

Small, cortical bone fragments formed 79.3 percent (NISP = 2,378) of the project collection (see Table 66). Seven animal-size class categories characterize these specimens, including mouse- to squirrel-size, squirrel-size, squirrel- to rabbit-size, rabbit-size, rabbit- to coyote-size, coyote- to deer-size, and deer-sized specimens. Regardless of category, these specimens primarily consisted of severely splintered diaphysis fragments. Squirrel- to rabbit-size and coyote- to deer-size included the largest number of specimens. This suggests that the bones of rabbits and deer were intensively processed by crushing and grinding. Only 6.5 percent of the collection proved unidentifiable. These 196 specimens were simply too small (<5 mm) and/or lacked the necessary diagnostic landmarks to confidently assign them to a specific taxon or animal-size category.

Recovery Contexts

SRI excavators collected faunal remains from six—Site 41/583, Site 103/2061, Vegas Ruin, Rock Jaw site, Site 408/2015, and the Crane site—of the nine prehistoric sites constituting the CCP (see Table 66). The following sections describe the faunal remains recovered from each of these sites. Particular attention is paid to the feature types (e.g., cobble-adobe-foundation rooms, roasting pits, and burials) that contained the identified remains. This was done for three reasons: (1) to be able to assess the possible function(s) of these feature types, (2) to identify particular food-processing loci and practices, and (3) to determine the locations of domestic refuse deposits and their taphonomic histories.

Site AZ O:15:41/583

Site 41/583 is a pre-Classic/Classic transition period limited-activity loci located about 100 m southeast of Ushklish Ruin (AZ O:15:31 [ASM]), a multicomponent site encompassing a Colonial period hamlet and a smaller Classic period habitation (Haas 1971). An *horno* (Feature 1) and associated rake-out accumulation contained 207 of the 211 specimens recovered from this site (Table 68; see Table 66). The 4 specimens not recovered from the *horno* included 1 charred long-bone fragment from a leporid collected from TP 11 and 3 calcined rabbit-sized long-bone fragments; 1 from TP 4 and 2 from the site surface in CU 15. Of these 4 specimens, the rabbit-sized specimens were 15–25 mm in length, whereas the deer-sized fragment was 25–35 mm long.

The 207 specimens recovered from the Feature 1 *horno* were from three vertebrate orders and at least 10 taxa. Lagomorph remains included 9 specimens identifiable as leporid only; a charred, distal cottontail metacarpal and intact, calcined second phalanx from 1 adult cottontail; and a charred horizontal ramus from 1 adult black-tailed jackrabbit. Only 1 leporid specimen was unaltered, whereas 1 was charred and the other 7 were calcined. All of these leporid specimens were less than 25 mm long.

Rodent remains (NISP = 19), from at least four taxa (see Table 66), formed 9 percent of the feature fauna. Small (<5 mm) diaphysis fragments assigned to the Rodentia order

Table 68. Number and Percentage of Identified Specimens Collected from Feature 1 at Site 41/583

Taxon	Unaltered		Charred		Calcined		NISP Total	
	n	%	n	%	n	%	n	%
Mammals								
Leporidae	1	1.3	—	—	7	7.3	8	3.9
Sylvilagus spp.	—	—	1	3.2	1	1.0	2	1.0
Lepus californicus	1	1.3	—	—	—	—	1	0.5
Rodentia	5	6.3	2	6.5	—	—	7	3.4
Muridae/Heteromyidae	4	5.0	—	—	3	3.1	7	3.4
Perognathus spp.	1	1.3	—	—	—	—	1	0.5
Neotoma spp.	—	—	—	—	2	2.1	2	1.0
Peromyscus spp.	2	2.5	—	—	—	—	2	1.0
Artiodactyla	2	2.5	6	19.4	1	1.0	9	4.3
Odocoileus spp.	—	—	1	3.2	—	—	1	0.5
Indeterminate mammals								
Squirrel to rabbit size	33	41.3	10	32.3	37	38.5	80	38.6
Rabbit size	24	30.0	9	29.0	37	38.5	70	33.8
Rabbit to coyote size	—	—	2	6.5	—	—	2	1.0
Deer size	—	—	—	—	3	3.1	3	1.4
Unidentifiable mammals	7	8.8	—	—	5	5.2	12	5.8
Total	80	100	31	100	96	100	207	100

Key: NISP = number of identified specimens.

(NISP = 7) were the most numerous. All specimens identified as Rodentia were less than 15 mm long; 5 were unaltered and 2 were calcined. The unaltered rodent specimens included 2 long-bone-shaft fragments, 1 radius, 1 femur, and 1 incisor. Charred rodent remains included 2 long-bone-shaft fragments. An additional 7 specimens lacked the landmarks necessary to identify them to a single vertebrate family, so they were placed in the Muridae/Heteromyidae category. Four of these specimens, 1 calcaneum, 1 metatarsal, 1 tibia, and 1 incisor were unaltered; a second phalanx and 2 metatarsals were calcined. Rodent remains assigned to a specific genus included 1 unaltered right mandible from a juvenile pocket mouse, 2 calcined wood-rat molars, and 2 unaltered white-footed mouse molars.

Artiodactyl remains (NISP = 10) were relatively rare. One long-bone-shaft fragment was the only calcined specimen assigned to the artiodactyl category. Charred artiodactyl remains included 1 distal astragalus fragment, 1 dorsal rib fragment, and 2 charred long-bone fragments. An unaltered lumbar vertebra zygapophysis and an ilium fragment were the only other specimens assignable to the artiodactyl category. One calcined diaphysis fragment was assigned to the deer-sized category. A charred, third phalanx from an adult deer was the only artiodactyl specimen identified to the level of genus.

Highly fragmented specimens assigned to the indeterminate mammal categories were the most numerous (see Tables 66 and 68). Squirrel- to rabbit-sized (NISP = 80) and rabbit-sized (NISP = 73) bone fragments were the most numerous indeterminate mammal specimens. Fifty percent of these specimens were calcined and 12 percent were charred (see Table 66). Rabbit- to coyote-sized (NISP = 2) and deer-sized (NISP = 3) specimens were also present. Only 12 specimens (5.7 percent) recovered from the feature could not be confidently assigned to an animal-size class and were placed in the unidentifiable mammals category.

Site AZ O:15:103/2061

Site 103/2061 is a small artifact scatter that represents both Archaic and Formative period occupations. An unaltered left innominate from an adult cottontail was the only specimen recovered from this site (see Table 66). It rested on the site surface and was point located.

Vegas Ruin (AZ U:3:405/2012)

The Vegas Ruin consisted of a multicomponent habitation and limited-activity site located on a low-lying Holocene terrace flanking the west side of Tonto Creek. Excavators identified three occupational episodes. Several roasting features that possibly date to the Archaic period represent the earliest use of the site. The site was then visited by people who constructed five pit structures during the pre-Classic–Classic period transition. A third and final episode of occupation consisted of a small cobble-adobe-foundation compound encompassing a single cobble-adobe-foundation room and a collection of 38 inhumation burials.

Cobble-Adobe-Foundation Architecture

The compound itself (Feature 1) contained two artiodactyl specimens: a distal, unaltered, metapodial condyle fragment from an indeterminate artiodactyl, and a proximal first phalanx from a deer. Both specimens exhibited fused epiphyses and represented adult animals. An unaltered coyote- to deer-sized long-bone fragment was the only other specimen associated with this feature.

Long-bone-shaft fragments from a deer-sized animal and a coyote- to deer-sized animal were recovered in association with the Feature 5 cobble-adobe-foundation wall. Another long-bone-shaft fragment from a deer-sized animal was found in association with the Feature 6 cobble-adobe-foundation wall.

Forty-four faunal specimens, representing four vertebrate classes and at least nine taxa, were recovered from the Feature 11 cobble-adobe-foundation room (Table 69). A small (<5 mm), precloacal vertebra was identified as representing a small cyprinid. Two intact, unaltered, and likely intrusive postcloacal snake vertebra were assigned to the vertebrate order Serpentes. Avian remains were represented by a small, unaltered, eggshell fragment. The thickness and curvature of this eggshell specimen suggest that it represented a quail-sized bird.

Mammal remains (NISP = 51, or 93 percent of the feature fauna) were the most numerous vertebrate remains in the compound and Feature 11. Lagomorph remains unaltered by fire included an unaltered left horizontal ramus from a cottontail and a portion of a cervical vertebra from a leporid. Calcined leporid remains included a right acetabulum, medial metapodial, and molariform tooth fragment. No charred lagomorph remains were recovered. Rodent specimens (NISP = 8) formed 15 percent of the feature fauna. Six of these specimens were placed in the Muridae/Heteromyidae category. Only one these 7 specimens, a charred incisor, was burnt. Whole skeletal elements, including a left humerus, right mandible, and incisor, were common. A proximal left and right femur were also recovered. An unaltered and intact caudal vertebra was assigned to the order Rodentia. The rodent remains from Feature 11 displayed minimal weathering (<Stage I), were seldom altered by fire, and were largely intact. This suggests that these rodent specimens were not subsistence refuse but were intrusive to the feature. Severely fragmented, indeterminate mammals remains were the most numerous mammalian remains (see Table 67). Ten calcined and 5 unaltered mouse- to squirrel-sized specimens formed 27 percent of the feature fauna. Similarly, 1 calcined and 10 unaltered squirrel- to rabbit-sized specimens formed 20 percent of the feature fauna. A single calcined diaphysis fragment was placed in the rabbit-sized category.

Pit Structures

Four pit structures—Features 19, 34, 99, and 179—contained faunal specimens. Specimens recovered from these pit structures (NISP = 206) (Table 70) represented the remains of 4 vertebrate classes and 18 taxa identified to at least the level of order. Relatively few specimens were recovered from Features 19, 34, and 99; most of the specimens were recovered from Feature 179. As a feature type, pit structures contained the second greatest quantity of faunal remains encountered at the Vegas Ruin.

Feature 19

The Feature 19 pit structure contained 10 specimens representing at least two vertebrate orders and four taxa. An intact and unaltered, left calcaneum from a black-tailed jackrabbit was the only lagomorph specimen. No rodent remains identifiable to a specific taxon were recovered. Recovered artiodactyl remains included 1 diaphysis fragment and 1 medial metapodial fragment. A 4-liter flotation sample collected from the hearth (Feature 19.1) contained 2 unburnt mouse- to squirrel-sized specimens. Another 4-liter flotation sample from an earlier hearth (Feature 19.4) contained 4 squirrel- to rabbit-sized bone fragments. One of these was charred, 1 was calcined, and 2 were unburnt.

Feature 34

Twenty-two specimens representing at least three vertebrate orders and seven taxa were recovered from the Feature 34 pit

Table 69. Number and Percentage of Identified Specimens Assigned to Each Burning Category from Feature 11 at the Vegas Ruin (405/2012)

Taxon	Unaltered		Charred		Calcined		NISP Total	
	n	%	n	%	n	%	n	%
Fish								
Cyprinidae	1	3.6	—	—	—	—	1	2.3
Reptiles								
Serpentes	2	7.1	—	—	—	—	2	4.5
Birds								
Aves (eggshell)	1	3.6	—	—	—	—	1	2.3
Mammals								
Leporidae	1	3.6	—	—	3	20.0	4	9.1
Sylvilagus spp.	1	3.6	—	—	—	—	1	2.3
Rodentia	1	3.6	—	—	—	—	1	2.3
Muridae/Heteromyidae	6	21.4	1	100	—	—	7	15.9
Indeterminate mammals								
Mouse to squirrel size	5	17.9	—	—	10	66.7	15	34.1
Squirrel to rabbit size	10	35.7	—	—	1	6.7	11	25.0
Rabbit size	—	—	—	—	1	6.7	1	2.3
Total	28	100	1	100	15	100	44	100

Key: NISP = number of identified specimens.

structure. Eight leporid bone fragments were the most common specimens identified to the level of vertebrate family or lower. Of those, 1 unaltered, left horizontal ramus was the only cottontail specimen. Black-tailed jackrabbit specimens included 1 left scapula head, 1 left medial tibia, and 1 medial metatarsal. All 3 black-tailed jackrabbit specimens lack evidence of exposure to fire. No rodent remains were recovered, but carnivore and artiodactyl specimens were present. One calcined, distal, left humerus fragment compared favorably with bobcat, whereas 1 calcined long-bone fragment was assigned to the artiodactyl category based on size and shape. Indeterminate mammal remains, such as the 11 squirrel- to rabbit-sized specimens, were the most numerous. All of the squirrel- to rabbit-sized specimens appeared to be unaltered by fire. One unaltered rabbit-sized long-bone fragment was also recovered.

Feature 99

This pit structure contained 62 specimens that represented at least three vertebrate orders and eight taxa. Forty-five, or 72.6 percent, of these specimens were calcined; the remaining 17 were unaltered by fire. Leporid, rodent, artiodactyl, and indeterminate remains were recovered.

Specimens identifiable as leporid only included two unaltered, medial, metapodial shafts. One unaltered molariform tooth fragment was from a black-tailed jackrabbit. Rodent remains were rare and consisted of an unaltered caudal vertebra and a calcined, right, calcaneum. Artiodactyl specimens included two unaltered long-bone-shaft fragments and an intact first phalanx from an adult deer.

Indeterminate mammal remains were the most numerous, particularly calcined (NISP = 44) and unaltered (NISP = 6) squirrel- to rabbit-sized bone fragments. These squirrel- to rabbit-sized specimens formed 80.6 percent of the feature fauna. One unaltered long-bone fragment from a rabbit- to coyote-sized animal was also collected.

Feature 179

This pit structure contained the greatest number of specimens (NISP = 112) recovered from a pit structure at the Vegas Ruin (see Table 70). Specimens representing 4 vertebrate classes

Table 70. Number of Identified Specimens from Pit Structures at the Vegas Ruin (405/2012)

Taxon	Feature 19		Feature 34		Feature 99		Feature 179		NISP Total	
	n	%	n	%	n	%	n	%	n	%
Amphibians										
cf. *Bufo* spp.	—	—	—	—	—	—	7	6.3	7	3.4
Reptiles										
Testudines	—	—	—	—	—	—	1	0.9	1	0.5
cf. *Kinosternon* spp.	—	—	—	—	—	—	1	0.9	1	0.5
cf. *Gopherus agassizii*	—	—	—	—	—	—	1	0.9	1	0.5
Birds										
cf. *Lophortyx* spp.	—	—	—	—	—	—	1	0.9	1	0.5
Lophortyx spp.	—	—	—	—	—	—	1	0.9	1	0.5
Mammals										
Leporidae	—	—	4	18.2	2	3.2	10	8.9	16	7.8
Sylvilagus spp.	—	—	1	4.5	—	—	21	18.8	22	10.7
Lepus californicus	1	10.0	3	13.6	1	1.6	9	8.0	14	6.8
Rodentia	—	—	—	—	2	3.2	—	—	2	0.1
Ammospermophilus spp.	—	—	—	—	—	—	1	0.9	1	0.5
Thomomys spp.	—	—	—	—	—	—	2	1.8	2	1.0
Muridae/Heteromyidae	—	—	—	—	—	—	4	3.6	4	1.9
Perognathus spp.	—	—	—	—	—	—	1	0.9	1	0.5
Neotoma spp.	—	—	—	—	—	—	1	0.9	1	0.5
Felidae										
Lynx cf. *rufus*	—	—	1	4.5	—	—	—	—	1	0.5
Artiodactyla	2	20.0	1	4.5	2	3.2	4	3.6	9	4.4
Odocoileus spp.	—	—	—	—	1	1.6	5	4.5	6	2.9
Odocoileus cf. *hemionus*	—	—	—	—	—	—	1	0.9	1	0.5
Indeterminate mammals										
Mouse to squirrel size	2	20.0	—	—	—	—	—	—	2	1.0

Table 70. Number of Identified Specimens from Pit Structures at the Vegas Ruin (405/2012) (*continued*)

Taxon	Feature 19		Feature 34		Feature 99		Feature 179		NISP Total	
	n	%	n	%	n	%	n	%	n	%
Squirrel to rabbit size	4	40.0	11	50.0	50	80.6	1	0.9	66	32.0
Rabbit size	—	—	1	4.5	3	4.8	23	20.5	27	13.1
Rabbit to coyote size	—	—	—	—	1	1.6	6	5.4	7	3.4
Coyote to deer size	—	—	—	—	—	—	6	5.4	6	2.9
Deer size	1	10.0	—	—	—	—	5	—	6	2.9
Total	10	100	22	100	62	100	112	100	206	100

Key: NISP = number of identified specimens.

and at least 22 taxa were collected. Two specimens were charred and 9 were calcined. Lagomorph and rabbit-sized specimens were the most numerous.

Specimens representing nonmammalian taxa included seven pleurocentral vertebrae that compare favorably with a small anuran (i.e., frog or toad); fragments of a single, unaltered carapace that represented mud turtle, desert tortoise, and an indeterminate turtle or tortoise; a right distal femur that compared favorably with quail; and a calcined left-distal quail humerus.

Mammal remains (NISP = 100) dominated the feature fauna. Specimens identified as leporid lacked evidence of exposure to fire and included 3 proximal metapodials, 1 intact first phalanx, 1 right ascending ramus, 4 thoracic vertebra fragments, and 1 incisor fragment. Cottontail specimens (NISP = 21) were more numerous than black-tailed jackrabbit specimens (NISP = 9). All of the cottontail specimens were unaltered by fire. Identified cottontail skeletal elements include 3 proximal and 2 distal femora, 1 right distal tibia, 1 intact right calcaneum, 1 nonmatching left and right acetabulum, 2 distal right humeri, 2 left and 2 right horizontal rami, 1 left auditory bulla and proximal ulna, 1 right maxilla, and 1 right navicular cuboid and proximal radius. Except for a calcined right proximal radius, all of the black-tailed jackrabbit elements were unburnt. Unburnt black-tailed jackrabbit bones include 1 left auditory bulla, 1 right acetabulum, 1 right maxilla and mandible, 1 maxillary incisor, 1 right navicular cuboid, 1 right scapula, and 1 left posterior squamosal.

Specimens from at least five rodent taxa were collected (see Table 70). None of the nine rodent specimens exhibited evidence of exposure to fire. A nonmatching distal and proximal right femur, left medial femur, and medial right maxilla were assigned to the Muridae/Heteromyidae category. Antelope ground squirrel was represented by an intact and likely intrusive right femur. A left horizontal ramus from a pocket mouse and nonmatching right and left pocket gopher mandibles represented the other rodent remains. The relative completeness of these specimens—coupled with little weathering and no evidence of burning—indicates that these rodent bones were likely intrusive to the structure.

Ten specimens were assigned to the vertebrate order Artiodactyla. Four of these were unaltered by fire and could only be identified as representing an artiodactyl. These 4 specimens included 1 lateral process from a lumbar vertebra, 1 enamel fragment, 1 medial ulna shaft fragment, and 1 indeterminate long-bone-shaft fragment. One large, left horizontal ramus fragment compared favorably with mule deer. Other identified deer specimens included 1 charred left horizontal ramus fragment, 1 unaltered left ascending ramus, 1 intact right mandible with dentition, and fragments of 2 molariform teeth.

Indeterminate mammal remains (NISP = 41) constitute 36.6 percent of bone fragments recovered from this pit structure. Twenty-three rabbit-sized bone fragments were the most numerous class of indeterminate remains, followed by 6 rabbit- to coyote-size, 6 coyote- to deer-size, and 5 deer-sized specimens, and 1 squirrel- to rabbit-sized specimen. One of the indeterminate mammal specimens was charred, 7 were calcined, and 33 were unburnt. None of the indeterminate mammal remains exceeded 25 mm in length.

Extramural Features

Middens

Two specimens, a diaphysis fragment from a rabbit- to coyote-sized animal and another from a squirrel- to rabbit-sized animal, were recovered from the Feature 10 sheet midden. Both specimens appear to have been unaltered by fire and were less than 25 mm long. Both specimens likely represent subsistence refuse.

Borrow Pits

Three borrow pits, Features 22, 69, and 195, contained faunal remains. In this analysis, these specimens and the deposits in which they were a part of were treated as midden materials. The Feature 22 borrow pit contained 1 charred artiodactyl diaphysis fragment and 1 unaltered, and likely intrusive, intact left ulna from a rodent in the family Muridae or Heteromyidae. Seventy-three specimens were collected from the Feature 69 borrow pit. All of these specimens lacked evidence of being altered by fire. Black-tailed jackrabbit remains were the most numerous and included 4 medial rib fragments, 4 right ilium fragments, 1 right femur head and trochlea, 13 proximal rib fragments, and 24 vertebral centrum fragments. Twenty-nine rabbit-sized specimens were also recovered. These bone fragments were unaltered by fire and were less than 25 mm long. A single unaltered artiodactyl bone fragment was recovered from the Feature 195 borrow pit.

Extramural Pits

Extramural pits of unknown function at the Vegas Ruin contained surprisingly few faunal remains (Table 71). Only 11 specimens, which were distributed among seven pits, were recovered from this feature type. Excavators gathered 10 of these 11 specimens from ¼-inch screens in the field. A 4-liter flotation sample taken from Feature 20 contained the eleventh specimen.

A single, unaltered, long-bone-shaft fragment from an artiodactyl was the only specimen recovered from the Feature 20 extramural pit. This specimen was 35–50 mm in length and exhibited oblique fracture margins, which suggests that the specimen was broken when dry. Feature 63 contained 1 left glenoid cavity that was unburnt and that represented a deer-sized artiodactyl. Sampling of Feature 70

Table 71. Number of Identified Specimens from Extramural Pits at the Vegas Ruin (405/2012)

Taxon	Feature No.							NISP Total
	20	63	70	84	129	136	158	
Mammals								
Leporidae	—	—	—	—	1	—	1	2
Lynx cf. *rufus*	—	—	—	—	—	1	—	1
Artiodactyla	1	1	—	1	—	—	—	3
Indeterminate mammals								
Rabbit size	—	—	—	—	—	—	2	2
Rabbit to coyote size	—	—	1	—	—	—	—	1
Coyote to deer size	—	—	—	—	—	2	—	2
Total	1	1	1	1	1	3	3	11

Key: NISP = number of identified specimens.

resulted in the collection of 1 diaphysis fragment from a rabbit- to coyote-sized animal. This specimen was unburnt and less than 15 mm long. Feature 84 contained 1 unburnt first phalanx from a deer. Epiphyses on the deer were fully fused and this specimen likely represented an adult animal. The lateral portion of a cervical vertebra was the only faunal specimen collected from Feature 129. This specimen was unaltered by fire and could be identified as representing a leporid. Three specimens, 2 identified as representing a coyote- to deer-sized animal and 1 that compared favorably with *Lynx rufus*, rested in Feature 136. The two coyote- to deer-sized specimens were 15–25 mm long and exhibited oblique fracture margins. Feature 158 contained 2 rabbit-sized shaft fragments and 1 proximal right femur, assigned to the family Leporidae. Intermediate in size, it was unclear whether this proximal right femur was from a cottontail or jackrabbit.

Adobe-Lined Pits

Two features assigned to this category, Features 56 and 189, contained faunal remains. As with the preceding general extramural pit category, this feature type contributed little to the project collection. Eleven specimens were recovered from these two features.

The Feature 56 adobe-lined pit contained three diaphysis fragments from a mouse- to squirrel-sized animal. Each specimen was unaltered by fire and was less than 5 mm long. Hardly weathered, these specimens were likely intrusive. Eight specimens, six unaltered squirrel- to rabbit-sized and two unaltered cottontail, were collected from Feature 189. The six squirrel- to rabbit-sized specimens were less than 15 mm long. The cottontail specimens included a left acetabulum and left posterior maxilla.

Archaic Period Roasting Features

Of the four possible Archaic period roasting features, Feature 162 was the only one that produced faunal remains. This feature contained five squirrel-to-rabbit-sized bone fragments, all of which were recovered from flotation. All of the bones were unaltered, less than 5 mm in size, and exhibited Stage I weathering. Their unburnt condition suggests that they were not associated with the use of this feature.

Roasting Pits

Faunal specimens from roasting pits (NISP = 1,987) constituted 80.7 percent of the Vegas Ruin collection. In fact, the Feature 132 roasting pit was the richest context, in terms of amount, encountered at the Vegas Ruin. Three other roasting pits, Features 15, 16, and 154, also contained faunal remains, but in far fewer numbers.

The Feature 15 roasting pit contained 10 specimens representing at least four taxa. Five mouse- to squirrel-sized specimens were the most numerous. One proximal left femur was placed in the Muridae/Heteromyidae category. All 6 of these rodent specimens were unaltered by fire, exhibited minimal weathering, and were likely intrusive. Two calcined squirrel- to rabbit-sized and 2 unaltered rabbit-sized diaphysis fragments were also recovered.

A calcined artiodactyl long-bone fragment was the only faunal specimen recovered from the Feature 16 roasting pit.

Table 72. Number and Percentage of Identified Specimens Assigned to Each Burning Category from the Feature 132 Roasting Pit at the Vegas Ruin (405/2012)

Taxon	Unaltered		Charred		Calcined		NISP Total	
	n	%	n	%	n	%	n	%
Fish								
Cyprinidae	1	0.1	—	—	—	—	1	0.1
Mammals								
Leporidae	—	—	1	6.7	—	—	1	0.1
Rodentia	1	0.1	1	6.7	—	—	2	0.1
Muridae/Heteromyidae	1	0.1	—	—	—	—	1	0.1
Artiodactyla	57	3.0	—	—	—	—	57	3.0
Odocoileus spp.	19	1.0	—	—	—	—	19	1.0
Indeterminate mammals								
Squirrel to rabbit size	1,002	52.5	2	13.3	—	—	1,004	52.2
Rabbit size	480	25.2	2	13.3	1	50.0	483	25.1
Coyote to deer size	206	10.8	9	60.0	1	50.0	216	11.2
Deer size	4	0.2	—	—	—	—	4	0.2
Unidentifiable mammals	137	7.2	—	—	—	—	137	7.1
Total	1,908	100	15	100	2	100	1,925	100

Key: NISP = number of identified specimens.

This specimen was 35–50 mm long and was calcined. It exhibited Stage I weathering and may represent subsistence refuse associated with the use of the feature.

Feature 132 contained 1,925 specimens, which represented at least 4 vertebrate orders and 10 taxa (Table 72). Represented vertebrate orders include Cypriniformes, Lagomorpha, Rodentia, and Artiodactyla. An unaltered centrum from 1 small cyprinid was the only fish bone recovered. This centrum was from a fish that was 10–20 cm in length. Most of the specimens were severely fragmented and minimally identifiable—thus, only 81 of the 1,925 specimens were able to be assigned to a specific taxon. Only 1 specimen, an unaltered cervical vertebra, could be identified as representing a leporid. The small size of 1 charred first phalanx and 1 unaltered diaphysis fragment were identified as rodent remains. One unaltered incisor was from a rodent in the family Muridae or Heteromyidae. All 57 specimens placed in the Artiodactyla category were unaltered by fire and included 1 distal third phalanx, 1 medial rib fragment, 1 medial sternebra, and 53 diaphysis fragments. Nineteen specimens, all unaltered by fire, were identified as deer elements. These included a first, second, and third phalanx; right medial astragalus, distal left radius; left accessory radial carpal; left radioulnar carpal; left scapholunar carpal; and a thoracic vertebra centrum.

Fifty-one specimens were recovered from the Feature 154 roasting pit. These specimens were severely fragmented and none of them was identifiable beyond the level of vertebrate order. Two specimens—an incisor and proximal metapodial—were from a leporid. Small (15–25 mm), unaltered squirrel- to rabbit-sized (NISP = 42) specimens were the most numerous. Five rabbit- to coyote-sized and 1 deer-sized specimen were also recovered. A charred rodent long-bone fragment was the only specimen exhibiting alteration by fire. This rodent specimen was from a mouse-sized creature.

Severely fragmented indeterminate mammal remains (NISP = 1,901) formed 95.7 percent of the feature fauna. Squirrel- to rabbit-sized specimens (NISP = 1,048) were the most numerous, and only 2 of these specimens were charred. Rabbit-sized specimens (NISP = 485) were the next most numerous, but only 2 of these were charred, and only 1 was calcined. Coyote- to deer-sized specimens (NISP = 216) were common but seldom charred or calcined. Only 5 specimens could be confidently identified as representing a deer-sized animal. A little less than 7 percent of the recovered specimens

(NISP = 137) lacked diagnostic attributes. These 137 specimens were placed in the unidentifiable mammal category.

At first, the dearth of blackened and calcined bones in roasting pits seems counterintuitive, since archaeologists often assume that burnt bone is evidence of cooking behavior. Yet as Maxwell (2006:29) explains, people would be unlikely to eat meat that had cooked to the point that of actually burning the bone. Even if cooked over an open flame, most bones would be protected by soft tissues. It is therefore more likely that calcined or blackened bones were the result of disposal practices rather than cooking.

Burials

Fifteen of the 38 burials discovered at the Vegas Ruin contained faunal remains (Table 73). Faunal remains were also recovered from the fill of a composite burial, Feature 216. Worked bone and bone tools that were directly associated with these inhumations, and which we considered to be mortuary items, are discussed separately in the bone tools section of this chapter. The following discussions focus on unworked specimens recovered from the sediments filling individual burials.

Feature 12

Five specimens were associated with the Feature 12 burial. Three fragments were identified as *Urocyon* cf. *cinereoargenteus* and appeared to articulate with one another. The remaining two specimens were an unburnt artiodactyl humerus shaft fragment and an unburnt rabbit-sized caudal vertebra. The rabbit-sized caudal vertebra was weathered more than the artiodactyl shaft fragment.

Feature 33

This burial contained six faunal specimens that represented at least four taxa. A calcined, right, cottontail acetabulum was the only specimen assigned to a specific taxon. The remaining five specimens were unburnt and less than 35 mm long. Three of them were from coyote- to deer-sized animals, one was from a rabbit-sized animal, and another was from a deer-sized animal.

Feature 49

Ten specimens were recovered from this burial. Specimens identified to the level of genus included 1 carapace fragment that compared best with desert tortoise and 1 unburnt distal right cottontail humerus. The desert tortoise fragment was unworked but may in fact represent a mortuary item. Small bone fragments assignable only to an animal-size class were most numerous and included 1 rabbit- to coyote-size, 3 coyote- to deer-size, and 1 deer-sized bone fragment. None of these indeterminate mammal remains was burnt and none was more than 35 mm long.

Feature 103

A thoracic vertebra fragment from a medium-sized artiodactyl was removed from this burial. Only a portion of the centrum and spinous process remained, and the specimen was 50–100 mm long.

Feature 137

Six bone tools were directly associated with this burial. These mortuary artifacts are discussed separately in the bone tools section of this chapter. Fifteen additional faunal specimens were recovered from this burial. All of them were unburnt and they consisted of 14 deer-sized diaphysis fragments and 1 cheek tooth fragment that likely represented a carnivore. None of these fifteen specimens conjoined with one another or with the bone tools directly associated with the burial. It is possible, however, that these specimens were, in fact, fragments of poorly preserved mortuary artifacts.

Feature 145

A distal left humerus, which compared favorably with that of a quail, was recovered from this burial. This specimen was unaltered by fire, 25–35 mm long, and exhibited Stage I weathering.

Feature 146

Two, unburnt, distal right tibia fragments were recovered from this burial. These specimens were 5–15 mm long and exhibited Stage I weathering. Both tibia represented a rodent in the family Muridae or Heteromyidae.

Feature 172

A precloacal vertebra, which compared favorably with that of a rattlesnake, was recovered from this infant burial. The vertebra was unburnt, less than 5 mm in diameter, and exhibited Stage I weathering. Rattlesnakes are adept burrow hunters and this specimen was likely intrusive to this feature.

Feature 175

A molariform tooth fragment that compared favorably with mule deer was recovered from this burial. This specimen was 5–15 mm long, unburnt, and exhibited Stage I weathering.

Feature 181

Eleven faunal specimens were recovered from this burial.

Table 73. Number of Specimens Recovered from Mortuary Features by Taxon and Site

Taxon	Vegas Ruin (405/2012)	Site 408/2015	Crane Site (410/2017)	NISP Total
Amphibians				
Bufo spp.	1	—	—	1
Reptiles				
Testudines				
cf. *Kinosternon* spp.	1	—	—	1
cf. *Gopherus agassizii*	1	—	—	1
Serpentes	2	—	—	2
cf. *Crotalus* spp.	2	—	—	2
Birds				
Lophortyx spp.	1	—	—	1
Mammals				
Leporidae	1	2	—	3
Sylvilagus spp.	2	—	—	2
Lepus californicus	8	1	—	9
Muridae/Heteromyidae	7	—	—	7
Perognathus spp.	2	—	—	2
Neotoma spp.	3	—	—	3
Carnivora	1	—	—	1
Canidae	—	1	—	1
Urocyon cf. *cinereoargenteus*	3	—	—	3
Canis spp.	1	3	—	4
Artiodactyla	10	4	1	15
cf. *Odocoileus* spp.	1	—	—	1
Odocoileus spp.	—	3	—	3
Indeterminate mammals				
Squirrel to rabbit size	3	—	—	3
Rabbit size	16	5	1	22
Rabbit to coyote size	1	—	—	1
Coyote to deer size	12	—	1	13
Deer size	21	1	5	27
Total	100	20	8	128

Key: NISP = number of identified specimens.

Three of these were bone tools that are discussed in detail in the bone tools section of this chapter. The remaining 8 specimens were unburnt and included 1 intact right calcaneum and 1 distal right tibia epiphysis from a black-tailed jackrabbit, 1 distal left tibia fragment assigned to the Muridae/Heteromyidae category, and 5 coyote- to deer-sized diaphysis fragments. The specimen assigned to the Muridae/Heteromyidae category was hardly weathered and was likely intrusive to the feature.

Feature 197

A calcined, medial, black-tailed jackrabbit radius was the only faunal specimen collected from this burial. This specimen was 5–15 mm long and exhibited Stage I weathering.

Feature 206

This burial contained a single bone tool that was directly associated with the burial. This mortuary artifact is discussed in detail in the bone tools section of this chapter.

Feature 207

This burial contained a single faunal specimen that compared favorably with *Bufo alvarius*. The specimen was unburnt, 15–25 mm long, and exhibited Stage I weathering.

Feature 216

This was a composite burial consisting of Features 219 and 220. This provenience was assigned to artifacts recovered from the mixed fill of the burials that could not be ascribed to either feature. This fill contained 30 vertebrate specimens and 1 bone tool. Half of the collection was indeterminate, mostly rabbit-sized mammals. The collection also included 6 rodent, 1 *Canis*, 5 leporid, and 2 Serpentes specimens.

Feature 219

A rabbit-sized bone fragment was recovered from this burial. This specimen was unburnt, 5–15 mm long, and exhibited Stage I weathering.

Feature 220

This burial contained two squirrel- to rabbit-sized diaphysis fragments. They were unaltered by fire, 5–15 mm long, and exhibited Stage I weathering. Three Muridae/Heteromyidae specimens and one cf. *Crotalus* spp. were hardly weathered and were likely intrusive to the feature.

Nonfeature Excavations

Nine specimens were recovered from nonfeature contexts. A metapodial fragment from a medium-sized artiodactyl and one calcined deer-sized bone fragment were collected during mechanical stripping operations. Another calcined deer-sized bone fragment was gathered from TP 84. TP 85 contained leporid and indeterminate mammal remains. Both of these test pits were located north of the compound. Identified leporid remains included one unburnt black-tailed jackrabbit metatarsal and an unburnt rabbit-sized bone fragment. One unburnt and one calcined deer-sized bone fragment and an unburnt coyote- to deer-sized bone fragment were also recovered.

Rock Jaw Site (AZ U:3:407/2014)

The Rock Jaw site was a small pre-Classic–Classic transition period farmstead located immediately north of Cottonwood Creek and on the second terrace above the current channel of Tonto Creek. It consists of two superimposed pit structures and several extramural pits and hearths. Faunal remains from this site included 49 specimens that represented a minimum of five taxa and three vertebrate orders (see Table 66). Excavators recovered faunal remains from each of the two pit structures (Features 1 and 3) discovered at this site.

Pit Structures

Of the 49 total specimens, 5 specimens were directly associated with the earlier pit structure, Feature 1, and 7 specimens were directly associated with the later pit structure, Feature 3. The rest of the fauna were from the general feature fill and could not be confidently assigned to either structure.

The earlier Feature 1 pit structure contained five specimens, of which two were small (<5 mm), calcined bone fragments that could not be confidently assigned to an animal-size class. The remaining three specimens were rabbit-sized mammals, of which two were weathered to Stage II.

Seven faunal specimens rested in the Feature 3 pit structure. A molariform tooth fragment was the only rodent specimen recovered. Two rabbit-sized bone fragments, one calcined and one unburnt, were also recovered. Both rabbit-sized specimens were 5–15 mm long and exhibited Stage I weathering. An unburnt molariform tooth fragment from an artiodactyl was also recovered along with a proximal left ulna that was identified as representing the genus *Canis* spp. The *Canis* spp. specimen rested atop the house floor. It was unburnt, exhibited Stage II weathering, and represented an adult animal that likely weighed 30–40 pounds. An unburnt coyote- to deer-sized long-bone fragment was recovered from a central-support posthole (Feature 3.6). This specimen was 15–25 mm long and exhibited Stage II weathering. One small

(<5 mm) fragment of mammal bone could not be assigned to an animal-size class.

Of the remaining 37 specimens from the pit house fill, all but 5 were weathered to Stage II. Severely fragmented specimens identifiable only to an animal-size class were the most numerous. A right ischium fragment was assigned to the leporid category. This specimen was 25–35 mm long, unburnt, and exhibited Stage II weathering. A right horizontal ramus from an artiodactyl was recovered from the fill of this structure. This mandible was intact, unburnt, and all of the molariform dentition was preserved. Five unburnt deer-size, long-bone fragments were also recovered. These deer-sized specimens were less than 35 mm long and exhibited Stage II weathering. Rabbit-sized bone fragments (NISP = 30) were the most numerous. One of these was calcined; the remaining specimens appeared unaltered by fire. All of the rabbit-sized bone fragments were less than 25 mm long and were recovered from the near-floor fill.

Site AZ:U:3:408/2015

Site 408/2015 is a large, dispersed multicomponent site encompassing a small Classic period compound, several Classic period field houses, and a poorly preserved pre-Classic period component. The fauna from this site consisted of 74 specimens (see Table 66). These specimens represented four vertebrate orders and a minimum of seven taxa. Most of these specimens were distributed among three features: a small extramural pit (Feature 2), a sheet midden (Feature 9), and an infant burial (Feature 8). The remaining specimens were recovered from 10-cm levels removed from 1-by-1-m test pits (TPs 59, 63, and 231). No faunal remains were recovered from Classic period contexts.

Extramural Pits

Feature 2 was the only excavated extramural pit that contained faunal remains. These included three charred coyote- to deer-sized bone fragments that were 15–25 mm long, uniformly charred, and exhibited Stage I weathering. Given that these specimens were charred and consisted of small splinters, they most likely represented subsistence refuse.

Middens

Forty-two faunal specimens were recovered from the Feature 9 midden. These specimens represented four taxa. One, 5–15 mm, calcined bone fragment was assigned to the rabbit-sized category. One unburnt shaft fragment represented a small rodent in the family Muridae or Heteromyidae. All of these specimens exhibited Stage I weathering.

Artiodactyl and deer-sized specimens were the most numerous (n = 28). Of these, 23 were unburnt, and most exhibited Stage I weathering. Five specimens were charred and included four long-bone-shaft fragments and a left anterior scapula border. These specimens were 5–35 mm long and exhibited Stage I–II weathering.

Twelve specimens could not confidently be assigned to an animal-size class and were treated as unidentifiable. These 12 specimens were unburnt and less than 5 mm long.

Burials

The Feature 8 infant burial contained 20 faunal specimens representing at least four vertebrate orders and a minimum of six taxa (see Table 73). Three fragments of lagomorph bone were among these remains. Identified leporid remains included 1 unburnt proximal metapodial and 1 medial rib fragment. One unburnt distal left jackrabbit radius was also recovered. All of these lagomorph remains exhibited Stage I weathering and were less than 25 mm long. Deer specimens included 1 charred second phalanx, 1 charred scapula, 2 burnt shaft fragments, 1 unburnt root from a molariform tooth, 1 metapodial awl, and 1 antler flaking tine (see bone tools discussion). Carnivore specimens included 1 unburnt and 1 calcined root of a molariform tooth, 1 unburnt canine, and 1 unburnt left carnassial. The carnassial compared favorably with coyote-sized canid and may have represented a domestic dog. Indeterminate remains included 5 unburnt rabbit-sized rib and shaft fragments, and 1 calcined splinter awl made from a deer-sized bone fragment.

Crane Site (AZ U:3:410/2017)

Located on the second terrace above the current channel of Tonto Creek, the Crane site is a small, multicomponent site. One deeply buried hearth that may date to the Archaic period represents the earliest identified use of the site. A shallow pit structure represents a later occupation that perhaps dated to the pre-Classic–Classic period transition. The latest occupation of the site entailed the construction of four Classic period cobble-adobe-foundation structures, two granaries, and several extramural thermal features. A deep and extensive midden that represents the pre-Classic–Classic transition and Classic period occupations of the site rested near the north-central site boundary. Seven Classic period human inhumations were either associated with the cobble-adobe-foundation structures or were located on the southern site slope.

Excavations at the Crane site resulted in the collection of 202 faunal specimens (see Table 66). These were distributed among the Classic period cobble-adobe-foundation structures, the pre-Classic–Classic period pit structure, a large midden, and a variety of extramural feature types, including burials. Structures were the richest recovery context in terms of the total number of faunal specimens recovered. Most of the specimens recovered from burial contexts were mortuary artifacts, and these are treated in greater detail in the bone tools section of this chapter.

Cobble-Adobe-Foundation Architecture

Four cobble-adobe-foundation structures (Features 2, 4, 6, and 19) contained faunal remains. Most of these remains rested in the fill removed from these structures, and they are best interpreted as representing postoccupational subsistence refuse.

Flotation samples collected from the Feature 2 cobble-adobe-foundation structure contained 11 faunal specimens. Eight indeterminate mammal remains were the most numerous type of specimen from the structure. Squirrel- to rabbit-sized shaft fragments were the most numerous indeterminate mammal remains. One charred, 15–25-mm-long, shaft fragment was from a rabbit-sized animal. A calcined long-bone fragment was assigned to the squirrel-sized category. Three of these specimens were calcined; the other was unburnt. All 4 specimens were less than 5 mm long and exhibited Stage I weathering. A leporid incisor was the only specimen that could be confidently assigned to the level of family. Another unburnt incisor and metapodial fragment from a rodent in the family Muridae or Heteromyidae were also recovered.

Forty-six specimens were recovered from the Feature 4 cobble-adobe-foundation structure. Lagomorph and artiodactyl remains were rare, and no rodent specimens were recovered. Indeterminate mammals remains (NISP = 27) and unidentifiable mammals remains (NISP = 13) were the most numerous types of specimens. Lagomorph remains included 1 charred molariform tooth from a leporid, 1 calcined jackrabbit radius and 1 distal metapodial, 1 unburnt right jackrabbit mandible, and 1 unburnt cottontail first phalanx. All the lagomorph remains exhibited Stage I weathering and were less than 35 mm long. A left proximal metatarsal was the only element that represented deer. Rabbit-sized specimens were common and included 13 unburnt and 1 calcined shaft fragment. These fragments were 5–15 mm long and exhibited Stage I weathering. Eight small (<5 mm) and calcined specimens represented squirrel- to rabbit-sized animals. Five specimens were from deer-sized animals. These included 2 calcined and 3 unburnt shaft fragments that were less than 50 mm long and exhibited Stage I–II weathering. Thirteen small (<5 mm), unburnt specimens could not be confidently assigned to taxon or animal-size class and were placed in the unidentifiable mammal category.

The Feature 6 cobble-adobe-foundation structure contained 19 faunal specimens that represented at least two vertebrate orders and four taxa. Indeterminate mammal remains were the most numerous specimens followed by rabbit-sized and rodent remains. Rabbit-sized remains included 2 unburnt and 4 calcined shaft fragments that were less than 15 mm long and exhibited Stage I weathering. An unburnt squirrel- to rabbit-sized specimen was also collected. Rodent remains included 1 charred left distal tibia, 2 unburnt incisor fragments, and 1 unburnt distal left tibia. These rodent specimens were from rodents in the family Muridae or Heteromyidae, were less than 15 mm long, and exhibited Stage I weathering.

A precloacal rattlesnake vertebra was gathered in a flotation sample. This specimen was intact, unburnt, and likely intrusive. Seven, small (<5 mm), unburnt specimens could not be confidently assigned to a specific taxon or animal-size class; therefore, these specimens were assigned to the unidentifiable mammal category.

Excavation of a possible cobble-adobe-foundation structure (Feature 19) resulted in the collection of one deer-sized shaft fragment. This specimen was 5–15 mm long, unburnt, and exhibited Stage I weathering.

Pit Structures

The Feature 30 pit structure contained 58 faunal specimens representing at least one vertebrate order and five taxa. Lagomorph and rabbit-sized specimens were the most numerous, followed by specimens representing the rodent family Muridae or Heteromyidae.

Identified lagomorph remains included a molariform tooth fragment from a leporid and two, nonconjoining, jackrabbit, medial tibia fragments. These lagomorph remains were recovered from the house fill. A proximal, leporid, metapodial fragment was recovered from a flotation sample removed from the hearth (Subfeature 30.01). All of the lagomorph remains were unburnt, less than 100 mm long, and exhibited Stage I weathering.

Nine rodent specimens were recovered, all from flotation samples. Identified rodent elements included an incisor, an atlas, one cervical and one thoracic vertebra, two caudal vertebrae, a distal right femur, an intact right calcaneum, and a proximal metapodial. These elements represented rodents in the family Muridae or Heteromyidae. Four unburnt shaft fragments were assigned to the category Rodentia. All of the recovered rodent remains exhibited Stage 0–I weathering and were likely intrusive.

Indeterminate mammal remains dominated the feature fauna. Fifteen rabbit-sized shaft fragments were recovered from the house fill and 10 were recovered from the hearth (Subfeature 30.01). These specimens were unburnt, less than 25 mm long, and exhibited Stage I weathering. Three squirrel- to rabbit-sized specimens were also recovered from the house fill and 1 from the hearth (Feature 30.1). Two deer-sized shaft fragments represented the only possible evidence of artiodactyl remains. These specimens were small (<15 mm) and unburnt.

Ten specimens could not confidently be assigned to a specific taxon or animal-size class, therefore, these 10 specimens were assigned to the unidentifiable mammal category.

Nine of these unidentifiable specimens were unburnt and 1 was calcined. All 10 specimens were less than 5 mm long and exhibited Stage I weathering.

Middens

Sampling of the Feature 1 midden resulted in the collection of 13 specimens, which represented at least one vertebrate order and three taxa. Specimens identifiable to animal-size class only were the most numerous. The only identifiable specimen was 1 excellently preserved, unburnt diaphysis fragment from a rodent; this was likely intrusive. Indeterminate mammal remains dominate the midden sample. Five calcined and 6 unaltered rabbit-sized specimens were recovered. There was a single calcined, squirrel- to rabbit-sized specimen that was less than 5 mm long.

Extramural Pits

Two extramural pits (Features 28 and 37) contained faunal remains. Those from Feature 28 included two unburnt rabbit-sized shaft fragments and a distal, right, cottontail humerus. The rabbit-sized specimens exhibited Stage I weathering, whereas the cottontail specimen exhibited Stage II weathering. Five unburnt, rabbit-sized shaft fragments were recovered from Feature 37. These specimens were 25–35 mm long and also exhibited Stage I weathering.

Extramural Hearths

Feature 29 contained 4 faunal specimens that represented at least one vertebrate order and two taxa. Leporid remains were the most numerous and included 1 calcined second phalanx, 1 unburnt third phalanx, and 1 unburnt caudal vertebra assigned to the leporid category. A small (<5 mm), calcined, squirrel- to rabbit-sized specimen was also recovered. All of the specimens from Feature 29 were gathered from the in-field screening of the feature fill. A flotation sample removed from the fill of another extramural hearth, Feature 13, also contained faunal remains. Feature 13 contained 14 faunal specimens. These specimens represented at least two vertebrate orders and five taxa. Ten indeterminate mammal remains were the most numerous followed by jackrabbit and rodent remains. Jackrabbit specimens included 1 charred distal metapodial and 1 charred proximal metatarsal. Rodent remains included 1 unburnt, distal right humerus from a rodent in the family Muridae or Heteromyidae and 1 intact and calcined packrat molar. Indeterminate mammal specimens included 2 charred and 3 unburnt rabbit-sized shaft fragments, and 1 calcined shaft fragment from a squirrel- to rabbit-sized animal. All of the indeterminate mammal specimens were 5–15 mm long and exhibited Stage I weathering.

Roasting Pits

Five faunal specimens were discovered in the flotation sample removed from the Feature 27 roasting pit. These included a rabbit-sized shaft fragment and four shaft fragments from squirrel- to rabbit-sized animals. All of these specimens were unburnt, less than 15 mm long, and exhibited Stage I weathering.

Granary

Three faunal specimens were recovered from a flotation sample gathered from the Feature 24 granary. These specimens included two unburnt rabbit-sized diaphysis fragments and an unburnt distal leporid metapodial. All of these specimens were 5–15 mm long and exhibited Stage I weathering.

Burials

Three of the seven Crane site burials, Features 25, 38, and 40, contained faunal remains (see Table 73). Feature 25 contained two faunal specimens, including one calcined rabbit-sized shaft fragment and an unburnt coyote- to deer-sized shaft fragment. Both specimens were less than 25 mm long and exhibited Stage I–II weathering. Feature 38 contained four unburnt deer-sized specimens, each of which had been worked. These four mortuary artifacts are treated individually in the bone tools section of this chapter. Two unburnt, deer-size, diaphysis fragments were recovered from Feature 40. Each of these specimens was 15–25 mm long and exhibited Stage I weathering.

Nonfeature Excavations

One point-located, distal, right cottontail tibia rested on the site surface. This specimen was from an adult and was likely eroded from the fill of a nearby feature. Four additional specimens from CU 30 also rested on the site surface. All were calcined, and they consisted of a two rabbit-sized bone fragments, one deer-sized bone fragment, and a humerus head fragment from a medium-sized artiodactyl. Three domestic cow bones were recovered from Wall Trench (WT) 77. Identified elements included a distal metacarpal and two first phalanges. The distal epiphysis on the metacarpal and the proximal epiphyses on the first phalanges remained unfused. A flotation sample from what was initially believed to be a feature contained a charred, rabbit-sized shaft fragment less than 15 mm long that exhibited Stage I weathering.

Bone Tools

When possible, worked bone specimens (n = 32) were assigned to one of nine morpho-functional tool classes. If the function of the worked bone specimen was not clear, it received a coding of "other." Mode of manufacture was recorded when possible by recognizing whether a specimen was shaped by chipping, grinding, or a combination thereof. Mastic and ochre (hematite) were treated as being present or absent, and the location of the mastic or ochre was recorded in the comments field. Measurements were recorded for each worked bone specimen, including length, width, thickness, maximum and minimum diameter, and when pertinent, perforation shape and diameter. The bone tool collections from each site were divided into nonmortuary and mortuary contexts in Table 74. Each site collection is discussed individually below by recovery context.

Vegas Ruin (AZ U:3:405/2012)

The Vegas Ruin contained the greatest number and diversity of bone tools, with 12 specimens from mortuary contexts and an equal number from nonmortuary contexts. These 24 specimens were from contexts that date primarily to the pre-Classic–Classic period transition. A single worked bone fragment was recovered during mechanical stripping. This artifact was made from a deer-sized long-bone fragment and exhibited a ground lateral margin and half of a uniconically drilled hole that was approximately 6 mm in diameter. The function of this artifact is unclear. A metapodial awl fragment with severe root etching was recovered from what was initially believed to be a feature context but which was subsequently voided. This awl was made from an artiodactyl long bone and was 33.4 mm in length.

Extramural feature types that contained bone tools included an extramural pit (Feature 84), large borrow pits (Features 22 and 195), and roasting pits (Feature 16). A single metapodial awl fragment was recovered from Feature 84. Numerous longitudinal striae covered the highly polished shaft that was 29.6 mm long, uniformly polished, and calcined. Another worked bone fragment with a uniconically drilled hole was recovered from the Feature 22 borrow pit. It was blackened, 51 mm long, and had a circular hole approximately 8 mm in diameter. This artifact perhaps functioned as a shaft wrench or straightener. A 91-mm-long splinter-awl fragment was recovered from the Feature 195 borrow pit. Two conjoining fragments of a 47-mm-long splinter awl rested in the Feature 16 roasting pit. Both fragments were calcined and highly polished.

Three pit structures (Features 19, 34, and 179) along with a cobble-adobe-foundation wall (Feature 6), contained splinter awls. Splinter awls were the only bone artifact type recovered from these features. Two were recovered from Features 19 and 179, and Feature 34 contained a single tool. These tools were 19–105 mm long and were highly polished. Two had been burned, perhaps fire-hardened, and the remaining two were unburnt.

Mortuary Contexts

Four inhumations, Features 49, 137, 181, and 206, contained bone tools that were sumptuary items. A burial plot (Feature 216) also contained a bone tool, but this specimen could not be clearly associated with a particular inhumation. Artifact types associated with inhumations at the Vegas Ruin included splinter awls, spatulate awls, awl/hairpins, and a tortoiseshell rattle. The awls were each made from artiodactyl long bones.

The Feature 49 inhumation contained a 40-mm-long splinter awl that consisted of two conjoining specimens. A tortoiseshell rattle that contained several quartz pebbles was recovered from the Feature 137 inhumation (Figure 48). One splinter awl (Figure 49), two spatulate awls, a possible awl handle, and an awl/hairpin were also components of the Feature 137 sumptuary collection. These three bone artifacts were 28–222 mm long, slightly polished, lack evidence of use wear, and were likely made for the burial event. The Feature 181 inhumation contained two awl/hairpins that were 119–154 mm long and a 227-mm-long spatulate awl. Splinter awls were also associated with the Feature 206 inhumation and Feature 216 burial plot.

Site AZ U:3:408/2015

Four bone tools, one from TP 231 and three from the Feature 8 inhumation, were recovered from this multicomponent site. The specimen from TP 231 consisted of two conjoining fragments from a calcined splinter awl. This awl was highly polished and 64 mm long.

Mortuary Contexts

The Feature 8 inhumation contained a 76-mm-long flaking tine, a splinter awl, and a metapodial awl. All of these artifacts were made from deer antler or bone. The splinter awl was 30 mm long, uniformly calcined, and was made from long-bone-shaft fragment. It exhibited a moderate polish and numerous longitudinal striae. The metapodial awl was 77 mm long, included both condyles, was unburnt, and exhibited minor polishing and no striae. This awl was perhaps made specifically for the burial.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm)			Comments
										Max.	Min.	Perforation	
Vegas Ruin (405/2012): Nonmortuary contexts													
Nonfeature	deer size	long bone	unaltered	unknown	FRAG	IND	39.1	21.1	5.4	21.1	5.4	6.3	Ground lateral margin and uniconically drilled hole; half of hole remains; no evidence of fire hardening.
	Artiodactyla	long bone	unaltered	metapodial awl	MEDIA	IND	33.5	16.4	3.2	16.4	2.8		Metapodial awl fragment exhibiting recent breaks and severe root etching.
Extramural pit													
84	Artiodactyla	metapodial	calcined	metapodial awl	MEDIA	IND	29.6	12.7	5.7	12.7	5.7		Metapodial awl fragment; uniformly polished and calcined; numerous longitudinal striae.
Borrow pit													
22	deer size	long bone	blackened	shaft wrench?	FRAG	IND	50.6	19.6	5.5	19.6	4.3	8	Bears portion of drilled hole; possible shaft wrench or straightener; uniformly calcined (fire hardened); from artiodactyl femur?
195	deer size	long bone	unaltered	splinter awl	FRAG	IND	90.6	15.7	8.1	15.7	6.2		Awl fragment lacking tip; severely root etched; polished at distal end only; no observable striae.
16	deer size	long bone	calcined	splinter awl	FRAG	IND	47.4	12.2	10.7	12.2	4.5		Two conjoining fragments and a tip treated as one specimen; an awl likely made from a metapodial; no observable striae; uniformly encrusted with carbonate.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number (*continued*)

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm) Max.	Diameter (mm) Min.	Diameter (mm) Perforation	Comments
Vegas Ruin (405/2012): Nonmortuary contexts (*continued*)													
Pit structure													
19	deer size	long bone	unaltered	splinter awl	FRAG	IND	105.7	14.4	4.7	4.7	1		Awl tip; severely root etched; partially polished along one margin and tip; few longitudinal striae.
	Artiodactyla	metapodial	unaltered	splinter awl	MEDIA	IND	43.3	12.7	2.8	12.7	4.2		Uniformly calcined and polished; numerous longitudinal striae.
Pit													
34	deer size	long bone	calcined	splinter awl	FRAG	IND	19.3	6.1	2.3	6.1	2.3		Awl fragment; numerous longitudinal striae; uniformly calcined (fire hardened); likely from a metapodial.
179	deer size	long bone	unaltered	splinter awl	FRAG	IND	41.3	5.1	4.7	5.1	2		Awl tip; uniformly polished; numerous longitudinal striae cover exterior surface.
	deer size	long bone	blackened	splinter awl	FRAG	IND	60.3	13.6	10.2	13.6	3.5		Charred on proximal end; specimen is likely from a split metapodial; distal end exhibits two old fracture scars; proximal end has been tillered flat.
Cobble-adobe-foundation wall													
6	deer size	long bone	unaltered	splinter awl	FRAG	IND	27.7	5	5	5	1		Awl tip; no polishing or striae; severely root etched.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number (*continued*)

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm)			Comments
										Max.	Min.	Perforation	
Vegas Ruin (405/2012): Mortuary contexts													
Inhumation													
49	deer size	long bone	unaltered	splinter awl	FRAG	IND	75.0	13.5	7.8	13.5	2.5		Awl fragment; two fragments were treated as one specimen.
137	*Gopherus agassizii*	carapace	unaltered	rattle	MEDIA		100.0	20.0	—	—	—		Seventy-seven fragments treated as one specimen; one fragment is perforated with a 6-mm-diameter hole that was drilled from the inside; 70 subrounded quartz pebbles were directly associated with the specimen—hence its identification as a rattle.
	deer size	long bone	unaltered	splinter awl	FRAG	IND	102	13.5	6.4	13.5	2.3		Possibly from anterior scapula border; likely not from metapodial; few striae from construction or use present; uniformly polished; three conjoining fragments treated as one specimen.
	Artiodactyla	ulna	unaltered	splinter awl	PROX	left	28	14.8	11.7	14.8	6		Possible awl handle made from an artiodactyl ulna.
	Artiodactyla	metapodial	unaltered	awl/hairpin	POSTE	IND	222	17.8	15.5	17.8	3		Found resting against top of cranium; uniformly and highly polished; no striae visible; six conjoining fragments treated as a single specimen.
	deer size	long bone	unaltered	spatulate awl	FRAG	IND	126	19.5	4	19.5	1		Uniformly polished; no striae; similar in morphology to other spatulate awl specimens.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number (*continued*)

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm) Max.	Diameter (mm) Min.	Diameter (mm) Perfora-tion	Comments
Vegas Ruin (405/2012): Mortuary contexts (*continued*)													
	Artiodactyla	femur	unaltered	spatulate awl	LATER	left	193	21.7	11	21.7	1.2		Tentative element and side identification; ochre covers a small 4-by-5-mm area on the tool's proximal end; well made; uniformly polished; long (>5 cm), parallel, longitudinal striae cover most of cortical surface—these striae are <1 mm deep and wide.
181	deer size	long bone	unaltered	awl/hairpin	FRAG	IND	154	21	5.8	21	1.5	2.4	Tool is covered with loosely adhering ochre; 10 conjoining fragments treated as a single specimen; perforation present on proximal end on small fragment—this perforation is circular and was biconically drilled.
	deer size	long bone	unaltered	awl/hairpin	FRAG	IND	119	11	8	11	4		Cylindrical bone rod; ochre covered; uniformly polished; no striae.
	Artiodactyla	metapodial	unaltered	spatulate awl	LATER	IND	277	36	12.7	14	1		Partially covered with loosely adhering ochre.
206	deer size	long bone	unaltered	splinter awl	FRAG	IND	75	13.5	7.8	13.5	2.5		Severely root-etched; cut marks along edges of tools distal tip; remnant longitudinal striae cover cortical surface.
Burial plot													
216	deer size	long bone	calcined	splinter awl	FRAG	IND	24.9	6.5	4.5	6.5	3		Awl tip; uniformly polished and covered by longitudinal striae.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number (*continued*)

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm)			Comments
										Max.	Min.	Perforation	
	Site 408/2015: Nonmortuary contexts												
Nonfeature	Artiodactyla	metapodial	calcined	splinter awl	MEDIA	IND	63.9	14.4	4.4	14.4	4.8		Metapodial awl fragment; two conjoining fragments treated as one specimen.
	Site 408/2015: Mortuary contexts												
Inhumation													
8	*Odocoileus* spp.	antler	unaltered	flaking tine	EYEGU	IND	76.3	13.1	11.9	—	—		Functional assignment is tentative; no evidence of abrasion or striae present on specimen.
	deer size	long bone	calcined	splinter awl	FRAG	IND	30.2	7.3	4.8	7.3	3.6		Numerous longitudinal striae; uniformly calcined; likely from a metapodial.
	Odocoileus spp.	metapodial	unaltered	metapodial awl	DIST	IND	77.6	23.1	18	23.1	2		Metapodial awl; includes condyle; moderately root etched; partially polished.
	Crane site (410/2017): Mortuary contexts												
Inhumation													
38	deer size	long bone	unaltered	awl/ hairpin	FRAG	IND	78.4	11.2	6	11.2	5.3		Fifteen fragments (some of them conjoining) treated as a single specimen; function of artifact is unclear; no use wear is visible; specimen is poorly preserved.
	deer size	long bone	unaltered	splinter awl	FRAG	IND	44.9	13.9	7.4	7.4	3.4		Poorly preserved; two conjoining fragments treated as one specimen.

Table 74. List of Worked Bone Artifacts, by Site, Context, and Feature Number (*continued*)

Feature No., by Recovery Context	Taxon	Element	Burning	Artifact Type	Portion	Side	Length (mm)	Width (mm)	Thickness (mm)	Diameter (mm)			Comments
										Max.	Min.	Perfora-tion	
Crane site (410/2017): Mortuary contexts (*continued*)													
	deer size	long bone	unaltered	splinter awl	FRAG	IND	139	15.5	14.9	15.5	2.2		Specimen is severely root-etched and exhibits few striae as the result of the manufacturing process or use; well polished; likely from a metapodial.
	deer size	long bone	unaltered	splinter awl	FRAG	IND	132.3	16	7.9	16	2		Uniformly polished; few transverse striae are present (perhaps from the manufacturing process); at least 20 conjoining fragments treated as a single specimen.

Key: DIST = distal; EYEGU = eyeguard; FRAG = fragment; IND = indeterminate; LATER = lateral; MEDIA = medial; POSTE = posterior; PROX = proximal.

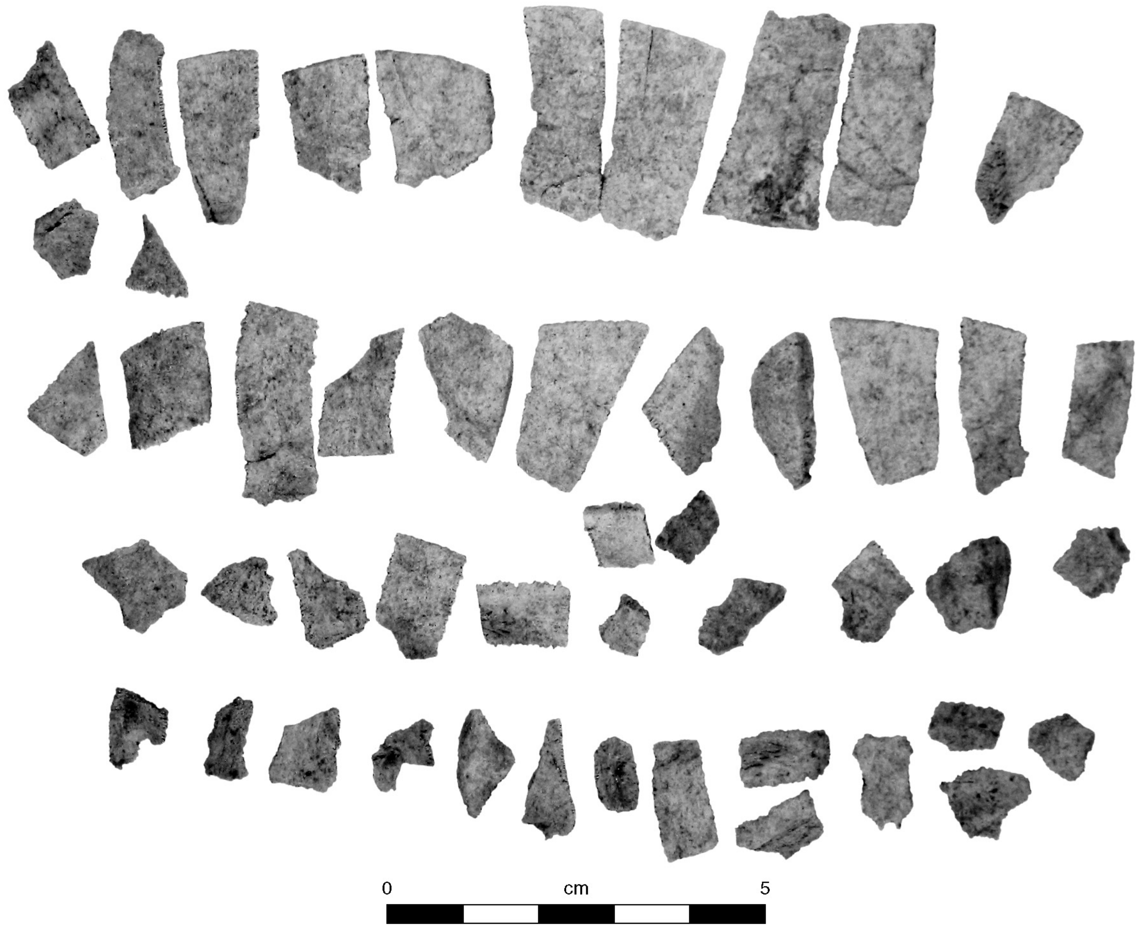

Figure 48. Tortoise shell rattle recovered from the Feature 137 inhumation, Vegas Ruin (405/2012).

Crane Site (AZ U:3:410/2017)

Mortuary Contexts

An inhumation (Feature 38) was the only feature at the Crane site that contained bone tools. These four tools were part of an elaborate sumptuary assemblage that was interred with this individual. A 139.0-mm-long splinter awl (Figure 50) rested along the lateral side of the proximal right humerus. A 78.4-mm-long awl/hairpin (Figure 51) and another large (132.3 mm long) splinter-awl fragment (Figure 52) rested along the lateral side of the proximal left humerus. A poorly preserved 44.9-mm-long splinter-awl fragment (Figure 53) was situated atop the right shoulder. Except for the poorly preserved splinter awl, each of these tools was unburnt, lacked evidence of use wear, and was likely made for the burial event.

Intersite Analyses

The CCP fauna was distributed among six prehistoric sites from features that span the prehistoric Sedentary period to the early Classic period. Most of the faunal remains were from pre-Classic–Classic transition and Classic period contexts; however, much of the collection (NISP = 2,231 or 74.4 percent of the NISP total) could not be assigned to a specific temporal component. Although this was an unfortunate outcome, the overall faunal collection still helped us to understand the sites themselves, the butchery and processing practices of their prehistoric inhabitants, and the disposal patterns that contributed to the formation of the archaeological record.

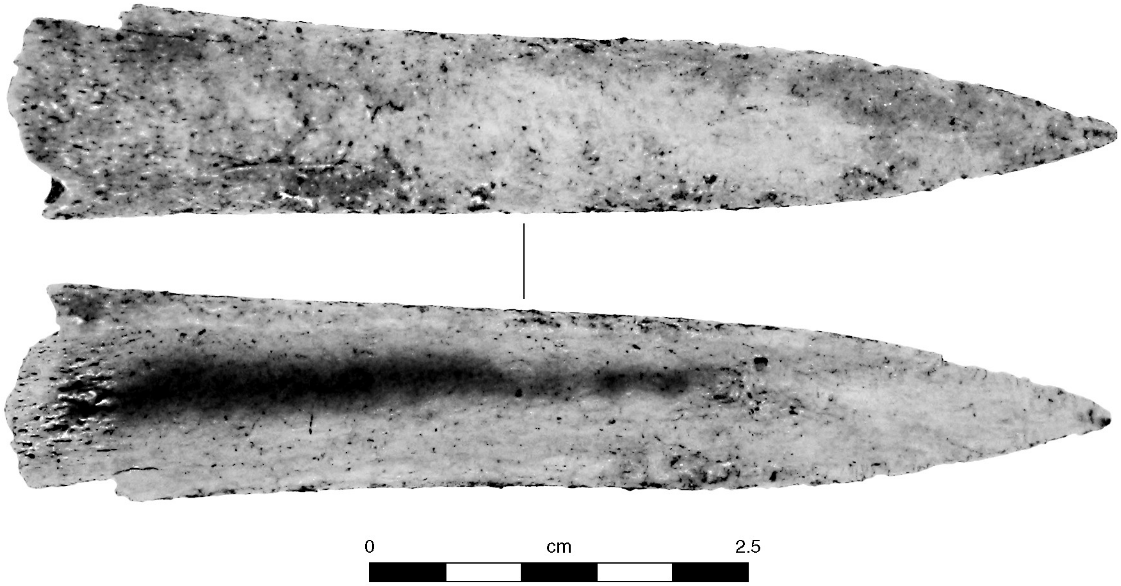

Figure 49. Splinter awl recovered from the Feature 137 inhumation, Vegas Ruin (405/2012).

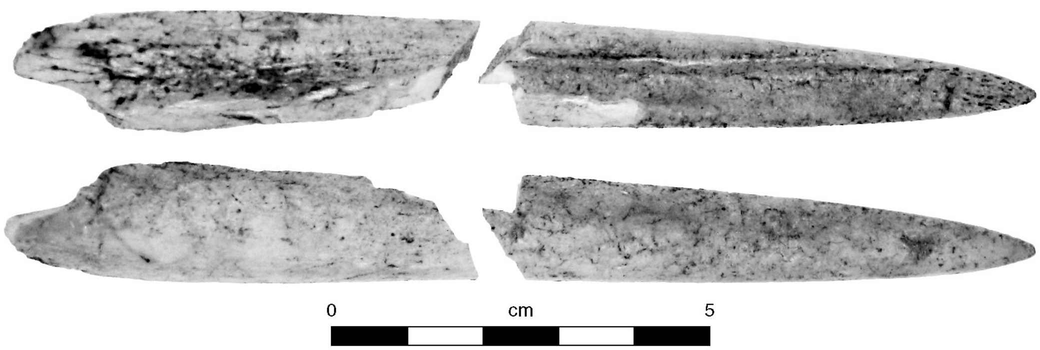

Figure 50. Splinter awl recovered from the Feature 38 inhumation, Crane site (410/2017).

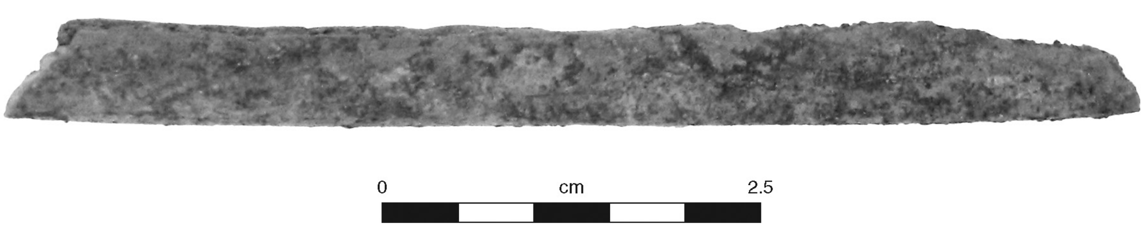

Figure 51. Awl/hairpin recovered from the Feature 38 inhumation, Crane site (410/2017).

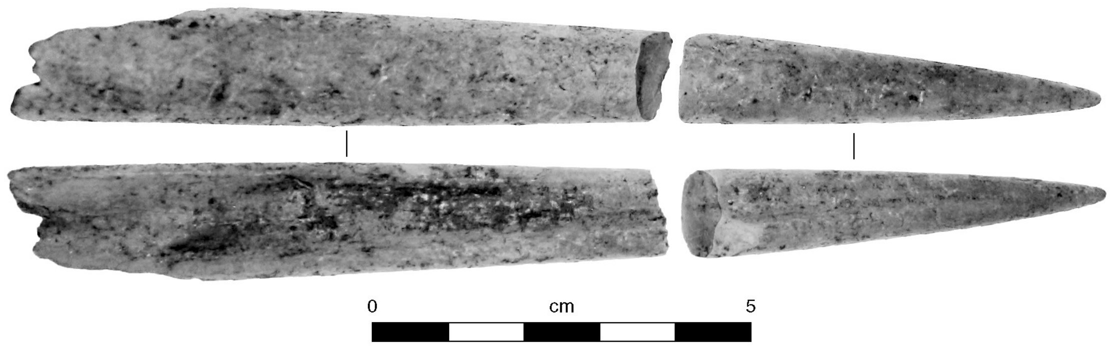

Figure 52. Splinter awl recovered from the Feature 38 inhumation, Crane site (410/2017).

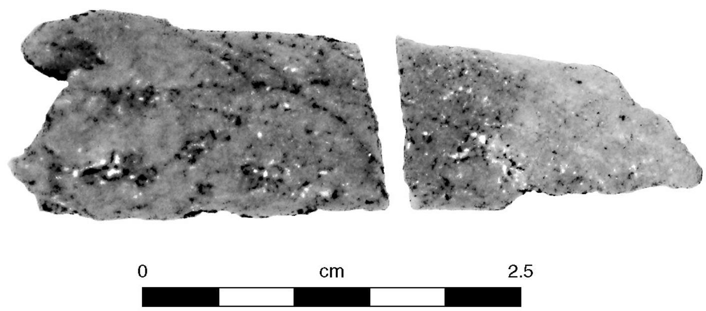

Figure 53. Splinter awl fragment recovered from the Feature 38 inhumation, Crane site (410/2017).

Primary Game Animals

Table 75 lists the number of specimens assigned to four archaeological periods of time: Archaic period, pre-Classic period, pre-Classic–Classic period transition, and Classic period. The Archaic period fauna included the specimens recovered from Feature 162 at the Vegas Ruin. The pre-Classic period fauna consisted of those specimens recovered from the Feature 1 *horno* at Site 41/583 and the two pit structures excavated at the Rock Jaw site. Specimens from pre-Classic–Classic period contexts included those collected from the pit structures at the Vegas Ruin and the Crane site. Faunal remains associated with the cobble-adobe-foundation structures, granaries, and inhumations at the Crane site, along with those remains associated with the cobble-adobe-foundation compound and inhumations at the Vegas Ruin, represented the Classic period fauna. It was unclear which period(s) the specimens collected from Sites 103/2061 and 408/2015 were associated with, and these specimens were therefore excluded from the index calculations.

Deer-sized artiodactyls and leporids clearly contributed the greatest amount of dietary protein and animal products at each of the sites that yielded faunal remains (see Table 66). This is a clearly established pattern that has been recognized at sites throughout southern and central Arizona (Szuter 1991). The prehistoric subsistence pattern was necessarily pragmatic, and it relied on whatever was readily available, edible, and not proscribed by custom or belief. A reliance on rabbits and deer is not surprising given that rabbits and deer were and are the most available sources of native animal protein in the project area. Further, rabbits and deer would have provided the most profitable returns relative to the time and energy expended.

Small, indeterminate mammal and intrusive rodent remains were the most numerous specimens recovered from the pre-Classic period contexts. Many of the indeterminate mammal remains, along with the rabbit-sized specimens, most assuredly represented the severely splintered remains of leporid skeletons. These bone fragments, and those positively identified as leporid remains, numerically dominated the

Table 75. Number of Identified Specimens from Each Identified Temporal Component

Taxon	Archaic Period	Pre-Classic Period		Pre-Classic–Classic Period		Classic Period	
	Vegas Ruin (405/2012)	Site 41/583	Rock Jaw Site (407/2014)	Vegas Ruin (405/2012)	Crane Site (410/2017)	Vegas Ruin (405/2012)	Crane Site (410/2017)
Fish							
Cyprinidae	—	—	—	—	—	1	—
Amphibians							
Bufo spp.	—	—	—	7	—	1	—
Reptiles							
Testudines	—	—	—	1	—	—	—
cf. *Kinosternon* spp.	—	—	—	1	—	1	—
cf. *Gopherus agassizii*	—	—	—	1	—	1	—
Serpentes	—	—	—	—	—	4	—
cf. *Crotalus* spp.	—	—	—	—	—	2	1
Birds							
Aves (eggshell)	—	—	—	—	—	1	—
cf. *Lophortyx* spp.	—	—	—	1	—	—	—
Lophortyx spp.	—	—	—	1	—	1	—
Mammals							
Leporidae	—	8	1	16	2	5	3
Sylvilagus spp.	—	2	—	22	—	3	1
Lepus californicus	—	1	—	14	2	8	3
Rodentia	—	7	1	2	4	1	—
Ammospermophilus spp.	—	—	—	1	—	—	—
Thomomys spp.	—	—	—	2	—	—	—
Muridae/Heteromyidae	—	7	—	4	9	13	6
Perognathus spp.	—	1	—	1	—	2	—
Neotoma spp.	—	2	—	1	—	3	—
Peromyscus spp.	—	2	—	—	—	1	—
Carnivora	—	—	—	—	—	1	—
Canis spp.	—	—	1	—	—	1	—
Urocyon cf. *cinereoargenteus*	—	—	—	—	—	3	—
Lynx cf. *rufus*	—	—	—	1	—	—	—
Artiodactyla	—	9	1	9	—	12	1
cf. *Odocoileus* spp.	—	—	—	—	—	1	—
Odocoileus spp.	—	1	1	6	—	1	1
Odocoileus cf. *hemionus*	—	—	—	1	—	—	—

Table 75. Number of Identified Specimens from Each Identified Temporal Component (*continued*)

Taxon	Archaic Period	Pre-Classic Period		Pre-Classic–Classic Period		Classic Period	
	Vegas Ruin (405/2012)	Site 41/583	Rock Jaw Site (407/2014)	Vegas Ruin (405/2012)	Crane Site (410/2017)	Vegas Ruin (405/2012)	Crane Site (410/2017)
Indeterminate mammals	—	—	—	—	—	—	—
Mouse to squirrel size	—	—	—	2	—	15	—
Squirrel size	—	—	—	—	—	—	1
Squirrel to rabbit size	5	80	—	66	4	14	13
Rabbit size	—	70	35	27	25	17	24
Rabbit to coyote size	—	2	—	7	—	1	—
Coyote to deer size	—	—	1	6	—	17	1
Deer size	—	3	5	6	2	24	11
Unidentifiable mammals	—	12	3	—	10	—	22
Total	5	207	49	206	58	155	88

Key: NISP = number of identified specimens.

pre-Classic fauna. This same pattern pertains to the pre-Classic–Classic transition and Classic period portions of the collection (see Table 75). This suggests that rabbits were an important source of meat, fat, and furs. Medium-sized artiodactyl, deer, and deer-sized bones and bone fragments also formed a significant portion of the collections from each site and temporal component. The number of specimens representing these large-game animals increased slightly over time. This suggests that artiodactyl populations may have increased during the Classic period or that large-game hunting became more important and large game was more intensively pursued later in time.

Faunal Indexes

Four faunal indexes were calculated for the pre-Classic–Classic period transition and Classic period sites (Tables 76 and 77). A riparian index (James 1994:313) was calculated by dividing the NISP of riparian taxa (R) by the NISP of the identifiable portion of a site fauna (ID). This measure tracks the relative abundance of riparian taxa in a collection, with greater index values representing a greater number of specimens from riparian creatures. Bayham and Hatch's (1985b:207) version of the lagomorph index (S/[S+L]), where the NISP total for cottontails (S) is divided by the NISP total of cottontails and all lagomorphs (L), was used in this analysis. The lagomorph index is considered to be a good measure of the local availability of cottontails vs. jackrabbits, and it has been used to interpret differences in lagomorph assemblages from Hohokam sites (Szuter 1991:174-209; Szuter and Bayham 1989:92–93). Low index values (e.g., <20 percent) indicate relatively few cottontail remains are present in a given sample compared to jackrabbit remains. The artiodactyl ratio (A/[A+L]), where the NISP total for artiodactyls (A) is divided by the sum of NISP of artiodactyls (A) plus the NISP of all leporids (L), measures the relative abundance of artiodactyls to lagomorphs (Bayham 1982; Szuter and Bayham 1989:90). This index allows a comparison of the dietary contributions made by leporids and artiodactyls. Archaeologists often use the artiodactyl index to assess the dietary contribution made by artiodactyls at a given site or to identify sites where big-game hunting was an important, if not primary, site activity. A similar measure, the large-game index (Szuter and Bayham 1989), was also calculated. It was calculated by dividing the sum of all identified artiodactyl and indeterminate large mammal remains (LG) by the total number of leporid and indeterminate leporid-sized bone fragments (MD1).

Riparian Index

Riparian index values (James 1994:313) remained low over time at the CCP sites (see Table 77). Identified riparian taxa included two fish centra, eight frog bones, and two

Table 76. Faunal Indexes Calculated for the CCP Sites

Site	NISP							S/(S+L)	A/(A+L)	All LG/ (Leporid + MD1)	Riparian/ NISP Total
	Lagomorph	Cottontail	Artiodactyl	Deer Size	Rabbit Size	Riparian	Identifiable				
41/583	12	2	10	3	73	—	199	0.14	0.45	0.15	—
103/2061	1	1	—	—	—	—	1	0.50	—	—	—
Vegas Ruin (405/2012)	120	27	115	37	562	12	2,325	0.18	0.49	0.22	<0.01
Rock Jaw site (407/2014)	1	—	2	5	35	—	46	—	0.67	0.19	—
408/2015	3	—	19	18	13	—	62	—	0.86	2.31	—
Crane site (410/2017)	18	3	3	14	79	—	170	0.14	0.14	0.18	—

Key: A = artiodactyls; L = lagomorphs; LG = sum of large game; MD1 = indeterminate leporid-sized bone fragments; NISP = number of identified specimens; S = cottontails.

Table 77. Faunal Indexes for the CCP Sites, by Period

Period	NISP							S/(S+L)	A/(A+L)	All LG/ (Leporid + MD1)	Riparian/ NISP Total
	Lagomorph	Cottontail	Artiodactyl	Deer Size	Rabbit Size	Riparian	Identifiable				
Pre-Classic	12	2	12	8	105	—	241	0.14	0.50	0.17	—
Pre-Classic–Classic	56	22	16	8	52	8	254	0.28	0.22	0.22	0.03
Classic	23	4	16	35	41	3	221	0.15	0.41	0.80	0.01

Key: A = artiodactyls; L = lagomorphs; LG = sum of large game; MD1 = indeterminate leporid-sized bone fragments; NISP = number of identified specimens; S = cottontails.

mud-turtle shell fragments. All of these specimens rested amid the remains of the Vegas Ruin and dated to the pre-Classic–Classic period transition or Classic period (see Tables 76 and 77). At least seven of the frog bones represented a single individual that is considered intrusive to the site sediments—thus, only the fish and turtle remains likely represented subsistence refuse. This suggests that riparian taxa made less of a dietary contribution than terrestrial taxa.

Lagomorph Index

Lagomorph index values track the ratio of cottontail and jackrabbit remains in a faunal collection. Low ratio values identify faunas with relatively few cottontail remains compared to jackrabbit remains. Interpretations for variability in the lagomorph index often rely on the habitat preferences of these animals and the physiographic setting of the sites containing their remains (Bayham and Hatch 1985a:421–423) or the inferred environmental consequences of Hohokam settlement and agriculture (Szuter 1991). For example, cottontails seek vegetative cover to hide from predators and raise their offspring, whereas jackrabbits thrive in open environments, where they can use their speed and agility to avoid predators. Declines in the lagomorph index over time have therefore been used to infer a decline in vegetative cover. Several processes could be responsible of or contribute to a reduction in vegetative cover. A prolonged decline in effective annual precipitation represents a possible natural cause. The use of fire and removal of cover for use as building materials and firewood are possible cultural causes. The Hohokam and other agriculturalists also altered their environment by preparing fields and constructing houses and canals. These ground-disturbing activities retarded plant succession, thereby promoting the growth of native weedy annuals providing little cover—an environment preferred by cottontails. A site's occupational history is another significant factor. Sites having records of continuous long-term occupation often yield lower lagomorph index values (Szuter 1985, 1986a, 1986b; Szuter and Brown 1986).

Szuter (1984:157, 160, 1991:199) also identified patterned variability when comparing sites types, with differences between faunas from farmsteads and larger villages being the most dramatic. Lagomorph index values from farmstead faunas were generally higher and more variable than faunas from village sites, with a mean of 0.34 and standard deviation of 0.23; the lagomorph index for the village sites had a lower mean and a standard deviation of 0.17. Manpower is another likely variable explaining the differences between site types based on their lagomorph index values. The coresidence of multiple families at village sites provided a larger labor force compared to less-populated farmsteads and would have made communal hunting easier to enact. Scheduling was likely not a problem because men, women, and children of nearly all ages likely participated. Subsequently, the number of communal hunts, particularly if nets were used, should have several archaeological signatures. If all entangled jackrabbits were dispatched, then net hunting would effectively produce a random sample of animals of various ages. Further, it should also produce collections dominated by jackrabbit bones.

The occupants of the Vegas Ruin and the Crane site captured far fewer cottontails compared to jackrabbits (see Table 76). This suggests that fewer cottontails were available in the immediate vicinity of the larger habitation sites such as the Vegas Ruin. Whether this was a result of reduced vegetative cover, hunting techniques, or the predominant use of ¼-inch screens during excavation is unclear. A reduction in vegetative cover would be expected in the immediate environment surrounding the larger CCP settlements like the Vegas Ruin and the Crane site. These larger settlements would have also housed a sufficient number of people in which to organize and conduct communal hunts.

The effects of archaeological recovery methods on the lagomorph index values cannot be underestimated, however. Several controlled studies (Casteel 1972; James 1995; Shaffer 1992; Shaffer and Sanchez 1994; Thomas 1969) have demonstrated that screen size will affect the recovery of bones from small animals. Many cottontail skeletal elements, particularly when they are broken, are substantially smaller than those of jackrabbits. Most broken cottontail bones that can be routinely captured with a ⅛-inch screen pass easily through a ¼-inch screen. Therefore, the use of ¼-inch screens to sample nonmortuary features at the CCP sites may have resulted in the disproportionate collection of a greater number of jackrabbit bones.

Temporal shifts in the lagomorph index for the CCP sites were also noted (see Table 77). The index values for each period presented in Table 76 are based upon the number of specimens assigned to a temporal period in Table 77. A greater number of cottontail remains were recovered from pre-Classic–Classic transition contexts compared to jackrabbit remains. This situation changed during the Classic period, when the lagomorph index value declined from 0.28 to 0.15. The decrease in the lagomorph index after the Classic–Classic period transition suggests a reduction in sufficient cottontail habitat and that perhaps communal hunts were conducted with greater frequency. If habitat was the controlling variable, then the decline of conditions suitable to perennial shrubs must have occurred during the late Sedentary period or Miami phase.

Artiodactyl and Large-Game Index

Continued settlement along Tonto Creek—coupled with increased agricultural investment—likely resulted not only in the depletion of suitable artiodactyl forage and cover but also encouraged the concentration of artiodactyl populations in upland settings (Waters 2002:761). A gradual decline in the number of artiodactyl bones and bone fragments, and hence a decline in artiodactyl and large-game index values, should reflect these expected changes in artiodactyl habitat and availability at lowland sites in Tonto Basin.

Artiodactyl remains formed a significant portion of the faunas recovered from the CCP sites (see Table 76). Surprisingly little difference exists between the collections from small, limited-activity sites such as Site 41/583 and the larger habitation sites like the Rock Jaw site, Vegas Ruin, or the Crane site. An exceptionally high artiodactyl index value of 0.86 was calculated for multicomponent Site 408/2015; however, this value is likely the result of a small sample of only 27 specimens identifiable beyond the level of vertebrate class. With the exception of Site 408/2015, the large-game index values are somewhat less than the artiodactyl index values, because they include the many minimally identifiable rabbit-sized specimens recovered from each of the sites (see Tables 66 and 76). Regardless, artiodactyls certainly contributed the greatest amount of dietary protein for the site inhabitants. This is particularly evident when one considers that one deer carcass contains approximately the same amount of meat as 100 rabbits (Shelley 1993).

The artiodactyl index values do not appear correlated with the lagomorph index values when organized by archaeological period (see Table 77), which suggests that they accurately reflect the ratio of leporid and artiodactyl remains. Artiodactyls were least available during the pre-Classic–Classic transition compared to the Classic period, when artiodactyl availability appears to have unexpectedly increased. Inspection of the large-game index indicates that artiodactyl availability steadily increased during the Classic period. Any interpretation of these fluctuations must be made with caution given the relatively small sample sizes. A possible explanation is that the relatively high artiodactyl index and dramatic increase in the large-game index during the Classic period is perhaps a consequence of the CCP sites being positioned near the juncture of the upper and lower Tonto Basins. Larger human populations and settlements characterize the Classic period in Tonto Basin. As such, it seems reasonable to assume that a concomitant increase in the demand for artiodactyl meat, bones, and hides may have occurred. The physical setting of the CCP sites may have allowed their occupants to easily pursue or trade for upland game products, which may have been traded into the CCP sites from settlements in the nearby upper Tonto Basin.

Butchery, Transport, and Processing Patterns

The number and condition of particular skeletal elements found at a site can be used to investigate not only a site's function but also prehistoric butchery, transport, and processing practices. Only four specimens, one from the Crane site and three from the Vegas Ruin, exhibited direct evidence of butchery in the form of cut marks. The specimen from the Crane site rested on the site surface and consisted of a calcined, distal, right, cottontail tibia. Two parallel cut marks laterally traverse the anterior surface of this specimen, and these cut marks likely represent the removal of the foot during skinning. The four specimens from the Vegas Ruin were distributed between a roasting pit (Feature 132), a pit structure (Feature 179), and an inhumation (Feature 49). A coyote- to deer-sized shaft fragment with a single cut mark was recovered from the roasting pit, whereas a deer mandible fragment with cut marks on the mental symphysis was recovered from the pit structure. The coyote- to deer-sized specimen perhaps represented a medial humerus fragment and the cut mark likely represented de-fleshing activities. Cut marks on the mandible fragment were likely the result of skinning. A rabbit- to coyote-sized shaft fragment with parallel cut marks was recovered from the burial. It is unclear if these cut marks were the result of de-fleshing or skinning.

Several southwestern researchers (Bayham and Hatch 1985b; James 1990; Szuter 1991; Szuter and Bayham 1989) have developed several models to explain patterned variability in the number of artiodactyl skeletal elements from faunal collections. Binford (1978) quantified the correlations between skeletal element and the amount of meat, grease, and marrow as part of his Nunamiut research and created the Modified General Utility Index (MGUI). Each of these models is based upon the fact that certain parts of the artiodactyl carcass contain more and higher-quality meat, fat, and grease than others. High-utility skeletal elements are those from the major meat-bearing segments of the carcass, such as the upper pelvic and thoracic limbs, thorax, innominates, and vertebrae (Binford 1978; Metcalfe and Jones 1988). Low-utility elements bear little meat, fat, and grease and include the skull, mandible, radius, ulna, tarsals, and carpals.

Bayham (1982) argued that different hunting patterns likely characterized upland and lowland Hohokam sites. Many limited-activity upland sites may have functioned as base camps for hunting and butchering ungulates. Upland field houses and farmsteads may have served a similar role on an intermittent basis. Hunters then transported selected portions of the ungulate carcasses to lowland villages. In Bayham's (1982) model, major meat-bearing skeletal elements would be left at the locus of butchery, with the meat being transported to a nearby lowland habitation site. James (1990:486) used this model for the Pine Creek sites and inferred that large numbers of low-utility skeletal elements should characterize butchery sites. Binford's (1978:74) MGUI model differs in that it suggests that high-utility skeletal elements are most likely to be transported to the habitation but is similar in that low-utility elements are expected to be left at the place of butchery. However, Szuter (1991), like Binford (1978:27, 33), has argued that crania, metapodials, and phalanges may also have been carried back to habitations not only because they contain large quantities of marrow and grease, but because they could be used to produce headdresses and bone tools.

Several logistical factors also conditioned the selection of which skeletal elements were transported back to habitation sites. At a fundamental level is the prey species. Small carcasses (i.e., rodents, rabbits and birds) were at times eviscerated and then simply carried back to the habitation intact, whereas hunters likely returned with complete ungulate carcasses only when the kill site was relatively close to the habitation, and a sufficient number of people were available to carry the carcass. Ungulates dispatched far from habitation would need to be butchered, likely into anatomical segments (e.g., hindquarter or front quarter) that could be carried by several people. In this scenario, low-utility elements such as carpals and tarsals may have been transported as "riders" along with the high-utility segments of the carcass (Binford 1978:74).

Five of the CCP sites contained identifiable artiodactyl skeletal elements, and the minimum number of elements (MNE), along with the anatomical region they represent, is provided in Table 78. Pre-Classic Site 41/583 contained both high-utility elements from the axial skeleton, along with lower-utility elements from the lower pelvic limb and feet. This suggests that the major meat-bearing portions of artiodactyl carcasses, including the associated skeletal elements, were brought to the site and consumed as predicted by Binford's (1978) Nunamiut model. The astragalus and third phalanx likely represent "riders" that were inadvertently brought to the site as part of the carcass and hide. A mandible and cheek tooth fragment were the only identifiable artiodactyl skeletal elements recovered from the pre-Classic period Rock Jaw site. With the tongue, mandibles are moderately high-utility elements with a large medullary cavity and plentiful marrow (Binford 1978; Metcalfe and Jones 1988). Low-utility elements dominated the small collection from multicomponent Site 408/2015; however, a high-utility scapula was also recovered. It is unclear which occupation(s) these elements represented, given that the site functioned as both a limited-activity loci and habitation. The Vegas Ruin contained the greatest number (MNE = 47) and diversity of identified artiodactyl skeletal elements; a likely consequence of its having the largest faunal collection and having been the most intensively occupied of the CCP sites. High- and low-utility elements from throughout the skeleton were recovered (see Table 78). This indicates that either entire carcasses were transported back to the Vegas Ruin or that the greater number of skeletal elements from the Vegas Ruin is a consequence of it having the largest faunal sample and longest occupational record of any CCP site.

Processing patterns at each of the sites were assessed primarily by recording specimen size. Table 79 lists the size of specimens recovered from each site and only includes specimens that lacked fresh fractures. Relatively few specimens exceeded 25 mm in length, whereas specimens smaller than this dominated the collections from each of the project sites. Most specimens are either less than 5 mm or 5–15 mm in maximum dimension, and many of these small specimens represented the remains of small to medium-sized mammals—primarily rabbits and hares. Such small specimens are particularly abundant at the larger habitation sites such as the Vegas Ruin. The prevalence of these severely splintered bone fragments may indicate that bones were routinely crushed in order to extract the grease and marrow that they contained. It has long been suggested that bone-grease rendering produces faunal assemblages dominated by many tiny bone fragments (Leechman 1951; Noe-Nygaard 1977). Vehik (1977:172–173) has proposed that bone grease production would leave the following archaeological signatures: (1) the presence of many small bone fragments; (2) a low percentage of bones with high grease content; and (3) the presence of fire-cracked rock, hammer stones, anvil stones, and firepits. If people did routinely crush grease-rich bones, then grease-rich bones would more often be rendered unidentifiable and significantly fewer of them should be identified.

This hypothesis was tested by calculating the observed and expected percentages of identified leporid and rabbit-sized skeletal elements for the Vegas Ruin and the Crane site (Table 80). I derived expected percentage for each skeletal element or group by dividing cranial elements into two groups: calvarium (frontal, parietal, occipital, squamosal, and tympanic bones) and rostrum (premaxilla, maxilla, palatine, nasal, and jugal bones). I assigned vertebrae to one of five axial regions: cervical, thoracic, lumbar, sacral, and caudal. All metatarsals and metacarpals were designated as metapodials, and no attempt was made to identify phalanges to limb or side. Observed percentages by site were based on the number of particular bones divided by the combined NISP total for leporids and rabbit-sized specimens per site. Expected percentages were calculated by dividing the number of particular bones (e.g., two for femora) by 185, which is the number of individual leporid bones that are routinely identifiable out of the possible approximately 200 bones in the leporid skeleton. One-way goodness-of-fit tests (Hays 1973:717–723) identified significant differences between the observed and expected frequencies for each of the sites (Vegas Ruin: χ^2 = 124.3, df = 17, p <.001; Crane site: χ^2 = 52.9, df = 8, p < .001). It is therefore unlikely that the differences between the observed and expected percentages are the result of sampling. Butchering and cooking methods likely account for these significant discrepancies. Long-bone articular ends are conspicuously overrepresented (see Table 80), but, generally speaking, the fat-rich calvarium and grease-rich vertebrae are somewhat underrepresented at both sites. Lumbar vertebra, however, are significantly overrepresented. This may indicate lumbar vertebra were more likely

Table 78. Minimum Number of Identified Elements that Represent Artiodactyls from the CCP Sites

Skeletal Region/Element	Site 41/583	Rock Jaw Site (407/2014)	Site 408/2015	Vegas Ruin (405/2012)	Crane Site (410/2017)	MNE Total
Head			1			1
Antler	—	1	1	5	—	7
Mandible	—	1	—	4	—	5
Axial						
Thoracic vertebra	—	—	—	2	—	2
Lumbar vertebra	1	—	—	1	—	2
Rib	1	—	—	2	—	3
Sternebra	—	—	—	1	—	1
Ilium	1	—	—	—	—	1
Upper thoracic limb						
Scapula	—	—	1	1	—	2
Humerus	—	—	—	1	1	2
Radius	—	—	—	1	—	1
Ulna	—	—	—	2	—	2
Lower thoracic limb						
Metacarpal	—	—	—	—	1	1
Accessory radial carpal	—	—	—	1	—	1
Radioulnar carpal	—	—	—	1	—	1
Scapholunar carpal	—	—	—	1	—	1
Upper pelvic limb						
Femur	—	—	—	1	—	1
Lower pelvic limb						
Astragalus	1	—	—	1	—	2
Metatarsal	—	—	1	3	1	5
Feet						
First phalanx	—	—	—	10	2	12
Second phalanx	—	—	1	4	—	5
Third phalanx	1	—	—	2	—	3
Indeterminate						
Metapodial	—	—	1	3	—	4
Total	5	2	6	47	5	65

Key: MNE = minimum number of identified elements.

Table 79. Number of Specimens Lacking Fresh Fractures in Each Ordinal Specimen Size Category from All CCP Sites

Specimen Size (mm)	Site 41/583		Vegas Ruin (405/2102)		Rock Jaw Site (407/2014)		Site 408/2015		Crane Site (410/2017)		NISP Total	
	n	%	n	%	n	%	n	%	n	%	n	%
<5	120	60.3	1,546	73.6	8	17.4	1	2.0	76	47.8	1,751	68.5
5–15	68	34.2	434	20.7	25	54.3	31	62.0	68	42.8	626	24.5
15–25	7	3.5	67	3.2	8	17.4	8	16.0	3	1.9	93	3.6
25–35	3	1.5	33	1.6	3	6.5	9	18.0	7	4.4	55	2.2
35–50	1	0.5	14	0.7	—	—	1	2.0	2	1.3	18	0.7
50–100	—	—	4	0.2	1	2.2	—	—	3	1.9	8	0.3
>100	—	—	3	0.1	1	2.2	—	—	—	—	4	0.2
Total	199	100	2,101	100	46	100	50	100	159	100	2,555	100

Key: NISP = number of identified specimens.

captured during screening because of their larger size compared to other vertebra or that that lumbar region, which is the loin region, was especially favored by the occupants of the Vegas Ruin.

Compared to procurement, ethnographic descriptions of small to medium-sized mammal processing are few. It is known, however, that the Maricopa (Spier 1933:66) and Tohono O'odham (Joseph et al. 1949:29) did dry and store rabbit meat. Whether this entailed the entire carcass is unclear. Perhaps the most-detailed descriptions of rabbit processing are from the Great Basin. Numic groups living in the Great Basin relied extensively upon rabbit meat and fur. People prepared the skinned rabbits, if eaten immediately, by pit roasting them whole. According to Wheat (1967:14), "the skinned rabbits, which were not immediately eaten, were dried and stored for the cold months ahead when they would either be boiled whole or pounded to a powder to make soup. The entire carcass was consumed—even the bones were ground [crushed] and boiled." In Africa, Yellen (1991:8–16) observed !Kung San men and women crush most of the porcupine and springhare bones added to meals in their Kalahari camps. Each of these accounts describes behaviors that result in highly fragmented and minimally identifiable faunal collections similar to those encountered by SRI excavators at the CCP sites.

The distribution of burnt specimens was also used to search for processing patterns, though it was often impossible to discern if individual specimens were burned naturally, during cooking, or during disposal of food waste. What is apparent, however, is that the remains of primary game animals (i.e., deer and rabbits) and rabbit-and deer-sized specimens were burned more often than the remains of other creatures (Table 81). This suggests that these specimens were most likely burned and deposited as a consequence of cultural behaviors. The frequency of burnt squirrel- to rabbit-sized and coyote- to deer-sized specimens is relatively high, and these specimens likely represent the severely splintered remains of rabbits and ungulates. Experiments conducted by Knight (1985), Gilchrist and Mytum (1986), and Johnson (1989) have indicated that burnt bones tend to be more fragmented than unburnt specimens. Increased fragmentation should be a likely consequence of burning, because it would destroy the collagen fiber matrix that normally provides the dramatic tensile strength that normally characterizes bone (Lyman 1994:389).

Disposal Patterns and Taphonomic Processes

Disposal patterns are a fundamental focus of zooarchaeological research. Reitz and Wing (1999:113–114) have distinguished three kinds of archaeological deposits: (1) habitation deposits that consist of village, home base, and temporary-camp refuse; (2) habitation deposits that consist of kill site and/or processing residues; and (3) features that represent the intentional burial of animal remains. Particular physical characteristics should theoretically distinguish each of these deposits. Identifying these characteristics requires a detailed examination of archaeological context, specimen distribution, and specimen condition.

Archaeologists often encounter habitation refuse, or

Table 80. Observed Leporid and Rabbit-Sized Skeletal Elements from the Vegas Ruin (405/2012) and the Crane Site (410/2017) Compared to Expected Frequency

Element	Vegas Ruin (405/2012)		Crane Site (410/2017)		Expected Percentage
	n	%	n	%	
Calvarium	3	3.2	—	—	4.86
Rostrum	2	2.1	—	—	5.41
Mandible	8	8.4	1	6.7	1.08
Vertebra (cervical)	2	2.1	—	—	3.78
Vertebra (thoracic)	4	4.2	—	—	6.49
Vertebra (lumbar)	24	25.3	—	—	3.78
Vertebra (caudal)	—	—	1	6.7	7.57
Ilium	5	5.3	—	—	1.08
Ischium	1	1.1	—	—	1.08
Scapula	2	2.1	—	—	1.08
Humerus	4	4.2	1	6.7	1.08
Radius	4	4.2	1	6.7	1.08
Ulna	2	2.1	—	—	1.08
Femur	8	8.4	—	—	1.08
Tibia	5	5.3	3	20.0	1.08
Calcaneum	4	4.2	—	—	1.08
Navicular cuboid	2	2.1	—	—	1.08
Metapodial	14	14.7	5	33.3	9.73
First phalanx	1	1.1	1	6.7	9.73
Second phalanx	—	—	1	6.7	9.73
Third phalanx	—	—	1	6.7	9.73

residential debris, as either artifact scatters fringing features, thin discontinuous sheet-middens, or as discrete deposits such as trash mounds, trash-filled pits, and trash-filled houses. This debris often contains the remains of numerous taxa, multiple artifact classes, and several tool types—a consequence of a full-range of domestic activities. Because a limited range of activities transpired at kill and processing sites compared to villages, deposits at kill and processing sites should primarily reflect butchery and transport activities and fewer taxa and artifact classes should be represented. Relatively complete skeletons in discrete pits typify most intentional burials. Intentional animal burials are also normally associated with human burials or architectural features.

Except for Sites 41/583 and 103/2016, which likely represent food-processing locales, the CCP sites functioned as habitations of varying duration. Extramural features contained the greatest number of faunal remains (Table 82). Burnt and calcined specimens were more frequent in *hornos* and roasting pits, although these specimens probably represent debris placed in these features after their last use. Borrow pits and middens contained similar amounts of intentionally discarded faunal remains. Bones and bone fragments also littered the postoccupational fill removed from both pre-Classic–Classic transition and Classic period structures. The hearths within these structures also commonly contained faunal specimens, many of which were calcined.

The weathering stage exhibited by individual specimens from specific recovery contexts was also examined (Table 83). Specimens exposed at the surface for long periods of time and particularly those that were repeatedly buried and reexposed should be weathered more than those that underwent rapid and prolonged burial (Lyman 1994:360–374). The distribution of

Table 81. Number of Charred and/or Calcined Specimens from Each Site

Taxon	Site 41/583		Vegas Ruin (405/2012)		Rock Jaw Site (407/2014)		Site 408/2015		Crane Site (410/2017)		NISP Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Birds												
Lophortyx spp.	—	—	1	0.9	—	—	—	—	—	—	1	0.3
Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Leporidae	8	6.1	4	3.7	—	—	—	—	2	3.4	14	4.3
Sylvilagus spp.	2	1.5	1	0.9	—	—	—	—	1	1.7	4	1.2
Lepus californicus	—	—	4	3.7	—	—	—	—	4	6.9	8	2.5
Rodentia	2	1.5	3	2.8	—	—	—	—	—	—	5	1.5
Muridae/ Heteromyidae	3	2.3	1	0.9	—	—	—	—	1	1.7	5	1.5
Neotoma spp.	2	1.5	—	—	—	—	—	—	1	1.7	3	0.9
Carnivora												
Canis spp.	—	—	—	—	—	—	1	4.8	—	—	1	0.3
Lynx cf. *rufus*	—	—	1	0.9	—	—	—	—	—	—	1	0.3
Artiodactyla	2	1.5	5	4.6	—	—	2	9.5	1	1.7	10	3.1
Odocoileus spp.	1	0.8	1	0.9	—	—	1	4.8	—	—	3	0.9
Indeterminate mammals												
Mouse to squirrel size	—	—	10	9.2	—	—	—	—	—	—	10	3.1
Squirrel size	—	—	—	—	—	—	—	—	1	1.7	1	0.3
Squirrel to rabbit size	47	35.9	51	46.8	—	—	—	—	20	34.5	118	36.5
Rabbit size	49	37.4	7	6.4	2	50.0	5	23.8	23	39.7	86	26.6
Rabbit to coyote size	2	1.5	1	0.9	—	—	—	—	—	—	3	0.9
Coyote to deer size	—	—	12	11.0	—	—	4	19.0	—	—	16	5.0
Deer size	8	6.1	7	6.4	—	—	8	38.1	3	5.2	26	8.0
Unidentifiable mammals	5	3.8	—	—	2	50.0	—	—	1	1.7	8	2.5
Total	131	100	109	100	4	100	21	100	58	100	323	100

Key: NISP = number of identified specimens.

Table 82. Number and Percentage of Specimens Assigned to Each Burning Category from Each Recovery Context from All CCP Sites

Recovery Context	Unburnt		Blackened		Calcined		NISP Total	
	n	%	n	%	n	%	n	%
Extramural								
Borrow pit	75	2.8	1	1.4	—	—	76	2.5
Midden	45	1.7	5	6.8	7	2.8	57	1.9
Extramural pit	18	0.7	3	4.1	1	0.4	22	0.7
Adobe-lined pit	11	0.4	—	—	—	—	11	0.4
Horno	66	2.5	21	28.4	63	25.3	150	5.0
Roasting pit	1,971	73.7	16	21.6	5	2.0	1,992	66.4
Granary	3	0.1	—	—	—	—	3	0.1
Archaic roasting pit	5	0.2	—	—	—	—	5	0.2
Hearth	6	0.2	4	5.4	8	3.2	18	0.6
Inhumation	113	4.2	4	5.4	11	4.4	128	4.3
Intramural								
Pit structure	227	8.5	3	4.1	21	8.4	251	8.4
Cobble-adobe-foundation compound	8	0.3	—	—	1	0.4	9	0.3
Cobble-adobe-foundation structure	69	2.6	3	4.1	37	14.9	109	3.6
Hearth	29	1.1	1	1.4	46	18.5	76	2.5
Nonfeature	30	1.1	13	17.6	49	19.7	92	3.1
Total	2,676	100	74	100	249	100	2,999	100

Key: NISP = number of identified specimens.

specimens exhibiting different stages of weathering should therefore partially reflect the depositional history of individual features or even sites. Very few specimens were weathered beyond Stage I, and only one specimen exhibited weathering beyond Stage II. This suggests that the recovered bones and bone fragments were buried fairly rapidly after being discarded. It also suggests that the chemistry of the site sediments was conducive to bone preservation. The greatest number of specimens weathered to Stage II were recovered from pit structures (n = 49). Several processes could account for this pattern. The pit structures could simply be older than many of the other features, or the sediments in these structures were more disturbed. If the pit structures are among the oldest features containing faunal specimens, then the extent of bone weathering should be greater simply because of time. The degree of weathering would also be increased if the specimens were reexposed by burrowing creatures or people. Both of these mechanisms likely contributed to the greater number of specimens that exhibited Stage II weathering from pit structures compared to other recovery contexts. Patterns in weathering data alone, however, cannot identify the cause(s) of this pattern.

Specimen size (Table 84) was used to further assess why specimens from pit structures were weathered more than specimens from other contexts. If mixing of the house fill intermittently reexposed the specimens, it may have also resulted in a greater degree of breakage and, hence, smaller bone fragments. The data presented in Table 84 indicate that the greatest relative amount of tiny specimens (i.e., <5 mm) was recovered from food-processing features such as *hornos*, roasting pits, and even extramural pits. Numerous specimens less than 15 mm in length were recovered from intramural features but not significantly more than were recovered from extramural features. Thus, if specimen size is an accurate proxy for mixing and intermittent re-exposure of specimens, it appears that the sediments in intramural features were no more mixed than sediments in extramural features. This suggests that time alone may account for the greater degree of weathering observed among specimens recovered from pit

Table 83. Number and Percentage of Specimens Assigned to Each Weathering Stage from Each Recovery Context from All CCP Sites

Recovery Context	Weathering Stage I		Weathering Stage II		NISP Total	
	n	%	n	%	n	%
Extramural						
Borrow pit	73	2.4	3	0.1	76	2.5
Midden	54	1.8	3	0.1	57	1.9
Extramural pit	19	0.6	3	0.1	22	0.7
Adobe-lined pit	11	0.4	—	—	11	0.4
Horno	148	4.9	2	0.1	150	5.0
Roasting pit	1,986	66.2	6	0.2	1,992	66.4
Granary	3	0.1	—	—	3	0.1
Archaic roasting pit	5	0.2	—	—	5	0.2
Hearth	18	0.6	—	—	18	0.6
Inhumation	119	4.0	9	0.3	128	4.3
Intramural						
Pit structure	202	6.7	49	1.6	251	8.4
Cobble-adobe-foundation compound	3	0.1	6	0.2	9	0.3
Cobble-adobe-foundation structure	108	3.6	1	<0.1	109	3.6
Hearth	76	2.5	—	—	76	2.5
Nonfeature[a]	84	2.8	7	0.2	91	3.0
Total	2,909	97.0	89	3.0	2,998	100.0

Key: NISP = number of identified specimens.
[a]One specimen exhibited weathering Stage III and was not included in this tabulation.

structures, which in turn suggests that they are among the oldest excavated features at the CCP sites.

When the Rock Jaw pit structures are analyzed separately from the other pit structures, however, an interesting pattern emerges. Of the 49 faunal specimens from all of the CCP sites that were weathered to Stage II, the vast majority (n = 40) were recovered from the two superimposed pit structures at the Rock Jaw site. Of the total faunal collection from the Rock Jaw pit structures, only 9 specimens were weathered to Stage I. This seems to suggest that these pit structures were older than the features at the other sites. To test this hypothesis, we analyzed the specimen sizes of the Rock Jaw pit structures separately from the other pit structures (Table 85). If the greater level of weathering was owing to greater mixing of the specimens, we would expect to find greater numbers of small specimens. As shown in Table 85, the Rock Jaw pit structures accounted for 19.5 percent of the total number of faunal specimens recovered from all pit structures. This percentage is reflected in each specimen size category. With only one exception, the Rock Jaw specimens accounted for 18–25 percent of the total specimens recovered within each size category. This suggests that the Rock Jaw pit structures were affected by the same taphonomic processes as all of the other pit structures. Therefore, if our hypotheses about weathering and specimen sizes are valid, then the Rock Jaw pit structures may be older than the pre-Classic features at the other project sites.

Table 84. Number of Specimens Placed in Each Specimen-Size Category from Each Recovery Context from All CCP Sites

Recovery Context	Specimen Size (mm)							Total
	<5	5–15	15–25	25–35	35–50	50–100	>100	
Extramural								
Borrow pit	—	54	6	9	5	2	—	76
Midden	15	31	3	7	1	—	—	57
Extramural pit	—	4	8	8	2	—	—	22
Adobe-lined pit	3	7	1	—	—	—	—	11
Horno	94	52	3	1	—	—	—	150
Roasting pit	1,602	335	36	17	2	—	—	1,992
Granary	—	3	—	—	—	—	—	3
Archaic roasting pit	5	—	—	—	—	—	—	5
Hearth	5	13	—	—	—	—	—	18
Inhumation	4	53	35	15	3	7	11	128
Intramural								
Pit structure	44	115	59	15	9	4	5	251
Cobble-adobe-foundation compound	—	4	3	2	—	—	—	9
Cobble-adobe-foundation structure	67	30	3	6	2	1	—	109
Hearth	56	19	1	—	—	—	—	76
Nonfeature	32	33	14	4	4	5	—	92
Total	1,927	753	172	84	28	19	16	2,999

Project Summary

A total of 2,999 faunal specimens were collected during the CCP (see Table 66). These specimens were distributed among six sites of the nine prehistoric sites investigated: Site 41/583, Site 103/2061, Vegas Ruin, Rock Jaw site, Site 408/2015, and the Crane site. Five vertebrate classes, including fish, amphibians, reptiles, birds, and mammals, that represented a minimum of 32 vertebrate taxa were identified. Small, minimally identifiable mammal bone fragments were the most numerous type of specimen recovered. Nearly all of the faunal specimens were collected from pre-Classic–Classic transition (Miami phase) or Classic period (Roosevelt phase) contexts.

Faunal remains were most often recovered from postoccupational contexts, particularly trash-filled houses, extramural pits, and thermal features (see Table 82). These remains were rarely burnt and usually were less than 15 mm long (see Tables 67, 79, and 84). There were no significant differences between recovery contexts based on the weathered state of individual bone and bone fragments, though the Rock Jaw pit structures contained more specimens weathered beyond Stage I (see Table 83). This suggests that these two pit structures are among the oldest pre-Classic features from which faunal materials were recovered or that the sediments filling these pit structures witnessed a greater degree of disturbance compared to other contexts.

The observed vs. expected values of identified leporid bones (see Table 80) suggest that rabbit skeletons were routinely crushed as a part of meal preparation. This preparation technique was likely similar to that documented for ethnographic groups in the Southwest, the Great Basin, and Africa. Little direct evidence of artiodactyl butchery techniques was recovered; however, the frequency of specific artiodactyl skeletal elements failed to confirm or refute established

Table 85. Specimen Sizes of the Rock Jaw Pit Structures Compared to All CCP Pit Structures

Specimen Size (mm)	Recovery Context			
	Rock Jaw (407/2014) Pit Structures		All Pit Structures Combined	
	n	%	n	%
<5	8	18.2	44	17.5
5–15	25	21.7	115	45.8
15–25	11	18.6	59	23.5
25–35	3	20	15	6
35–50	—	—	9	3.6
50–100	1	25	4	1.6
>100	1	20	5	2
Total	49	19.5	251	100

transport models based on measures of economic utility (see Table 78). Major meat-bearing portions of the carcass were apparently transported to Site 41/583. A mixture of low- and high-utility elements characterized the artiodactyl elements recovered from the Rock Jaw site and Site 408/2015. The greatest diversity of artiodactyl skeletal elements was recovered from the larger Crane site and the Vegas Ruin. Many of the artiodactyl elements from these larger sites had been worked into bone tools that were interred with the dead.

Faunal indexes calculated for each site and archaeological period (see Table 77) indicate that riparian resources formed a minor component of prehistoric diet over time. Temporal shifts in the lagomorph index values for the CCP sites indicate a greater number of cottontails were likely available and dispatched during the pre-Classic–Classic transition compared to jackrabbits. This situation changed during the Classic period when the lagomorph index value declined from 0.28 to 0.15, suggesting a reduction in sufficient cottontail habitat or perhaps a greater frequency of communal hunts. It was unclear whether environmental change, hunting techniques, or a combination of these factors were responsible for the observed shift. However, if habitat was the controlling variable, then the decline of conditions suitable to the shrubby habitat favored by cottontails must have occurred during the Miami phase. Artiodactyls were least numerous in pre-Classic–Classic transition contexts compared to the Classic period contexts, where artiodactyl remains were found in greater amounts. Large-game index values indicate that artiodactyl availability skyrocketed during the Classic period, at least at the Vegas Ruin and the Crane site. The unexpected increase in the availability of artiodactyls in the Classic period was perhaps a consequence of the CCP sites being positioned near the juncture of the upper and lower Tonto Basins. Compared to earlier periods, larger populations and settlements typified the Classic period Tonto Basin. A concomitant increase in the demand for artiodactyl meat, bones, and perhaps hides also appear to characterize the Classic period components of the CCP. Located at the juncture of the lower and upper Tonto Basin, the Classic period occupants of the CCP sites could have easily pursued or traded for upland game products from the nearby upper Tonto Basin or surrounding upland locales.

Regional Research Issues

Previous research (Bayham 1982; James 1990, 1995) has indicated that significant patterns distinguish the faunal procurement strategies that were employed at lowland and upland sites. Many upland sites surrounding Tonto Basin likely functioned as staging areas for the hunting and butchering of ungulates (James 1990; Maxwell and Shelley 2003). Projects conducted in the Salt-Gila-Verde region have produced results that further support this interpretation (James 1994; Shelley and Cairns 1998).

Faunal analysts have also repeatedly identified a broadening of the diet during the Classic period. This temporal shift in prey selection has been identified in the Phoenix area at Pueblo Grande (James 1994:313), at the Water Users site (James 1991:10-2), along the Lower Verde River (Shelley and Cairns 1998), and in Tonto Basin (Cameron 1998:142).

The greater number of taxa, increased density of fish remains, ground-dwelling birds, and rabbits at Gila phase sites suggests that this increase in diet breadth was perhaps a response to dietary stress. A concomitant and overall decline in the number of artiodactyl remains at Classic period sites has also been interpreted as the consequence of overhunting in lowland settings that surrounded Classic period villages and platform-mound sites (James 1995:145).

The environmental implications of prolonged settlement in and around Tonto Basin should have been striking near long-occupied, lowland settlements but perhaps negligible around small, limited-activity upland locales. Widespread declines in the availability of cottontails and artiodactyls, inferred from declines in lagomorph and artiodactyl index values, perhaps signal when significant changes in local environments occurred (Szuter 1991:174–209; Szuter and Bayham 1989:90–93; Waters 2002:752). Cultural modifications to the local environment would have included field preparation, building houses, gathering firewood, and the use of fire to retard plant succession and promote the growth of economically important weedy annuals like little barley (*Hordeum pusillum*).

Regional Procurement Strategies

Most upland settlements consisted of small farmsteads or limited-activity loci, whereas larger village settlements were established in lowland riverine settings. The seasonal occupants of the upland sites routinely hunted cottontails and artiodactyls, which were apparently present in greater numbers near small, limited-activity upland sites compared to the areas surrounding larger lowland villages. Site location therefore appears to have largely determined which animals were most available and which animals were most often hunted.

Individual projects and their results are summarized below by archaeological region. Projects conducted in Tonto Basin are discussed first, followed by projects involving upland locales, and then by projects in the Gila-Salt-Verde region. These discussions focus on basic trends and are not meant to be exhaustive treatments. Rather, they are intended as background data that are later used to discuss regional diachronic trends in faunal exploitation.

In this study, the results of projects conducted in Tonto Basin are compared to the results of projects in surrounding upland locales and the Salt-Gila-Verde region. Three research themes are then discussed individually. Differences in procurement strategies are discussed first, followed by inferences concerning land use and paleoenvironmental conditions. It is intended that each of these discussions represent a summation of what is known concerning each research theme. Data presented as part of each discussion are drawn from the CCP and those projects mentioned in the following section of this chapter.

Tonto Basin

Ash Creek Project

Bayham and Hatch (1985b) identified 1,019 faunal specimens that were recovered from eight prehistoric sites during the Ash Creek Project. These sites are situated along Theodore Roosevelt Lake in the lower Tonto Basin and represent occupations starting at A.D. 700 and lasting until about A.D. 1450. Leporids and artiodactyls were the primary game animals and accounted for 51 and 18 percent of the identifiable bone, respectively.

Examination of lagomorph ratios for this interval suggested that the occupants of the Ash Creek sites dispatched significantly greater numbers of cottontails before A.D. 1200, whereas they dispatched significantly greater numbers of jackrabbits after this time. This suggested that prior to A.D. 1200, the local environment supported more perennial shrubs and dense vegetation suitable for cottontails (see discussion above on Rabbits and Hares). Potential causes of this pattern included reduced effective annual precipitation, increased human population and subsequent predation, and increased agricultural investment. Bayham and Hatch (1985b:209) concluded that increases in the human population of Tonto Basin and the subsequent expansion of intensive agricultural practices best explained the inferred decline in cottontail populations.

Rye Creek Archaeological Project

Eleven of the RCAP settlements located in the upper Tonto Basin along the Hardt Creek, Deer Creek, Clover Wash, and Rye Creek drainages contained faunal remains. These 11 sites were occupied between A.D. 750 and 1450 and contained a total of 2,785 faunal specimens that represented a minimum of 24 taxa (Szuter 1992). The Boone Moore site (AZ O:15:55 [ASM]) yielded nearly 70 percent of the collection, and it and Rye Creek Ruin (AZ O:15:1 [ASM]) produced the greatest diversity of vertebrate taxa. Both sites were occupied during the Classic period (A.D. 1150–1350).

Low lagomorph index values typified the RCAP sites (Szuter 1992:427)—the exact opposite of what was encountered at the Pine Creek sites (James 1990:Tables 20.1 and 20.2). This indicates that few cottontails inhabited the RCAP Project area compared to the Pine Creek Project area. It is unclear what was the cause of these differences, but differences in environmental setting and/or hunting techniques were perhaps involved.

As with the Pine Creek Project (discussed below), the hunting of large game was an important activity among some of the RCAP sites. Deer mandibles from newborns to very old individuals indicated that the inhabitants of the Boone

Moore site hunted deer during the fall and winter months (Szuter 1992:427, Table 21.9). Similarly, the inhabitants of the Sedentary period Clover Wash site (AZ O:15:100 [ASM]) brought deer and also bear carcasses back to the site. The large numbers of bone fragments and diversity of vertebrate taxa recovered from these sites suggested that hunting was an important, if not primary, activity for the occupants of these sites.

Roosevelt Rural Sites Study

Cairns (1994) presented the analysis of 303 specimens collected from nine RRSS sites that were occupied between A.D. 950 and 1320. These sites were situated around Lake Roosevelt in the lower Tonto Basin. Based on edible meat estimates, deer, followed by jackrabbits, provided the bulk of the animal protein (Cairns 1994:Table 10.4). As with the Ash Creek collection (Bayham and Hatch 1985b:207–209), calculation of lagomorph index values for the RRSS sites indicated a shift in the number of cottontails and jackrabbits, with cottontails having decreased in number around A.D. 1200, whereas jackrabbit populations increased after this time. This shift signals the degradation of the local environment around A.D. 1200.

Both the RRSS and Ash Creek Project sites are located in transitional settings situated between the lowland and upland resources. These sites were also functionally similar in that they consisted of agricultural sites, field houses, farmsteads, and hamlets.

FLEX Tonto Basin Project

Thirteen of the 40 sites investigated as part of the FLEX Tonto Basin Project contained faunal remains. All 13 of these sites are situated in the lower Tonto Basin. Analysis of these remains resulted in the identification of 4,771 specimens (Cameron 1997c). Leporids were the most commonly identified taxa, followed by rodents, artiodactyls, and birds. Fish, amphibian, and reptile remains formed a small part of the collection.

Unlike the nearby Ash Creek and RRSS sites, which were located 5–10 miles to the south, no significant differences in the number of cottontail remains distinguished FLEX Tonto Basin sites occupied before and after A.D. 1200. Cameron (1997c:376, Tables 16.9 and 16.10) speculated that differences in physical setting likely accounted for the discrepancies between pre-Classic and Classic period lagomorph ratios. The FLEX Tonto Basin Project area was located in a relatively flat area, whereas, the Ash Creek Project area consisted of the often rugged first Pleistocene terrace overlooking Tonto Creek. Cameron suggested that these topographic differences best explained the overall greater abundance of jackrabbits at the FLEX Tonto Basin sites compared to those in the Ash Creek area. This observation would have also applied to the RRSS sites. Bayham and Hatch (1985b) have also concluded that upland sites in other areas of south-central Arizona with dissected terrain supported greater numbers of cottontails.

The general paucity of artiodactyl remains indicated that these animals were rare in the surrounding lowlands. This situation, coupled with the artiodactyl elements identified, suggested that high-meat-bearing elements (e.g., femurs and innominates) were transported back to the sites from kill sites, perhaps from distant upland locales.

Roosevelt Platform Mound Study

The RPM faunal collections (Cameron 1995, 1996, 1997a, 1997b, 1997d, 1997e, 1998) were distributed among small habitation sites, large roomblock sites, and platform-mound sites. These sites were located in the lower Tonto Basin and dated from the early Ceramic period (A.D. 100–600) to the Gila phase (A.D. 1320–1450). Small habitations consisting of several pit houses were the predominant settlement type from the early Ceramic period through the Roosevelt phase (ca. A.D. 1250–1320). Large, permanently occupied, roomblock sites characterized the Gila phase. Platform-mound sites were occupied during both the Roosevelt and Gila phases and these sites functioned as either ceremonial centers with few permanent residents such as Pyramid Point (Elson 1994) or as primarily domestic sites with as many as 100 permanent residents such as Cline Terrace and Pinto Point mounds.

The number of specimens assigned to taxon per cubic meter was the primary analytical unit used in the RPM analysis (Cameron 1998:141). Density values were only calculated for specimens recovered from ¼-inch screens. Pre-Classic period and Roosevelt phase sites yielded the lowest densities for all identified taxa, whereas the larger Gila phase roomblock and platform-mound sites contained the greatest density of faunal remains. Artiodactyl remains were far more numerous at Roosevelt and Gila phase platform-mound sites, and Gila phase sites contained the greatest diversity of taxa. Cameron (1998:142) interpreted this pattern as a consequence of population aggregation during the Gila phase, which would explain why Gila phase sites are larger than earlier Roosevelt phase settlements. The greater number of taxa and increased density of fish, ground-dwelling birds, and rabbits at Gila phase sites signals an increase in diet breadth that was perhaps a response to dietary stress.

Roosevelt Community Development Study

Excavators recovered faunal remains from 19 of the 27 prehistoric RCD sites located around the southern end of

Theodore Roosevelt Lake (James 1995). These 19 sites represented about 1,200 years of prehistory starting with the early Ceramic period at A.D. 100 and ending with the early Classic Miami/Roosevelt phases (A.D. 1150–1350). A total of 6,530 specimens that represented at least 43 taxa were analyzed (James 1995:Table 20.1).

Leporid bones numerically dominated each of the collections; however, the ratio of cottontails and jackrabbits fluctuated in a pattern nearly opposite to that identified during the Ash Creek (Bayham and Hatch 1985b) and RRSS (Cairns 1994) studies. Lagomorph index values of 0.40–0.43 suggested that cottontails were fairly numerous between A.D. 100 and 850. The index value declined to about 0.30 during A.D. 850–1050, indicating environmental degradation that perhaps favored jackrabbits. By A.D. 1150, however, conditions changed rapidly with the development of more vegetative cover as reflected by a lagomorph ratio of 0.63. The Classic period (A.D. 1150–1350) witnessed a return to conditions similar to the A.D. 100–850 period with an index value of 0.41. James (1995:143–144) cautioned, however, that these fluctuations could be the result of small sample sizes from contexts dating to A.D. 850–1050.

Artiodactyl index values essentially mirrored the lagomorph index values during the early Ceramic and pre-Classic periods; however, a dramatic decline in the availability of artiodactyls appears to have occurred during the early Classic period (James 1995:145, Figure 20.5, Table 20.25). This decline in artiodactyl populations was likely a consequence of increased human population and hunting pressure coupled with the settlement history of particular sites. Increased human population and aggregation during the Classic period would have resulted in increased hunting pressure. Similarly, some sites first occupied intermittently during the Colonial or Sedentary periods were occupied permanently during the Classic period. Such prolonged and permanent settlement likely resulted in the rapid depletion of local artiodactyl populations.

Riparian index values clearly demonstrated that riparian fauna made dietary contributions during all prehistoric periods. Data from Las Manos (AZ V:5:101/1545) suggest that riparian taxa were most abundant during the transitional Colonial/Sedentary periods (A.D. 850–1050) with an index value of 0.29 (James 1995:146). This prevalence of riparian fauna testifies to the paleoeconomic importance of the riparian resources associated with the Salt River. A radiocarbon date from a corn cupule from the floor of structure that contained a charred right maxilla from a relatively large Gila coarse-scaled sucker suggests that riparian fauna were collected as early as A.D. 410–540 (James 1995:133).

Tonto Creek Archaeological Project

Located immediately south of the CCP area, in the upper Tonto Basin, 14 of the TCAP sites contained faunal remains (NISP = 2,146) which represented a minimum of 32 vertebrate taxa (Waters 2002). These specimens were recovered from Early Agricultural period (pre-A.D. 100), Colonial period (A.D. 750–950), Sedentary period (A.D. 950–1150), and early Classic period (A.D. 1150–1350) contexts. As with the RPM and RCD faunas, early Classic period components contributed the greatest number of specimens and taxa.

Lagomorph index values showed a slight decline over time at the TCAP sites, with values for the Colonial period of 0.37, a value of 0.35 for the Sedentary period, and a value of 0.31 for the early Classic period (Waters 2002:Tables 13.15 and 13.16). This gradual decline may signal slight environmental degradation; however, Waters (2002:752) warns that the use of ¼-inch screens and the frequency of communal rabbit drives may have biased against the recovery of cottontail remains. Analysts should therefore be cautious in interpreting the TCAP patterns.

Based on artiodactyl index values, the inferred availability of artiodactyls increased slightly from the Colonial (0.20) to Sedentary (0.27) periods. This increase was enlarged dramatically when all possible large-mammal bones were included in the computation, with a large-game index of 0.34 for the Colonial period and 0.57 for the Sedentary period (Waters 2002:Table 13.15). These results indicated that greater numbers of artiodactyls were available during the Sedentary vs. the Colonial period—a trend also encountered by James (1995) at Eagle Ridge Locus A and by Cameron (1997d) at ceremonial centers among the RPM sites. As documented for the RPM and RCD faunas, the inferred availability of artiodactyls declined dramatically during the early Classic period with an artiodactyl index value of 0.06 and large-game index of 0.22.

Riparian taxa made a minor dietary contribution based on the riparian index values of 0.09 for the pre-Classic period and 0.04 for the Classic period (Waters 2002:Table 13.16). The inhabitants of the TCAP sites certainly used riparian taxa, but terrestrial species met more of their daily animal product needs.

Upland Locales

Miami Wash Project

Faunal remains were recovered from eight of the Miami Wash Project sites, but only those recovered from the Columbus site (AZ V:9:57 [ASM]), the type site for the Miami phase (Doyel 1978:194–195), are discussed here. The Columbus site is located on a low ridge and overlooks Pinal Creek. Faunal remains from the site consisted of 740 specimens that represented a minimum of 24 taxa (Sparling 1978:Table 41).

Deer and leporids dominated the site fauna, forming 22.5 and 19.5 percent of the collection, respectively. Calculation of a lagomorph index value for the site resulted in a value of 0.35, which indicated that cottontails were relatively numerous compared to jackrabbits. The artiodactyl index value was exceedingly high at 0.66 and indicated that the inhabitants of the Columbus site had ready access to artiodactyls. Artiodactyls were certainly the primary meat source for the people(s) that occupied the site between A.D. 1150 and 1200—the primary occupation of the site.

Ord Mine Project

A total of only 66 specimens from six upland sites were collected as part of the Ord Mine Project (Ciolek-Torrello 1987:399–401). Mazatzal House (NA 16,486), which is an early Classic period roomblock site, contained 56, or 85 percent, of these specimens. Margaret Glass analyzed the collection and identified reptile, bird, and mammal remains. Indeterminate rodent/rabbit-sized and large-mammal bone fragments were the most numerous specimens. Two mule deer, three indeterminate leporid, and one jackrabbit bone fragment were also reported. Though a small collection, it appeared that leporids and artiodactyls were the primary game animals sought by the inhabitants of these upland project sites.

Cholla Project

Faunal remains were reported for two of the Cholla Project sites: a rockshelter with early Pioneer and Classic period components (AZ V:5:49) and a Classic period roomblock site (AZ V:5:105). No discussions were provided concerning the faunal remains recovered from these sites, though identifications made by Sandra L. Olsen are summarized in tabular format (Reid 1982:Tables 8.11 and 10.17).

A total of 1,241 specimens that represented amphibians, reptiles, birds, and mammals were recovered from the rockshelter. Indeterminate mammal remains (NISP = 733) dominated the rockshelter fauna. Cottontail bones outnumbered jackrabbit bones by 4:1; however, this drops to 2:1 based on the MNI represented. Identified artiodactyl taxa included bighorn sheep, deer, and pronghorn. These animals appeared to have provided the bulk of the dietary protein and animal products. It is unclear, however, what occupation(s) these remains represented. Regardless, a pattern of big-game hunting was apparent.

Excavations at the Classic period roomblock site resulted in the collection of 71 faunal specimens. Identified leporid remains included 3 jackrabbit and 10 cottontail bone fragments, and artiodactyl remains were represented by 2 indeterminate artiodactyl, 1 deer or pronghorn, and 14 deer bone-fragments. Though few remains were encountered, a reliance on big-game animals and exploitation of cottontail rabbits on an encounter basis was suggested.

Pine Creek Project

Faunal remains (NISP = 1,493) were recovered from seven of the Pine Creek Project sites. These sites represent Colonial and Sedentary period occupation of a segment of the Mazatzal Mountains located south of Sunflower and about 60 km northeast of Phoenix (James 1990). Two Sedentary period sites—AZ U:3:83 and AZ U:3:87 (ASM)—contained 94 percent of the collection, and the bulk of the analysis focused on collections from these two sites.

Leporid bones and bone fragments numerically dominated the collections from both sites; however, a relatively large number of artiodactyl remains were also present. Specifically, artiodactyls formed 39.6 percent of the AZ U:3:83 fauna and 37.0 percent of the AZ U:3:87 fauna, and leporids formed 47.4–50.6 percent of the site faunas (James 1990:506). The large number of artiodactyl remains was interpreted as likely evidence of upland Hohokam hunting activities. A general paucity of high-meat-bearing skeletal elements, coupled with the presence of numerous low-utility elements, suggested that the sites may represent upland hunting locales where butchery took place, but the meatier body parts were transported back to lowland village sites.

SR 87–Sycamore Creek Project

A total of 3,313 faunal specimens, which represented a minimum of 21 taxa, were collected from 9 of the 29 SCP sites (Maxwell and Shelley 2003:Table 8.1). These sites dated to the Colonial through early Classic periods. Identified temporal patterns were similar to those encountered among the Pine Creek sites by James (1990) for the pre-Classic period, with an emphasis on upland game—particularly deer. Long-term environmental stability was inferred based on the taxonomic composition of the faunal collections. The inferred subsistence system in the Sycamore Creek area consisted of a distinctive pre-Classic–Classic period emphasis on upland big-game hunting by people that had little interaction with the Hohokam (Maxwell and Shelley 2003:8.26).

People inhabiting the SCP sites routinely relied on cottontail rabbit, deer, and jackrabbit to meet their dietary and animal-product needs. An overall proportion of 45 percent artiodactyl and 55 percent lagomorph remains was collectively calculated for the nine SCP sites (Maxwell and Shelley 2003:8.23, Figure 8.4). Significant patterns distinguished the earlier and lower-elevation southern sites from the later and higher-elevation northern sites. Collections from the southern sites contained a greater number of taxa, including the remains of amphibians, reptiles, and birds, and the greatest proportion of leporid remains, including the only jackrabbit bones. Cottontail remains were the only leporid specimens found in the northern sites, which were also distinguished by significantly greater numbers of artiodactyl and large-mammal bones and bone fragments.

Cottontail remains dominated the leporid remains at four of the SCP sites that contained more than 10 leporid bone fragments. Lagomorph index values for these sites range from 0.69 to 0.86, which were exceptionally high values (Szuter 1991:199), and indicated that cottontails were pursued opportunistically in a densely vegetated setting. Maxwell and Shelley (2003:8.25) suggested that this scenario indicates that leporids did not make a crucial dietary contribution but that artiodactyls were the primary source of dietary protein.

Large numbers of artiodactyl remains were recovered from the late Sedentary to early Classic era at the Sunflower Valley (AZ U:3:304/567) and O'Neil Tank (AZ U:3:333/563) sites. These sites, like others identified along Pine Creek, Miami Wash, the Lower Verde River, and in the upper Tonto Basin, are situated at higher elevations where preparation for deer hunts and carcass processing were important, if not primary, site activities. Maxwell and Shelley (2003:8.21) concluded that the inhabitants of the SCP sites relied on the exploitation of deer and cottontail rabbits to a much greater extent than their Hohokam cohorts in the surrounding desert basins.

Gila-Salt-Verde Region

Las Colinas

Located in Phoenix, the Colonial through Classic period components at Las Colinas contained a total of 10,289 faunal specimens, which represented a minimum of 49 taxa (Szuter 1989:123). Artiodactyls, carnivores, birds, reptiles, and fish were represented.

Lagomorph and artiodactyl index values were calculated for each temporal component (Szuter 1989:137). The Colonial period component, which likely represents a small farmstead, had the highest index value at 0.33. This value dropped to 0.24 as the settlement grew during the Sedentary period. Contrary to the hypothesis that continued occupation of a site results in a decrease in the lagomorph index, the index value unexpectedly increased to 0.31 during the Classic period. The relative abundance of artiodactyls followed a similar pattern, with Sedentary-Classic and Classic period contexts having the highest index values (Szuter 1989:Table 8.11). Identified artiodactyl remains consisted primarily of cranial and foot elements.

Pueblo Grande Project

The Pueblo Grande Project was conducted in Phoenix and resulted in the collection of 25,858 specimens that represented a minimum of 58 taxa (James 1994:255). Most of the collection dated to the Classic period, a time in which people had already overexploited artiodactyl populations along the nearby Salt River. James (1994:250, 316–318) interpreted a dramatic increase in the number of riparian species, compared to collections from earlier time periods, as a response to subsistence stress during the Classic period at Pueblo Grande.

Lagomorphs composed 34 percent of the collection and the lagomorph index for the Pueblo Grande collection was 0.21, which suggested that relatively few cottontails were available in the local environment. Artiodactyl remains formed just a little over 1 percent of the collection, and nearly half of the artiodactyl remains were made into bone tools. Surprisingly, beaver and muskrat bones were recovered, and fish remains composed 27.5 percent of the vertebrate remains identifiable beyond the level of class. Fish ranked second in dietary importance, being exceeded only by lagomorphs, which provided the bulk of the animal protein. The importance of riparian taxa, particularly fish, and the inferred availability of artiodactyls during the pre-Classic–Classic period transition were negatively correlated. For example, the riparian index for the pre-Classic period is 0.08 compared to 0.30 for the early Classic, whereas the artiodactyl index continued a decline that began in the Sedentary period (James 1994:Figure 7.5). James (1994:313) viewed this shift as representing an increase in diet breadth that was likely a response to the overexploitation of locally available artiodactyl populations that perhaps led to subsistence stress at the site.

Water Users Project

Located along the Salt River below Stewart Mountain, the Water Users Project fauna consisted of 5,519 specimens that represented a minimum of 24 taxa (James 1991:10-2). Most of the collection dated to the Colonial period.

Lagomorphs accounted for about 45 percent of the identified remains and represented the primary source of meat, fat, and furs. A lagomorph index value of 0.36 was calculated from the data presented by James (1991:Table 10.1). Artiodactyl elements formed only 3.4 percent of the collection and represented both deer and bighorn sheep. Computing the artiodactyl index value for the Water Users Project resulted in a surprisingly low value of 0.07. Rodent bones were the second most numerous category of specimens, which even included the remains of muskrat and beaver. Fish bones were the third most numerous category of specimens and composed 12.6 percent (NISP = 443) of the collection. Other identified riparian taxa included Sonoran mud turtle and raccoon. It appears that the Colonial period occupants of the Water Users site routinely hunted lagomorphs and collected fish, but artiodactyls appear to have been rarely encountered.

Verde Bridge Project

The Verde Bridge Project excavations at the multicomponent site of La Escuela Cuba resulted in the recovery of 894 faunal specimens that represented a minimum of 17 taxa (James 1992:294, Table 13.1). La Escuela Cuba was occupied from A.D. 200–1100, but most of the faunal remains dated to the Sedentary period.

Lagomorphs numerically dominated the project fauna regardless of archaeological period. The first exploitation of riparian taxa appeared to have taken place during the Colonial period (James 1992:307). Identified riparian taxa included beaver, fish, and Sonoran mud turtle. A greater number of specimens from riparian taxa were recovered from Sedentary period contexts; however, lagomorphs still provided the bulk of the meat diet.

Lower Verde Archaeological Project

SRI excavators recovered 5,231 faunal specimens from 11 prehistoric sites as part of the Lower Verde Archaeological Project (LVAP) (Shelley and Cairns 1998). The collection contained bones and bone fragments that represented a minimum of 22 taxa. These majority of the specimens (NISP = 4,888) dated to the pre-Classic period, whereas only 345 specimens were from Classic period contexts.

Artiodactyl and turtle remains decreased in number during the Classic period, whereas the proportion of fish and bird remains increased. Significant differences were also identified in the disposal of faunal remains during the pre-Classic and Classic periods. Faunal remains were a common component of trash-filled pre-Classic structures; however, none of the excavated Classic period structure was trash-filled. Regardless of time, artiodactyl index values indicated that big-game hunting was far more important at upland LVAP farmsteads compared to hamlets and villages (Shelley and Cairns 1998). This suggested that the majority of artiodactyls were dispatched in the uplands, that they were butchered at these smaller sites, and then particular segments of the carcasses were transported to nearby lowland hamlets and villages.

Regional Synthesis

Past projects have resulted in the repeated observation that the Classic period occupants of Tonto Basin and Salt-Gila-Verde region dispatched fewer cottontails and artiodactyls compared to their Sedentary or Colonial period predecessors. Explanations for this have implicated climatic fluctuations, overhunting resulting from increased human population, and extensive cultural modifications to the environment. Many upland sites were seasonally occupied farmsteads or limited-activity loci that often functioned as staging areas for big-game hunting. The environments surrounding these upland sites supported significantly larger artiodactyl populations and significantly more cottontails compared to jackrabbits.

Based on lagomorph index values, James (1995:155) suggested cottontails were fairly abundant in the Roosevelt region around A.D. 800, their numbers declined by A.D. 900, and then rose dramatically by A.D. 1150. Lagomorph index values were also highest during the Colonial period at the Water Users site (James 1991:Table 10.1) and Los Colinas (Szuter 1989:137). Cottontail populations then plummeted during the pre-Classic–Classic transition; a pattern similar to that identified in the CCP fauna, which dates primarily to the Miami phase. A prolonged decline in the inferred availability of cottontails between the pre-Classic and Classic periods was also documented at the FLEX Tonto Basin Project (Cameron 1997c), RRSS (Cairns 1994), RPM (Cameron 1998), and TCAP sites (Waters 2002:752) south of the CCP area. Examination of the faunal collection from Pueblo Grande also indicated that cottontails were rare compared to jackrabbits during the Classic period (James 1994:Figure 7.5).

Lagomorph index values were significantly higher at upland sites during all archaeological periods. This suggests that the occupants of upland sites placed greater emphasis on hunting cottontails and that cottontails were more numerous in upland settings. The greater vegetative cover that characterizes the upland environment, coupled with a lower human population, most certainly explains the differences between lowland and upland sites based on their lagomorph index values. Physical setting and site function alone likely accounts for the higher lagomorph index values encountered during the Cholla Project (Reid 1982) and at sites along Pine Creek (James 1990), Miami Wash (Sparling 1978), and Sycamore Creek (Maxwell and Shelley 2003).

Artiodactyl index values in the Roosevelt region followed the lagomorph index values during the early Ceramic and pre-Classic periods; however, a dramatic decline in the availability of artiodactyls seems to have occurred during the pre-Classic–Classic period transition at the RCD (James 1995:145, Figure 20.5) and TCAP (Waters 2002:Table 13.16) sites. This scenario contrasts sharply with the upland regions where artiodactyl remains actually increased in number at the Pine Creek and Rye Creek sites during the Sedentary period (James 1990; Szuter 1992). The inferred availability of artiodactyls also increased significantly during the Sedentary period at the TCAP and Rye Creek sites, but no such increase was apparent among the RPM sites where the artiodactyl index actually declined in the Sedentary period. These results perhaps suggest that the upper Tonto Basin afforded better artiodactyl habitat and that the upper Tonto Basin was the focus of artiodactyl hunting during the Sedentary period.

Increased artiodactyl hunting also appears to characterize Classic period upland sites (Waters 2002:762). Artiodactyl bones and bone fragments at pre-Classic and Classic period upland sites consisted primarily of low-utility skeletal elements, which suggests that the meatier segments of the carcasses were transported elsewhere—likely to lowland villages. The presence of both low- and high-utility skeletal elements at the Vegas Ruin (see Table 76) is consistent with the results of the TCAP, RCD, and RPM studies. It thus appears that people occasionally processed complete carcasses at lowland sites. What is unclear, however, is whether the occupants of lowland villages primarily hunted artiodactyls themselves, or regularly traded for carcasses and hides with upland groups. Larger proportions of high-utility elements at early Classic platform mounds suggest the transport of high-utility segments of the carcass and possible trade (Cameron 1998). Lowland populations in Tonto Basin and the Salt-Gila-Verde region likely hunted artiodactyls in the lowlands and uplands whenever possible. Artiodactyls contributed the greatest amounts of dietary protein, workable bone, and hides. Shelley and Cairns (1998) concluded that the majority of artiodactyls were dispatched in the uplands, that they were butchered at smaller limited-activity sites and farmsteads, and then particular segments of the carcasses were transported to nearby lowland hamlets and villages.

Riparian taxa were also sought by prehistoric people in Tonto Basin and the Salt-Gila-Verde region but to a lesser degree than terrestrial taxa. Very few specimens representing riparian taxa, primarily fish bones and Sonoran mud turtle carapace fragments, were collected as part of the CCP and TCAP projects (see Table 66 and Waters [2002:Tables 13.15 and 13.16]). The almost exclusive use of ¼-inch screens has likely resulted in the underrepresentation of fish remains in faunal collections from sites in the Southwest (Casteel 1972; James 1994). This aside, significant patterns in the exploitation of riparian resources are evident when the regions are compared. Archeologists have recovered few faunal remains from riparian creatures in Tonto Basin. What has been collected seems to suggest that riparian taxa were more available along the Salt River arm vs. the Tonto Creek arm of Tonto Basin (James 1995:157). Riparian taxa would have been less plentiful along Tonto Creek because of its lower annual flow; a situation that likely existed throughout the Formative period (Waters 1998:23–28). Riparian index values steadily declined over time throughout Tonto Basin and surrounding upland locales (James 1995:Figure 20.6); however, fish were routinely captured by the Colonial period occupants of the Water Users sites (James 1991) and by Sedentary people living at La Escuela Cuba (James 1992). Further, the exploitation of riparian resources was vitally important for the Classic period inhabitants of Pueblo Grande, where fish were the second most important source of animal protein, exceeded only by lagomorphs (James 1994). At the LVAP sites (Shelley and Cairns 1998), riparian taxa seldom contributed to the pre-Classic diet, but their importance increased significantly during the Classic period. A greater number of taxa are often recovered from Classic period habitations. This broadening of the subsistence base may signal a response to the overexploitation of locally available artiodactyl populations that led to dietary stress for some Classic period populations. Alternatively, the inclusion of riparian taxa may represent changing dietary preferences that represent the occupation of Classic period sites by differing ethnic groups. Faunal data alone, however, cannot be easily used to distinguish whether the broadening of the Classic period diet was the result of environmental degradation or population movements.

CHAPTER 6

Analysis of Shell Artifacts and Materials

Arthur W. Vokes

Excavations at the CCP sites recovered 327 pieces of worked and unworked shell (Appendix C.1). The sample was recovered from seven of the nine prehistoric sites investigated during the two phases of the project. These settlements were temporally associated with the occupation of the area extending from the Archaic to the middle Classic period and represent a number of different activities, including food-processing loci and habitation settlements.

No shell material was recovered from two prehistoric sites investigated during the project: AZ U:3:404/2011, a Classic period field house, and AZ O:15:103/2061, a limited-activity surface artifact scatter. The absence of shell in these samples appears to reflect the relatively low intensity of the prehistoric occupation at these sites.

Methods

The shell collection was subjected to a detailed analysis that involved the creation of a descriptive record, including a scale drawing and a set of linear measurements obtained with a digital vernier caliper. Notes on condition, shape, decorative motifs, and technology were recorded. Wherever possible, estimates of the percentage of the original valve or artifact that remained were made. For purposes of analysis, fragments that could be refitted were considered to be single occurrences with the number of pieces recorded in the notes. In some instances, particularly with regard to *Anodonta*, where fragments could not be refitted but the evidence indicated a high probability that the pieces were from the same artifact, the pieces were also recorded as a single occurrence with a count indicated on the specimen's sheet. Specimens were generally considered to be complete if a full set of linear measurements could be obtained.

The artifact classification structure employed during this analysis was largely based upon the system developed by Haury for the material from Snaketown (Haury 1937, 1976) and Los Muertos (Haury 1945). The nomenclature and biological determinations were made in accordance with Keen's (1971) *Sea Shells of Tropical West America*. Additional information was obtained from Abbott's (1974) *American Seashells*. The freshwater and terrestrial pelecypods and gastropods were identified through the use of several guides, particularly Bequaert and Miller's (1973) *The Mollusks of the Arid Southwest*; Cheatum and Fullington's (1971) *The Aquatic and Land Mollusca of Texas*, and Abbott's (1989) *Compendium of Landshells*. Definitions for specific terminology related to the structural elements of shell can be found in the glossaries available in most malacology guides, and figures that illustrate these elements have been published in previous text by the author (Vokes 1984, 1986a).

Genera and Species

The shell species identified in the CCP collection are summarized in Table 86. There were 11 marine and 3 freshwater and terrestrial genera presenting the sample. *Glycymeris* and *Laevicardium* were the most common marine bivalves. *Olivella* was the most common univalve, and the most common genera, in the entire collection. The prevalence of these three genera is a common feature of Southwestern assemblages, as each is the principal shell associated with different popular artifact forms. Bracelets and ring-pendants are generally manufactured from *Glycymeris* valves, whereas carved ornaments were commonly made of *Laevicardium*. *Olivella* valves were commonly used to make whole-shell beads, and—in Late period collections—a related barrel-style bead.

There are two principal marine biotic communities off the western coasts of North and Central America. The division

Table 86. Species Present in the CCP Shell Collection

Species	NISP	Biotic Province
Marine species		
Pelecypods		
Glycymeris		
Glycymeris gigantea	9	Gulf of California
Glycymeris spp.	17	Gulf of California and California coast
Laevicardium elatum	26	Gulf of California and California coast
Pecten vogdesi	2	Gulf of California
Argopecten ventricosus	1	Gulf of California and California coast
Spondylus/Chama	1	Gulf of California
Unidentified pelecypods	1	
Gastropods		
Olivella		
Olivella fletcherae	1	Gulf of California
Olivella spp.	67	Gulf of California and California coast
Conus		
Conus regularis	1	Gulf of California
Conus spp.	8	Gulf of California
Turritella anactor	7	Gulf of California
Oliva		
Oliva spicata	1	Gulf of California
Oliva spp.	2	Gulf of California
Strombus galeatus	1	Gulf of California
Haliotis spp.	5	California coast
Unidentified gastropods	2	
Unidentified marine species	117	
Freshwater/terrestrial species		
Pelecypods		
Anodonta californiensis	17	freshwater
Gastropods		
Succinea spp.	26	terrestrial
Hawaiia minuscula	5	terrestrial
Unidentified snail	9	
Unidentified shell	1	
Total	327	

Key: NISP = number of identified specimens.

between these two biotic communities is located off the western coast of Baja California, in the area of Magdalena Bay. Here, the warm waters of the Panamic province and the colder waters of the California province converge and then turn out to sea. The differences between these biotic environments has produced a pattern where many species of mollusca are found in only one zone or have limited distribution and frequency in one zone relative to the other. Although both biotic communities contributed in some degree to the shell material available to the prehistoric inhabitants of the Southwest, the principal source appears to have been the Gulf of California, a northern finger of the tropical Panamic province, a pattern that was replicated in the CCP collection.

It seems probable that the *Glycymeris* valves originated from the Gulf of California. Although there are species of *Glycymeris* present in the California province, they are quite small and would not have been suitable for bracelet production. *Laevicardium elatum* was the only species found in considerable number in this collection that is present in both biotic communities. Its northern range extends into the area near San Pedro, California (Abbott 1974:486), although it does not appear to be as common in the colder waters off the California coast as it is in the Gulf region (Keen 1971:160). Additionally, there is little evidence for its extensive use by the aboriginal populations of southern California (Gifford 1947). Thus, it would seem more likely that most—if not all—of the *Laevicardium* recovered from sites in the southern portion of the Southwest originated in the Gulf of California.

Olivella is a gastropod represented in both provinces, although the various species are specific to the different biotic communities. One characteristic that appears to be diagnostic of this regional separation is the shape of the shell's callus (Silsbee 1958). In the CCP material, all cases where this feature could be observed, the shape of the callus suggested a southern, or Gulf, origin with most appearing to be consistent in shape to *Olivella dama*, although the shells lacked diagnostic features that would have confirmed this assessment. The one other species that was identified, *Olivella fletcherae*, is also restricted to the Panamic waters of the Gulf of California (Keen 1971).

Relatively few specimens represent the other genera. *Pecten vogdesi* and *Argopecten ventricosus* are both pelecypods endemic to the warm waters of the Gulf of California, with the latter having a limited distribution to the north. *Conus*, *Oliva*, *Turritella* and *Strombus* are all largely restricted to the warm waters of the Panamic province. Each of these genera is represented by several species in the Gulf of California.

All of the North American species of *Haliotis* are found in the colder waters of the California province. These shells were extensively used by the cultural groups along the Pacific coastline and were widely traded. Studies of the Hohokam shell industry have indicated that this genus was consistently available, although in low quantities, throughout the occupational sequence (Vokes 1984:470–472).

The second major resource for shell exploited by local inhabitants was the freshwater rivers and streams of the local region. Although it is unlikely that the most of the creeks along the side drainages sustained populations of *Anodonta*, the immediate proximity of Tonto Creek would have provided a convenient source of freshwater shellfish for the inhabitants of the sites under investigation. *Anodonta californiensis* is a comparatively large, although very gracile, bivalve that was endemic to most of the permanent watercourses in Arizona prior to the development and impoundment of the rivers that occurred earlier this century (Bequaert and Miller 1973:220–223). Today, this species is listed as endangered within Arizona, with a remnant population restricted to the upper reaches of the Black River (Landye 1981:26) and other drainages in the White Mountains of eastern Arizona. It is commonly recovered in considerable quantities in prehistoric sites that are found along the Salt River and other Arizona rivers in central Arizona, and it has been suggested that some prehistoric populations may have employed this shellfish as a food resource and may also have served as raw material for the local artisans (Haury 1976:308; Howard 1987:77; Vokes 1988:373).

The occurrences of the terrestrial gastropod genera *Succinea* and *Hawaiia* appear to be fortuitous. These are snails that favor moist, well-vegetated areas along the periphery of marshes and watercourses, and are frequently recovered from drift assemblages. They could easily have been inadvertently introduced into the archaeological record through the collection of grasses and mud from the river banks. Thus, the occurrence of these genera was considered to be incidental to the collection and will not be discussed in the following descriptive portion of the text.

Artifact Forms

Excluding the incidental terrestrial gastropods, a total NISP of 287 complete or fragmentary cultural shell specimens were identified in the excavated sample (Table 87). These were mostly finished artifacts, with a few specimens representing material related to manufacturing efforts, and unworked fragments.

Finished Artifacts

The most-common artifacts in the CCP collection—in terms of absolute numbers—were beads in one form or another, although these were found in a relatively limited number of deposits. In addition, the collection included examples of the other major classes of artifacts that are common to contemporaneous collections, including bracelets, pendants, and ring-pendants.

Table 87. CCP Shell Collection Summarized by Genera and Artifact Form

Species	Finished Artifacts					Manufacturing Evidence			Fragments		Whole Valve	Total
	Beads	Pendants	Bracelets	Ring Pendant	Reworked Bracelet	Artifact in Process	Reworked Artifact	Raw Material	Worked Fragment	Unworked		
Cultural material												
Marine shell												
Glycymeris	5	4	14	1	1	—	—	—	1	—	—	26
Laevicardium	—	4	—	—	—	1	1	4	7	9	—	26
Pecten	—	—	—	—	—	—	—	—	—	2	—	2
Argopecten	—	—	—	—	—	—	—	—	1	—	—	1
Spondylus/Chama	1	—	—	—	—	—	—	—	—	—	—	1
Unidentified pelecypods	—	1	—	—	—	—	—	—	—	—	—	1
Olivella	68	—	—	—	—	—	—	—	—	—	—	68
Conus	7	2	—	—	—	—	—	—	—	—	—	9
Turritella	—	7	—	—	—	—	—	—	—	—	—	7
Oliva	—	3	—	—	—	—	—	—	—	—	—	3
Strombus	—	—	—	—	—	—	—	—	—	1	—	1
Haliotis	—	1	—	—	—	—	—	—	4	—	—	5
Unidentified gastropods	1	—	—	—	—	—	—	—	—	1	—	2
Unidentified marine shell	117	—	—	—	—	—	—	—	—	—	—	117
Freshwater pelecypods												
Anodonta	—	1	—	—	—	1	—	—	3	12	—	17
Unidentified shell	—	—	—	—	—	—	—	—	—	1	—	1
Subtotal	199	23	14	1	1	2	1	4	16	26	—	287
Environmental snails												
Succinea	—	—	—	—	—	—	—	—	—	19	7	26
Hawaiia	—	—	—	—	—	—	—	—	—	2	3	5
Unidentified snail	—	—	—	—	—	—	—	—	—	9	—	9
Total	199	23	14	1	1	2	1	4	16	56	10	327

Beads

A total of 199 shell beads was recovered during the excavations of 17 different contexts at the various sites along the CCP corridor. The majority were disk beads, but whole-shell beads were also well represented. The great majority of these beads were recovered from a limited number of mortuary contexts.

Whole-Shell Beads

Seventy-nine whole-shell beads were recovered from 13 different contexts at four sites. Most were simple, spire-lopped forms made from *Olivella* (n = 66) (Figure 54a) or *Conus* (n = 7) shells. One was an unidentified gastropod. All of these beads had the apex of the spire removed to permit the passage of the cord through the top of the spire and out the natural aperture. The *Olivella* beads ranged in size from 10.38 mm to a maximum of 16.57 mm, with a mean length of 12.24 mm. By contrast, the beads created from the larger *Conus* shell were between 22.0 mm and 27.41 mm in length.

The remaining five whole-shell beads were fashioned by grinding away the beak of small *Glycymeris* valves (see Figure 54b). Thread could then be looped around the taxodontic plate and the bead suspended below the cord. In the CCP sample, these beads were restricted to the Miami/Roosevelt and Roosevelt phases of the early Classic period. This is consistent with other known collections from the desert regions of southern Arizona, where this style is found to be a relatively accurate marker of Classic period assemblages (Nelson 1991:56). The CCP specimens ranged in size from a minimum of 8.94 mm to a maximum of 12.73 mm, with a mean length of 11.03 mm. These measurements are well below the upper limit defined by Nelson (1981:166) for distinguishing beads from pendants. The backs of two beads were ground away to create a relatively large central hole that had an uneven interior edge. Although these might be considered to be small variants of the ring-pendants, the interior diameters were no greater than 6 mm across.

Barrel Beads

A form that is closely related to the spire-lopped bead is the barrel-shaped bead. This type is similar to the spire-lopped form in that the bead is made from small gastropods—mostly *Olivella*—that have the spire's apex removed for the perforation. Additionally, the anterior end of the body whorl is truncated by grinding. In the Southwest, *Olivella* is the most common genera employed in the manufacturing of this form. The degree to which the body whorl is truncated can vary considerably. The two specimens in the CCP collection were made from different species of *Olivella*. In both instances, the shell's spire was fully removed and at least the lower third of the body whorl—up to the fasciole fold on the columella—was also removed. This bead form has been most commonly associated with Sedentary and Classic period assemblages among the Hohokam (Vokes 1984:478).

Disk Beads

The most numerous bead form in the CCP collection was the disk bead (see Figure 54c). These were cut from white marine shells and were essentially discoidal forms with a perforation centered in the flattened face. They had an average maximum diameter of 3.95 mm and a mean thickness of 2.09 mm. Nearly half of the beads (44 percent) had an essentially rectangular profile, whereas the rest exhibited some degree of beveling or wedge form of profile. This may relate to the portion of the shell used in the manufacturing of the beads, as the valve wall will vary across the back of the valve. Additionally, if the beads were shaped individually, the differences may reflect the variation in pressure applied to the disk as the face was ground flat. Nearly all of the disk beads (n = 99) were recovered from one particular burial (Feature 166) at the Vegas Ruin (AZ U:3:405/2012), where strands of beads encircled the right wrist and both ankles. Eleven of the remaining 12 disk beads were recovered—along with a whole-shell pendant—from a vessel in a pit (Feature 28) at the Crane site (AZ U:3:410/2017). Thus, the total of 111 beads represents no more than 5 artifacts (given that the beads in Feature 166 represented 3 different ornaments).

Tubular Beads

Six cut tubular beads were also recovered from burial Feature 166 at the Vegas Ruin. These were associated with the disk beads that were found around the right ankle. These cut-shell beads were similar to cut-disk beads in some features but were distinct in that their length, which was aligned with the perforation, was greater than the bead's diameter. Furthermore, these did not appear to represent a simple extreme in the distribution of the disk-bead dimensions but represented a discrete population. The length of the bead's tube ranged from a minimum of 3.77 mm to a maximum of 5.90 mm.

Although I have used the term "tubular" in my typology, beads identified as such correspond to Di Peso et al.'s (1974:412) Type VIII: Cylindrical Beads, and Bradley's (1996:86) cylindrical beads. Similar beads were recovered in a mortuary deposit reported at the Boone Moore site (Vokes 1992:308) from the Punkin Center portion of the SR 188 corridor (Vokes 2001:362). In contrast with the latter collection, where a number had angular faceted sides giving them a

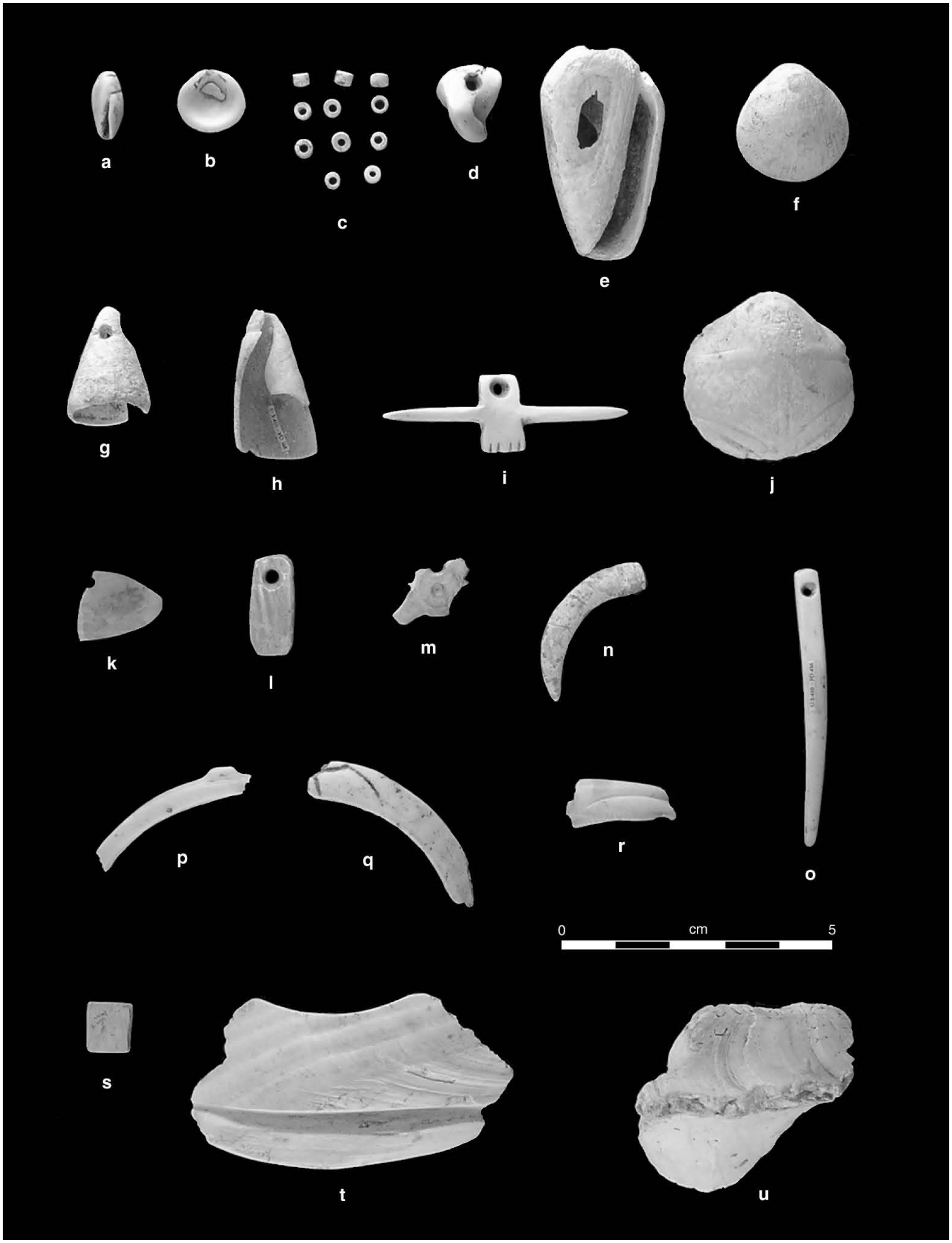

Figure 54. Selected shell artifacts from the SR 188–Cottonwood Creek Project sites.

squared cross section, all of the CCP specimens were cylindrical in form.

Irregular Bead-Pendants

The final bead form present in the CCP collection was a single irregular bead-pendant (see Figure 54d) that may have been associated with a child's inhumation (Feature 21) at the Vegas Ruin. This deposit was disturbed by the backhoe, and the bead was recovered from the trench backdirt, so its association with the body is uncertain. The specimen was complete and was carved from the hinge area of either a *Spondylus* or *Chama* valve. It exhibited a mottled, purple-white color and a twisted form, with two somewhat flattened facets that were set at an angle to each other. A single, essentially cylindrical, perforation passed through these facets. The maximum length of the bead was 14.15 mm, and the width/thickness varied between 8.98 and 12.38 mm.

Pendants

Excavations conducted as part of the CCP resulted in the recovery of 23 different pendants representing a number of different styles and motifs (Table 88). These included whole-shell forms, which required little modification beyond perforating the shell wall, to fairly complex carved and incised forms representing zoomorphic themes. Also present was an example of a bracelet segment that had been reworked into a pendant and several pieces of *Anodonta* (see Table 87) that—although appearing to be part of a geometric shape—were too fragmentary for the form to be discernible.

Whole-Shell Pendants

Seven of the 10 whole-shell pendants were *Turritella* valves, which were found around the neck of a single infant burial (Feature 165) at the Vegas Ruin. Most of these (n = 5) were perforated by punching a small hole through the back of the body whorl and then reaming or drilling out the resulting perforation so that the edges were smoothed. The perforation of two other specimens was achieved by sawing a groove across the curved exterior of the body whorl—opposite the natural aperture—until the cut penetrated the shell wall. As with the punched perforations, the resulting hole was then reamed out to enlarge it and smooth the edges.

The other whole-shell pendants included two examples of *Oliva* shells, whose spires were removed to permit passage of the cord. In the case of the pendant recovered from a general site context at the Crane site, the shell was not further modified, and the specimen might be considered to be a bead were it not for its substantial size—nearly 38 mm in length. In this case, the cord would have passed through the natural aperture. A similar pendant was recovered from an inhumation from Ventana Cave (AZ Z:12:5 [ASM]), where it was a part of an amulet. It was recovered along with two San Pedro style points and a wooden nose plug (Haury 1950:290, Plate 21). It that case, the cord was knotted and shell suspended from its end.

The second *Oliva* pendant, which was found above the right wrist of burial Feature 220 at the Vegas Ruin, had a second perforation centered in the body whorl near the inner lip (see Figure 54e). This perforation was achieved by grinding away the convex face of the body whorl, thus creating an oval hole that was surrounded by a flattened facet. There was a notch worn into the edge of the spire's perforation, suggesting the cord was looped through these holes and possibly sewn to a cloth or hide backing. Similar perforation sets have been found with other *Oliva* pendants in the Tonto Basin area (Vokes 2001:367).

The final whole-shell pendant was a relatively small *Glycymeris* valve measuring 21.63 by 21.11 mm (see Figure 54f), which—like the beads made from this genus—was perforated by grinding away the convex surface of the umbo-beak area. In addition, the perimeter of the shell along the sides and ventral margin was lightly ground, possibly to smooth the edge. This pendant was recovered from an extramural pit (Feature 28) at the Crane site.

Tinklers

Three shell tinklers were also recovered during the excavations. Two were recovered from the Crane site: a large fragment of an *Oliva* shell tinkler from the fill of a cobble-adobe-foundation room (Feature 6) and a complete *Conus* shell tinkler from the general site area. A small fragment of a *Conus* shell tinkler was recovered from a pit structure (Feature 179) at the Vegas Ruin. These three artifacts were fashioned by grinding away the spire and shoulder area of the shell, thus leaving the cone shape of the body whorl. The body whorl was then perforated by sawing a groove into the convex surface near the anterior end of the shell (see Figure 54h). In two cases the groove was cut deep enough to create an oval perforation, whereas in the third specimen, which was recovered from the general-site area of the Crane site (see Figure 54g), was perforated by drilling the hole while using the cut as a platform for the drill's bit. This appears to be a case of mending a pendant that was originally perforated with a cut groove that had subsequently broken away, as there was a partial cut groove along the broken edge of the outer lip.

Table 88. CCP Shell Pendants

Species	Natural		Cut Forms									Unknown Form	Total
			Zoomorphic			Geometric				Other			
	Whole Shell	Tinkler	Avian	Unknown Quadruped	Frog/ Toad	Solid Disk	Washer	Lenticular	Rectangular	Claw-Shaped	Needle		
Marine shell													
Pelecypods													
Glycymeris	1	—	—	—	1	—	1	—	—	1	—	—	4
Laevicardium	—	—	1	1	—	1	—	—	—	—	—	1	4
Unidentified marine shell	—	—	—	—	—	—	—	—	—	—	1	—	1
Gastropods													
Conus	—	2	—	—	—	—	—	—	—	—	—	—	2
Turritella	7	—	—	—	—	—	—	—	—	—	—	—	7
Oliva	2	1	—	—	—	—	—	—	—	—	—	—	3
Haliotis	—	—	—	—	—	—	—	—	1	—	—	—	1
Freshwater shell													
Pelecypods													
Anodonta	—	—	—	—	—	—	—	1	—	—	—	—	1
Total	10	3	1	1	1	1	1	1	1	1	1	1	23

Cut Pendants—Zoomorphic Forms

There were three pendants or pendant fragments recovered that appeared to represent various zoomorphic motifs. One of the pendants was a variant of the flying-bird style (see Figure 54i), with its body and head depicted as a simple rectangular block with two narrow, triangular wings extending out to the sides. The wings measured 45 mm from tip to tip. The bird's tail feathers were depicted by a series of short, shallow notches cut into the base edge of the interior face. A single, uniconical perforation was centered in the "head," which extended above the horizontal axis formed by the wings. This pendant was crafted of *Laevicardium* and was found in the Feature 4 cobble-adobe-foundation room at the Crane site.

A frog or toad pendant (see Figure 54j) was recovered from the surface of the Crane site. The specimen was carved from a medium-sized to small *Glycymeris* valve. Both the fore and hind legs were shown drawn up in a resting position. The spinal cord was indicated by a pair of shallow incised grooves that extended from near the ventral margin, where it joined with the hind legs. Little effort was made to depict the head, and the area was defined by the incised front legs, which extended out from the top of the spine and wrapped forward. Two drilled depressions were spaced to ether side of the central axis to indicate the eyes. Pendants that were carved into the shapes of frogs or toads became quite popular during the Classic period. It has been suggested that some of the more elaborate of these pendants—often associated with turquoise mosaics—may have served as status markers or symbols of office among the diverse groups of the Southwest during the Classic period (Crown 1994:4; Wilcox 1987:140) and that the frog/toad image may be associated with fertility (Vokes 2001:414).

A carved segment of a quadruped was recovered from the general fill of the burial at AZ U:3:408/2015. The piece was likely a leg of a canine, or *cipactli*, figure. It was carved from the back of *Laevicardium* shell and had a foot, complete with toes/claws indicated by a set of notches cut into the face. An incised line extended down the leg, which was a common method of depicting a paired leg in profile. The leg attached to a narrow body but this portion of the animal was broken away from each side, and thus the animal depicted remains uncertain.

Cut Pendants—Geometric Forms

One complete pendant and three fragmentary specimens represented geometric shapes. The three fragments were all curvilinear forms. The pendant recovered from the Feature 1 pit structure at the Rock Jaw site (AZ U:3:407/2014) site was approximately one-third of a solid disk form that was carved from the back of a *Laevicardium* shell, whereas another specimen, which was recovered from a general site context at the Vegas Ruin, was a portion of an open-centered washer shape that seems to have been cut from the back of a *Glycymeris* shell. Each was represented by roughly one-third of the original artifact's area. A lenticular-shaped pendant (see Figure 54k) that was carved from the back of an *Anodonta* valve was recovered from the fill of an extramural hearth (Feature 67) at the Vegas Ruin. Approximately half of the specimen remained, with the break passing through the perforation, which was placed so that the pendant would have hung with its longest axis being the horizontal.

The one complete pendant was a rectangular-shaped specimen (see Figure 54l) that was carved out of abalone. It measured nearly 19 mm in length and had a uniconical perforation located near one end. It was recovered from the fill of a pit structure (Feature 34) at the Vegas Ruin, which also contained the only other pieces of *Haliotis* in the collection. These were worked and may have represented a second pendant, although the pieces were too fragmented to be able to confirm this possibility.

Other Cut Pendants

There were two—quite distinct—examples of needle or claw-shaped pendants in the CCP sample. One appeared to be a remodeled segment of a plain *Glycymeris* shell bracelet that had been fashioned into a pointed, crescent-shaped, claw-like pendant (Figure 54n). The specimen, which was recovered from the fill of a burial (Feature 145) at the Vegas Ruin, incorporated portions of the side-ventral margin of the bracelet. Although there was no perforation present, a series of grooves were cut into the perimeter of the shaft, with two—close to the blunt end—cut sufficiently deep into the surface to have served to anchor a wrapped cord.

The other pendant was a long, slender needle-shaped pendant (see Figure 54o) that was recovered from the fill of the pit structure (Feature 30) at the Crane site. This pendant was carved from the back of a large *Laevicardium* shell. Its curvature indicated that this pendant was not fashioned from a bracelet fragment. The shaft was quite long (51.56 mm) and gradually tapered down to a point over its entire length. The wider end had a rectangular cross section that shifted to a round shaft near the point end. A single, biconical perforation was drilled through the flattened end.

Cut Pendants—Unknown Form

A small fragment of a cut-shell pendant (see Figure 54m) was recovered from a surface collection unit at the Rock Jaw site. The fragment had a central depression that was enclosed within an encircling groove. A uniconical perforation intersected the groove, thus indicating the piece was from a pendant of some form; however, nearly all of the surrounding area was broken away, removing all indications of the original form.

Bracelets

Bracelets, particularly plain bracelets, are often recovered from excavations of sites in southern Arizona. A total of 14 bracelets and band fragments—all made from *Glycymeris* valves—were recovered during the course of the CCP excavations. These included a number of plain bracelets, as well as two decorated forms.

Plain Bracelets

Twelve plain bracelet fragments were recovered during the course of the excavations. Two burnt, conjoining fragments representing 10 percent of a *Glycymeris* shell bracelet were recovered from the general fill of burial Feature 8 at Site 408/2015. Most of these were small fragments that did not include the umbo-beak portion of the band. The largest fragment represented approximately 30 percent of the original band. Only one specimen retained the umbo (see Figure 54p), and it had been ground down to a small tabular extension that was not perforated.

The majority of the bands had some portion of the exterior surface reduced to a near vertical face. Only three specimens were left with the shell's natural slope. An additional five pieces were ground only along the marginal edge, leaving the upper section alone. Three had the exterior surface ground back to the point that the surface was vertical to the marginal edge.

The band widths of these plain bracelets ranged from nearly 4 mm to a maximum of 8.5 mm, with a mean width of 5.84 mm. Thus, the majority of the bands measured between 4 and 6 mm, which is the range that Haury (1976:311) provided for his Type II band. Four bands exceeded the upper boundary, but none exceeded 10 mm, which was the boundary suggested by Di Peso (1956:97) for distinguishing bracelets from armlets.

Decorated Bracelets

Two complete bracelets were recovered from mortuary contexts. These were distinguished from the plain bands in that their umbones were outlined and their shape enhanced by reducing the adjoining band. This provided a triangular bezel that extended above and projected out from the band. In both instances, the bands were otherwise plain, although quite wide—ranging from 9.04 mm to a maximum of 11.97 mm. These bands were both recovered from the upper left arms of adult males: one from Feature 220 at the Vegas Ruin and the other from Feature 38 at the Crane site. This pattern has previously been noted in burials at other sites in the Tonto region (Vokes 2001:415) and elsewhere (Di Peso 1956:95–98).

Ring-Pendants

A single, fragmentary ring-pendant made out of a medium sized *Glycymeris* valve (see Figure 54r) was recovered from the fill of a surface room at the Crane site. The specimen incorporated portions of the dorsal and side margin with one break passing through the umbo. The band was quite wide—averaging around 7 mm—and had a deep, broad groove cut into it. The groove extended from the side of the umbo and ran along the center line of the band around its circumference toward the ventral margin. Although it terminated at the break, there was no reason not to suppose that it would have wrapped around to the other side of the umbo. The interior diameter of the ring-pendant was estimated to fall around 18 mm and, thus, could have been either a finger ring or a ring-pendant.

Other Artifacts

It is not uncommon to find pieces of shell that have been refashioned into other ornaments or even utilitarian objects. In the CCP sample, one such specimen was recovered from the Crane site. This was a section of a plain bracelet's ventral margin that was remodeled into an awl or punch (see Figure 54q). The shaft was formed by the bracelet's original band with one end ground to form a crude, steeply tapered, sharp point, and limited high-point grinding rounded off the opposite end.

Manufacturing Evidence

The evidence reflecting local manufacturing activities includes unfinished artifacts and the presence of waste material discarded during the production process. There were no whole, unmodified valves of marine materials representing raw material recovered during the CCP excavations.

Unfinished Artifacts

There were two specimens that appeared to be artifacts in the process of production. One was a small, nearly square section of the lower back of a *Laevicardium* shell recovered from a wall trench in Feature 4, a cobble-adobe-foundation room at the Vegas Ruin (see Figure 54s). In this case, the artifact had been ground and finished along three of its sides. The fourth edge had limited high-point grinding along its length. The piece seemed to be a geometric form, possibly a relatively large mosaic tablet. The other example was a small fragment of *Anodonta* that was recovered from a general-site context at the Vegas Ruin. This specimen had one clearly worked edge and two other sides that appeared to have limited grinding present. The intended form was unclear, although it may have been a small pendant or another geometric form.

Reworked Artifacts

Also present was a large fragment of a *Laevicardium* "perforated shell" that was being remodeled and sectioned (see Figure 54t). This was recovered from a pit house (Feature 99) at the Vegas Ruin. A portion of the original, large central perforation was present along one edge, and the outer marginal edge had been ground to reflect the interior curve. These are common features of these large armlets. The remodeling of the fragment was evident from a deeply cut groove that paralleled the outer edge and the presence of numerous high-point grinding facets along the broken edges. There was no indication of what the intended form was to be, and it is possible that this was simply being prepared for an unspecified future use.

Waste Materials

A common method of shaping pieces of marine shell was to cut a groove into the valve's surface and use it to control breaking off the section. The result is the creation of a beveled cut with a residual, roughly broken lip. Although this edge is generally ground smooth on a finished artifact, it is likely to be left unmodified on the residue or waste fragments. Four pieces of *Laevicardium* shell were recovered that exhibited such features as to indicate they were manufacturing waste. These fragments were characterized by one or more edges having the rough edge of a cut groove or limited areas of grinding. Each lacked any evidence indicating efforts to finish the edges or to shape other sides of the fragment. Two of these fragments were recovered from general-site contexts and two from the Feature 179 pit structure at the Vegas Ruin.

Fragmentary Material

The occurrence of fragmentary shell pieces that were worked but lacked diagnostic features, were unworked, or had an original form that could not be ascertained are relatively common in archaeological collections of any size. These fragments could derive from three different sources: fragmented, finished artifacts; manufacturing activities; or breakage of whole valves. The absence of whole, unmodified shells in the CCP sample suggests that the latter was the least likely of the three.

Worked Fragments of Unknown Form

There were 16 pieces that exhibited clear evidence of purposeful modification but whose original form was obscure. These pieces generally possessed one or more worked facets or edges that were often well finished, suggesting that they were portions of finished artifacts. However, the possibility that some of these specimens—particularly the fragments of *Anodonta*—were fragments from artifacts late in the production sequence should not be ignored.

Seven of these fragments represented *Laevicardium*. Other genera present were *Glycymeris*, *Argopecten*, and *Haliotis*. The *Laevicardium* fragments were from various portions of the back and side panels. Two were long, well-formed, geometrically shaped pieces that may have been pieces from carved pendants. In this case, the piece might have represented a lizard's tail or the extended wing of a bird. It was long and tapered to a rounded point. In another instance, the piece, which was broken at both ends, seemed to taper from one end toward the other but then abruptly expanded again. Unfortunately, a break terminated the shaft at this point. The other worked pieces of *Laevicardium* were small and medium-sized fragments with one or more cut and ground edges.

Like one of the *Laevicardium* pieces, the *Haliotis* fragment was a slender shaft of shell that was carved along both sides. It ended with a squared knob. It is likely that it was part of a carved pendant, but the form is unclear. The *Argopecten* had been ground along the margin so as to remove the "ear." This is a feature common to some pendants and is also characteristic of the smaller perforated shells, which Haury (1976:316) suggested might be rings. The one piece of *Glycymeris* was a small segment of the umbo and might have been either a fragment of a whole-shell pendant or a part of a large bracelet. It was unmodified except for a flat ground facet near the beak that had part of a drilled perforation along the break.

The three worked fragments of *Anodonta* were each fairly small pieces with one or more worked edges. The degree to which these edges appeared to be finished determined their assignment into this category as opposed to placement in the manufacturing section.

Unworked Fragment

The most-common marine genus represented in the unworked shell material was *Laevicardium*, represented by nine fragments. Its prominence here is likely a reflection of its use as a medium in the production of pendants and other artifact forms. In general, these fragments were small pieces that derived from the back and side of these large gracile shells.

Other marine genera represented by unworked fragments included *Pecten* and *Strombus*. In both instances, these were the only instances of these genera in the collection. Like the *Laevicardium*, the *Pecten* fragments were small segments from the lower back and margin sections. All pieces were from the flattened, left-hand valve characteristic of this species.

The *Strombus* fragment (see Figure 54u) was a large, blocky section of the penultimate whorl and the adjoining internal structure. Surface features suggested the piece was from near the outer lip. When recovered from Classic period contexts, *Strombus galeatus* shells are often found to have been fashioned into trumpets. Unfortunately, this fragment was from a portion of the shell that would not normally have been modified to make a trumpet, so the absence of any worked features neither supports nor discounts this possibility. The size of the fragment suggested that the valve would have been quite massive, and would certainly have been suitable for such use.

Twelve fragments of *Anodonta* were recovered during the excavations. Most of these were small segments from the back of the shell and could easily have derived from the fragmentation of whole shells. The sample was largely concentrated in architectural and midden deposits at the Vegas Ruin, although both the Rock Jaw and Crane sites also contributed one or more specimens. Other sites along the Salt River and in the upper Verde Valley have produced large numbers of this gracile shell (Howard 1987; Vokes 1988:373, 1989:131, 1991:12.2) leading analysts to suggest that the local populations may have been using this shellfish as a dietary resource. The limited numbers in the CCP collection indicates that the local inhabitants were not as actively exploiting this resource, even though Tonto Creek, which would have been a source for this shellfish, was just to the east of many of these settlements.

Discussion

Investigations were conducted at nine prehistoric sites during the course of the CCP. Two sites did not produce any shell material and another two, AZ U:3:406/2013 and AZ U:3:409/2016, produced a total of three pieces between them. These settlements appear to reflect occupations that were limited in scope and in duration. The samples from some other project sites were also somewhat restricted, in that the portions of the sites within the project's corridor were limited and somewhat marginal to the main occupation areas. Site 408/2015 is an example of this, in that the ROW passes to the west of the visible architecture and presumably any associated activity areas and extramural features. The features that were within the corridor at this site provided a small but tantalizing sample of what appears to have been a diverse assemblage.

Several of the sites were multicomponent, with the Vegas Ruin possibly occupied as early as the Archaic period. Other than the 13 terrestrial gastropods (which are considered fortuitous and therefore excluded from this study), there was no shell material associated with this early component. The shell sample that was recovered was largely associated with the late pre-Classic and early Classic period occupations. Contexts attributed to the former were present at two sites, whereas three Classic period settlements contained material associated with the Miami and Roosevelt phases.

Because of the limited nature of the sample recovered from the investigated components, it is difficult to assess much in the way of specific patterns regarding intrasite distributions and implied activities. Some observations on distributions, however, can be made on a general level. Table 89 groups the deposits from which shell materials were recovered at each of the sites into several broad categories that reflect the nature of these contexts. It is apparent that inhumations, although producing the greatest number of shell objects, had a relatively limited range of forms associated with them. It is not surprising that the greatest concentrations of beads—over 88 percent—were from mortuary deposits. In part, this reflects the more intensive screening that these deposits received, which would increase the recovery rate of small artifacts—particularly cut beads. It is likely that these beads were somewhat underrepresented in the more secular contexts, which were not as intensively screened. Most of the other artifact forms were well represented in nonmortuary contexts, with some of the less plentiful types recovered exclusively from the nonmortuary contexts. To some degree, this is a sampling issue, but it is also likely a reflection of the activities associated with these artifacts. Tinklers, for example, were recovered from general-fill and architectural contexts at the two largest sites in the sample. This may reflect the role of these instruments in the performance of ceremonies that may have been conducted at the larger Classic period settlements. Similarly, the absence of manufacturing-related forms in burials within the sample may be a reflection of the limited number of individuals that participated in this craft. At other sites in Tonto Basin where these items have been recovered in mortuary contexts, the interred individual was buried with stockpiles of raw material and partially worked items (Vokes 2001:409–411).

Table 89. Summary of CCP Shell Collection, by Site and Artifact Type

Feature Type	Site 41/583		Vegas Ruin (405/2012)				Site 406/2013	Rock Jaw Site (407/2014)		Site 408/2015		Site 409/2016	Crane Site (410/2017)				Subtotal				Total
	N	O	N	O	A	M	N	N	A	N	O	N	N	O	A	M	N	O	A	M	
Finished artifacts																					
Beads																					
Natural	—	1 (1)	—	1 (1)	7 (6)	68 (4)	—	—	1 (1)	—	—	—	—	—	1 (1)	2 (1)	—	2 (2)	9 (8)	70 (5)	81
Cut forms	—	—	—	—	—	106 (4)	—	—	—	—	—	—	—	11 (1)	1 (1)	—	—	11 (1)	1 (1)	106 (4)	118
Pendants																					
Whole shell	—	—	—	—	—	8 (2)	—	—	—	—	—	—	1 (1)	1 (1)	—	—	1 (1)	1 (1)	—	8 (2)	10
Tinklers	—	—	—	—	1 (1)	—	—	—	—	—	—	—	1 (1)	—	1 (1)	—	1 (1)	—	2 (2)	—	3
Cut forms	—	—	1 (1)	1 (1)	1 (1)	—	—	1 (1)	1 (1)	—	1 (1)	—	1 (1)	—	1 (1)	—	3 (3)	2 (2)	3 (3)	—	8
Other	—	—	—	1 (1)	—	—	—	—	—	—	—	—	—	—	1 (1)	—	—	1 (1)	1 (1)	—	2
Bracelets	1 (1)	—	2 (2)	1 (1)	2 (2)	1 (1)	2 (2)	—	1 (1)	—	1 (1)	—	—	—	2 (2)	1 (1)	5 (5)	2 (2)	5 (5)	2 (2)	14
Ring-pendants	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 (1)	—	—	—	1 (1)	—	1
Awl	—	—	—	—	—	—	—	—	—	—	—	—	—	1 (1)	—	—	—	1 (1)	—	—	1
Manufacturing																					
Artifacts in process	—	—	—	—	2 (2)	—	—	—	—	—	—	—	1 (1)	—	—	—	1 (1)	—	2 (2)	—	3
Debris	—	—	2 (2)	—	2 (2)	—	—	—	—	—	—	—	—	—	—	—	2 (2)	—	2 (2)	—	4
Fragmentary material																					
Worked, unknown form	—	—	1 (1)	3 (3)	6 (6)	—	—	—	4 (4)	—	1 (1)	—	1 (1)	—	—	—	2 (2)	4 (4)	10 (10)	—	16
Unworked	1 (1)	—	3 (3)	3 (3)	10 (10)	—	—	—	1 (1)	1 (1)	2 (2)	1 (1)	3 (3)	—	1 (1)	—	9 (9)	5 (5)	12 (12)	—	26
Total	2 (2)	1 (1)	9 (9)	10 (10)	31 (30)	183 (11)	2 (2)	1 (1)	8 (8)	1 (1)	5 (5)	1 (1)	8 (8)	13 (3)	9 (9)	3 (2)	24 (24)	29 (19)	48 (47)	186 (13)	287

Note: In each cell, counts are followed by the number of occurrences in parentheses.
Key: A = architecture; M = mortuary; N = nonfeature and surface; O = pits, trash middens, rock alignments, and other nonarchitectural cultural contexts.

Table 90. Shell Genera Summarized by Period and Phase

Species	Pre-Classic Period	Classic Period				Unplaced Sedentary Phase–Classic Period	Total
		Miami Phase	Miami/Roosevelt Phase	Roosevelt Phase	Classic Period Subtotal		
Marine shell							
Pelecypods							
Glycymeris	2	—	7	8	15	9	26
Laevicardium	7	4	5	1	10	9	26
Pecten	1	—	—	—	—	1	2
Argopecten	1	—	—	—	—	—	1
Spondylus/Chama	—	—	1	—	1	—	1
Unidentified pelecypods	—	—	—	—	—	1	1
Gastropods							
Olivella	2	2	63	1	66	—	68
Conus	—	1	7	—	8	1	9
Turritella	—	—	7	—	7	—	7
Oliva	—	—	1	1	2	1	3
Strombus	—	1	—	—	1	—	1
Haliotis	—	—	—	—	—	5	5
Unidentified gastropods	—	1	—	—	1	1	2
Unidentified marine shell	—	—	105	12	117	—	117
Freshwater/terrestrial shell							
Pelecypods							
Anodonta	1	2	6	—	8	8	17
Unidentified shell	—	—	—	—	—	1	1
Total	14	11	202	23	236	37	287

Temporal Patterns

The combined pre-Classic period sample (Table 90) was relatively limited, consisting of a total of 14 specimens, but it was quite diverse and included 1 whole-shell bead, a number of cut pendants, and 2 plain bracelets, along with several worked and unworked fragments. The pre-Classic period material was primarily associated with components at the Rock Jaw site and Site 408/2015. In both instances, only a small portion of the site lay within the project ROW, so the sample was limited in scope. The shell artifacts were associated with both of the pit structures at the Rock Jaw site and with a trash midden at Site 408/2015. This midden also contained an inhumation (Feature 8). Although some shell was recovered in the fill near the burial, the nature of the deposit—along with the extremely fragmented nature of the shell in them—suggests that this material was from the trash fill derived from the surrounding midden and was not associated with the individual. Three small fragments of shell artifacts—a *Glycymeris* bracelet, *Olivella* bead, and an unworked *Laevicardium* fragment—were recovered from AZ O:15:41/583.

The Classic period occupation was represented by material from the Vegas Ruin and the Crane site, which were by far the most intensively occupied settlements in the project sample. We investigated a variety of Classic period features at these sites, including surface cobble-adobe-foundation architecture, granaries, extramural features, and burials. Additionally, there were slightly earlier pit structures at both sites, which may date to late pre-Classic or Miami phases. These two settlements produced the bulk of the shell artifacts attributed to the Classic period. This dominance is both a reflection on the relatively extensive nature of the deposits and the comparatively intense nature of these occupations.

Genera

The small pre-Classic period occupation was largely dominated by the genus *Laevicardium* (see Table 90), as nearly half of the shell artifacts associated with this period were made from this genus. The reasons for its strong representation may be owing to, in part, the diverse number of artifact forms that were manufactured from it—particularly cut-pendant forms, which were relatively prominent in the limited sample. The fact that the genus was also relatively well represented among the unworked fragments may be a testament to its popularity in the local production of these forms, although the direct evidence for such manufacturing efforts, in the form of unfinished artifacts or associated waste, was absent in the pre-Classic period sample. Alternatively, this large, comparatively gracile shell could produce numerous fragments if shattered. Considerable efforts were made by the analyst to account for this possibility.

Laevicardium remained relatively prominent in the collection during the following Classic period, but there was also a rise in frequency of a number of other shells, particularly *Olivella*, as well as the introduction of several new genera. The increase in *Olivella* and the inclusion of other univalves into the sample appears to be related to the number of whole-shell and barrel-shaped beads in mortuary contexts. The increasing number of items that were made of *Glycymeris* seems to reflect the general increase of shell associated with the Classic period collection, as well as the introduction of whole-shell beads made from juvenile shells.

With the increased volume of shell in the early Classic period sample, there were a number of genera that were not present in the smaller pre-Classic period material. These were generally present in low numbers and were used in the manufacture of familiar artifact forms. Some of these, particularly *Turritella* and *Haliotis*, are known to have been present in earlier assemblages from the Hohokam and other regions (Nelson 1991). The appearance of other genera at this time seems to reflect the rise in popularity of certain artifact forms. *Conus*, which is known from earlier assemblages, exhibited an increase in popularity that corresponds to the adoption of tinklers into the local repertoire. In the Southwest, *Oliva* and *Strombus* were largely restricted to the Classic period. *Oliva* is generally associated with tinklers and whole-shell pendants, both of which were present in the CCP collection. *Strombus* is generally associated with shell trumpets, which were largely restricted to Classic period settlements. Although the CCP specimen cannot be conclusively identified as such, trumpets have been reported from several of the Classic period site complexes in the lower Tonto Basin (Bradley 1997; Bradley and Rice 1997; Griffith and McCartney 1994; McCartney 1995).

Artifact Forms

The composition of the artifact collection recovered from these excavations largely reflects the presence of forms that are familiar to archaeologists who have researched ornaments associated with the late pre-Classic and early Classic period occupations of Tonto Basin and Hohokam sites in the Salt and Gila Basins. The pre-Classic period material, although relatively limited in the size of the sample, was quite diverse and somewhat unusual in its relative composition. Bracelets, often by far the most common type of ornament in assemblages of this period, were matched in frequency by carved-shell pendants. The particular representations and geometric shapes that were present are all well known from Hohokam assemblages. Haury (1976:Figures 15.17, 15.28) illustrated several examples of the quadruped-pendant style he termed

Table 91. Contemporary Shell Collections from Tonto Basin

Project, by Period	Beads: Naturalistic Forms: Whole Shell n	Beads: Naturalistic Forms: Whole Shell *Occ*	Beads: Naturalistic Forms: Barrel n	Beads: Naturalistic Forms: Barrel *Occ*	Beads: Shaped Forms: Cut Forms n	Beads: Shaped Forms: Cut Forms *Occ*	Beads: Shaped Forms: Bead-Pendant n	Beads: Shaped Forms: Bead-Pendant *Occ*	Pendants: Naturalistic Forms: Whole Shell	Pendants: Naturalistic Forms: Tinklers	Pendants: Shaped Forms: Cut Forms	Pendants: Shaped Forms: Other/ Unknown	Bracelets	Perforated Shells	Ring/ Pendants	Other	Utilitarian	Artifacts In-Process	Remodeling Artifacts	Debris	Whole Valves	Total n	Total *Occ*
CCP Collection																							
Pre-Classic	2	2	—	—	—	—	—	—	—	—	2	—	2	—	—	—	—	—	—	6	—	12	12
Early Classic	77	12	2	2	117	5	2	2	8	2	1	1	7	—	1	—	1	1	1	6	—	227	50
Rye Creek Project[a]																							
Pre-Classic	4	4	—	—	—	—	—	—	—	—	6	1	24	2	3	3	1	2	—	2	—	48	48
Classic	56	8	1	1	20	2	—	—	—	14	2	—	6	—	2	—	—	1	—	1	—	103	37
Mazatal House (Ord Mine)[b]																							
Classic	—	—	—	—	—	—	—	—	—	—	1	1	2	—	—	—	—	—	—	—	—	4	4
FLEX Tonto Basin Project[c]																							
Pre-Classic (plus transitional)	3	3	—	—	9	1	—	—	2	—	2	1	25	1	3	1	1	1	2	—	—	51	43
Early Classic	3	2	—	—	2	2	—	—	1	5	2	—	5	—	—	1	3	—	1	—	—	23	22
SR 188: Tonto Creek[d]																							
Pre-Classic	1	1	—	—	3	3	—	—	—	—	6	—	42	—	2	—	1	3	3	1	—	62	62
Early Classic	1,093	64+	1,758	36	11,784	39	—	—	27	152	79	9	70	—	14	—	2	11	2	8	—	15,009	513
Ash Creek Project[e]																							
Pre-Classic	4	4?	—	—	—	—	—	—	—	—	—	—	15	—	—	1	—	—	—	—	—	20	20
Pre-Classic-Classic	—	—	—	—	1	1	—	—	4	3	3	—	7	—	—	—	—	—	—	—	—	18	18
Early Classic	987	7	—	—	1,132	2	—	—	6	12	—	1	10	—	3	—	—	2	—	—	1	2,154	44
Roosevelt Rural Sites Project[f]																							
Pre-Classic	—	—	—	—	—	—	—	—	—	—	2	—	7	—	3	1	—	—	—	—	—	13	13
Early Classic	2	1	—	—	—	—	—	—	1	3	2	—	4	—	—	—	—	—	—	—	—	12	11
Roosevelt Community Development[g]																							
Pre-Classic	1	1	—	—	2,515	9	—	—	19	—	3	3	24	1	10	1	—	2	1	1	—	2,581	75
Early Classic	39	18	4	3	67	15	—	—	3	82	23	5	77	—	19	8	6	10	3	12	1	359	285

Note: The total value for *Occ* may not be the sum of the cells as several forms may be combined as one artifact (e.g., pendant found with beads).

Key: Occ = the number of discrete artifacts (e.g., 68 beads around wrist = 1 strand/artifact)

[a] Vokes 1992.

[b] Ciolek-Torrello 1987.

[c] Vokes 1997.

[d] Vokes 2001.

[e] Kelley et al. 1985.

[f] Vokes 1994.

[g] Vokes 1995.

"Cipactli," although others have taken issue with this attribution, suggesting these are representations of the coyote or another local animal (Jernigan 1978:59; Vokes 1984:496).

The Classic period collection is, in terms of absolute numbers, dominated by whole-shell and cut-shell bead forms. When these are considered as single occurrences—assuming that multiple beads in a restricted context represented a single artifact, like a wristband or necklace—the collection takes on a somewhat different appearance. Although beads, or bead lots, were still the most common artifact form, they did not overwhelm the other artifact forms.

Shell material was associated with 11 burial features out of the total sample of 46 burial features investigated during this project. Of these 11 features, shell was directly associated with human remains in only 6 cases. The analysis of these 6 features revealed that shell was associated with nearly all age groups, including an infant (Feature 165) with 7 whole-shell pendants placed about its neck. The one group that lacked associated shell was the oldest adult subgroup. Most of the shell was associated with adult inhumations, and although both genders were represented in the sample, there was a greater tendency for males to have shell associated with them—of the 5 burials containing shell for which gender could be ascribed, 4 were males. The 1 instance, however, in which the individual was female (Feature 166 at the Vegas Ruin), the deposit was among the richest in shell material, with 3 sets of beads representing a bracelet and 2 anklets. It should be noted that shell was also not necessarily associated with the wealthier mortuary contexts. The middle-aged female in Feature 166 had a total of only 4 vessels interred with her and no other associated materials.

Intersite Comparisons

The shell material recovered during the CCP primarily derives from contexts that date to the late pre-Classic and early Classic periods. The degree to which this material reflects the general patterns present among the communities of the region can be assessed to some extent by reviewing Table 91, which presents the artifact composition of several contemporaneous collections from throughout the basin.

The small size of the pre-Classic sample in the CCP collection makes comparisons with the other projects with much larger collections somewhat tenuous, but some observations do appear appropriate. As noted previously, the relatively low incidence of bracelets was certainly less than what might be expected from the levels at other sites. Given the broad geographic placement of these other collections, it seems probable that the CCP pattern is likely a sampling issue. The greater number of cut pendants in contrast to naturalistic forms may reflect the broader regional emphasis on cut pendant forms. If one views the CCP pre-Classic collection in terms of presence or absence, it is interesting to note that the three forms that were represented were recovered from most of the other projects as well. Thus, the relative quantities of these forms may be skewed by sampling biases, but the greater pattern of use appears to be represented in the CCP collection.

The relatively large size of the early Classic period sample from the CCP allows for more-detailed observations regarding the correspondence between this collection and others in the region. For this purpose, beads were counted by the number of occurrences rather than in absolute numbers, as they were worn in multiple sets. With this qualification, a number of general observations can be made. The relative frequency of bracelets in the current collection (about 16 percent of the occurrences) is very similar to that of the RCAP (about 16 percent) (Vokes 1992) and the Tonto Creek material (about 14 percent) (Vokes 2001). These two projects were situated to the north and immediately to the south of the current project area. Three other samples have somewhat higher frequencies, but these were still substantially below what was commonly reported from Formative period components of these collections. A general pattern of decreasing emphasis on bracelets in the Classic period has been observed by many investigators in the Southwest, although data from the CCP, Tonto Creek, and RCD might suggest the contrary. The much higher frequencies of bracelets from Classic period contexts relative to pre-Classic contexts in these projects is, however, owing to the much better representation of the former. The reasons for the increased number of contexts with beads in the Classic period, in part, reflect the shift to inhumation burials over cremation, as mortuary contexts account for many of the occurrences of shell beads. This is not to say that beads were never placed in cremations, but the process of burning the body is likely to have destroyed many smaller offerings.

By contrast, the widespread and enthusiastic adoption of *Conus* and *Oliva* shell tinklers as an artifact form appears to be a Classic period manifestation. Although there are some examples from earlier contexts (Bradley 1980:45; Vokes 1986b:317, 1988:382), these are few in number. I have suggested elsewhere (Vokes 1995:195) that the key to understanding the increasing popularity of this pendant form may lie in the ceremonial or ritual activities associated with Classic period compounds and platform mounds. Tinklers are musical instruments designed for use in dances and other public performances. They were worn wrapped around the ankles and as fringe on clothing. The individual in the Magician's burial appears to have held a loop of tinklers in his right hand (McGregor 1943:283). These dances and rituals were likely to have been performed in the plazas and on the mounds associated with the Classic period compounds. This tradition continues to the present day among the Puebloan populations of the Southwest.

Conclusion

The collection of shell recovered during the CCP was associated primarily with late pre-Classic and early Classic period occupations of the nine investigated prehistoric sites. Although the collection was relatively small and derived from a limited range of deposits, there are a number of patterns that can be identified. Most of the worked shell was probably acquired as finished ornaments. There was relatively limited evidence for local production, and much of what was present may reflect reuse of broken ornaments.

It is likely that the pre-Classic populations of Tonto Basin, including those along the middle and upper portion of Tonto Creek, were actively connected with the exchange structures associated with the Hohokam cultural system. Through established networks, these local populations were able to acquire shell material, which ultimately was obtained from the Gulf of California. By the beginning of the Classic period, a shift had occurred in the composition of the collections examined, characterized by a marked increase in certain genera and artifact forms. These changes may well be a reflection of changing economic or social ties in the region at this time. Evidence from the RCAP (Elson 1992:142) and the RCD (Elson et al. 1995) indicate that there was a major shift—during the latter part of the pre-Classic period or during the transition to the early Classic period—in exchange networks in Tonto Basin. This shift appears to be reflected in the trends present even in this relatively small collection.

CHAPTER 7

Analysis of Plant Remains

Karen R. Adams and Richard Ciolek-Torrello

A major research focus of the CCP is to examine the Sedentary–Classic period transition in Tonto Basin, with an emphasis on refining knowledge of the Ash Creek and Miami phases, including the nature of subsistence during this transition. To that end, archaeobotanical remains from six sites along a portion of SR 188 near Jakes Corner in Tonto Basin are reported here. In addition, pollen from 47 soil samples and 59 artifact washes were analyzed (see Appendixes D.2 and D.3). These sites are located at the junction of the lower and upper Tonto Basins and are spread along a 3.8-mile-long stretch of the highway, approximately 780–865 m (2,560–2,840 feet) above mean sea level (AMSL) in elevation. AZ O:15:41/583 is possibly a satellite of Ushklish Ruin, a multicomponent habitation site near Hardt Creek occupied from the late Colonial period to the early Sedentary period. AZ U:3:404/2011 consists of a Classic period cobble-adobe-foundation field house situated on a broad ridge overlooking Gold Creek. The Rock Jaw site (AZ U:3:407/2014) is a small, late pre-Classic period habitation site consisting of two superimposed pit houses and associated cooking pits near Cottonwood Creek. AZ U:3:408/2015 is a large, dispersed, multicomponent site encompassing several discrete habitation loci. The Vegas Ruin (AZ U:3:405/2012) is an intensively occupied site located on a terrace overlooking Tonto Creek near Cottonwood Creek. This site includes a small cobble-adobe-foundation compound, pit houses, and dozens of extramural pits, hearths, roasting pits, an extensive midden, and burials. Much of the Vegas Ruin dates to the late pre-Classic and early Classic periods, although there are contexts representing the Archaic period as well. Finally, the Crane site (AZ U:3:410/2017) is a small, primarily Classic period site located on a high ridge overlooking a broad alluvial area along Tonto Creek. The Classic period features at the site include a small compound, granary pedestals, a large midden, and several burials; an earlier, Sedentary or Miami phase pit house was also excavated.

Methods

A total of 83 flotation samples, ranging in original sediment volume from 2.1 to 15.4 liters, were individually processed via water separation to light fractions ranging from 10–790 ml. These light fractions were further subdivided into a series of particle sizes for ease of microscopic examination, and all materials greater than 0.5 mm were examined. Archaeologists also provided the plant specimens recovered from the heavy fractions from the flotation process, and these items were examined and included in this analysis. The complete archaeobotanical flotation database, including provenience information and parts recovered, is available in Appendix D.1. An additional set of 20 construction element samples was also examined and is presented in Table 92.

Charred reproductive parts and 20 wood-charcoal fragments in each sample that were large enough to retain anatomical features were segregated for identification. A collection of modern specimens representing many of the tree and shrub species of Tonto Basin and lower Verde Valley provided comparative materials for the CCP wood-charcoal analysis. A similar collection of reproductive parts, along with a comparison to specimens in the University of Arizona Herbarium and the use of seed-identification manuals (e.g., Delorit 1970; Martin and Barkley 1961), allowed for the identification of seeds and fruit. The criteria of identification for all charred plant parts has been reported elsewhere for the region (Adams 1994a, 1998a, 2003a). Partially charred items and uncharred plant materials within samples were also noted and have been included in the archaeobotanical database.

A total of 47 soil samples was submitted to Dr. Owen Davis for pollen analysis from five prehistoric CCP sites (see Appendix D.2). Fourteen samples were from the Vegas Ruin: 3 from Archaic period roasting features; 7 from pit structures; 1 each from the cobble-adobe-foundation Feature 11 and its associated granary, Feature 51; 1 from the compound wall;

Table 92. Macrobotanical Remains from the CCP Sites, by Feature

Feature No. and Type, by Site	Subfeature	Taxon	Part	Condition	Count
Vegas Ruin (405/2012)					
F 12 burial		*Juniperus*	wood	uncharred	1
F 34 pit structure	Posthole 34.7	*Juniperus*	wood	uncharred	1
F 99 pit structure	Posthole 99.40	*Juniperus*	wood	uncharred	1
	Posthole 99.41	*Juniperus*	wood	uncharred	1
	Posthole 99.43	*Juniperus*	wood	uncharred	1
	Posthole 99.50	*Juniperus*	wood	uncharred	1
F 179 pit structure		*Juniperus*	wood	uncharred	1
	Posthole 179.21	*Juniperus*	wood	uncharred	1
	Posthole 179.22	*Juniperus*	wood	uncharred	1
	Posthole 179.35	*Juniperus*	wood	uncharred	1
	Posthole 179.36	*Juniperus*	wood	uncharred	1
	Posthole 179.37	*Juniperus*	wood	uncharred	1
F 181 burial		*Juniperus*	wood	uncharred	1
F 182 burial		*Juniperus*	wood	uncharred	1
		Juniperus	wood	uncharred	1
Rock Jaw (407/2014)					
F 1 pit structure		*Juniperus*	charcoal	charred	1
	Posthole 1.8	*Juniperus*	wood	uncharred	1
F 3 pit structure	Posthole 3.05	*Juniperus*	charcoal	charred	1
	Posthole 3.06	*Juniperus*	wood	uncharred	1
Crane site (410/2017)					
F 33 burial		*Juniperus*	wood	uncharred	1

and 1 control sample from SU 940. Fourteen additional samples were submitted from the Crane site: 5 from cobble-adobe-foundation structures; 1 from the Feature 31 granary; 2 from the Feature 30 pit structure; 1 from the Feature 13 extramural hearth; 2 from midden areas; and 3 from burials. Seven samples were analyzed from Site 408/2015: 1 from the Feature 2 pit; 2 from extramural hearths Features 4 and 5; 3 from midden areas; and 1 from burial Feature 8. Two samples were analyzed from the Feature 1 *horno* at Site 41/583. Finally, 10 samples were analyzed from Site 404/2011: 9 from the field house and 1 from the associated enclosure. In addition to these soil samples, 59 pollen wash samples were analyzed from 58 vessels recovered from mortuary contexts at the Vegas Ruin (55 vessels) and Crane site (3 vessels) (see Appendix D.3). Pollen concentrations were low in all of the analyzed samples with moderate to good preservation in the soil samples but with generally poor preservation in the pollen washes. A detailed discussion of the analytic methods that were used is presented in Appendixes D.2 and D.3, along with pollen counts for individual samples.

Charred-Plant Results

A minimum of 24 separate charred plant taxa were preserved in the CCP sites (Table 93), and some taxa were represented by more than one part. Identifiable reproductive and vegetative

Table 93. Ubiquity of Charred Plant Remains within CCP Features of Different Time Periods Arranged in Approximate Chronological Order

Plant Remains	Part(s)	Ubiquity (%)[a], by Period or Phase[b]						
		Archaic Period (n = 4)[c]	Late Pre-Classic Period (n = 5)	Sedentary–Early Classic Period (n = 1)	Transitional Sedentary Period–Miami Phase (n = 3)	Miami Phase (n = 5)	Roosevelt Phase (n = 6)	Early Classic Period (n = 9)
Domesticates/likely managed								
Agavaceae type	leaf base	—	20	—	—	—	—	—
Gossypium type	seed	—	20	—	33	40	17	33
Hordeum pusillum type	caryopsis	—	20	—	—	—	—	—
Monocotyledon type	fibrovascular bundle, tissue	—	20	—	—	40	33	33
Phaseolus type	seed fragment	—	20	—	—	—	—	—
Zea mays	kernel, cupule	—	—	100	33	60	66	44
Wild plants, reproductive								
Arctostaphylos type	seed	—	20	—	—	—	—	—
Astragalus type	seed	—	20	—	—	—	—	—
Cheno-am	seed	—	60	100	33	60	33	44
Descurainia type	seed	—	20	—	—	—	—	—
Echinocereus type	seed	—	60	—	—	—	17	33
Poaceae (Gramineae) type	caryopsis	—	40	—	—	—	—	—
Opuntia (prickly pear)	seed fragment	—	—	—	—	20	—	11
Plantago type	seed	—	20	—	—	—	—	—
Portulaca type	seed	—	20	—	—	—	—	—
Sphaeralcea type	seed	—	20	—	—	—	—	—
Wild plants, nonreproductive								
Forestiera type	charcoal	—	—	—	—	20	—	—
Fraxinus type	charcoal	—	—	—	—	20	—	—
Poaceae (Gramineae) type	stem fragment	—	—	—	—	—	—	—
Fabaceae (Leguminosae) type	spine	—	—	—	—	20	—	—

Table 93. Ubiquity of Charred Plant Remains within CCP Features of Different Time Periods Arranged in Approximate Chronological Order (*continued*)

Plant Remains	Part(s)	Ubiquity (%)[a], by Period or Phase[b]						
		Archaic Period (n = 4)[c]	Late Pre-Classic Period (n = 5)	Sedentary–Early Classic Period (n = 1)	Transitional Sedentary Period–Miami Phase (n = 3)	Miami Phase (n = 5)	Roosevelt Phase (n = 6)	Early Classic Period (n = 9)
	Wild plants, nonreproductive (*continued*)							
Juniperus type	charcoal, partially charred wood	100	60	—	100	80	67	22
Larrea type	charcoal	—	40	100	33	40	50	33
Phragmites type	stem fragment	—	20	—	33	20	—	—
Pinus type	charcoal	—	—	—	—	20	—	—
Prosopis type	charcoal	75	100	—	—	60	83	44
Quercus turbinella type	charcoal	—	20	—	—	—	—	—
Simmondsia type	charcoal	—	20	—	—	20	—	11

[a] Ubiquity is calculated as a percentage equal to the presence of each plant taxon within the total number of features examined.
[b] See text for discussion of the date ranges assigned to each period or phase.
[c] Number of features examined per time period.

parts were recovered in a high percentage of flotation samples examined (82 percent); a smaller percentage of samples (18 percent) contained no reproductive parts. Many taxonomic identifications are followed by the word "type" in both the text and tables of this report, which suggests that the ancient specimen closely resembles the taxon named, but may also compare well to other taxa. This conservative approach reflects both the similarity in appearance of parts of southwestern plants that are burned and degraded and the incomplete nature of modern comparative collections.

Highlights of the Archaeobotanical Record

Prehistoric groups living in the vicinity of the CCP project area had access to at least five domesticated or likely managed plants, including maize (*Zea*), cotton (*Gossypium*), common beans (*Phaseolus*), *Agave* (Agavaceae), and little barley (*Hordeum pusillum*). They also had access to the reproductive parts of five native annual and four perennial plants that likely represented foods, and eight separate wood-charcoal types deriving from fuel and construction-timber use. The archaeological and ethnographic evidence establishing the use of many of these plants as important human resources has been presented elsewhere (Adams 1987, 1988, 1994b, 1998b; Adams and Welch 1994; Bohrer 1962, 1987, 1991; Gasser and Kwiatkowski 1991a, 1991b) and will not be repeated here.

Domesticates/Likely Managed Plants

Evidence of five domesticates or likely managed plants are present in the CCP research area. Materials clearly identifiable as an Agavaceae leaf base, numerous U-shaped monocotyledon fibrovascular bundles (likely *Agave*), and monocotyledon tissue were preserved at three sites (Site 41/583, the Vegas Ruin, and the Crane site). *Agave* and other useful monocotyledons, such as sotol (*Dasylirion wheeleri*), bear grass (*Nolina microcarpa*), and Yucca (*Yucca baccata*), all grow in the region at present (Hodgson 1990).

Maize (*Zea mays*) cupules and a kernel fragment were recovered in 10 features at the Vegas Ruin and 8 features at the Crane site. This moderate recovery rate of maize in the CCP flotation samples suggests reliance on this agricultural resource. Likely leftover cobs were often used as a fuel or tinder source in thermal features.

Cotton (*Gossypium*) seeds were excavated from a number of features from the Vegas Ruin, the Rock Jaw site, and the Crane site. It is likely the ancient occupants of the area either grew or had access to cotton in the local area. In addition to the seed hairs that could be used for fabrics, the edible seeds are high in oil.

A single common bean (*Phaseolus*) seed fragment was recovered from a habitation pit structure at the Rock Jaw site. This minimal record may result as much from the common method of preparing beans by boiling as to actual use in prehistory. It is likely the record of domesticated-bean use in the region is greater than it appears.

Finally, a single naked, or hull-free, little barley (*Hordeum pusillum*) grain preserved in Site 41/583, revealed the presence of this domesticate in the area (Adams 1987). The grain was preserved in a late pre-Classic period *horno*, which is suggestive of food preparation. Little barley currently grows along SR 87, west of the study area.

Wild-Plant Resources: Reproductive Parts

Reproductive parts of wild-plant resources have been divided into two groups: (1) annual, often weedy plants, and (2) perennial plants. The first group is composed of plants that often thrive in disturbed habitats, such as agricultural fields and field edges, along pathways, and on midden heaps. They are often responsive to moisture, with population size and reproductive success dependent upon precipitation. The second group includes perennial plants that are part of established vegetation and represents more-stable and less-disturbed portions of the landscape.

Annual, Often Weedy Plants

The record of charred seeds or fruit of annual native plants reveals a fairly broad distribution of cheno-am seeds in all four sites. Cheno-ams could represent either *Chenopodium* or *Amaranthus*, which are often available as both a greens and seed resource throughout a long portion of the summer–fall growing season. There also is a relatively rare presence of woolly wheat (*Plantago*), purslane (*Portulaca*), tansy mustard (*Descurainia*) seeds, and grass (Poaceae [Gramineae]) grains. With the exception of the cheno-ams, this record of annual plants suggests a limited reliance on wild-plant resources and some level of environmental disturbance, such as that associated with agricultural activities.

Perennial Plants

The record of charred reproductive parts of perennial native plants is moderate. The most commonly recovered taxon/part combination is represented by hedgehog cactus (*Echinocereus*) seeds, present in features from all sites except for the Rock Jaw site. The predictable fruiting of hedgehog cacti on a regular basis would have made the sweet fruit a valuable resource. Mallow (*Sphaeralcea* type) and manzanita (*Arctostaphylos* type) seeds were recovered in a single *horno* feature at Site 41/583, suggestive of food preparation; the manzanita was possibly acquired from higher upland locations. Prickly pear (*Opuntia*) seeds were preserved only at the Vegas Ruin, and provided another sweet cactus fruit product.

Wild-Plant Resources: Vegetative Parts

Wood-charcoal recovered from CCP sites reveals information on both construction needs and fuelwood use. Twenty macrofossil samples from the Vegas Ruin, the Rock Jaw site, and the Crane site have all been identified as *Juniperus* charcoal or uncharred *Juniperus* wood that appeared darkened and degraded enough to likely be prehistoric (see Table 92). In five samples from four features–from Features 12, 181, and 182 at the Vegas Ruin and Feature 33 at the Crane site–the material represented cribbing in burials. The remaining specimens represent wood found in the postholes of structures. The additional presence in flotation samples of partially charred juniper wood from a number of postholes at the Vegas Ruin reveals that juniper is quite capable of being preserved when it is partially uncharred. Although juniper is generally considered to be a fuelwood, in this record it was considered to be representative of construction materials. A limited presence of reedgrass (*Phragmites*) stem fragments in the CCP sites may also reflect the use of the long and narrow stems in roofing and other building needs.

Wood Charcoal

Other wood-charcoal types likely derived from wood being used as a fuel for cooking or for keeping warm; some could also have been used for other purposes, such as roofing and tool manufacturing. The most extensively recovered charcoal type was mesquite (*Prosopis*), which was found in numerous features at all four sites. Mesquite prefers drainage bottoms and edges and would have been available along Tonto, Hardt, and Cottonwood creeks, as well as along the Salt River to the south. Another commonly sought wood at all four sites was creosote bush (*Larrea*). Creosote shrubs typically grow on terraces above the valley bottoms and are abundant in the region today. Jojoba (*Simmondsia*) wood was carried in on occasion by occupants of the Vegas Ruin and the Crane site. Finally, on rare occasions, ash (*Fraxinus*), pine (*Pinus*), and oak (*Quercus turbinella*) wood was used, possibly obtained from sources a short journey away from the sites or gathered opportunistically as driftwood transported during the flooding of nearby drainages.

Land Use and Resource Reliance

To determine whether there were any major changes in resource use through time, the entire flotation data set was organized by time period (see Table 93). In this case, the time period categories assigned to contexts by the archaeologists differ in their level of specificity (Deaver et al. 2001). The Late Archaic period represents a time period prior to A.D. 100. Pre-Classic contexts most likely represent late Colonial and early Sedentary phases that date to ca. A.D. 700–1150 in Tonto Basin. The Ash Creek phase, transitional in the A.D. 1100–1150 span between the pre-Classic and Classic periods, has not been formally recognized in the CCP sites. The transitional Sedentary–Classic period deposits are assumed to date somewhere near the end of the Sedentary and the beginning of the Classic period, likely in the period between A.D. 1100 and 1200. The early Classic period represents the general time from the end of the Sedentary until the late Classic period and incorporates the Miami and Roosevelt phases. The Miami phase is the earliest phase of the Classic period, dating after A.D. 1150, and is followed by the Roosevelt phase, likely dating to between A.D. 1250 and 1325. The broad Classic period generally dates between A.D. 1150 and 1450. None of the CCP sites, however, has evidence of occupation during the late Classic period Gila phase (A.D. 1325–1450).

Archaic Period

Four thermal features dating to the Archaic period at the Vegas Ruin preserved only charred wood. All contained juniper (*Juniperus*), and three of the four features contained mesquite (*Prosopis*) charcoal, the two most commonly recovered charcoal types at all project sites. This limited record reflects only fuelwood use and does not reveal the nature of food use early in the history of the region.

Late Pre-Classic Period

The CCP late pre-Classic contexts preserved the widest variety of identifiable plant parts at a late pre-Classic *horno* at Site 41/583 and the Feature 1 pit structure and three associated extramural hearths at the Rock Jaw site. This plant record likely reflects everyday subsistence and wood needs. Four of the five documented domesticated or likely managed plants were preserved in this time period, with the notable exception of maize (*Zea mays*) parts. The largest diversity of wild-plant reproductive plant parts (9 of 10 types recovered from all sites) were recovered, representing both disturbed-ground plants and well-established members of the flora of the area. Three common charcoal types—juniper, mesquite, and creosote bush—document fuel and construction use, as does the presence of reedgrass (*Phragmites*).

Sedentary–Early Classic Period

The Feature 1 midden at the Crane site fell within the Sedentary–early Classic period. Maize, cheno-ams, and hedgehog cacti seeds suggest some of the foods used. Material culture needs included grass and reedgrass stems, common woods (juniper, mesquite, and creosote bush), and the only example of oak (*Quercus turbinella*) identified in the CCP samples.

Transitional Sedentary Period–Miami Phase

The transitional Sedentary period–Miami phase, encompassing the transition from the Sedentary to the early Classic period, is represented by three pit structures: Feature 3 from the Rock Jaw site, Feature 30 from the Crane site, and Feature 34 from the Vegas Ruin. These contexts preserved a very low variety of identifiable plant parts, which likely reflect everyday subsistence and wood needs. Maize and cotton are the only likely managed plants that were identified, and cheno-am was the only wild-plant food identified. *Juniperus*, *Larrea*, and *Phragmites* likely document fuel and construction use. The presence of juniper within all three features attests to the frequency with which it was used as structural elements. The postholes contained only partially charred *Juniperus* wood, reflecting the ability of this wood to be preserved for centuries when buried in the ground.

Miami Phase

Samples were collected from five features spanning the Miami to early Roosevelt phases, including three pit structures (Feature 19, 99 and 179), one cobble-adobe-foundation room (Feature 11), and one burial (Feature 137) at the Vegas Ruin. Much of the wood was recovered from postholes within the pit structures. Three of the five documented domesticated or likely managed plants—cotton, monocotyledon, and maize—were preserved in these features. Cheno-am and *Opuntia* were also preserved. The four houses dating to this phase also preserved the most diverse record of fuel and structural wood, with almost every type represented except for Poaceae (Gramineae) and *Quercus*. As with the transitional Sedentary–Miami period houses, the presence of juniper within all four houses attests to the importance of this wood for structural purposes. The presence of *Prosopis* in three of the houses indicates that this may have also been an important structural material, although it could have been used primarily for fuel. New Mexican privet, ash, pine, creosote wood, and possibly a legume wood that sported spines were also burned.

Roosevelt Phase

Six Roosevelt phase features, consisting of three cobble-adobe-foundation structures (Feature 2, 4, and 6), one granary (Feature 24), one extramural pit (Feature 28), and one roasting pit (Feature 27) at the Crane site were sampled for plant remains. Cotton, maize, and monocotyledon evidence all reflected domesticated and likely managed plants within this time period. Cheno-ams and hedgehog cacti were also used. As with earlier groups, common woods included juniper, mesquite, and creosote bush.

Early Classic Period

Nine features were assigned to the broader time frame of the early Classic period, which extended from the end of the Sedentary period through the Roosevelt phase. These features included the field house at Site 404/2011; four roasting pits, one adobe-lined pit, and a nonfeature context at the Vegas Ruin; and one extramural hearth and a burial at the Crane site. Nothing identifiable was preserved in the field house deposits. Cotton, maize, monocotyledon, cheno-ams, and hedgehog cacti represented a nearly identical record to the Roosevelt phase reported above. The only difference was the occurrence of *Opuntia* in a roasting pit at the Vegas Ruin. A variety of woods were carried in and burned, including commonly used juniper, mesquite, and creosote bush, and rarely sought jojoba.

Summary of the Charred-Plant Record

This archaeobotanical record of the CCP sites suggests that during the Archaic period, groups living in this area used commonly available woods from both dry (*Juniperus*) and mesic (*Prosopis*) locations. Later the pre-Classic period occupants were clearly relying upon at least four domesticated/managed plants (*Agave*, *Gossypium*, *Hordeum pusillum*, and *Phaseolus*), suggesting a commitment to agriculture. They were also taking advantage of a variety of wild annual and perennial plants. During the Classic period, there was a reduced diversity of foods used, and a shift to emphasis on maize, cotton, and cactus. Throughout the long chronological sequence from the Archaic through the Classic period, groups burned juniper, mesquite, and creosote-bush wood; sought reedgrass and other grass stems for other needs; and only occasionally brought in a number of other wood types (ash, New Mexican privet, pine, oak, and jojoba) either available locally or possibly recovered as driftwood coming down local drainages.

Discussion of Charred-Plant Results

Resource Diversity

The diversity of subsistence resources was greatest in the pre-Classic period and diminished during the Classic period (see Table 93). Looking at specific resource use during the pre-Classic through Classic periods, cotton and maize reliance may have increased slightly, based on the relatively small number of features examined per time period. *Agave* (represented here also by monocotyledon fibrovascular bundles and tissue) use does not appear to have changed through time, although it was slightly more common in the Classic period. Little barley and domesticated beans were preserved only in pre-Classic deposits; elsewhere in the region, little-barley use appears to have lessened by the Classic period, and beans have rarely been recovered in any quantity. As for wild plants, occupants of the area clearly gathered and relied upon two wild-plant resources throughout prehistory: cheno-am seeds and hedgehog cactus fruit. The Miami phase, Roosevelt phase, and the undifferentiated early Classic period contexts are similar to each other in terms of the foods and the construction and fuelwoods sought.

Rank Order of Resources

A rank ordering of resources according to time period, based on ubiquity, reveals an interesting pattern (see Table 93). In the pre-Classic period, all the domesticated and managed plants appear to have been of similar rank. The *Agave* and monocotyledon type were recovered from the same feature and, thus, represent only a single occurrence when calculating ubiquity. In contrast, cotton and especially maize were the top-ranked plants by the Classic period. Among wild-plant resources, cheno-ams and hedgehog cacti hold the number-one ranking through time. As for charcoal, juniper ranked number one early and late in the sequence, at times sharing or alternating that top ranking with mesquite and creosote bush. This suggests that a number of locally available woods satisfactorily met the occupants' needs.

Shift in Emphasis to Domesticates from Wild Plants

Although domesticates and likely managed plants were preserved throughout the sequence, two (little barley and common beans) were recovered only in the pre-Classic period. Similarly, the number of wild-plant taxa recovered in Classic period features was reduced relative to the pre-Classic period. The shift toward a smaller set of subsistence resources during the Classic period may reveal an increased reliance on a small number of dependable resources, perhaps owing in part to increasing population pressure in the area. In the case of wood types carried in for fuelwood and construction materials, commonly relied-upon types and overall diversity is quite similar through time for the CCP sites.

Degree of Agricultural Dependence

Agricultural dependence can be examined by considering not only the ubiquity of recognized agricultural and likely managed resources but also by looking at the potential weeds that increase because of farming efforts and become edible foods in their own right. Plants recovered from CCP sites that could be considered garden weeds include cheno-ams, *Descurainia*, *Plantago*, *Portulaca*, and *Sphaeralcea* (Adams and Welch 1998; Gish 1991:244).

By grouping the domesticated/likely managed plants with native resources likely to have been garden weeds, this record suggests that pre-Classic period groups were harvesting agricultural products along with plants from disturbed habitats, such as field edges. Nonweedy plants, such as cacti, grasses, and manzanita (*Arctostaphylos*) may have provided additional food resources. The Classic period groups appear to have included a reduced variety of both domesticates and wild plants in their diets with a greater emphasis on maize.

Seasonality of Resource Availability

The CCP archaeobotanical record reveals plant harvesting in both the cool and warm seasons. The season of plant availability is fairly well known for many of the resources recovered from the CCP sites. Some of this information comes from general floras (Kearney and Peebles 1960) and some from specific phenological records gathered in Tonto Basin to the southeast (Adams and Welch 1994) and Lower Verde Valley to the southwest (Adams and Welch 1998). Based on these sources, plants such as little barley (*Hordeum pusillum*), tansy mustard (*Descurainia*), and woolly wheat (*Plantago*) have some of the first-ripening fruit and seeds and can be classified as "cool-season" resources. Mallow (*Sphaeralcea*) plants are generally perennials that can flower and produce seeds both in the spring and later in the growing season after the summer rains (Kearney and Peebles 1960:541). Other plants, including cheno-ams (*Chenopodium*, *Amaranthus*), purslane (*Portulaca*), manzanita (*Arctostaphylos*), and grasses (Poaceae [Gramineae]), generally ripen in the warmer portions of the growing season. Young leaves and plants of both cool- and warm-season plants can sometimes be eaten. Domesticated maize, beans, and cotton would have been planted in late spring, when soil was still moist from winter precipitation, or possibly as a second crop when the summer rainy season again brought moisture to the land. The harvesting of these crops would have taken place in midsummer through fall.

Floodwater or Dryland Agriculture?

The CCP plant record can shed light on past land-management practices. Based on plant remains, Bohrer (1996) recognized two different forms of land management in two adjacent tributaries to Tonto Creek, located in the general study area. Hardt Creek and Rye Creek both drain southeastward across the Mazatzal piedmont until joining Tonto Creek. Along Hardt Creek, ancient groups supplemented maize agriculture with native resources available from the semidesert grassland, including grass grains, cheno-ams, and legumes. In contrast, people living along Rye Creek practiced an agricultural cycle that included maize but also relied heavily on cool-season resources such as little barley and tansy mustard, along with later-maturing cheno-ams and purslane. Both groups included *Agave* as part of their plant husbandry system. Bohrer suggested that these very different records may reflect an emphasis on dryland farming along Hardt Creek and floodwater farming in the Rye Creek Valley, which integrated productive native annuals into the agricultural cycle.

The plant record from the CCP for the pre-Classic period suggests a combination of *Agave*, other indigenous plants, and Mesoamerican crop husbandry. Seeds of three cool-season annuals, little barley (*Hordeum pusillum*), tansy mustard (*Descurainia*), and woolly wheat (*Plantago*), were used in fairly low amounts. The pre-Classic period occupants also gathered later-maturing cheno-am and manzanita seeds, cactus fruit, and grass grains. This record suggests a mixture of low levels of floodwater farming and dryland land-management strategies suited to the varied topography of the region.

During the Classic period, maize and cotton husbandry probably increased, as did the emphasis on *Agave*. Use of cool-season resources (little barley, tansy mustard, and woolly wheat) was absent by the Classic period. Use of summer- and fall-maturing cheno-ams was maintained. A shift away from floodwater management and a focus on dryland farming is suggested by these trends. Hedgehog cacti provided all groups with a dependable resource.

Chronological Trends

The differences perceived in both plant-use and land-use strategies among these CCP sites between the pre-Classic and Classic periods may be the result of internal organizational, societal, or environmental changes tied to increasing population pressure during the Classic period, which has been noted elsewhere in the Hohokam area. All sites are located within the Arizona Upland Subdivision of the Sonoran Desertscrub (Brown 1982) at elevations between 780 and 865 m (2,560 and 2,840 feet) AMSL with similar floral and faunal resources; thus, differences in locally available resources do not account for the chronological differences in this record.

Mobility vs. Sedentism

The perspectives presented above permit some speculation regarding the level of sedentism or mobility displayed by groups living in Tonto Basin in prehistory. Pre-Classic groups appear to have been fairly sedentary, focusing on domesticates and likely managed plants and practicing limited floodwater farming of native cool-season resources and maize. This required them to occupy their hamlets minimally through the growing season and, perhaps, beyond. The Classic period occupants of the study area also seem to have been reliant on their own agricultural efforts, with an emphasis on cotton and maize, along with weeds of agricultural fields. Their focus on warm-season and dry (hedgehog cacti and *Agave*) resources implies that they were present in the area during certain periods of time but generally may have been more mobile and less inclined to stay in one location throughout the calendar year. When the time periods are examined relative to one another, the plant record suggests permanent occupation during the pre-Classic period, at least before, during, and after the agricultural growing season and, possibly, a form of short-term sedentism during the Classic period. Archaeobotanical records are often mute regarding winter occupation (Adams and Bohrer 1998), and this record is no exception.

General Nature of the Environment

The archaeobotanical record also reveals a fair amount of information about the past environment of the CCP area. The majority of taxa listed in Table 94 are known from the

Table 94. Carbonized Plant Remains from the CCP Sites

Taxon	Common Name	Part(s)
Domesticates/likely managed plants		
Agavaceae type[a]	agave	leaf base
Gossypium type	cotton	seed
Hordeum pusillum type	little barley	caryopsis (grain)
Monocotyledon type	monocot, likely *Agave*	fibrovascular bundles, tissue
Phaseolus type	common bean	seed fragment
Zea mays	maize, corn	cupule, kernel fragment
Wild-plant resources: reproductive parts		
Group 1: Annual, often weedy plants		
Cheno-am[b]	cheno-am	seed
Descurainia type	tansy mustard	seed
Poaceae (Gramineae)?[c]	grass family	caryopsis (2 types)
Plantago type	wooly wheat	seed
Portulaca type	purslane	seed
Group 2: Perennial plants		
Arctostaphylos type	manzanita	seed
Astragalus? Type	milk-vetch	seed
Echinocereus type	hedgehog	seed
Opuntia type	prickly pear	seed
Sphaeralcea type	mallow	seed
Wild-plant resources: vegetative parts		
Forestiera type	New Mexican privet	charcoal
Fraxinus type	ash	charcoal
Poaceae (Gramineae) type	grass	stem fragment
Juniperus type	juniper	charcoal, partially charred wood
Larrea type	creosote bush	charcoal
Fabaceae (Leguminosae) type	legume family	spine, *Acacia* type?
Phragmites type	reedgrass	stem fragment
Pinus type	pine	charcoal
Prosopis type	mesquite	charcoal
Quercus turbinella type	oak	charcoal
Simmondsia type	jojoba	charcoal

[a] "Type" cautions the reader that the ancient specimen is similar to the taxon named but that other taxa may have parts whose morphology is within the range of the taxon cited.
[b] "Cheno-am" is used to designate burnt and degraded specimens that could represent either *Chenopodium* of the Chenopodiaceae or *Amaranthus* of the Amaranthaceae.
[c] "?" indicates uncertainty whether a specimen represents an annual member of the taxon.

area at present (Hodgson 1990; Kearney and Peebles 1960), allowing the assumption of some level of similarity between plants on ancient and modern landscapes. At least a few resources (*Juniperus*, *Pinus*, and *Arctostaphylos*) would have required some travel to higher elevations. What could not be determined from the record were the relative proportions of the different plant taxa available over time.

Human Landscape Modification

Based on the flotation record, arguments have already been made for a general emphasis on agricultural/likely managed resources, including annual plants of disturbed habitats, such as field edges. This implies some level of intentional landscape disturbance, which could include taking advantage of overbank flooding of local drainages for floodplain management of both crops and indigenous wild plants. Some visitation to stable landscapes to harvest perennial plants is also implied.

The CCP Plant Record in the Broader Regional Context

A nearby project along SR 188, the TCAP, included analysis of hundreds of flotation, macrofossil (Huckell 2002), and pollen (Fish 2002) samples from 16 sites spanning the Middle Archaic through the historical period (Clark 2002). TCAP investigated the human use of dissected terraces along the west side of Tonto Creek. Researchers documented resource stability over time, including reliance on maize agriculture and a suite of wild, locally available plants (many of them weeds) for at least two millennia (Fish 2002; Huckell 2002). According to Huckell (2002), ceramic period Tonto Basin residents were agriculturalists who used the Hohokam crop complex and used Hohokam solutions to food-production problems. This included a maize-centered crop complex, exploitation of a broad range of wild plants, and efforts to manage/cultivate selected wild plants, especially *Agave*. Huckell further reported that a smaller number of cultigens were focused upon in the Classic period, specifically maize and cotton on irrigated floodplains and *Agave* on drier terraces. During the Classic period there also were reductions in wild-plant-taxon ubiquities, particularly for cool-season resources. Notably, hedgehog cacti fruit were used throughout the long prehistoric sequence, and it has been suggested that this plant may have been managed or manipulated to achieve large-scale fruit production (Huckell 2002). There is a general lack of use of upland plants within Tonto Basin, with the notable exception of higher-elevation conifers, such as juniper and pine, used for construction purposes; such a Puebloan-like habit is one of the few to suggest influence of Puebloan migrants into the region. The CCP plant record, based on a relatively small number of flotation and macrofossil samples, agrees closely with these reported trends. The pollen record of TCAP sites reinforces the perception of certain resource distribution in Tonto Basin, in that cholla and cattail pollen diminish in ubiquity from south (Salt River area) to north, up to and including the Rye Creek drainage; this likely reflects environmental factors related to increased habitat in the warmer southern area that would favor cholla, with potentially broader and flatter riparian habitats that would favor cattail (Fish 2002). An exception to this trend occurs in some larger sites, apparently capable of amassing resources less available to residents of smaller Classic period sites along Tonto Creek.

The ancient plant record for the broader northeastern periphery region has also been previously summarized (Adams 2003b), and specific comparisons will now be made with those sites excavated immediately to the west along SR 87, where pre-Classic sites share archaeobotanical similarities with the CCP record. In both areas, maize (*Zea mays*) appears to often play a minor role in the pre-Classic subsistence base. The lack of recovery of *Agave* and little-barley (*Hordeum pusillum*) type evidence in many pre-Classic regional contexts may be in part owing to a combination of flotation processing method(s) and/or general unfamiliarity with these microfossils prior to their recognition and description rather than to their absence from the archaeological record. Presence of relict stands of *Agave* and common recovery of mescal knives in the region provides circumstantial evidence for ancient use of *Agave* and possibly *Nolina*, *Dasylirion*, and/or *Yucca*. Reliance on a variety of both cool- and warm-season wild-plant resources is repeated in many of the pre-Classic records examined. The single project that stands out is the Verde Bridge Project, for which the pre-Classic record of domesticated plants is quite varied and extensive in relation to most sites within the region, and where maize, agave, cultivated amaranths, mesquite, saguaro, and goosefoot were more abundant than even in contemporaneous Phoenix Basin sites (Miksicek 1992). The availability of ample arable floodplain in the Verde Bridge Project area, coupled with low elevation, may, in part, explain these differences.

Trends in the region for the Classic period have been summarized by Huckell (2002), as described above. However, other Classic period sites deviate from the basic pattern of reduction in taxon diversity and the shift in emphasis to domesticates. For example, Classic period sites associated with the head of the Scottsdale Canal System produced an extensive archaeobotanical record, where structures often have high ubiquities of maize, agave, pigweed, cotton, mesquite pods/seeds, woolly wheat, and cactus seeds, as well as a wide variety of other wild and semidomesticated resources in lower amounts (Miksicek 1995; Smith 1995). The resource diversity in this set of sites is notably higher than for most of the sites in the region, including the CCP sites, which does reveal the importance of maize and cotton to Classic period occupants.

Any very broad overview forces one to simplify a complicated record with differences due to site type, environmental location, sample size, and methodological differences between projects and analysts. With this in mind, when looked at regionally, the CCP archaeobotanical record retains a relatively low diversity and recovery rate of domesticated/likely managed plants, especially during the Classic period. The inhabitants of CCP sites used little barley in the pre-Classic period, as did most of the Hohokam cultural sphere. *Agave* was particularly important to most regions discussed here, increasing in use during the Classic period in the Lower Verde, Tonto, and Phoenix Basins. A similar trend was noted at the CCP sites. All groups relied heavily on warm-season cheno-ams, and earlier groups focused more on cool-season annuals than did later ones. In the CCP, the pre-Classic occupants used weeds gathered throughout the growing season, some of which they may have encouraged via floodwater farming. By the Classic period, the focus was on warm-season resources, dryland farming, and established plants on the landscape.

Three recent synthetic reports (Bohrer 1991; Gasser and Kwiatkowski 1991a, 1991b) also help place the CCP archaeobotanical record in a regional context. Within the northern periphery, smaller sites located along small drainages and in mountainous terrain often have low levels of maize recovery and exhibit an emphasis on wild plants such as cholla or saguaro (Gasser and Kwiatkowski 1991a). The CCP Classic period sites share a low emphasis on maize, accompanied by other domesticated/likely managed plants and plants of disturbed habitats, such as agricultural fields. Possible cultivated resources, such as agave, little barley, cheno-ams and other plant taxa (e.g., *Plantago* and *Descurainia*) were recovered in low amounts in Bohrer's (1991) study. Although most CCP groups did not share the range of Mesoamerican domesticates found in other northern periphery subregions and along the lower Salt River, their use of indigenous domesticates and field weeds suggests a predominantly agricultural focus during the pre-Classic period, with an increasing emphasis on maize and possibly *Agave* in the Classic period. CCP groups did not regularly gather mesquite pods, consistent with the findings of studies in the northern periphery drainages (Gasser and Kwiatkowski 1991a). Taxonomic diversity decreased during the Classic period, consistent with many Hohokam archaeobotanical records (Gasser and Kwiatkowski 1991b).

Summary and Discussion of Pollen Results

The pollen assemblages were dominated by cheno-am and Compositeae. Davis (see Appendix D.2) attributes this to the proximity of the sites to the Tonto Creek floodplain. Cheno-am frequencies, however, were generally much higher in samples from the Vegas Ruin and Crane sites (30–60 percent) than other sites, especially the field house at Site 404/2011 where cheno-ams constituted only 5–10 percent of the pollen assemblage. By contrast, juniper (Cupressaceae) constituted 10–30 percent of the assemblage at the field house but, with one exception, only 0–8 percent at the Vegas Ruin and Crane site. The exception was a pollen wash from a red plain bowl (Sample 49) in which juniper pollen represented about 24 percent of the assemblage (see Appendix D.3). The high frequencies of cheno-ams at the larger habitation sites is most likely owing to greater disturbance caused by more-intensive and widespread activities associated with the greater resident population size and longer term occupation.

Pollen weeds such as *Eriogonum*, *Boerhavia*, *Euphorbia*, *Kallstroemia*, *Sphaeralcea*, and *Tidestromia* were also common to abundant in both soil and vessel samples. They provide further evidence of aboriginal human disturbance and food use. *Sphaeralcea* was the most common and abundant weed, occurring in 39 of the soil samples and 56 of the pollen washes; although the 4 pollen washes where it was most abundant (Samples 9, 12, 50, and 60)—reaching frequencies of 15–30 percent—appeared to be from disturbed contexts. *Boerhavia* was equally common and the secondmost abundant weedy species, occurring in 35 of the soil samples and 56 of the pollen washes.

Modern disturbance was indicated by the presence of exotic species such as *Eucalyptus*, mulberry (*Morus*), elm (*Ulmus*), pecan (*Carya*), and filaree (*Erodium cicutarium).* Pollen from the exotic trees was generally rare; 9 samples contained trace frequencies of *Eucalyptus* pollen, whereas 1 each contained traces of *Ulmus* and *Carya* pollen. Two samples contained *Morus* pollen; however, a red plain jar (Sample 54) from the Vegas Ruin contained almost 13 percent *Morus* pollen, suggesting it was contaminated. Filaree was much more common as a contaminant, occurring in 19 of the soil samples and 19 of the washes, albeit usually in trace frequencies. Filaree, however, constituted between 4 and 23 percent of the pollen assemblage in 7 pollen washes—2 Salado Red Corrugated jars (Samples 9 and 12), 2 Salado Red Corrugated bowls (Sample 51 and 60), 2 red plain jars (Sample 50 and the one with a high frequency of *Morus* pollen, Sample 54), and a red plain bowl (Sample 5)—suggesting that these samples were also contaminated. Significantly, the 2 Salado Red Corrugated jars contained the highest frequencies of beeweed (*Cleome*) pollen, suggesting that this might also represent a contaminant rather than a food resource stored or processed in these 2 vessels. As noted above, the samples with the highest frequencies of *Sphaeralcea* also came from 4 of these likely contaminated vessels. Overall, the pollen washes exhibited greater evidence of contamination than did the soil samples. Contamination may have occurred in the field during excavation, while the vessels were being stored or while the samples were being collected from the vessels.

Other native economic plants identified in the pollen samples included *Cereus*, *Opuntia*, *Agave*, *Yucca*, and jojoba (*Simmondsia*). Surprisingly, *Cereus* pollen was extremely rare, occurring in trace frequencies in only 3 soil samples and 1 pollen wash. *Opuntia* pollen, both cholla (*Cylindropuntia*) and prickly pear (*Platyopuntia*), was much more common and abundant, occurring in 37 of the soil samples and 49 of the pollen washes. Frequencies of *Opuntia* pollen were generally under 5 percent, although in the case of a red plain bowl (Sample 26), cholla pollen constituted 97 percent of the assemblage, presenting a strong case for use or storage. Jojoba pollen was common, occurring in 21 of the pollen wash samples, but none of the soil samples. Generally, jojoba pollen occurred in very low frequencies, although like *Sphaeralcea*, the 2 samples with high frequencies came from likely contaminated samples (Samples 50 and 60). Agave pollen, which is rarely found in archaeological assemblages, was less common, occurring in 12 soil samples and 12 pollen washes. Where it was found, it occurred in very low frequencies; significantly, however, it was recovered from all 5 sampled sites. Yucca, by contrast, was recovered in trace frequencies from only 9 samples, 8 from the Vegas Ruin and 1 from the field house at Site 404/2011. *Typha* pollen was also very rare considering the proximity of the sites to the Tonto Creek floodplain. Only 2 soil samples and 5 pollen washes contained trace frequencies of *Typha* pollen.

The pollen of cultivated plants was also commonly recovered from all sampled sites. Maize (*Zea mays*) was the most common, being found in 22 soil samples and 25 pollen washes, although it usually occurred in trace frequencies. It exceeded 15 percent, however, in a single soil sample from burial Feature 38 at the Vegas Ruin, suggesting that maize pollen may have been added as an offering. Maize pollen also exceeded 3 percent of the assemblage in 1 sample from a Salado Red Corrugated jar (Sample 37) from the Crane site. Unfortunately, this sample also contained over 2 percent filaree and a single *Eucalyptus* pollen grain, placing suspicion on the maize in this sample. The field house at Site 404/2011 had a surprisingly high ubiquity of corn pollen (4 of the 10 samples). Again, this is suspect, as all 4 samples contained trace frequencies of filaree pollen and 1 contained a single pecan pollen grain. Cucurbitaceae pollen was rare and occurred in trace frequencies in only 4 pollen wash samples: 2 red plain bowls (Samples 8 and 55) and 1 Snowflake Black-on-white jar (Sample 61) from the Vegas Ruin, along with a Salado Red Corrugated jar from the Crane site. This pollen could represent the use of cultivated squash or native gourds. Finally, the cultivated plant pollen included two grains of cotton (*Gossypium*) pollen found in the soil sample recovered from the burial Feature 38 at the Vegas Ruin, which also contained an unusually high frequency of maize pollen.

The pollen evidence reinforces and fills out the record of prehistoric plant use documented in the charred-plant record. Supporting pollen evidence was found for three of the major cultivated and managed plants identified in the charred-plant record: *Agave*, maize, and cotton. Maize was especially widespread, occurring in 45 percent of the pollen soil and wash samples. To this record can be added evidence for the use of Cucurbitaceae. The ubiquity of the usually rare *Agave* pollen in CCP samples (23 percent) is especially significant, as it suggests that the monocotyledon tissues identified in the charred-plant record most likely represent this taxa and, to a lesser degree, *Yucca*. We can say little about temporal trends in plant use, because the pollen samples were dominated by samples from Classic period contexts. The pollen record, however, documents the importance of maize and *Agave* to the Classic period inhabitants of the project area. The pollen evidence from the Archaic period roasting features at the Vegas Ruin is meager. No evidence of cultivated or managed plants was evident and pollen frequencies of most taxa were very low. Two of the four samples, however, had high frequencies of cheno-ams (31-36 percent) and one had moderate frequencies of *Boerhavia* (11 percent) and cholla (7 percent), suggesting that these plants may have been used in these features. The pollen evidence also adds to the record of *Opuntia*, especially cholla, and *Sphaeralcea* as important plants for the residents of the project area but shows little evidence for the use of *Cereus*-type cacti and manzanita that were found in the charred-plant record.

CHAPTER 8

Bioarchaeology of Human Remains

Penny Dufoe Minturn and Jill L. Heilman

Introduction

During the CCP, we excavated 45 inhumation burials from three sites: the Vegas Ruin (AZ U:3:405/2012), the Crane site (AZ U:3:410/2017), and AZ U:3:408/2015. The majority of the human remains discussed in this chapter are from the Vegas Ruin, where 37 individuals were excavated. An additional inhumation, Feature 187, was discovered extending underneath the existing roadbed. Because this burial was neither excavated nor analyzed, it is excluded from the following discussion. Thirty-five of the 37 excavated burials were recovered from within five spatially defined groupings. Two individuals (Features 106 and 199) were recovered from the site outside of these spatially defined groupings. The Crane site yielded 7 poorly preserved individuals, with completeness ranging from 10 to 70 percent. An eighth possible burial feature was identified and excavated; however, no human remains were recovered. Finally, a single 3–4-year-old of undetermined sex was identified from Site 408/2015. The skeleton of this individual was approximately 20 percent complete, poorly preserved, and had no observable pathology.

The three sites will be considered separately with analyses of age, sex, and stature reconstruction; metric measurements and nonmetric traits; and a discussion of pathology. Although the mortuary analysis is discussed elsewhere, the discussion of pathology and human variation presented here will take into account the groupings and burial plots. The information in this rFlexor hallucis breviseport is most useful when it is combined with other reports to aid in an overall reconstruction of life during the Miami and Roosevelt phases in Tonto Basin. As the title suggests, this chapter focuses on the bioarchaeology of the CCP population, information about the mortuary behavior associated with this population is presented in Volumes 1 (site and feature descriptions) and 3 (syntheses).

Methods and Preservation

Excavation of the burials at each of the sites was done with great care. General burial excavation methods are described in Chapter 1 of Volume 1 and specific excavation methods for each burial are described in detail under the individual feature descriptions in Chapters 5, 7, and 8 of Volume 1. The human remains were removed to the SRI laboratory in Tucson, where they underwent further analysis. All analyses were nondestructive, as per the treatment plan (Ciolek-Torrello and Klucas 1999). Field and laboratory analysis forms detailing all observations for each burial were prepared and are on file at SRI and the ASM. Inventories of preserved bones of each individual are illustrated in Appendix E.1.

The term "preservation" encompasses both completeness of individual remains and the condition of the bone itself. Both completeness and bone condition were moderate to poor across all sites (Table 95). Poor preservation conditions existed at Site 408/2015; the single individual was represented by only a few skeletal elements. The Crane site burials were better preserved, although none of the 7 individuals recovered was greater than 70 percent complete. The best preservation conditions existed at the Vegas Ruin, with several individuals 90–95 percent complete and only 18 of the individuals less than 70 percent complete. Ochre staining was present in 60 percent of the burials, with 24 burials at the Vegas Ruin and 3 burials at Crane site exhibiting extensive evidence of staining over parts of their bodies. Although it is likely that the application of ochre was a common part of the mortuary ritual in the CCP area, it is unclear how or when the ochre was applied and what affect it might have had on bone preservation.

Even with complete and perfectly preserved remains, physical anthropologists cannot determine age or sex with 100 percent certainty. With regard to sexing, there will always be some individuals with both male and female attributes; and with regard to aging, our ability to estimate age decreases as the individuals get older. Skilled physical anthropologists

Table 95. Percentage of Completeness of Individuals, by Group and Site

Group, by Site	Number of Individuals, by Completeness			
	0–25%	26–50%	51–75%	76–100%
Vegas Ruin (405/2012)				
Group 1	—	2	4	3
Group 2	—	1	1	—
Group 3	—	—	1	5
Group 4	3	1	5	—
Group 5	1	—	6	2
No group	—	—	2	—
Subtotal (% of site total)	4 (11)	4 (11)	19 (51)	10 (27)
Site 408/2015				
No group (% of site total)	1 (100)	—	—	—
Crane site (410/2017)				
No group (% of site total)	3 (43)	2 (29)	2 (29)	—

Note: Counts and percentages include analyzed samples only.

can still achieve good accuracy, 90 percent and above, with well-preserved remains, however. The lack of completeness and poor preservation of the remains from the CCP sites made some age and sex determinations difficult to estimate. More importantly, the diagnosis of disease or trauma from these remains could be problematic. Erosion of the outer table of bone on a complete skeleton, for example, could erase all evidence of many diseases and some evidence of trauma. When viewed in comparison with other skeletal collections from the Southwest, however, the preservation of these individuals was not significantly better or worse and should be considered as a good comparative sample.

Multiple methods were used for determining age and sex. Subadult aging was accomplished using dental growth and eruption (Ubelaker 1978, 1989; see Chapter 9), epiphyseal fusion (Krogman and İşcan 1986), and long-bone length (Fazekas and Kosa 1970; Regan 1988). For adults, pubic-symphyseal aging (Suchey-Brooks method, as described in Buikstra and Ubelaker 1994; Todd 1920, 1921) would be ideal, but preservation was usually too poor to apply these methods. Instead, dental development (Ubelaker 1989) and dental wear (Buikstra and Ubelaker 1994) were used, as well as rib ends (İşcan et al. 1985a, 1985b), epiphyseal fusion (Krogman and İşcan 1986), and degree of osteoarthritis (Krogman and İşcan 1986).

Sex determinations were made using Phenice's (1969) techniques using pelvis shape when possible and also using mastoid size, mandibular angle, brow-ridge morphology, nuchal-crest size, femur-head size, general robustness, and presence of scars of parturition (Buikstra and Ubelaker 1994). Stature was reconstructed using Genovés's (1976) calculations based on a Mexican cadaveric sample, measuring the length of the tibia and femur. Finally, both nonmetric traits and skeletal measurements were recorded, when possible, for both the crania and postcrania (Buikstra and Ubelaker 1994).

Results

Vegas Ruin (AZ U:3:405/2012)

The sex and age distribution by group for the Vegas Ruin is listed in Table 96. Locations of the burials are illustrated in Figure 55. Because the level of precision that age at death could be determined varied from case to case, we followed several conventions. When age at death was determined to fall within a range (e.g., 35–45 years), the midpoint of the range was used for tabulation purposes. When the age at death was estimated to exceed a given age (e.g., 45+ years), the individ-

Table 96. Age and Sex Distribution at the Vegas Ruin (405/2012), by Group

Sex Distribution, by Group	Age Distribution							
	0–6	10–14	15–20	21–30	31–40	41–50	50+	Adult
Group 1 (n = 9)								
Male	—	—	—	—	3	2	1	—
Female	—	—	—	1	—	—	1	—
Indeterminate	1	—	—	—	—	—	—	—
Subtotal	1	—	—	1	3	2	2	—
Group 2 (n = 2)								
Male	—	—	—	—	—	—	—	—
Female	—	—	—	—	—	—	—	—
Indeterminate	2	—	—	—	—	—	—	—
Subtotal	2	—	—	—	—	—	—	—
Group 3 (n = 6)								
Male	—	—	—	2	—	1	1	—
Female	—	—	—	—	1	1	—	—
Indeterminate	—	—	—	—	—	—	—	—
Subtotal	—	—	—	2	1	2	1	—
Group 4 (n = 9)								
Male	—	—	1	—	—	1	—	—
Female	—	—	—	—	—	—	2	1
Indeterminate	4	—	—	—	—	—	—	—
Subtotal	4	—	1	—	—	1	2	1
Group 5 (n = 9)								
Male	—	1	1	1	—	1	—	—
Female	—	—	—	—	3	1	—	—
Indeterminate	1	—	—	—	—	—	—	—
Subtotal	1	1	1	1	3	2	—	—
Not in group (n = 2)								
Male	—	—	—	—	1	1	—	—
Female	—	—	—	—	—	—	—	—
Indeterminate	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	1	1	—	—
Combined population								
Male	—	1	2	3	4	6	2	—
Female	—	—	—	1	4	2	3	1
Indeterminate	8	—	—	—	—	—	—	—
Total	8	1	2	4	8	8	5	1

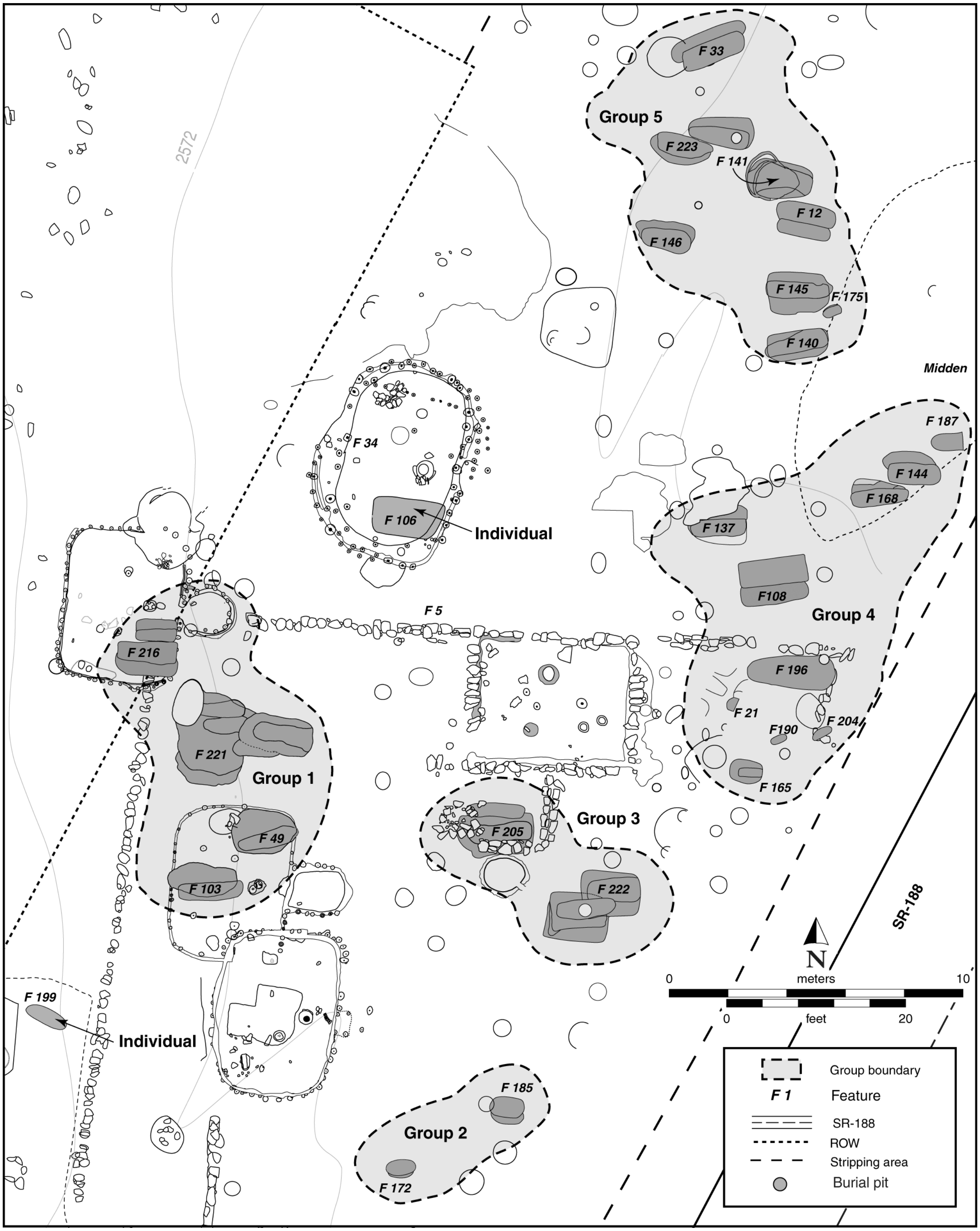

Figure 55. Locations of burial features at the Vegas Ruin (405/2012).

ual was included in category encompassing that minimum age. Thirty-seven individuals were recovered; 18 were male or probable male, 11 were female or probable female, and 8 were subadults of indeterminate sex. Because even complete and well-preserved subadults are difficult to sex (Hunt 1990; Weaver 1980, 1998), sexing of prepubescent individuals was not attempted, although 1 individual aged 10–12 years was assessed as a possible male (Feature 12, Group 5) based on projectile points within the burial assemblage.

There were slightly more adult males (15) than adult females (11) for the site as a whole. The age of 1 of the adult females could not be determined. Eleven subadults were recovered, or 29.7 percent of the burial population at the Vegas Ruin. Fink (2003) found 21.6 percent of subadults in a sample of 37 individuals for the SCP and Turner et al. (1994) had a similar finding at the Livingston sites, where 27.7 percent were under the age of 10 in a sample of 65 individuals. Minturn (2001) reported that 34 percent (n = 104), of the TCAP burial population (n = 307) were subadults. Ethnographic accounts and archaeological studies suggest that subadults account for up to half of the death rate in preindustrial societies (Gruber 1971:64; Mosothwane and Steyn 2004:49; Ucko 1969:271). Three reasons have been suggested for finding a lower percentage of subadults than might be expected: (1) greater decomposition of subadult bone, (2) subadults being buried in other areas than those excavated, or (3) subadults were living past the age of 10 (Turner et al. 1994). In addition to these three reasons, a fourth may simply be that the small number of subadults is an artifact of sample size. Overall, distribution within groups was not unusual. Only the two smallest groups, 2 and 3, did not have both adults and subadults, the former having only 2 subadults and the latter having only adults.

Stature was calculated for only six females, with heights ranging from 153 to 161 cm (5–5¼ feet) and for only eight males, with a range of 162–174 cm (5¼ feet–5 feet 8 inches). Even though the tibia and femur were often present, it was not possible to estimate stature in a number of cases, because these bones were not sufficiently well preserved. Cranial and postcranial measurements and nonmetric traits were scored whenever possible. Table 97 lists those features that had a score for at least one measurement or trait. None of those features had a full complement of scores, and most had only a few. For example, four cranial and five postcranial measurements could be obtained from Feature 12. Also, the same traits or measurements are not likely to be available for all individuals. There is a dearth of information with regard to metrical and nonmetrical scores, yet they may be significant if combined with other, similar samples and have been provided for that reason.

Descriptions of Burial Groups

Group 1

Group 1 includes two burial plots, Feature 221 and 216, both located in the northwest corner of the Feature 1 compound. Group 1 also includes two individual burials, Features 49 and 103, placed in the floor of the Feature 99 pit structure.

Feature 14, Burial Plot 221

Male, aged 40+ years, 70 percent complete. The skeleton was fairly complete and preservation was good, even though the body was disarticulated. The burial had been disturbed prehistorically by the burial of the individual in Feature 101. The individual was determined to be male based on very blunt eye orbits, left femur length (47 cm), and a large nuchal crest. Age was based on dental attrition. No ochre or pathologies were observed. The cranium was too fragmented to allow for a determination of cranial deformation. The stature of this male was 173 cm (5 feet 8 inches) based on left femur length.

Feature 101, Burial Plot 221

Male, aged 31–35 years, 90 percent complete. The skeleton was largely intact. The individual was determined to be male by a narrow sciatic notch, male pubic angle, and right femur length (44.5 cm), although the chin was round, the sacrum flat, and left-femur-head measurement was 42.6 mm. The metopic suture was fully open, and there were many wormian bones in the lambdoidal suture. Dental wear placed the age of this male at 31–35 years. There was no obvious osteophytic lipping on the vertebrae. Cervical vertebra 2 (C2) had a superior-inferior fracture separating the right articular facet from the dens process. There was evidence of healing and the right articular facet was slightly enlarged. The right clavicle had a bone spicule at the costoclavicular ligament site, which is indicative of trauma or heavy use at that site. Degenerative joint disease (DJD) on the mandibular condyles was indicated by extra bone growth at that site. Ochre staining was present on the acromion of the left shoulder and on the heels of both feet. The skull exhibited symmetrical occipital flattening. The stature of this male was 167 cm (5 feet 6 inches) based on right femur length.

There was also fusion of C2 and C3. C2–C3 "fusion" is typical of Type II Klippel-Feil syndrome, where the vertebral segments fail to separate in utero, causing the block appearance (Barnes 1994; Ortner and Putschar 1985). Two other individuals from this site also exhibited block C2–C3 vertebrae: one found in Feature 33 (Group 5, male) and one in Feature 182 (Group 3, female). It is important to note that preservation of the vertebrae was insufficient to determine if a diagnosis of Klippel-Feil syndrome is warranted in all three

Table 97. Cranial and Postcranial Metric and Nonmetric Traits Taken at Vegas Ruin (405/2012), by Feature

Feature No.	Cranial Measurements	Postcranial Measurements	Cranial Nonmetrics	Postcranial Nonmetrics
12	X	X		
14			X	
33		X		
49		X	X	
101	X		X	
102	X	X	X	
106	X	X	X	
137	X	X	X	
140	X	X		
141	X	X	X	X
142	X	X	X	
143	X	X	X	
144	X	X	X	
145	X	X	X	
164	X	X	X	
181	X	X		
206		X	X	X
207	X	X	X	
219	X	X		
220	X	X	X	

cases or if some other etiology was at play, but Barnes (1994) has suggested an autosomal recessive inheritance for Type II Klippel-Feil syndrome. This argues for some potential degree of relatedness among these three individuals.

Feature 102, Burial Plot 221

Female, aged 50+ years, 65 percent complete. This skeleton was determined to be female based on left-femur-head measurement (40.7 mm) and wide mandible angle and was aged at 50+ by dental wear. There was symmetrical occipital flattening. There was ochre staining on the upper pubic rami. The stature of this female was estimated at 158 cm (5 feet 2 inches) based on the length of the left femur (42 cm).

Feature 133, Burial Plot 221

Female, aged 21–23 years, 60 percent complete. The skeleton appeared to be female based on a wide mandible angle and wide sciatic notch and was aged 21–23 years by dental wear, very young rib ends, and the beginning fusion of the right clavicle's sternal end. Severe insect disturbances were present, especially on the underside of the bone. There was heavy ochre staining on the pelvis, sacrum, lumbar vertebrae, left radius and ulna, beneath the pelvis, and right femur in the acetabulum. There was also ochre staining on the back of the proximal and distal right femur and the back of the shaft of the left femur. There was a circular depression on the occipital area of the skull, approximately 2.13 cm in diameter and 0.5 cm deep. This depression was located higher than the crux of the inner cruciform and was possibly caused by trauma but, ultimately, the etiology remains unknown. The cranium exhibited occipital flattening.

Feature 143, Burial Plot 221

Male, aged 50+ years, 40 percent complete. Large brow ridges and mastoids and the left-femur-head measurement of 43.2 mm indicated that this individual was male. Age was placed at 50+ years related to Stage 2 osteophytes on the fifth lumbar vertebrae (L5) and dental wear. A spiral fracture to the distal right tibia was well healed with a slight callus remaining. The distal end was offset medially. There were well-healed fractures to the right ribs Number 4 and 5 at midarc. There was a large extra bony growth on the lateral proximal edge of the fourth right metatarsal, suggesting trauma. It is impossible to know if these injuries were the result of a single traumatic episode, but the degree of healing in all three instances is similar enough to be suggestive of that scenario. There was fairly symmetrical flattening of the occipital skull. No ochre was present on this individual, whose stature was estimated at 164 cm (5 feet 4 inches) based on the length of the right femur (43 cm).

Feature 219, Burial Plot 216

Child, aged 5–6 years, 75–80 percent complete. This skeleton was of an individual of indeterminate sex and an age of 5–6 years based on dentition. Bone preservation was excellent, and the skeleton was 75–80 percent complete. There was ochre staining on the right clavicle, the left and right humerus, the left and right ribs, the right radius and ulna, the left hand, the pelvis and sacrum, the proximal shafts of both femurs and the distal shaft of the left femur, the proximal tibia and fibula bilaterally, and the right distal tibia and fibula. The skull was wider than it was long and demonstrated occipital flattening, which was asymmetric and more pronounced on the right. No pathologies were noted.

Feature 220, Burial Plot 216

Male, aged 45–50 years, 85 percent complete. The skeleton was determined to be male by a very narrow sciatic notch and left-femur-head measurement of 45.7 mm. The spine was fragmentary, but Stage 2 osteophytes were present on the cervical, thoracic, and lumbar vertebrae. The individual was aged at 45–50 years based on dental wear. There was some ochre staining on the posterior surface of the right ribs (located on the arc near the vertebral end of at least two), the back of the right scapula, a small spot on the back of the left scapula, and the front arc of one of the lower left ribs. There was occipital flattening to the foramen magnum.

Feature 49

Male, aged 41–50 years, 85 percent complete. There was extensive rodent disturbance at this feature that resulted in the displacement of the ribs. There also was scattering of the phalanges, carpals, and tarsals. Large cobbles were located throughout the fill and on top of the bone, accounting for the presence of crushed bone. The individual was determined to be male based on a right-femur-head measurement of 44.4 mm, right-femur length of 44 cm, and a square chin. The individual was aged at 41–50 years based on dental wear. The skull had been fragmented by ground pressure, and occipital flattening of the observable right side was present. The right patella showed osteoarthritis all around the articular surface and slight lipping. The shafts of the left and right tibias were thickened. The thoracic vertebrae showed large osteophytes. The lumbar vertebrae showed three curved spicules and were near fusion. On the vertebral ends of the right ribs, there were new articular surfaces inferior and slightly more lateral than the normal original surfaces. Some osteophytes were present on the vertebral ends of two other ribs, one left and one right. The right and left tibial shafts were thickened from periostitis and osteitis. The stature of this older male was estimated to be 166 cm (5 feet 5 inches) based on the length of the right femur (44 cm).

Feature 103

Male, aged 31–40 years, 35 percent complete. Preservation of this individual was poor, with the skull being fragmented and only the legs having good preservation. The left-arm bones exhibited rodent gnawing and the remaining jumble of ribs, phalanges, and other bones supported an interpretation of extreme rodent disturbance, especially in the upper part of the body. Teeth and bone fragments were recovered from a rodent burrow near the left side of the cranium. Sex was determined to be male based on a very sharp nuchal crest and large left-femur-head measurement (43 mm). Age was based on dental attrition and was estimated at between 31 and 40 years. The skull showed evidence of symmetrical occipital flattening.

Group 2

Group 2 was located in the southeast corner of the Feature 1 compound and includes two child burials.

Feature 172

Neonate, aged birth–3 months, 30 percent complete. This was a fragmentary skeleton of an infant of indeterminate sex that was aged birth–3 months based on dental development. A portion of the left occipital skull, clavicle shafts, portions of the lumbar vertebrae, the blade of the left pelvis, and shafts of the left and right humerus, radius, and ulna were present. Also present was the shaft of the left femur and right tibia and fibula. No ochre staining was present and no pathologies were noted. The cranium was too partial to assess cranial flattening.

Feature 185

Child, aged 6–12 months, 65 percent complete. Bone preservation was fair. Most of the skeletal remains of this infant were present but had been moved as a result of rodent and root disturbance throughout different levels of the pit. This child was determined to be 6–12 months of age based on dental development and measurements of long bones. This young child exhibited active cribra orbitalia, or pitting of the roof of the eye socket, in both eye orbits. Cranial deformation could not be assessed, and no ochre was present.

Group 3

Group 3 includes two burial plots, Features 222 and 205. These burial plots are located in the east-central portion of the compound. A cobble-adobe-foundation structure, Feature 54, overlay burial plot Feature 205. Feature 222 was southeast of Feature 205.

Feature 164, Burial Plot 222

Male, aged 45–50 years, 90 percent complete. The individual, despite having small mastoids, was determined to be male based on the flat auricular surfaces of the pelvis, narrow sciatic notches, small pelvic blades, no preauricular sulcus or scars of parturition and no ventral arc, and a left-femur-head measurement of 45.4 mm. An age of 45–50 years was based on the pubic symphysis, auricular surface, and dentition. This older male had slight DJD on left metatarsals 1, 2, and 4 and proximal phalanx 1. There was ochre staining midshaft on both femurs. Both left and right fibulas had light ochre on the front and medium to light ochre staining on the tibias. There was a small amount of ochre on the right medial talus, as well as on the heel and the left medial talus. There was cranial deformation low on the occipital surface; it was very asymmetrical and more pronounced on the right side. Flattening continued past the rim of the foramen magnum, so that the occipital condyles were in the same plane as lambda. The stature of this older male was estimated at 164 cm (5 feet 4 inches) based on the length of the left femur (43.2 cm).

Feature 181, Burial Plot 222

Male, aged 21–25 years, 95 percent complete. The skeleton was determined to be male by a squarish chin, large mastoid, small sciatic notches, and a flat auricular surface. The left third molar had not erupted, and the sternal end of the left clavicle had not fused (although the right clavicle was beginning to fuse), aging this individual to 21–25 years. There were two small areas of eburnation, which is suggestive of early DJD, on the left patella of this young male. There was ochre staining of the right side of the skull, the right clavicle, the right lower rib cage and lower sternum, and the left pelvic blade and head of the femur. This individual had extreme cranial deformation on the right side, causing the face to be slightly pushed forward on the right side. This deformation probably occurred during this individual's early childhood years when the bone was still malleable. The stature was estimated at 166 cm (5 feet 5 inches) based on the length of the right femur (44.7 cm).

Feature 182, Burial Plot 222

Female, aged 45+ years, 90 percent complete. The individual was determined to be female by a gracile chin, no brow ridges, blunt eye orbits, a wide sciatic notch, and a deep and wide preauricular pit. The individual was aged to 45+ years based on dentition. Stature could not be estimated, because neither the tibias nor the femurs were complete. There was congenital fusion of the anterior bodies of C2 and C3 of this older female. As in the case of the individuals contained in Features 102 and 33, this may reflect an instance of Klippel-Feil syndrome, suggesting a degree of relatedness between the individuals. There was ochre staining, front and back, on the distal end of the right humerus; the left and right radius and ulna; and both hands. Ochre was thick on the left hand, especially the fingertips. There was ochre all around the distal shafts of the femurs, and bilaterally on the proximal ends of the tibias and fibulas, as well as on the right patella. The bottoms of the right metatarsals, tops of metatarsals 3 and 4, and some of the right phalanges, as well as the plantar surface and one middle phalange of the left foot were ochre stained. There was symmetrical occipital flattening.

Feature 197, Burial Plot 205

Male, aged 25–30 years, 90 percent complete. In addition to being largely intact, this skeleton was well preserved. The individual was determined to be male based on a very narrow sciatic notch, a square chin, and the subpubic angle. Tooth wear was moderate in the mandible; there were no maxillary remains. The individual was aged between 25 and 30 years based on dental wear. The distal, lateral aspect of the right fifth metacarpal was thickened. The morphology was suggestive of soft-tissue trauma to the area. An unlikely but also possible explanation is that an additional, nonrecovered sesamoid bone was present and rubbed at that site during the individual's lifespan. There was symmetrical occipital flattening. No ochre was present. The stature of this male was estimated at 162.5 cm (5¼ feet) based on the length of the left femur (42.5 cm).

Feature 206, Burial Plot 205

Female, aged 31–40 years, 70 percent complete. This skeleton was from a secondary inhumation. Bone preservation was good. The individual was determined to be female because of a very wide sciatic notch, flat auricular surface, small mastoid, and very wide, deep scars of parturition. Age based on dentition was placed at 31–40 years. There was ochre staining on the ribs, the back of the right innominate bone, the right pubic bone, the left iliac crest, the left femur head, the shafts of both femurs, the distal end and patella of the left leg, the right of the right patella, the proximal ends of the tibias, the distal end of the left tibia, and the heel of the right foot. There was also ochre staining on the bones of the left hand, above the left eye orbit, and on the left side of the mandible. A 60-by-40-mm button osteoma was present on the posterior left parietal. Button osteomas are common, benign bone growths typically occurring on the outer table of the skull (Ortner and Putschar 1985). The skull showed symmetrical occipital flattening. The stature of this female was estimated at 161 cm (5 feet 3 inches) based on measurement of the left femur (43 cm).

Feature 207, Burial Plot 205

Male, aged 55+ years, 90 percent complete. Bone preservation was fair to good; however, stature could not be estimated, because neither the tibias nor the femurs were complete. The individual was determined to be male by a square mandible and small sciatic notch. Age was estimated to 55+ years based on dental attrition and level of osteoarthritis. The skeleton demonstrated severe osteoarthritis of the lumbar spine, particularly on L4, the right side of the vertebral body, superior and inferior on the anterior surfaces. L5 had been sacralized. The superior body showed pitting and rimming; there were osteophytes on the inferior aspect. Of the cervical vertebrae: C3 and C4 were cupped; C5 and C6 were cupped and Stage 3 and 2, respectively with osteophytes present; and C7 was cupped. The thoracic vertebrae were very fragmented, but Stage 1 and 2 osteophytes plus rimming and pitting were present. The left patella showed bony spicules on the superior anterior edge and slight osteoarthritis on the back. Both tibia shafts were thickened in the middle with rounded anterior surfaces suggestive of osteitis. There was thick and extensive ochre staining, especially in the right lumbar and pelvis region, the inside and back of the acetabulum and ramus, and the head of the left femur. Symmetrical occipital cranial deformation was present.

Group 4

Group 4 consists of the burials discovered in the northeast corner of the compound as well as those immediately north of this area. These burials were located just west of SR 188. Feature 187 was found at the northeast edge of this burial group, although it was not excavated and is not reported below.

Feature 21

Child, aged 5–6 years, 25 percent complete. This individual of indeterminate sex was poorly preserved and very fragmented. Age was based on dental development. No ochre was present and no pathologies were noted. The cranium was too fragmented to assess cranial flattening.

Feature 108

Male, aged 15–17 years, 75 percent complete. The skeleton was largely complete, although preservation of individual bones was only fair to poor because of extensive root disturbance throughout the skeletal and cranial remains. Stature could not be estimated because neither the tibias nor the femurs were complete. The approximate age of the individual was 15–17 years, with the right third molar ready to erupt into the oral cavity. The remains were determined to be male because of the robust cranial features and rather square chin. This young male showed an instance of pedal symphalangism (PS). The phalange was unsided and probably from the third or fourth toe. The fifth digit was not preserved. PS is ankylosis, or fusion, of the intermediate and distal phalanges of one or more toes. This congenital defect is the result of the failure of cartilaginous separation in utero (Case and Heilman 2005). The highest occurrence of PS is in the fifth digit. If present in the fifth, it may occur in the fourth and then third digits. This tends to be a largely underreported defect. There was a small patch of ochre beneath the left ulna and occipital flattening in the posterior cranium.

Feature 137

Male, aged 45–55 years, 75 percent complete. Bone preservation was good, although roots had grown into the posterior cranium. Although the skeleton was largely intact, stature could not be estimated, because neither the tibias nor the femurs were complete. The individual appeared to be male based on a square chin, large right-femur-head measurement (46.3 mm), and narrow sciatic notch. Age was approximately 45–55 years based on tooth wear and molar resorption. The vertebral ends of the left ribs were depressed with small osteophytes. The left clavicle showed a healed fracture at the acromial end at the tubercle, approximately 4 cm from the lateral end. Both right and left femurs had very robust linea aspera. Thoracic vertebral bodies showed Stage 1–2 osteophytes; other vertebral bodies were not preserved for observation. Rib ends were rimmed and pitted. There was occipital flattening. No ochre was found in the burial.

Feature 144

Female, aged 55+ years, 75 percent complete. Preservation of the bone of this skeleton was fair, although root disturbance was prevalent for the dorsal side of the bone. Stature could not be estimated because neither the tibias nor the femurs were complete. The individual was determined to be female by a wide sciatic notch and round chin, although the deltoids were quite robust for what was otherwise a gracile, petite skeleton. Age was determined to be 55+ years based on severe resorption of nearly all of the maxilla and posterior regions of the mandibular alveolar bone. This older female had two instances of pedal symphalangism out of 13 left and 14 right phalanges (see Feature 108). There was a fracture to a right metatarsal that was well healed with a callus. There was ochre staining on the distal end of the right femur; the left foot, tibia, and fibula; and the right tibia. Ochre was also present on the right humerus and hand, and beneath the left femur, as well as on the metatarsals and foot phalanges. Symmetrical occipital cranial deformation was present.

Feature 165

Child, aged 6–9 months, 75 percent complete. This was the skeleton of a juvenile with fair bone preservation and aged to approximately 6–9 months based on dental development. Extensive porotic hyperostosis was found on both right and left parietals and onto the occipital. Cribra orbitalia could not be observed, as neither eye orbit survived. There was rodent and insect disturbance throughout. There was ochre on the right humerus and pelvis. There was symmetrical occipital flattening.

Feature 168

Female, aged 50+ years, 70 percent complete. The individual was determined to be female based on a small left mastoid, blunt eye orbits, and flat sacrum. She was aged at 50+ years based on dentition. The skull showed the sagittal suture was nearly obliterated endocranially and ectocranially. This older female exhibited slight to moderate vertebral osteophytosis on the lower thoracic and upper lumbar vertebrae. The parietals were thickened, suggestive of healed porotic hyperostosis. There was ochre staining on the front and back of the shafts of the left and right tibias and fibulas. The cranium was too fragmented to assess cranial flattening.

Feature 190

Neonate, 5 percent complete. This feature contained just a few fragments of bone, presumably from a newborn based on size of the pit and frailty of the bones. There was a small amount of ochre scattered in the pit throughout the fill, with a slightly thicker amount underneath the body. Cranial deformation could not be assessed, and no pathologies were visible.

Feature 196

Female, adult, 25 percent complete. As there was a large amount of root disturbance, very little of this skeleton remained, although the preservation of the bone that survived was good. The skeleton was of indeterminate age and determined to be female by the gracility of the bone and the in-field height measurement (top of crania and heel of left foot remained in situ) of 4 feet 10 inches. No ochre was present, no pathologies were noted, and the skull could not be assessed for cranial deformation.

Feature 204

Child, aged 3–6 months, 35 percent complete. This was a very fragmentary infant skeleton of indeterminate sex. Dental development placed the age at between 3 and 6 months. Bone preservation was poor. There was scattered ochre stain on the back of the skull, as well as in the soil around the chest and upper abdominal area. Extensive and active porotic hyperostosis was present on the remaining cranial bone (occipital). The presence of cribra orbitalia could not be assessed, nor could cranial deformation.

Group 5

Group 5 is the northernmost burial group, located more than 10 m north of the Feature 1 compound. It consists of several individual inhumations as well as one burial plot, Feature 223.

Feature 142, Burial Plot 223

Female, aged 30+ years, 85 percent complete. The skeleton was largely intact with good preservation. Sex was determined to be female based on the left-femur-head measurement (38.7 mm), wide sciatic notch, wide mandibular angle, and general gracility of skeleton. Age (30+ years) was based on dental wear. Slight osteophytosis on the thoracic and lumbar vertebrae was found on this middle-aged female. There was slight lipping on the right rib ends, with some scalloping present. Thickening of the parietals was noted and is suggestive of well-healed porotic hyperostosis (PH). PH is a bony reaction to disease characterized by diploic expansion and porosity on the outer table, typically on the parietals but also on the frontal and occipital. Bony changes to the skull vault are vertical or have a "hair-on-end" appearance that can be observed on X-rays (Angel 1966; Ortner and Putschar 1985). Changes to the superior aspect of the eye orbits and cribra orbitalia have been associated with PH but can occur independently and should be considered separately (Grauer 1993). PH is most commonly associated with hemopoietic disorders (sickle-cell anemia and thalassemia in the Old World and iron-deficiency anemia in the New World), but many other diseases can cause this bony reaction. Other diseases implicated are nonspecific infection, osteomyelitis, subperiosteal hematoma from trauma, certain tumors, and metabolic disturbances, such as scurvy and rickets (Schultz 2001.) Iron-deficiency anemia is typically seen in those "involved in faster rates of growth and development, resulting in higher nutritional requirements" (Stuart-Macadam 1989:214). These groups include pregnant and lactating women, children at puberty, and infants. PH is implicated in diets poor in iron, but also in a population or individuals with poor general health and, perhaps, a high parasite load (Schultz 2001; Stuart-Macadam 1989).

The ribs were fragmented (postmortem) and stained with fairly thick ochre, mostly outside but with some inside. There was also thick ochre staining of the left humerus shaft, and some ochre on the occipital, with a spot on the left-mandible ramus. There was symmetrical occipital flattening. The stature of this female was estimated at 157 cm (5 feet 1 inch) based on the length of the left femur (41.4 cm).

Feature 166, Burial Plot 223

Female, aged 35–40 years, 55 percent complete. This individual was determined to be female based on a wide mandibular angle and left-femur-head measurement (39.9 mm). She was aged 35–40 by dentition. Cervical vertebrae 1–4 were fragmentary, and C3 and C4 showed bodies that were cupped and pitted; osteophytes were not visible because of broken edges. Of interest was the ochre staining of the front and back of the pelvis, front and back of the sacrum, and proximal ends of the femurs. There was ochre in the soil beneath the pelvis and the proximal ends of both legs, but none distal to these areas. Small amounts of ochre stain were also present on the right hand, the right proximal radius and ulna, and the left distal radius and ulna. Occipital cranial flattening was present and symmetrical.

Feature 12

Possibly male child, aged 10–12 years, 90 percent complete. All epiphyses were present but not fused, including the femur head and trochanters. Age was based on dental eruption and long-bone measurements. The assumption of male for the sex is based on the presence of a male burial assemblage, including projectile points. There was light ochre staining present on the posterior of the left tibia and on both feet.

Feature 33

Male, aged 18–22 years, 65 percent complete. The skeleton was fairly well preserved. Sex determination was based on a square mandible angle, narrow sciatic notch, square chin, and robustness of bone. Age was based on dental wear. Of particular note was ochre staining inside the palate on the molars, as well as a small spot on the left mastoid at the base of the skull and C2. Ochre had washed in between the cervical vertebral bodies and on the right clavicle. There was very dark, thick ochre staining on the front and back of the right tibia and fibula, but none on the left. Very slight osteophytosis existed on the lumbar vertebrae of this young adult and there was congenital fusion of C2 and C3. As indicated above, this may reflect an instance of Type II Klippel-Feil syndrome. This individual exhibited symmetrical occipital flattening.

Feature 140

Female, aged 40+ years, 60 percent complete. The individual was determined to be female by a wide mandible angle, small left-femur-head measurement (41.3 mm), a large sciatic notch, female subpubic angle, small brow ridges, gracile features, and a round chin. There was a preauricular parturition scar evident on the pelvis. Age was placed at 40+ years based on dental wear. There was ochre staining on the distal ends of the right and left humerus, both radii and ulnae, backs of both hands, proximal ends of the femurs, the sacrum, and front and back of the pelvis. Slight osteophytes were noted on the lumbar vertebrae. Slight osteophytosis was present on the thoracic and lumbar vertebrae. Osteitis was present on both tibial diaphyses and periostitis was present on the right tibia as well. There was occipital flattening of the posterior cranium. The stature of this female was estimated to be 157.5 cm (5 feet 2 inches) based on the right femur length (41.6 cm).

Feature 141

Female, aged 41–50 years, 60 percent complete. The skeleton was largely present, with moderately good preservation. The cranium was present but fragmented. The individual was determined to be female because of the septal aperture of the right humerus, a wide sciatic notch, the left-femur-head measurement (39.6 mm), and the sub pubic angles. There were scars of parturition on the left-side preauricular sulcus. Her age was estimated at 41–50 years. Stage 1 osteophytes were present on the lumbar vertebrae. Wear of teeth in the anterior mandible was heavy. The kneecaps were slightly arthritic. The stature of this female was estimated at 158 cm (5 feet 2 inches) based on the length of the left femur (41.4 cm). No ochre was present.

Feature 145

Male, aged 41–50 years, 60 percent complete. This individual was determined to be male based on right-femur-head measurement (48.3 mm), length of left femur (46.4 cm), and general robustness of the bone. He was aged at 41–50 based on dental wear. The major vault sutures were mostly obliterated endocranially, and there was a large nuchal crest. Some rib ends had ossified cartilage. On the left side, there was only one rib with the vertebral end intact; it was arthritic, porous, and lipped. The articular surfaces on C2 and C3 were very pitted, malformed, and compressed. On these vertebrae, the articular surface sloped anterior to posterior, top and bottom. Lumbar vertebrae showed Stage 3 osteophytes with depressions in the centers of the bodies; thoracic vertebrae showed Stage 2 osteophytes. The articular surfaces of these vertebrae were pitted. There was a bone spur on the proximal lateral side of the left middle phalange. The lateral end of the right clavicle had either a fracture or dislocation at about the conoid tubercle (the bone was fragmented postmortem at that spot). There was dark ochre on the right scapula, located on the coracoid and acromion. There was also very thick ochre on the right humerus, radius, and ulna. Lighter ochre staining was present on the ribs; the lumbar spine; the tops, but not the backs, of the pelvic blades; the medial surfaces of the femurs; the right patella; and the proximal end of the right tibia. The left humerus, radius, and ulna were stained, and the hands, both left and right, were stained top and bottom, with less color on the left than right. The ochre also covered a shell bracelet on the lower right arm. The stature of this older male was estimated at 171 cm (5 feet 7 inches) based on length of the left femur (46.4 cm).

Feature 146

Male, aged 25–30 years, 65 percent complete. The skeleton was largely intact, but preservation was only fair. There was evidence of rodent gnawing on the bones of the left elbow and right forearm. This individual was determined to be male based on a very square chin and a large nuchal crest. He was aged at 25–30 based on dental wear. There was ochre staining throughout the pelvis, ribs, hands, feet and long bones of the body. Staining was particularly heavy on the proximal ends of the right humerus and ulna, the proximal and distal ends of the femurs, the patellae, the right tibia and proximal fibula, and the proximal left tibia and fibula. No pathologies were noted, and the cranium was too fragmented to assess cranial deformation.

Feature 175

Neonate, aged birth–3 months, 15 percent complete. The skeleton was of a neonate aged birth–3 months based on dental development. The skull was fragmented. The ribs were tiny and fragmentary. There was ochre staining on the shaft of the left humerus, the back of the shaft of the right femur, the shaft of the left femur, the shafts of the right tibia, and the left tibia and fibula. No pathologies were noted, and the cranium was too fragmentary to assess cranial deformation.

Descriptions of Ungrouped Burials

We excavated two individual burials that were spatially separate from the five burial groups. Feature 106 was located in the Feature 34 pit structure, and Feature 199 was located west of the main compound wall.

Feature 106

Male, aged 45–55 years, 70 percent complete. The skeleton was largely present and determined to be male based on a very square chin, large mastoids, left-femur-head measurement (44.1 mm), lack of ventral arc on the pubic bones, male subpubic angle, and the absence of scars of parturition. The mandibular angle was extreme (132°) owing to tooth loss and resorption of all but three teeth. Age was estimated to be 45–55 years based on dental wear. Bone preservation was good. DJD was evident in the knees; the patellae articular surfaces were very porous and rough, and the right patella was rimmed all around with extra bony growth. The distal ends and articular surfaces of the femurs were also rough and rimmed with a small amount of extra bony growth. A robust bone spur on the right first metatarsal was present distolaterally at the site of *Flexor hallucis brevis*, which is suggestive of soft-tissue trauma to the right foot. Only two sternal rib ends were present, probably Number 1 or 2, and the cartilage was completely ossified to sternal articulation, complete and regular. The right mandibular foramen was quite large, deep, and very regular with extra depressions anterior and posterior to it. The stature of this older male was estimated at 174 cm (5 feet 8½ inches) based on the length of the right femur (47.5 cm). No ochre was present, and the skull could not be assessed for cranial deformation.

Feature 199

Male, aged 31–40 years, 65 percent complete. This skeleton was removed by the backhoe. Based on the square chin and minimum right femur length measurement of 48 cm, the individual was possibly male. By dentition, the age was placed at 31–40 years. No ochre staining was present. The skull could not be assessed for cranial deformation, and no pathologies were noted.

The Crane Site (AZ U:3:410/2017)

Of the seven individuals recovered from the Crane site (see Table 95), five were adult females, one was an adult male, and one was an adult of indeterminate sex (see Figure 5). An eighth possible burial pit, Feature 35, did not contain human remains. There were no subadults found at the site. Based on previous studies of mortuary populations from small sites in the region (Fink 2003; Minturn 2001; Turner et al. 1994), one would expect to see two or three subadults in a cemetery with this number of adults. The obviously small sample size, affected in part by the limits of the ROW and previous road construction activities, however, suggests that the absence of subadults could be largely attributed to sampling error.

Only two individuals were more than 50 percent complete, and stature was estimated for these two. An adult female aged 40+ years was estimated to be 153 cm (5 feet) tall. For the individual found in Feature 36, the stature was estimated at 4 feet 4 inches–4 feet 7 inches. In situ, this feature presented as a child of 9–13 years based on overall size; however, irregularities in the dentition suggested to the senior author that the remains might be those of an adult, as long-bone epiphyses that were present were completely fused, and muscle attachments were well developed. Remains were too fragmented to determine age or sex with any reliability. This individual probably suffered from pituitary dwarfism; see individual feature description below for further description of this individual.

Descriptions of Individual Features

Feature 21

Female, aged 41–50 years, 70 percent complete. The skeleton was largely intact, with insect disturbance throughout. The individual in this feature was determined to be female from femur-head measurements (40.8 mm), a wide sciatic notch, a round chin, small mastoids, and gracile supraorbital ridge. She was aged at 41–50 years based on dental wear. The individual's height, based on femur length (40.0 cm), was 153 cm (5 feet). No ochre was present, and the cranium was too fragmented to determine whether cranial deformation was present. This older female had a healed fracture of her left second metacarpal. A small callus was still evident, and there was a slight misalignment, although not enough to have inhibited movement of the hand. Slight osteophytosis was present on the lumbar vertebrae, indicative of degenerative disk disease (DDD). DDD is a disease similar to DJD or osteoarthritis. However, the term DJD applies only to diarthrodial, or freely moving, joints. The same degenerative changes can occur between the vertebral bodies—amphiarthrosis, or slightly moving joints—and, therefore, the disease goes by a slightly different name.

Feature 25

Female, aged 40+ years, 25 percent complete. The skeleton was very poorly preserved. Extensive rodent disturbance was evident, as well as a small amount of root activity. All joint areas were extremely eroded, and the ribs, vertebrae, hands, and feet were merely dust. This individual was determined to be female based on a small mastoid, wide mandibular angle, pointed chin, wide sciatic notch, and general gracility. Age, 40+ years, was based on dental wear. There was symmetrical occipital flattening. No ochre or pathologies were observed for this individual.

Feature 33

Female, aged 40+ years, 20 percent complete. This burial was very poorly preserved and had extensive rodent and insect disturbance, especially in the cranial area. The individual appeared to be female, with small stature and a rounded, gracile chin. Dental wear and bone resorption aged the individual at 40+. There was ochre staining on the right tibia.

Feature 36

Adult of indeterminate sex, 70 percent complete. Bone preservation was surprisingly good, considering that the cranium and the distal and proximal ends of most the long bones were missing. Insect disturbance was observed, and there were minor root and rodent disturbances.

This individual exhibited the stature of a 9–13 year old child (4 feet 4 inches–4 feet 7 inches), but with the dentition and robust muscle attachments of an adult. The mean height for contemporary Tonto Basin populations was 5 feet for females and 5 feet 5 inches for males (Minturn 2006). Because the variation within a population is seldom more or less than 3 inches, it is possible that Feature 36 represents an adult dwarf. The skeletal remains consisted of a right temporal bone, mandible, and the diaphyses of most long bones and short bones. No trabecular bone existed except in very small fragments; for example, there were no ribs or vertebrae present. All bone was examined, and no evidence of disease and trauma was evident.

Cases of dwarfism recovered archaeologically are rare, yet they do occur (Dasen 1993). In many types of dwarfism, disproportionate bone growth occurs because not all human bone ossifies from the same matrix. The parietals ossify from a membranous matrix, whereas most of the long bones have endochondral ossification (Boskey and Posner 1984). Different types of dwarfism affect these two types of bones differently, causing disproportionate growth. All recovered remains from this individual were proportionate in size. Assuming proportionate dwarfism, there are several potential causal factors. These include congenital problems, such as Turner's syndrome, microcephaly, and an array of neurological disorders, as well as some congenital heart conditions. Several diseases can also produce shortened stature, including congenital syphilis, rickets, or hepatic disease (Ortner and Putschar 1985; Raiti 1969; Roberts 1988). Shortened stature can also occur normally from delayed onset of adolescence or nutritional deficiency (Raiti 1969; Roberts 1988). Finally, there are nonhereditary endocrine disturbances, such as pituitary dwarfism and hypothyroidism, that can cause proportionate dwarfism (Ortner and Putschar 1985; Roberts 1988).

Postcranial remains were intact enough to rule out syphilis, rickets, hypothyroidism, and nutritional deficiency as causes of shortened stature for this individual, as all these conditions affect multiple sites of the skeleton and do not only cause shortened stature. Also, this individual was estimated to be about 4½ feet tall, and Turner's syndrome patients, although of shortened stature, are not usually that short, suggesting that this rare syndrome is not the most likely option. Microcephaly can only be diagnosed with certainty from cranial remains of which there are few; however, the dentition does not support a diagnosis of microcephaly. Several other conditions causing short stature are soft-tissue disorders (e.g., hepatic disease and congenital heart disease), leaving few traces on bone. It would be impossible to completely rule these out as possible causal agents, except that the dentition suggests another likely possibility.

Four teeth, lying horizontally within the mandible crowns pointing to midline, were present. These teeth included both deciduous and permanent canines, all with intact roots. Kosowicz and Rzymski's (1977) survey of 48 pituitary dwarfs found several common dental traits typical of pituitary dwarfism. These include a delay in the resorption of deciduous tooth roots, a delay in the eruption of permanent teeth, and agenesis of the third molars. They also found that deciduous teeth were retained longer than normal. Although this individual exhibited extreme agenesis (all teeth except canines) and also exhibited an odd eruption pattern, the other aspects described in Kosowicz and Rzymski's survey support pituitary dwarfism as the most likely causal agent of shortened stature in this individual.

Feature 38

Male, aged 25–30 years, 40 percent complete. Bone preservation was poor. This individual was determined to be male by the large, square chin shape and extreme robustness of bones; he was aged at 25–30 years based on dental wear. The cranium was fragmented, and most of the bones were very weathered. There was dark ochre staining between the ribs and on the anterior surface of the ribs on the left side. Small dots of ochre were present on the articular surface of the left radius, the posterior and palmar sides of the left hand, the right femur and tibia shaft, and the right mandible. No pathology was noted, and the cranium was too fragmentary to be assessed for cranial deformation.

Feature 39

Female, aged 45–60 years, 45 percent complete. The skeleton was poorly preserved. The individual was determined to be female by a rounded chin and measurements of the length of the right femur and right humerus. There was slight ochre staining in the soil around the bone matrix of the cranium, as well as in the pelvis. Ochre stains were also found on the ribs, the proximal end of the right femur, the head of the left femur, the distal end of the right tibia, and around the phalanges of the left hand. No pathologies were noted and the cranium was too fragmented to assess cranial deformation.

Feature 40

Possible female, aged 35–40 years, 10 percent complete. A backhoe removed the little amount of bone present for the left side of this burial. Preservation of the remaining bone was poor, with only 10 percent of cranial and postcranial material and 25 percent of dental material present. The sex was thought to be possibly female based on height measurements taken in the field of a maximum of 4 feet 10 inches. Dental wear aged the individual at 35–40 years. No ochre was found, no pathologies were noted, and the cranium was not preserved well enough to assess cranial deformation.

AZ U:3:408/2015

Feature 8 contained a single individual represented by a few skeletal elements in poor condition. The size of the material suggested an individual of indeterminate sex aged 3–4-years. No scores of metric or nonmetric traits were able to be made.

Summary and Conclusion

The rate of pathology appears to be high at the Vegas Ruin, with 90 percent of individuals that were 76 percent or more complete having at least one observable pathological trait (Table 98). Although this rate appears high when looking at the types of pathology, the individuals from this site are not as highly stressed as the numbers suggest. Only three cases of nonspecific infection and four or five fractures or healed fractures were evident. There were three cases of porotic hyperostosis and one case of cribra orbitalia. Other abnormalities, such as pedal symphalangism and failure of separation of vertebral segments (possible Klippel-Feil syndrome), are genetic in nature and would not affect the individual's health. The highest prevalence of pathology was DDD, with

Table 98. Comparison of Pathology Prevalence between Sites

Pathology	CCP: Vegas Ruin (405/2012) (%) (n = 37)	Schoolhouse Point Mesa[a] (%) (n = 294)	TCAP[b] (%) (n = 122)	SR 87 Project[c] (%) (n = 37)	Cline Terrace Mound Sites[d] (%) (n = 52)
Degenerative disc disease	24	15	14	—[e]	8
Porotic hyperostosis and/or cribra orbitalia	11	10	6	5	8
Degenerative joint disease	14	5	19	19	12
Trauma	11–14[f]	2	8	NR	NR
Nonspecific infection	8	NR	6	8	2
Cervical vertebra 2–3 fusion	8	<1	NR	NR	NR

Key: CCP = State Route 188–Cottonwood Creek Project; NR = not reported; SR = State Route; TCAP = Tonto Creek Archaeological Project.
[a] Regan and Turner 1997.
[b] Minturn 2001.
[c] Fink 2003.
[d] Turner and Regan 1997.
[e] No distinction is made between degenerative disc disease and degenerative joint disease for the SR 87 project. The high rate of degenerative joint disease suggests some cases could be degenerative disc disease.
[f] One individual is reported as having a possible fracture.

nine cases, and DJD, with five cases. Degenerative arthritis etiology is complex, and age and repetitive actions are primary factors. Diet, weight, and genetics also play a role (Resnick and Niwayama 1988). As severity increases, an individual's overall health and well-being can be affected; however, most of the changes observed in the current study were not severe.

Prevalence rates are actually quite similar to nearby, contemporaneous sites, including the Schoolhouse Point Mesa sites (Regan and Turner 1997), TCAP sites (Minturn 2001), SCP sites (Fink 2003), and the Cline Terrace Mound site (Turner and Regan 1997) (see Table 98). The prevalence of porotic hyperostosis, DJD, and nonspecific infection is similar to that observed at the other sites, whereas the prevalence of DDD and trauma are higher. Caution must be exercised when drawing conclusions from these numbers, however, because the sample sizes were significantly higher at the TCAP and Schoolhouse sites than those from the Vegas Ruin. All sites that have small sample sizes have the potential for sampling error. The higher rate of DDD could be attributed to an older population at the Vegas Ruin or to underreporting by other authors, although Minturn did the laboratory analyses for both the TCAP sites and this site, for which a 10 percent difference is noted.

The higher rate of trauma at the Vegas Ruin is interesting. One individual (Feature 145) is reported as having a possible fracture. If this was a traumatic lesion, the rate for overall fractures would be 14 percent, much higher than what has been reported elsewhere, except for the TCAP sites, which yielded an 8 percent prevalence. If the individual in Feature 145 did not have a traumatic lesion, the overall rate would be 11 percent, which brings it more in line with the 8 percent observed at the TCAP sites. Fractures can result from many activities: accidents, interpersonal violence, hunting activities, and warfare. The one fracture that can be argued to be an accidental injury was to the foot of an adult female. If we look at the types of trauma observed at the Vegas Ruin, it is interesting to note that all the fractures one might attribute to interpersonal violence occurred in older adult males and that the three well-healed fractures occurred in males aged 45–50+ years, suggesting that the injuries might have occurred in their thirties to early forties (Table 99). There were no obvious signs of warfare in the physical anthropology; for example, we encountered no weapon wounds or projectile points embedded in bone or found within body cavities (Heilman et al. 1991). Future excavations in this area may shed some light on this rather high trauma rate and whether it is a product of small sample size or indicative of male-male interpersonal violence, accidents, or hunting.

Finally, with regard to the Vegas Ruin, there is little osteological evidence to argue for or against any genetic relationship within groups, but the suggestion of three possible cases of Klippel-Feil syndrome, two cases of vastus notch, and two cases of pedal symphalangism over the whole of the site suggests a close genetic relationship between the affected individuals.

Little can be said for Site 408/2015 and the Crane site, as the small samples are not likely representative of the population as a whole. It is a quirk of fate that at the very poorly preserved Crane site one of the individuals that was preserved

Table 99. Trauma at the Vegas Ruin (405/2012), by Feature

Feature No.	Burial Group	Age	Sex	Trauma
101	1	31–35	male	Healing or healed fracture to C2.
137	4	45–55	male	Healed fracture to left clavicle.
143	1	50+	male	Healed spiral fracture to right tibia and two rib fractures.
144	4	55+	female	Healed fracture to right metatarsal.
145	5	41–50	male	Possible clavicle fracture.

exhibited a condition, pituitary dwarfism, that is rarely observed archaeologically. The only other dwarf documented in the Southwest that we could find data for was a skeleton accompanied by burial goods that was sent to the Smithsonian in 1915 (Scott Keuren, personal communication 2003). A Mr. Spellmeyer, who was manager for William Babbitt, a cattle permittee on the Fort Apache Reservation, found a skull eroding out of an arroyo and notified authorities. An employee of the Department of the Interior removed the burial and reported the following:

> The peculiarity of the skeleton lies in the fact that it has two very peculiar projections on each side of the skull, and that it appears to be an adult, judging by the teeth, and yet the skeleton is not to exceed three feet in length. Of course, it was not intact, but a large part of the skull, a number of ribs, several of the vertebrae, and a number of the arm and leg bones were secured [Peterson 1915].

We have not recovered any other analysis of this individual; however, the description by Peterson lends credibility to the idea that the skeleton belonged to a dwarf. The burial included a black-on-white vessel, possibly a Pinedale (Scott Keuren, personal communication 2003), and a few shell beads.

The individuals from the CCP sites were healthy, and the osteological indicators of infection, degenerative changes, porotic hyperostosis, and, to some extent, trauma, are consistent with other reports of neighboring Salado peoples. Even though the sample sizes were small, the finding of a high rate of a potentially genetic syndrome, such as Klippel-Feil, is interesting. The fact that C2–C3 fusion also occurred at the nearby Schoolhouse Point sites argues for further work.

Traditionally, skull deformation has been considered to be cultural modification related to the use of cradle boards in infancy when the cranial bones are pliable. The type of cradle board used and the type of swaddling that accompanies it determine where the flattening occurs on the cranium (Minturn 2001:326). Occipital deformation is common throughout the Southwest and was most likely the unintentional result of swaddling infants to hard cradle boards. By contrast, lambdoidal flattening has been considered to be an intentional modification most commonly found in Puebloan crania of the San Juan Anasazi and upper Rio Grande areas (Minturn 2001). More-recent studies, however, suggest that occipital flattening may be attributable to premature suture closer—a genetic syndrome—rather than cultural practices (Danforth et al. 1994:97). In their study of a prehistoric population from the Carter Ranch Pueblo in the Little Colorado River valley, Danforth et al. (1994) observed a high incidence of genetic abnormalities such as Klippel-Feil syndrome and short stature/cranial anomaly syndrome that may reflect genetic isolation of the small resident population. It is unclear, however, if the form of occipital flattening observed in this study is the same as the cranial abnormalities observed by Danforth et al. (1994) in the Carter Ranch population.

Occipital flattening was observed in 85 percent of the CCP individuals (n = 22) with sufficiently preserved crania where this observation could be made. This trait was absent only in 4 cases: 3 at the Vegas Ruin and 1 at the Crane site. All 3 at the Vegas Ruin were found in burial Group 5, the scattered burials at the northern end of the site. The 4 burials without evidence of cranial deformation included 2 adult females, 1 adult male, and 1 juvenile male, indicating no sexual patterning in this trait. This frequency of occipital flattening is similar to that of the nearby contemporary TCAP population (Minturn 2001) and suggests overall homogeneity in the CCP population. If this trait reflects a genetic syndrome, however, the predominance of occipital flattening suggests a high degree of genetic isolation in this small population, especially when the incidence of Klippel-Feil syndrome and dwarfism is considered.

CHAPTER 9

Analysis of Human Dentition

Lorrie Lincoln-Babb

In 1999 and 2000, SRI mitigated several sites along SR 188 in Tonto Basin, from the Jakes Corner area to just north of Punkin Center. In the course of the CCP, human remains were discovered at three sites: the Vegas Ruin (AZ U:3:405/2012), a large site designated as AZ U:3:408/2015, and the Crane site (AZ U:3:410/2017). All of the burial features encountered and recovered from these sites were inhumations. None of the bone or teeth exhibited any degree of incineration. The human remains were exhumed and analyzed by Bioarch personnel, under contract with SRI.

Nearly all of the burial features analyzed during the CCP contained some amount of preserved dental remains, teeth, or associated alveolar bone (Table 100). This allowed dental data to be recorded for most of the individuals from this project and supports the notion that teeth are typically the best-preserved skeletal elements found in burials. The Vegas Ruin produced the largest burial population of this project. Dental remains were recovered from 36 of the 37 excavated inhumations. The Feature 190 infant burial from this site lacked any dental remains and, thus, was excluded from the dental analysis.

Five groupings of burials, based on location, were recognized at the Vegas Ruin (see Figure 55). Group 1 comprised 9 inhumations. Group 2 encompassed only two infants and was excluded from any of the dental analyses, although minimal dental data for both children are included in Table 100. Group 3 comprised 6 inhumations. A scatter of burials was identified on the eastern edge of the main excavation area and was divided into two groups. The 10 inhumations from the southern part of the scatter, including the unexcavated Feature 187 and the Feature 190 infant burial that lacked dental remains, were assigned to Group 4. Group 5 consisted of the 9 burials recovered from the northern part of the scatter. Two burials, Feature 106 and Feature 199, were not assigned to a burial group because of their isolated locations.

Burial plots, or large mortuary features that contained more than one individual, were found in three of the groups at the Vegas Ruin. Group 1 contained two burial plots (Features 216 and 221), Group 3 contained two burial plots (Features 205 and 222), and Group 5 contained a single burial plot (Feature 223). All of the members in Group 3 were contained within the two burial plots that comprise this group. Only two inhumations from Group 1, Features 49 and 103, were not in burial plots.

Teeth were preserved in all seven burials at the Crane site (see Figure 5 for burial locations). One possible burial pit, Feature 35, did not contain any skeletal or dental remains. The individual recovered from Feature 36 was an anomalous case with four nonerupted teeth. This individual was excluded from any dental analyses but is discussed at length in Chapter 8. One subadult was recovered from Site 408/2015. The dental data for this 3–4-year-old child are included in Table 100, but no further analyses were conducted on the dentition of this individual.

There have been a number of archaeological projects in Tonto Basin over the past two decades that together have produced a large corpus of mortuary data. Besides the CCP, the RPM (ASU) and the TCAP (DAI) examined large burial populations. Despite this corpus of research, the basic bioarchaeological research questions pertaining to the Salado have not radically changed in recent years. These important questions include (1) determining the subsistence strategies of each population and the degree of dependence upon cultigens, (2) individual and population health status, (3) the extent to which lifestyles differed between males and females, and (4) the affinity of Tonto Basin populations. All of these issues are considered within this report.

Methods

Prior to repatriation, the dental remains from the CCP inhumations were analyzed in the laboratory at SRI's Tucson office.

Table 100. Dental Data of Burial Groups and Plots for the CCP, by Site

Group	Feature	Sex	Age (years)	Number of Teeth							Number of Abscesses
				Permanent	Deciduous	Postmortem Loss	Antemortem Loss	Carious	With Enamel Hypoplasia	Chipped	
	Vegas Ruin (405/2012)										
Group 1	14	M	40+	9	—	5	5	2	—	—	—
	49	M	41–50	20	—	—	—	8	2	1	—
	101	M	31–35	28	—	—	3	2	—	—	—
	102	F	50+	12	—	2	13	4	1	3	2
	103	M	31–40	21	—	1	2	3	—	1	—
	133	F	21–23	27	—	—	—	1	—	—	—
	143	M	50+	8	—	—	—	4	1	1	—
	219	U	5–6	17	13	1	—	2	—	—	—
	220	M	45–50	29	—	—	—	3	12	3	2
Group 2	172	U	birth–3 months	—	4	—	—	—	—	—	—
	185	U	6–12 months	1	17	—	—	—	—	—	—
Group 3	164	M	45–50	13	—	3	13	10	—	—	3
	181	M	21–25	26	—	1	—	3	3	3	2
	182	F	45+	20	—	1	11	2	—	2	—
	197	M	25–30	16	—	1	4	5	2	—	—
	206	F	31–40	23	—	2	5	5	6	—	—
	207	M	55+	1	—	—	31	1	—	—	1
Group 4	21	U	5–6	8	5	—	—	—	—	—	—
	108	M	15–17	30	—	1	—	2	—	—	—
	137	M	45–55	7	—	5	16	3	1	—	2
	144	F	55+	4	—	—	16	4	—	—	—
	165	U	6–9 months	—	19	—	—	—	—	—	—
	168	F	50+	16	—	1	10	4	—	3	1
	190	U	neonate	—	—	—	—	—	—	—	—
	196	F	adult	2	—	—	—	—	—	—	—

Table 100. Dental Data of Burial Groups and Plots for the CCP (*continued*)

Burial Group, by Site	Feature	Sex	Age (years)	Number of Teeth							Number of Abscesses
				Permanent	Deciduous	Postmortem Loss	Antemortem Loss	Carious	With Enamel Hypoplasia	Chipped	
Vegas Ruin (405/2012) (*continued*)											
	204	U	3–6 months	—	12	—	—	—	—	—	—
Group 5	12	M	10–12	28	—	1	—	1	—	—	—
	33	M	18–22	25	—	7	—	—	—	1	—
	140	F	40+	13	—	—	6	—	—	—	—
	141	F	41–50	19	—	2	9	2	—	—	1
	142	F	30+	22	—	—	9	5	—	—	4
	145	M	41–50	11	—	1	9	3	—	—	—
	146	M	25–30	30	—	1	1	—	—	—	—
	166	F	35–40	10	—	3	5	1	—	—	1
	175	U	birth–3 months	—	12	—	—	—	—	—	—
No group	106	M	45–55	3	—	—	13	—	2	—	—
	199	M	31–40	15	—	6	5	1	5	—	—
Site 408/2015											
No group	8	U	3–4	1	14	—	—	—	—	—	—
Crane site (410/2017)											
No group	21	F	41–50	26	—	—	3	5	4	—	1
	25	F	40+	7	—	—	—	1	—	1	—
	33	F	40+	3	—	1	6	—	—	—	—
	36	U	adult	4?	—	—	?	—	—	—	—
	38	M	25–30	29	—	3	—	—	—	—	—
	39	F	45–60	15	—	4	—	1	—	2	—
	40	F	35–40	9	—	—	—	—	—	—	—

Key: F = female; M = male; U = undetermined.

Each tooth and section of alveolar bone was gently cleaned with a dry brush or bamboo pick and closely inspected under a bright light and with a 10× hand lens. No destructive analysis was performed, as specified by the interagency agreement regarding the treatment of the human remains.

Overall preservation of the alveolar bone and teeth of the CCP population was fair to good, which permitted dental information to be gathered for most of the individuals from the Vegas Ruin and the Crane site. Each dentition was inventoried, in which the identification and location of each tooth present was recorded. The antemortem and postmortem loss of teeth was also recorded if there was adequate alveolar bone. Dental pathologies, including caries, enamel hypoplasia, abscesses, and calculus, were observed and recorded using the methods specified within the *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). Aging of subadults to young adults in their early 20s was assessed using the dental development and eruption chart created by Ubelaker (1978, 1989). The loss of dental enamel due to attrition and abrasion was also evaluated and recorded using criteria presented by Turner et al. (1991) and Molnar (1971). Angled or grooved wear due to the consumption of certain foods or occupational activities was also recorded if observed (Fink 1989; Lincoln-Babb 2001; Molnar 1971, 1972; Turner and Machado 1983). The methods and graded trait plaques of the ASU Dental Anthropology System (Turner at al. 1991) were used to determine the morphological crown traits of minimally worn permanent teeth.

Caries and Antemortem Tooth Loss

Caries, commonly recognized as necrotic cavities in the dental hard tissue, is an oral disease. Two conditions are necessary for the initiation of caries: (1) the presence of particular microorganisms in the naturally occurring dental plaque in the mouth and (2) the regular consumption of cariogenic foods, or foods that have the capacity to cause caries (Bibby 1966; Mandel 1976). Inadequate cleansing of the teeth, in particular the complex surfaces of molars, contributes to an oral environment conducive to the initiation of an acid-based deterioration of the dental hard tissue (Knutson et al. 1938; Russell 1966; Schaefer 1966). Once the decalcification of the hard tissue begins, it continues on to the pulp chamber of a tooth and may infect the supporting tissue and bone of the tooth. The extent of this infection results in an abscess, which is observable in dry bone as a drainage channel or perforation in the bone, often at the apex of an alveolus or tooth socket. Carious teeth are treated by the removal of the diseased area of the dental hard tissue. If this does not happen and the pulp chamber is invaded, the tooth ultimately dies and is usually lost before the death of the individual. Sometimes a carious root stump may remain in the socket.

Alveolar bone is essential to the recording of any tooth loss. Antemortem loss, or the loss of a tooth before the death of the subject, is identified by the closure or remodeling of an alveolus. Conversely, an open socket with no tooth indicates loss of the tooth just before or after death. Antemortem loss of teeth can occur from trauma, excessive wear, or systemic infections but is most frequently caused by caries. Therefore, the amount of teeth lost antemortem has a significant relationship with the predominance of caries for an individual and population. If alveolar bone is available, it is essential to record the amount of teeth lost before and after death for each individual.

Caries frequencies are valuable tools in generating assumptions about the diets of prehistoric populations. Numerous studies have demonstrated the significance of caries in relation to the utilization of carbohydrates (Leigh 1925; Lukacs 1996; Mandel 1976; Nelson et al. 1999; Powell 1985; Schmucker 1985; Scott and Turner 1988; Tanzer 1995; Turner 1979; Walker and Erlandson 1986). Proteins and fats are the other two major dietary nutrients; however, only carbohydrates demonstrate a causal relationship with the development of caries (Miller 1966a, 1966b; Sweeney 1966). In fact, there is nearly a complete inverse relationship for caries formation with high-protein diets, whereas fats have little influence in the caries process. A low caries rate for a population generally is interpreted as signifying a diet with a larger percentage of proteins consumed, as opposed to carbohydrates. Most cultigens are quite rich in carbohydrates and can be processed into a pasty texture that remains in the oral environment longer than many other foods. The paste is not easily rinsed out of the mouth or off of the teeth and consequently binds with the dental plaque, and acid-based decalcification begins.

Turner (1979) presented observed caries rates for over 80 prehistoric and living worldwide populations in a well-known study. An observed caries rate is obtained simply by dividing the number of carious teeth by the number of observed teeth. Based on these rates and some information about the subsistence behavior of each group, ranges were generated for observed caries rates for three standard economies practiced throughout the world (Turner 1979). Hunting and gathering economies had the lowest percentage of carious teeth (0–5.3 percent), followed by mixed economies (0.44–10.3 percent), and, with the highest number of caries, agriculturists (2.3–26.9 percent). The mixed economy and agricultural ranges are rather broad but understandably so, as they encompass a multitude of diets composed of different foods and processed in just as many ways different ways. For prehistoric groups of the Greater Southwest, depending upon the group's dietary practices, most observed caries rates fall into the middle to the upper two-thirds of each range. To demonstrate, Early Agricultural or Archaic period groups from southern Arizona and northern Mexico have caries frequencies ranging from 3.0 to 9.9 percent (Guthrie and Lincoln-Babb 1998; Minturn and Lincoln-Babb 1995; Villalpando et al. 1998). These groups survived on a mixed economy of hunting, gathering, and cultivating foods (Huckell 1995; Mabry 1998). Classic period populations like the Hohokam and Salado were considerably more dependent upon cultigens and are good examples of typical agriculturists of the ancient southwest. Observed caries rates for southwest agricultural groups usually ranged between 12 and 17 percent (Fink 1989; Hill and Lincoln-Babb 2001; Regan et al. 1996; Turner 1979; Turner and Regan 1995).

There are over 425 wild edible species in the Sonoran Desert flora, and roughly 25 crop species have been cultivated since prehistoric times (Nabhan 1985:6). Numerous foods collected and prehistorically cultivated by the inhabitants of the upper Sonoran desert were abundant in carbohydrates. Maize, agave, prickly pear seeds, acorns, juniper berries, desert and mountain yucca, wolfberries, and squash yield high amounts of carbohydrates (Sobolik 1994; Wolfe et al. 1985). Additionally, the carbohydrate value can increase for some foods depending upon the processing technique that is used (Harris 1966). For example, squash or cactus fruits are richer in carbohydrates when dried and so is maize when roasted, steamed, or ground into flour (Wolfe et al. 1985). Flour from processed maize was used to make many regularly consumed foods (dumplings, flatbreads, cakes, and tamales) that are still prepared and eaten today by modern Native American groups (Green 1979; Kuhnlein and Calloway 1977; Magill 1995; Wolfe et al. 1985).

The development of caries is age related, as the possibility of developing this pathology increases with the amount of time the permanent teeth are in the oral cavity. For this reason, the permanent teeth of individuals younger than 15 years of age at time of death are excluded from these types of analyses. Nevertheless, it is worthwhile to note the presence of carious teeth for subadults, as discussed further below.

There are three important types of caries frequencies that may be determined for a study population. As discussed earlier, the observed caries rate is the most frequently reported caries frequency for populations. A corrected caries rate is often twice the amount of the observed rate and provides a more accurate index of caries, as it accounts for the antemortem loss of teeth in the population. Different formulas are available, and each requires several additional calculations with the inclusion of the antemortem tooth loss (Erdal and Duyar 1999; Lukacs 1995). This analyst prefers the method developed by Lukacs (1995), as it includes counts for pulp chamber exposure due to either caries or wear. If most of the pulp chamber exposure (PCE) was caused by caries, as observed for the individuals analyzed for the CCP, the corrected caries rate will be substantially greater than the observed caries rate. The individual caries rate is another type of caries rate that indicates the prevalence of caries within a given population. This rate is obtained by dividing the number of individuals with carious teeth within a population by the number of individuals observed within that same population.

The observed and individual caries rates for the CCP people and other prehistoric groups of the Southwest are presented in Table 101. A quick review of these data indicate that these people, especially the inhabitants of the Vegas Ruin, suffered from caries more than many of the other early indigenous populations. Approximately 76.5 percent of the people of the Vegas Ruin and Crane site had one or more carious teeth. The observed caries rate for the combined populations is 15.5 percent. The corrected caries rate is 36.6 percent, a high rate due to the extensive amount of antemortem tooth loss (195 teeth) and that the pulp chamber exposure for 73 out of 77 teeth in the group was caused by caries. The individuals associated with Features 12 and 219 at the Vegas Ruin were the only subadults in the entire CCP population with erupted permanent teeth, and both of these juveniles had carious teeth. The individual from Feature 12 was aged 10–12 years and was the single subadult with permanent teeth. The lower left first molar had a large carious lesion and obvious pulp-chamber exposure. The individual from Feature 219 had a mixed dentition of deciduous and permanent teeth, with only the first molars beginning to erupt. This child had carious deciduous maxillary first incisors.

Vegas Ruin (AZ U:3:405/2012)

The pervasiveness of caries among the adults of the Vegas Ruin was considered at various levels: the site population as a whole; groups of burials based on location; and subgroups, including males and females and members of burial plots. Group 2 was excluded from all the analyses because it consisted of two subadults, both under 9 months of age. No dental remains were recovered from the individuals in Features 187 and 190 in Group 4.

There were 28 prehistoric inhabitants of the Vegas Ruin considered for the caries analyses that were at least 15 years of age. Twenty-three of these individuals had one or more carious teeth, rendering an individual caries rate of 82.1 percent. The overall population observed caries rate was 16.9 percent (78 carious teeth/460 observed teeth). The observed caries rate for just the males from the Vegas Ruin was 17.1 percent (50 carious teeth/292 observed teeth). The observed caries rate for the females from the site was 16.7 percent (28 carious teeth/168 observed teeth).

The corrected caries rate for the Vegas Ruin population was obtained following the steps outlined by Lukacs (1995). These steps are as follows:

(1) The estimate for the amount of teeth lost due to caries (183 teeth) was first acquired by multiplying the number of teeth lost antemortem (186) by the proportion of

Table 101. Caries Data for CCP and Other Prehistoric Southwest Populations

Site Names and Numbers	Observed Caries Rate (%) (no. carious teeth / no. teeth observed)	Individual Caries Rate (%) (no. individuals with caries / no. individuals observed)
Vegas Ruin (405/2012)	17.0 (78/460)	82.1 (23/28)
Crane site (410/2017)	7.9 (7/89)	50 (3/6)
Vegas Ruin (405/2012) and Crane site (410/2017) combined	15.5 (85/549)	76.5 (26/34)
Salado (TCAP)[a] (AZ U:3:5; AZ U:3:289; AZ U:3:294;AZ U:3:297; AZ U:3:298; AZ U:3:299; AZ U:3:300 [ASM])	14.1 (396/2,806)	71.8 (125/174)
Salado (RPM) Schoolhouse Mound[b] (AZ U:8:24 [ASM])	15 (114/760)	40.6 (41/101)
Hohokam Grand Canal Ruins[c] (AZ T:12:14 and AZ T:12:16 [ASU])	23.5 (244/1,036)	74 (46/62)
Elden Pueblo[d] (NA 142 [CNF])	14.1 (71/505)	70 (28/40)
Matty Canyon[e] (AZ EE:2:137 and AZ EE:2:30 [ASM])	9.9 (14/142)	20 (1/5)
Wetlands Cienega phase[f] (AZ AA:12:90 [ASM])	7.1 (16/225)	57 (8/14)
La Playa[g] (SN F:10:3 [ASM])	2.7 (5/185)	38.5 (5/13)

Key: RPM = Roosevelt Platform Mound; TCAP = Tonto Creek Archaeological Project.
[a] Lincoln-Babb 2001.
[b] Regan et al. 1996.
[c] Fink 1989.
[d] Hill and Lincoln-Babb 2001.
[e] Minturn and Lincoln-Babb 1995.
[g] Guthrie and Lincoln-Babb 1998.
[h] Villalpando et al. 1998.

teeth with pulp chamber exposure due to caries (70/71).

(2) This estimated number of teeth (183) was added to the number of observed carious teeth (78) to achieve the total estimated number of carious teeth (261).

(3) The number of observed teeth (460) and the number of teeth lost antemortem (186) were added to obtain the total number of original teeth (646).

(4) The total estimated number of carious teeth (261) was divided by the total number of original teeth (646) in order to acquire the corrected caries rate, 40.4 percent, for the Vegas Ruin population.

The Vegas Ruin males and females were evaluated independent of each other, and observed caries rates were generated. These frequencies were 17.1 percent and 16.7 percent, respectively. Of the 17 males, 14 (82.4 percent) had caries and 9 of the 11 females (81.8 percent) had carious teeth. The observed caries frequencies for the members of burial groups and male and female members of each group are presented in Table 102.

Group 1

All eight of the adults in this group had caries. Three of the adults were aged younger than 40 years and five were older. The individual in Feature 49, an adult male aged 41–50 years, had 8 carious teeth. Only one other individual at the Vegas Ruin, located in Feature 164 of Group 3, had as many carious teeth. Many of the dental lesions exhibited by the individual in Feature 49 were located on the upper anterior teeth at the cemento-enamel junctions of the teeth. It was not possible to evaluate the degree of antemortem loss experienced by this male owing to the poor preservation of alveolar bone. Consequently, 9 of the 12 molars for the dentition of this

Table 102. Caries Frequencies for the Vegas Ruin (405/2012) Burial Groups

Burial Group	Feature No.	Population Observed Caries Rate (%) (no. of carious teeth / no. of observed teeth)	Male Observed Caries Rate (%) (no. of carious teeth / no. of observed teeth)	Female Observed Caries Rate (%) (no. of carious teeth / no. of observed teeth)	Male Individual Caries Rate (%) (no. of males with caries / no. of observed males)	Female Individual Caries Rate (%) (no. of females with caries / no. of observed females)
1	14, 49, 101, 102, 103, 133, 143, 220	17.5 (27/154)	19.1 (22/115)	12.8 (5/39)	100 (6/6)	100 (2/2)
3	164, 181, 182, 197, 206; 207	26.3 (26/99)	33.9 (19/56)	16.2 (7/43)	100 (4/4)	100 (2/2)
4	108, 137, 144, 168, 196	22.0 (13/59)	13.5 (5/37)	36.4 (8/22)	100 (2/2)	66.6 (2/3)
5	33, 140, 141, 142, 145, 146, 166	8.5 (11/130)	4.5 (3/66)	12.5 (8/64)	33.3 (1/3)	75 (3/4)
Individual burials	106, 199	5.6 (1/18)	5.6 (1/18)	—	50 (1/2)	—
Total		17.0 (78/460)	17.1 (50/292)	16.7 (28/168)	82.4 (14/17)	81.8 (9/11)

individual were missing. Feature 49 was one of the two burials within this group that was not included in a burial plot. The individuals found in Features 102 and 143 had the next highest amount of caries, with 4 carious teeth each. The individual in Feature 102 also had 13 teeth that had been lost before death, the lower molars and the upper and lower incisors. The observed caries rate for Group 1 was determined to be 17.5 percent.

Group 3

All of six of the adults within the group had carious teeth. Three of the individuals were aged younger than 40 years and three were older. The individual in Feature 164, a 45–50 year old male had 10 carious teeth and 13 teeth that were lost before death, most likely due to caries. The individual in Feature 207, an elderly male, was nearly edentulous. Only one root stump remained in situ in the well-preserved alveolar bone. The individuals in Features 181 and 197 were two of the younger males, both in their twenties, and had 8 carious teeth between them. These two males were also members of Burial Plot 205, which had the greatest observed caries rate of all the burial plots. As indicated by Table 102, Group 3 had the highest observed caries rate of all the combined-sex groups considered. The males of this group also had the highest observed rate for all the male groups. The observed caries rate for Group 3 was determined to be 26.3 percent.

Group 4

Four of the five adults excavated in this burial group with dental remains had carious teeth. The individuals found in Features 137, 144, and 168 were approximately 50 years of age, and each suffered from substantial antemortem tooth loss and had three or more carious teeth. The individual in Feature 108 was aged 15–17 years and was destined to lose the lower first molars owing to extensive decalcification of the occlusal surfaces and pulp chamber exposure from caries. The individual in Feature 196, with only two teeth and no alveolar bone, was the only one that lacked carious teeth. Group 4 had the second highest group observed caries rate and the highest female observed caries rate. Both are, in part, owing to the small sample sizes and the advanced age of the individuals in this burial group. The observed caries rate for Group 4 was determined to be 22 percent.

Group 5

Four of the seven adults in this group had carious teeth. The group as a whole was rather representative of a prehistoric burial population with the adult age categories. The individual in Feature 142 had the most carious teeth (five) and was tied with the individuals from Features 141 and 145 with nine teeth lost before death—the highest amount for this group. This is a substantial amount of caries and antemortem loss considering that the individual found in Feature 142 was aged at approximately 30 years. The individuals in Features 33, 140, and 146 had no carious teeth, although the individual in Feature 140 had six teeth lost before death, probably as a result of caries. The individuals in the other two features had only one antemortem loss and nearly all of their teeth. Overall, Group 5, at 8.5 percent, had the lowest amount of caries, as well as other dental pathologies, of all the burial groups of the Vegas Ruin.

Summary

Various observed caries rates have been presented here and in the accompanying tables. Agricultural period populations like the Salado, the Hohokam of the Grand Canal Ruins, and the Sinagua of Elden Pueblo demonstrate higher caries rates than the populations from the Archaic or Early Agricultural period populations shown in Table 103. Though the samples were small for the burial groups and plots, a few patterns emerged that are indicative of overall diet and possible dietary differences within the Vegas Ruin population. Cervical caries with pulp chamber exposure and extensive antemortem loss of the molars were typical for nearly all of the adults at the Vegas Ruin, particularly the older individuals. There was also a substantial amount of antemortem loss of the anterior teeth, but this usually occurred after the loss of the molars.

There is virtually no difference between males and females in terms of the presence of carious teeth (see Table 102). There were, however, differences between the burial groups. Groups 3 and 4 had the highest rate of caries (20–30 percent), whereas Groups 1 and 5 had the lowest (8–18 percent). Males in Groups 1 and 3, however, had much higher rates than females in these groups, whereas females in Groups 4 and 5 had much higher rates than males in these same groups. Given the small sample sizes, these differences may relate to sampling error.

The Crane Site (AZ U:3:410/2017)

Six burial features at the Crane site were evaluated for caries. As previously stated, one feature was excluded from the dental analyses. The individual in Feature 36 had a very atypical dentition that is briefly described in the dental anomaly section of this chapter.

Five of the burials observed for caries were female and four of them were at least 40 years of age. The one male recovered from the site was found in Feature 38. This adult male was aged

Table 103. Hypoplasia Rates for CCP and Other Populations of the Prehistoric Southwest

Site Names and Numbers	Percent of Individuals in Population with Enamel Hypoplasia (no. of Individuals with EH / no. of Individuals Observed)	Percent of Teeth with Enamel Hypoplasia (no. affected teeth / no. observed teeth)
Vegas Ruin (405/2012)	34.5 (10/29)	7.2 (35/488)
Crane site (410/2017)	16.7 (1/6)	4.5 (4/89)
Vegas Ruin (405/2012) and Crane site (410/2017) combined	31.4 (11/35)	6.8 (39/577)
TCAP[a] (AZ U:3:5; AZ U:3:289; AZ U:3:294;AZ U:3:297; AZ U:3:298; AZ U:3:299; AZ U:3:300 [ASM])	21.9 (40/183)	5.2 (158/3,034)
RPM Schoolhouse Mound[b] (AZ U:8:24 [ASM])	54.4 (75/138)	24 (206/849)
Hohokam Grand Canal Ruins[c] (AZ T:12:14 and AZ T:12:16 [ASU])	25 (16/65)	—
Elden Pueblo[d] (NA 142 [CNF])	61 (25/41)	11.3 (60/530)
Matty Canyon[e] (AZ EE:2:137 and AZ EE:2:30 [ASM])	20 (1/5)	1.4 (2/142)
Wetlands Cienega Phase[f] (AZ AA:12:90 [ASM])	16.7 (3/18)	6.0 (17/285)
La Playa[g] (SN F:10:3 [ASM])	7.7 (1/13)	1.1 (2/185)

Key: RPM = Roosevelt Platform Mound; TCAP = Tonto Creek Archaeological Project.
[a] Lincoln-Babb 2001.
[b] Regan et al. 1996.
[c] Fink 1989.
[d] Hill and Lincoln-Babb 2001.
[e] Minturn and Lincoln-Babb 1995.
[f] Guthrie and Lincoln-Babb 1998.
[g] Villalpando et al. 1998.

25–30 years with 29 teeth present, no antemortem loss of teeth, and no caries. The number of teeth present for this adult and the lack of any pathologies was unusual when compared to the vast majority of the individuals in the CCP population.

The observed caries rate for this site population was approximately 7.9 percent (7 carious teeth/89 observed teeth). The corrected caries rate was nearly double this amount at 15.3 percent. Half of the six individuals observed had carious teeth, producing an individual caries rate of 50 percent. The individual from Feature 21 was approximately 41–50 years old and had the greatest number of carious teeth (5) within the sample. This older female had also managed to retain the majority of her teeth to an advanced age.

Not much can be said of this small population other than it was perhaps less dependent upon carbohydrates and had a better status of health than the inhabitants of the Vegas Ruin. This, however, is speculative in light of the small sample size of the population.

Abscesses

Pulp chamber exposure of a tooth from caries frequently results in an abscess in the alveolar bone. Because caries are the primary impetus behind dental abscessing, it follows that this pathology is more commonly observed in agricultural populations, which have higher caries frequencies than hunting and gathering or mixed-economy populations.

Roughly 42 percent of the individuals from the combined populations of the CCP had one or more abscesses. Eleven of the 26 individuals with preserved alveolar bone evinced localized bone degeneration, usually the apices of the roots. All of the abscesses that were observed for the CCP population appeared to be caused by caries.

Calculus

The consumption of certain foods, especially those that have been processed into soft, pasty textures, can lead to the deposition of mineralized plaque on a tooth's surface. If adequate dental hygiene is not practiced, these accretions can occur at the junction of the crown and root and between adjoining teeth. As with caries and abscesses, agriculturists usually have a greater tendency to have calculus deposits on their teeth. Only 3.5 percent (19/547) of the observed teeth had calculus. The dentitions of 30 of the individuals from the combined CCP populations were observed, and six of the burial features, all from the Vegas Ruin, had accumulations of calculus on one or more of their teeth. Four of these individuals were males and the other 2 were females.

Enamel Chipping and Dental Wear

Healthy teeth are the hardest, most durable elements of the body. However, like obsidian or some other crystalline material, dental enamel can be chipped if it comes into sharp contact with an equally hard or resistant material. Animal bone has proven to be such a material, which led to the observation that populations or societies that consume large amounts of meat have numerous chipped teeth (Turner and Cadien 1969). It follows that individuals of hunting-and-gathering and mixed economies exhibit more chipping of the enamel than agriculturists.

A total of 21 (3.7 percent) teeth out of 575 observed for the Vegas Ruin and the Crane site had chipped enamel. Slightly less than one-third of the 35 total individuals (28.6 percent) had chipped teeth. Eight of the 11 people with chipped teeth had chips removed from the right side of their dentitions. This may suggest a tendency to bite or chew on one side or right-handedness in people who use their teeth as tools. There was no significant difference between the number of males and females with enamel chipping.

Nine individuals at the Vegas Ruin exhibited blocky chips, usually observed on the premolars or molars. Five of the nine individuals with chipped enamel were from Group 1. All of the chips appeared to be related to the consumption of foods or biting on hard objects, such as bones or, possibly, stone inclusions from the processing of food with ground stone tools. Two individuals at the Crane site had at least one chipped tooth, and one of these individuals also had a molar with a blocky chip.

Two individuals from the Vegas Ruin shared a distinctive pattern of dental chipping, with enamel removed from the labial and occlusal edges of incisors and canines. The individual in Feature 181, a male in his early twenties, displayed small chips from the incisal edges of the upper central and right lateral incisors. This young male demonstrated an unusual reliance on his anterior teeth, considering 10 of the 12 permanent molars were present and the 2 absent molars were not lost before death. He did, however, have 3 carious upper premolars, which may have impeded use of the molars. His lower anterior teeth projected labially owing to slight crowding and perhaps to the particular manner of use of the upper teeth. The individual in Feature 182, a female aged 45+ years, had small chips removed from the upper right canine and lower right lateral incisor and first premolar. These teeth, in occlusion, create a biting platform. This female also exhibited transverse grooves on the occlusal surfaces of teeth from the left side of the dentition, the upper and lower canine, and first premolar. Transverse grooves have been associated with task wear, specifically the processing of material in the construction of baskets (Newman 1974; Wheat 1967). The individual in Feature 182 was the only one from the CCP burial population that exhibited some form of task wear.

Dental wear can also be indicative of subsistence practices. Excessive dentine exposure and sharp angled or unevenly worn crowns is commonly encountered with middle-aged adults (30+ years) identified as Archaic or Early Agricultural period inhabitants of the prehistoric Southwest. These individuals used their teeth as grinding and stripping tools to aid the processing of the coarse and/or fibrous foods they consumed on a regular basis. For same-aged prehistoric agriculturists like the Hohokam and Salado, minimal to moderate dentine exposure, flattening of the cusps, and slight oblique angled wear of the molars is usually observed. The dental wear for the CCP population did not deviate from the standard. Nearly two-thirds of the individuals in the population were over the age of 30 years and exhibited moderate amounts of dentine exposure and smoothing of the cusps. Only one person, located in Feature 49 from the Vegas Ruin, exhibited angled and lingual wear of the upper and lower incisors. This type of wear has been related to the consumption of agave or other fibrous plants that require the teeth for the stripping the fleshy food from the pad or stalk of the plant (Anderson 1965; Lincoln-Babb 2001; Turner and Machado 1983).

Enamel Hypoplasia

The prevalence of enamel hypoplasia within a population indicates whether the group maintained a good status of health and experienced a minimal amount of metabolic disturbances during childhood (Goodman 1993; Goodman and Rose 1991; Goodman et al. 1980). Permanent scars can form in the enamel on the labial and lingual surfaces of the teeth during amelogenesis, or the deposition of the enamel during a tooth's development. These insults to the enamel typically appear as linear grooves, numerous small pits, or areas of enamel discoloration. The latter description is referred to as hypocalcification and is considered a lesser manifestation of the pathology.

A child's maintenance of good health from the ages of 4 months in utero to 18 years is vital for preventing the formation of enamel defects. Nevertheless, the etiology of enamel hypoplasia remains as complicated as the definition of "good health." Malnutrition and illness obviously disrupt the physiological well-being of an individual. The synergistic effect of these two conditions during early childhood impair growth and cause responses by the body like the interruption of the enamel laying process of the teeth.

Weaning and postweaning stress have been considered physiologically disruptive episodes for young children and, as such, have been related to the formation of enamel hypoplasias. Ethnographic studies have shown that there are a number of factors involved with weaning and that these factors are rather consistent throughout the world (Almedom 1991; Goodman et al. 1987; Hrdlièka 1908). To begin with, weaning can either be a lengthy process or can happen abruptly. In nonurban societies, the abrupt cessation of breast-feeding rarely occurs. Should it take place, the most prevalent reason for such is the ill health of the mother. In the same type of societies, the most commonly given reasons for initiating the weaning process are the eruption of the child's teeth, a new pregnancy, the seasonal availability of weaning foods, and the child's desire for other foods. The notion that nursing a child prevents conception is not widely accepted. In a modern study, it was found that Ethiopian women never considered breast-feeding to have a contraceptive effect (Almedom 1991). Several cases of women continuing to nurse a child during pregnancy and after the birth of a new infant were reported in Hrdlièka's (1908) study of indigenous people of the Southwest. This source also noted a Pima mother nursing a child up to the age of 7 years. Ultimately, between and within populations, the inception of weaning can be quite variable.

Male children have been reported as desiring supplemented foods earlier in life than female children. When the diet is supplemented, it is usually with foods the mother consumes on a regular basis (Almedom 1991; Hrdlièka 1908; Kaiser and Dewey 1991). For indigenous groups of the Southwest, children with minor dental development received pieces of fruit or meat to suck (Hrdlièka 1908). Maize gruel has been mentioned as a dietary supplement during weaning, but in a number of those cases, food variety and availability were limited (Blakey et al. 1994; Wood 1996). If there were an abundance of other foods, they probably would have been introduced. It follows that a food surplus in the home or community may influence the timing for weaning a child. For example, women in Ethiopia started the supplementation of breast milk a couple of months earlier than the norm, because it coincided with the harvest of the staple crop, barley (Almedom 1991). In several studies, it was found that no special effort was made to enhance the flavor of weaning foods, which could make a child become choosy as to what he or she will consume (Almedom 1991; Hrdlièka 1908; Kaiser and Dewey 1991). The mother ultimately lets the child eat whatever they desire, which may not be the most nutritious. This suggests that a child with specific dietary preferences may actually contribute more to his or her own poor nutritional status rather than a lack of access to healthy foods.

Concerning the etiology of enamel hypoplasias, it is apparent that weaning or postweaning phases do not directly promote a malnourished state for the child (Almedom 1991; Blakey et al. 1994; El-Najjar 1976; El-Najjar et al. 1978; Goodman et al. 1987; Hrdlièka 1908; Kaiser and Dewey 1991; Wood 1996). Gastrointestinal disorders caused by parasites and the increased exposure to infection from interaction with others in the community are what more likely promote the development of enamel defects (Duray 1996; El-Najjar et al. 1976; El-Najjar et al. 1978; Goodman et al. 1984; Malville 1997).

Hypoplasias have been observed more frequently in prehistoric agricultural groups than hunters and gatherers. Poor hygiene and aggregation, rather than diet, contributed to less than optimum conditions for the maintenance of good health. Agriculturists also exhibit wider bands of hypoplastic activity, thereby being more noticeable to the observer. It has been argued that without the use of high magnification, it is not possible to determine whether a hypoplasia is the result of a restricted period of metabolic stress (acute) or from a lengthy period of poor health (chronic) (Hillson and Bond 1997). Though magnification does reveal disturbances of the enamel unseen by the naked eye, a chronic condition is obvious without the use of a microscope, as a large area of the tooth's surface exhibits irregularities of the enamel (Blakey and Armelagos 1997; Ensor and Irish 1995).

All of the deciduous and permanent teeth of the CCP burials were inspected for enamel hypoplasias; however, none of the deciduous teeth displayed enamel defects. This is not uncommon for prehistoric or living populations. Inherited conditions for enamel hypoplasia are rare and causation can be difficult to determine.

Hypoplasia rates for several other Southwest prehistoric populations are presented in Table 103. In reviewing these data, it appears that the CCP population experienced an amount of stress comparable to the other agricultural populations. The hypoplasia rate—or the number of affected teeth divided by the number of observed teeth—for the combined Crane site and Vegas Ruin populations is 6.8 percent. An individual count (number of individuals with hypoplasias/number of individuals observed) is frequently used in population comparisons. Using this measure, 31.4 percent (11/35) of the recovered individuals from the CCP had teeth with enamel defects.

Males appear to have been affected by hypoplasias much more frequently than females. For example, less than 5 percent of the female teeth (11 affected teeth/228 teeth observed) exhibited hypoplasias, whereas 8 percent (28/349) of the male teeth exhibited this pathology. The proportions of males and females with enamel hypoplasias produced similar results. Over 44 percent (8 males with affected teeth/18 males observed) of the males from the Vegas Ruin and the Crane site had affected teeth, whereas only18.8 percent (3/16) of the females from both sites had teeth with hypoplasias. These differences between males and females, however, do not appear to be significant. Chi-square tests were performed in which $\chi 2$ values of 2.243 and 2.555 were obtained for affected teeth and affected individuals, respectively. At one degree of freedom, these values do not meet the tabled value of 3.481 required for a probability equal to 0.05 (Thomas 1976). Thus the null hypothesis cannot be rejected in either case.

Hypoplasias caused by trauma (i.e., some sort of blow to the developing tooth) are rare in comparison to those caused by some sort of environmental or health stress. It would seem logical that metabolic disturbance would be the cause if more than one tooth has defects and antimeres (e.g., both upper incisors, upper canines, or lower canines) exhibit the enamel insults. All but one of the individuals from the CCP sample fulfill this criteria.

Vegas Ruin (AZ U:3:405/2012)

The rate for affected teeth within the burial population from the Vegas Ruin was 7.2 percent. More than one-third of the individuals (10/29) had teeth with enamel hypoplasias for a frequency of 34.5 percent. Rates were also calculated for four of the five identified burial groups from the Vegas Ruin. Group 2 was again excluded. These frequencies are presented below, along with some information about affected adults from each group, including the possible ages of the individuals when they experienced a metabolic disturbance that caused the hypoplasia. The age of an individual (at the onset of the disturbance) is determined by measuring the distance from the cemento-enamel junction to the occlusal edge of the insult and then comparing the measurement to an enamel mineralization table for the permanent dentition (Goodman et al. 1980; Rose et al. 1985).

Group 1

Four of the eight adults from this group had teeth with enamel hypoplasia. The individual in Feature 49 had shallow horizontal grooves on the upper first molars that had formed at approximately 1.5–2 years of age. The female child in Feature 102 had one lower canine that also exhibited a shallow horizontal groove that developed at approximately 4 years of age. The individual in Feature 143 also had the same manifestation on a canine. This insult occurred between the ages of 3–3.5 years of age. The individual in Feature 220 had 12 teeth, incisors and canines, with horizontal grooves and pits. The measurements on the involved teeth indicated the disturbances occurred between the ages of 2.5–4 years of age. Because of this range of time and the number of affected teeth, this individual probably suffered from a chronic condition of metabolic stress. All of the individuals in this group with hypoplasia were males, except for the individual in Feature 102. Overall, 16 out of 154 observed teeth had enamel hypoplasias, a rate of 10.4 percent.

Group 3

Three of the six individuals assigned to this group had teeth with enamel defects. The individual in Feature 181 had 3 canines with a series of shallow grooves that develop anywhere from the ages of 3 to 5.5 years. The individual in Feature 197 also exhibited shallow grooves on a canine and premolar. Timing for the development of these insults ranges from 4.5 to 6 years of age. The individual in Feature 206, the only female in the group with hypoplasias, had 6 incisors and canines with shallow, horizontal furrows on the surfaces of the teeth. There were 11 teeth with enamel hypoplasias in this group and a total of 99 observed teeth. The percentage of affected teeth for Group 3 was 11.1 percent.

Group 4

Only one individual out of this group of five adults with dental remains had a tooth with an enamel hypoplasia. Minor pitting was observed on the surface of a lower canine for the individual in Feature 137, an adult male. The onset of the defect was approximately 3.5 years of age. A hypoplasia rate of 1.7 percent (1 affected tooth/59 observed teeth) was figured for this group.

Group 5

None of the individuals in this group evinced enamel defects. The individuals, both males, that were recovered in the two burials located outside of the identified burial groups had teeth with enamel hypoplasias.

Individual Burials

The individual in Feature 106 exhibited a series of grooves on the two lower canines that developed between the ages of 3.5–6 years. The individual in Feature 199 had shallow grooves on five teeth, incisors and canines, that occurred when the individual was approximately 3–3.5 years of age. Between these two individuals, a rate of 38.9 percent (7 affected teeth/18 observed teeth) was produced.

The Crane Site (AZ U:3:410/2017)

As with the caries analysis, the individuals in Features 33 and 36 of the Crane site were excluded from the analysis for hypoplasias. Only one individual out of six at this site had teeth with hypoplastic defects of the enamel. All four canines of the female associated with Feature 21 had shallow grooves that began developing at approximately the age of 3.5 years. The hypoplasia rate was 4.5 percent (4 affected teeth/89 teeth observed). The population rate was 16.7 percent (1/6).

Dental Anomalies

Several individuals from the CCP burial population had dentitions with unusual characteristics. The individual in Feature 14 from the Vegas Ruin had a supernumerary peg tooth that was positioned by an upper lateral incisor. The individual in Feature 12 at the same site also had a supernumerary tooth in the same location. The individuals found in Feature 137, an adult male, and Feature 175, a neonate, had fused lower incisors. Supernumerary and fused teeth have a genetic basis and are not frequently encountered (Pindborg 1970). However, it is not that unusual to have one or two people with these features within a prehistoric or historic Southwest population of 40 or more individuals (Hrdlièka 1908; Pindborg 1970).

Three individuals from Group 3 at the Vegas Ruin had malpositioned teeth. The individuals interred in the burials in this group (Features 181, 197,and 205) exhibited minor crowding of the teeth, which has been related to a shift to softer diets over time (Larsen 1995).

The dentitions of two individuals from the Crane site were especially noteworthy. The individual in Feature 36 was missing the cranium and maxillary dentition but exhibited an extremely unusual lower arcade. The mandible of this individual was intact and revealed four nonerupted teeth in situ in the anterior portion of the mandibular alveolar bone (Figure 56). The teeth present were positioned horizontally with two on each side of the midpoint of the mandible. All of the teeth crowns had the morphology of canines; their roots, however, were bulbous rather than long and pointy. Because of the degeneration of the alveolar bone in the molar and premolar regions, it was possible to determine that no other nonerupted teeth were present within the bone. This extraordinary dentition, never observed before by this analyst, resembled given descriptions of teeth for genetic disorders like dwarfism. Although this particular anomaly appears to be unique, dwarfism is usually associated with some kind of anomalous dentition. The individual in Feature 36 is described and discussed in detail in Chapter 8.

The teeth of the other individual from the Crane site, Feature 38, did not exhibit any remarkable pathologies or morphology. The unusual aspect of this well-preserved young male's dentition was the intentional placement of plain ware sherds within the mouth and between the posterior teeth on the right side. During the excavation of the intact maxilla and mandible (in proper occlusion), it was observed that a sherd was clenched between the right molars. Further excavation of the alveolar bone and teeth revealed a broken sherd within the mouth positioned perfectly between the lower first molars (Figure 57). The significance of this occurrence is uncertain. This male was buried in an elaborately cribbed grave with a large collection of locally made Salado Red pottery, and numerous other artifacts suggesting wealth or high status. The intentional placement of sherds in this individual's mouth may represent another aspect of his special treatment.

Morphological Trait Analyses

Dental morphological traits are features of the teeth, including ridges, crenulations, pits, and cusps visible on the crowns. The roots also exhibit distinctive characteristics that may be recorded. These phenotypic expressions of the teeth are believed to be primarily genetically determined and are not thought to substantially influence reproductive fitness (Scott 1973; Scott and Turner 1997). Consequently, dental traits are useful for examining the genetic affinity of prehistoric groups.

This analysis compares dental trait frequencies for the CCP burials with those of other prehistoric Southwestern populations. This type of analysis previously has successfully differentiated populations at both racial and subracial levels

Figure 56. Mandible from Feature 36 at the Crane site (410/2017).

(Greenberg et al. 1986; Scott 1973; Scott and Dahlberg 1982; Scott and Turner 1997; Turner 1969, 1986). Dental traits are quasi-continuous variables and, when present, can appear in different degrees of expression. Therefore, the presence or absence of a trait must be defined based on grades that establish a minimal threshold for appearance. The Arizona State University (ASU) Dental Anthropology System (Turner et al. 1991) has defined these grades and incorporates reference criteria that facilitate accurate and consistent assessment of dental traits. Plaster reference plaques, depicting minimal to maximal grades of trait expression, are used to allow three-dimensional comparison. The plaques are used in conjunction with written descriptions of the characteristics. Brief descriptions of the traits observed in this study are presented in Appendix F.1.

Several traits in the ASU system do not have plaque representations: palatine torus, winging (UI1), interruption groove (UI1, UI2), premolar accessory cusps (UP1, UP2), mandibular torus, groove pattern (LM, LM2, and LM3), and cusp number for the same teeth. Root characteristics were not recorded for the CCP population for several reasons, including problems with preservation of loose teeth and because assessment of the root traits of in situ teeth requires their extraction from alveolar bone. The crown characteristics were determined by visual inspection, using a bright light and a l0× hand lens. Observations for teeth of the right and left sides were recorded on standard ASU dental forms, and the individual-count method was used to derive a single score. This procedure considers the highest grade of expression as representative of the individual, thereby maximizing sample size and avoiding potential problems with trait asymmetry and missing antimeres (Scott 1980; Scott and Dahlberg 1982; Scott and Turner 1997; Turner et al. 1991). Fifty-nine dental traits were evaluated and recorded for individuals with permanent teeth from the CCP sites. Moderately to severely worn teeth were only considered if the trait was observable. Sample sizes and trait frequencies for the combined CCP sample are presented in Table 104.

Interregional Cluster Analysis

The section presents the results of cluster analyses that were conducted in order to examine the relationship of the

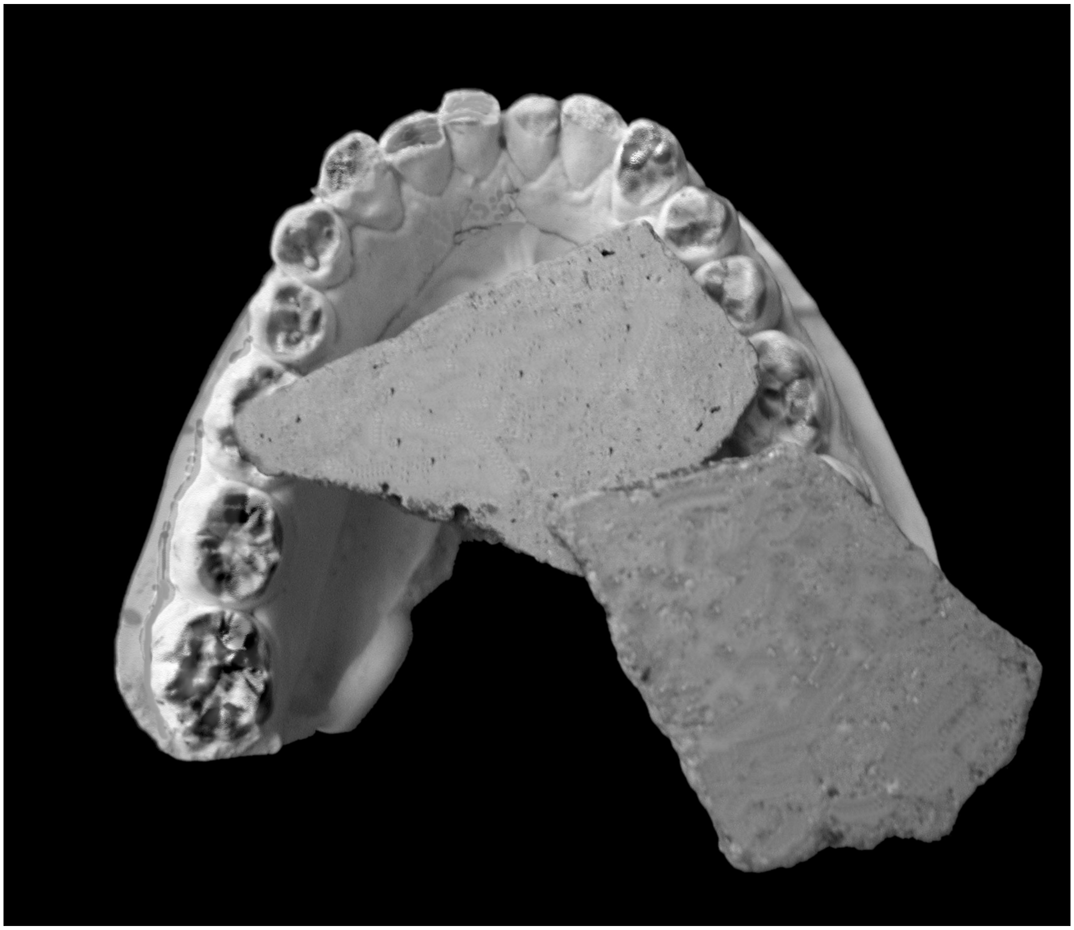

Figure 57. Sherds placed over mandible from Feature 38 at the Crane site (410/2017).

combined CCP populations with other prehistoric groups in the Southwest. Ward's minimum variance clustering algorithm and squared Euclidean distance measures were employed using SPSS version 10.0.

Turner's (1998) dental affinity analyses for the RPM burial population is the most comprehensive examination to date of dental traits for prehistoric Tonto Basin populations. The RPM sites were temporally and geographically diverse, permitting evaluation of both spatial variation and changes through time. In contrast, the CCP sites are close together and date to the early Classic period. Trait frequencies for nine other prehistoric Southwest groups were obtained from the RPM data (Turner 1998), and dental data obtained during the TCAP excavations located to the south along SR 188 are also included (Lincoln-Babb 2001).

Figure 58 is a dendrogram of the results of a cluster analysis preformed on 18 dental crown trait frequencies for groups from a wide geographical area. Although Turner considered 29 traits, these results are highly similar to what he observed (Turner 1998). I recorded as many of the traits that are listed in Turner et al. (1991) as possible for each person. This does not mean, however, that all of the observations were used in population comparisons. The few traits that were usually excluded were not used because the sample sizes were either nonexistent or too small or because these were redundant traits and not that powerful in determining the dental morphology of a population. Root traits were generally excluded, because if not already broken or loose, studying the tooth would require the destruction of the alveolar bone to observe. But if any abnormality with root number or form was observed, it was recorded and addressed within the report. This holds true for other traits that were not included in the comparative trait analysis, like labial convexity, tri-cusped premolar, metacone, and peg-shaped incisor.

The clustering of the populations is generally consistent with their geographical location, which is expected based on the likelihood of common ancestry and/or gene flow. Similar to Turner's findings, the RPM samples from the Salt and

Table 104. Trait Sample Sizes and Trait Frequencies for Combined CCP Populations

Trait and Tooth	Grade												Crown Trait Frequency
	n[a]	0	1	2	3	4	5	6	7	8	9	10	
Palantine torus	9	8	**1**	—	—	—	—	—	—	—	—	—	
Percent		88.9	**11.1**	—	—	—	—	—	—	—	—	—	11.1
Winging UI1	8	—	**2**	—	6	—	—	—	—	—	—	—	
Percent		—	**25.0**	—	75.0	—	—	—	—	—	—	—	25.0
Shoveling UI1	14	—	—	3	**8**	**3**	—	—	—	—	—	—	
Percent		—	—	21.4	**57.1**	**21.4**	—	—	—	—	—	—	78.6
Shoveling UI2	14	—	1	—	**1**	**7**	**4**	**1**	—	—	—	—	
Percent		—	7.1	—	**7.1**	**50.0**	**28.6**	**7.1**	—	—	—	—	92.9
Double shoveling UI1	9	1	6	**1**	—	—	—	**1**	—	—	—	—	
Percent		11.1	66.7	**11.1**	—	—	—	**11.1**	—	—	—	—	22.2
Double shoveling UI2	10	4	5	—	**1**	—	—	—	—	—	—	—	
Percent		40.0	50.0	—	**10.0**	—	—	—	—	—	—	—	10.0
Interruption groove UI1	8	6	**2**	—	—	—	—	—	—	—	—	—	
Percent		75.0	**25.0**	—	—	—	—	—	—	—	—	—	25.0
Interruption groove UI2	11	8	**2**	**1**	—	—	—	—	—	—	—	—	
Percent		72.7	**18.2**	**9.1**	—	—	—	—	—	—	—	—	27.3
Tuberculum dentale UI1	9	6	2	—	**1**	—	—	—	—	—	—	—	
Percent		66.7	22.2	—	**11.1**	—	—	—	—	—	—	—	11.1
Tuberculum dentale UI2	11	9	—	—	—	**1**	**1**	—	—	—	—	—	
Percent		81.8	—	—	—	**9.1**	**9.1**	—	—	—	—	—	18.2
Triform variant UI2	12	12	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Canine mesial ridge UC	6	6	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Distal accessory ridge UC	7	2	1	**4**	—	—	—	—	—	—	—	—	
Percent		28.6	14.3	**57.1**	—	—	—	—	—	—	—	—	57.1

Table 104. Trait Sample Sizes and Trait Frequencies for Combined CCP Populations (*continued*)

Trait and Tooth	Grade												Crown Trait Frequency
	n[a]	0	1	2	3	4	5	6	7	8	9	10	
Accessory cusps UP1	8	6	**2**	—	—	—	—	—	—	—	—	—	
Percent		75.0	**25.0**	—	—	—	—	—	—	—	—	—	25.0
Accessory cusps UP2	6	3	**3**	—	—	—	—	—	—	—	—	—	
Percent		50.0	**50.0**	—	—	—	—	—	—	—	—	—	50.0
Uto–Aztecan premolar UP1	12	11	**1**	—	—	—	—	—	—	—	—	—	
Percent		92.7	**8.3**	—	—	—	—	—	—	—	—	—	8.3
Hypocone UM1[b]	15	—	—	—	—	3	**9**	**3**	—	—	—	—	
Percent		—	—	—	—	20.0	**60.0**	**20.0**	—	—	—	—	80.0
Hypocone UM2[b]	12	4	—	2	3	2	**1**	—	—	—	—	—	
Percent		33.3	—	16.7	25.0	16.7	**8.3**	—	—	—	—	—	8.3
Hypocone UM3[b]	5	2	—	—	1	1	**1**	—	—	—	—	—	
Percent		40.0	—	—	20.0	20.0	**20.0**	—	—	—	—	—	20.0
Cusp 5 UM1	10	7	**2**	**1**	—	—	—	—	—	—	—	—	
Percent		70.0	**20.0**	**10.0**	—	—	—	—	—	—	—	—	30.0
Cusp 5 UM2	10	10	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Cusp 5 UM3	3	3.0	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Carabelli's trait UM1	12	1	4	**4**	**2**	—	—	**1**	—	—	—	—	
Percent		8.3	33.3	**33.3**	**16.7**	—	—	**8.3**	—	—	—	—	58.3
Carabelli's trait UM2	9	5	1	**3**	—	—	—	—	—	—	—	—	
Percent		55.6	11.1	**33.3**	—	—	—	—	—	—	—	—	33.3
Carabelli's trait UM3	3	3	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Parastyle UM3	11	8	**1**	**1**	—	—	—	**1**	—	—	—	—	
Percent		75.7	**9.1**	**9.1**	—	—	—	**9.1**	—	—	—	—	27.3

Table 104. Trait Sample Sizes and Trait Frequencies for Combined CCP Populations (*continued*)

Trait and Tooth	Grade												Crown Trait Frequency
	n[a]	0	1	2	3	4	5	6	7	8	9	10	
Enamel extension UM1	11	8	—	**2**	**1**	—	—	—	—	—	—	—	
Percent		72.7	—	**18.9**	**9.1**	—	—	—	—	—	—	—	27.3
Enamel extension UM2	6	4	**2**	—	—	—	—	—	—	—	—	—	
Percent		66.7	**33.3**	—	—	—	—	—	—	—	—	—	33.3
Enamel extension UM3	2	2	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Mandibular torus	17	12	**4**	**1**	—	—	—	—	—	—	—	—	
Percent		70.6	**23.5**	**5.9**	—	—	—	—	—	—	—	—	29.4
Shoveling LI1 and LI2	3	3	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Distal accessory ridge LC	5	2	1	**1**	**1**	—	—	—	—	—	—	—	
Percent		40.0	20.0	**20.0**	**20.0**	—	—	—	—	—	—	—	40.0
Premolar lingual cusp LP1[c]	7	5	—	—	—	—	**1**	—	—	—	—	1.0	
Percent		71.4	—	—	—	—	**14.3**	—	—	—	—	14.3	14.3
Premolar lingual cusp LP2[c]	5	3	—	—	**1**	—	—	—	—	—	—	1	
Percent		60.0	—	—	**20.0**	—	—	—	—	—	—	20.0	20.0
Anterior fovea LM1	8	1	2	**4**	**1**	—	—	—	—	—	—	—	
Percent		12.5	25.0	**50.0**	**12.5**	—	—	—	—	—	—	—	62.5
Groove pattern LM1[d]	7	—	**6**	1	—	—	—	—	—	—	—	—	
Percent		—	**85.7**	14.3	—	—	—	—	—	—	—	—	85.7
Groove pattern LM2[d]	9	—	**3**	5	1	—	—	—	—	—	—	—	
Percent		—	**33.3**	55.6	11.1	—	—	—	—	—	—	—	33.3
Groove pattern LM3[d]	3	—	**1**	1	1	—	—	—	—	—	—	—	
Percent		—	**33.3**	33.3	33.3	—	—	—	—	—	—	—	33.3
Cusp number LM1[e]	8	—	—	—	—	—	6	**2**	—	—	—	—	
Percent		—	—	—	—	—	75.0	**25.0**	—	—	—	—	25.0

Table 104. Trait Sample Sizes and Trait Frequencies for Combined CCP Populations (*continued*)

Trait and Tooth	Grade												Crown Trait Frequency
	n[a]	0	1	2	3	4	5	6	7	8	9	10	
Cusp number LM2[e]	10	—	—	—	—	5	4	**1**	—	—	—	—	
Percent		—	—	—	—	50.0	40.0	**10.0**	—	—	—	—	10.0
Cusp number LM3[e]	3	—	—	—	—	2	1	—	—	—	—	—	
Percent		—	—	—	—	66.7	33.3	—	—	—	—	—	0.0
Deflecting wrinkle LM1	5	1	—	**3**	**1**	—	—	—	—	—	—	—	
Percent		20.0	—	**60.0**	**20.0**	—	—	—	—	—	—	—	80.0
Deflecting wrinkle LM2	4	3	—	—	**1**	—	—	—	—	—	—	—	
Percent		75.0	—	—	**25.0**	—	—	—	—	—	—	—	25.0
Deflecting wrinkle LM3	2	2	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Protostylid LM1	8	2	**3**	**3**	—	—	—	—	—	—	—	—	
Percent		25.0	**37.5**	**37.5**	—	—	—	—	—	—	—	—	75.0
Protostylid LM2	9	4	**4**	—	**1**	—	—	—	—	—	—	—	
Percent		44.4	**44.4**	—	**11.1**	—	—	—	—	—	—	—	55.5
Protostylid LM3	3	3	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Cusp 5 LM1	6	2	—	—	1	—	**3**	—	—	—	—	—	
Percent		33.3	—	—	16.7	—	**50.0**	—	—	—	—	—	50.0
Cusp 5 LM2	7	4	—	—	2	—	**1.0**	—	—	—	—	—	
Percent		57.1	—	—	28.6	—	**14.3**	—	—	—	—	—	14.3
Cusp 5 LM3	3	2	—	1	—	—	—	—	—	—	—	—	
Percent		66.7	—	33.3	—	—	—	—	—	—	—	—	0.0
Cusp 6 LM1	7	5	—	**2**	—	—	—	—	—	—	—	—	
Percent		71.4	—	**28.6**	—	—	—	—	—	—	—	—	28.6
Cusp 6 LM2	8	6	**2**	—	—	—	—	—	—	—	—	—	
Percent		75.0	**25.0**	—	—	—	—	—	—	—	—	—	25.0

Table 104. Trait Sample Sizes and Trait Frequencies for Combined CCP Populations (*continued*)

Trait and Tooth	Grade												Crown Trait Frequency
	n[a]	0	1	2	3	4	5	6	7	8	9	10	
Cusp 6 LM3	3	3	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Cusp 7 LM1	6	5	**1**	—	—	—	—	—	—	—	—	—	
Percent		83.3	**16.7**	—	—	—	—	—	—	—	—	—	16.7
Cusp 7 LM2	9	9	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Cusp 7 LM3	3	3	—	—	—	—	—	—	—	—	—	—	
Percent		100.0	—	—	—	—	—	—	—	—	—	—	0.0
Enamel extension LM1	6	3	**1**	**1**	**1**	—	—	—	—	—	—	—	
Percent		50.0	**16.7**	**16.7**	**16.7**	—	—	—	—	—	—	—	50.0
Enamel extension LM2	7	3	**1**	**2**	**1**	—	—	—	—	—	—	—	
Percent		42.9	**14.3**	**28.6**	**14.3**	—	—	—	—	—	—	—	57.2
Enamel extension LM3	2	—	—	**1**	**1**	—	—	—	—	—	—	—	
Percent		—	—	**50.0**	**50.0**	—	—	—	—	—	—	—	100.0

Note: Numbers in bold signify grade(s) at which trait is considered present. For definitions of traits see Appendix F.1.

[a] Number of teeth for which the trait observation could be made.

[b] Hypocone UM1; UM2; UM3—Grade 4 = 3a (ASU), Grade 5 = 4 (ASU), Grade 6 = 5 (ASU).

[c] Premolar Lingual Cusp UP1; UP2—Grade 10 is ASU Grade A.

[d] Groove Pattern LM1; LM2; LM3—Grade 1 = Y, Grade 2 = X, Grade 3 = +.

[e] Cusp Number LM1; LM2; LM3—Grade 4 = 4 cusps, Grade 5 = 5 cusps, Grade 6 = 6 cusps, Grade 7 = <4 cusps. Cusp 7 is not included in this trait count.

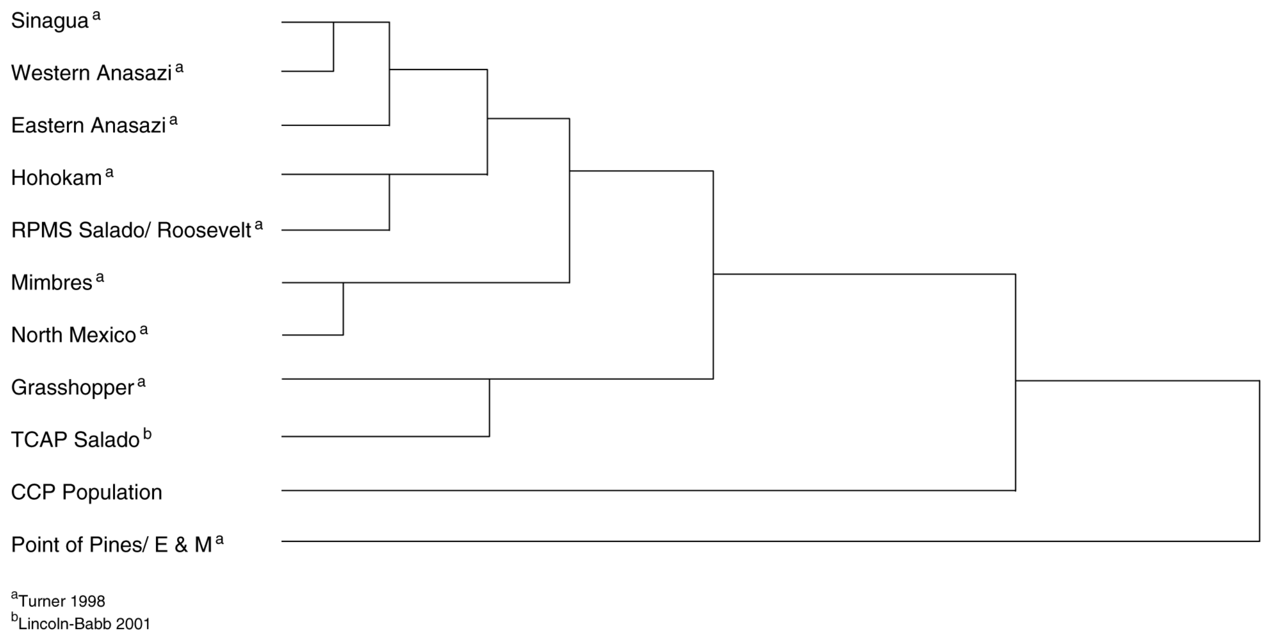

Figure 58. Dendrogram using 18 dental traits for three projects studying Salado populations: the Cottonwood Creek Project, the Roosevelt Platform Mound Study (Roosevelt Phase), and the Tonto Creek Archaeological Project. Dental Traits: Winging, Shoveling UI1, Double Shoveling UI1, Interruption Groove UI2, Canine Mesial Ridge UC, Distal Accessory Ridge UC, Uto Aztecan Premolar UP1, Carabell'is Trait UM1, Cusp 5 UM1, Hypocone UM2, Parastyle UM3, Premolar Lingual Cusps LP2, Cusp # LM1, Deflecting Wrinkle LM1, Protostylid LM1, Cusp 7 LM1, Enamel Extension UM1, Groove Pattern LM2.

Tonto arms of the basin clustered with the Hohokam sample from the Phoenix Basin. Turner (1998) has suggested that this is consistent with other archaeological evidence, such as Hohokam pottery, similar house plans, mortuary practices (cremations), use of shell jewelry, and platform mounds. This group is part of a larger cluster that includes the Sinagua, Western Anasazi, Eastern Anasazi, Basketmaker, Mimbres, and Northern Mexico samples.

Grasshopper and Point of Pines show less similarity with the above groups (Turner 1998). Somewhat surprisingly, the CCP population is more closely related to the Pueblo IV populations from the Mogollon sites of Grasshopper and Point of Pines. This clustering is consistent with the TCAP sample, which appears to be even more closely related to the Mogollon samples. Although the sample for the CCP was relatively small, the available data suggest that groups living in this portion of the basin shared closer genetic affinity with the Mogollon populations.

Figure 59 is a dendrogram comparing the same groups with the RPM sites divided into the Salt River and Tonto Creek groups. The clustering of the groups is highly similar to that observed in Figure 58. Despite the geographical proximity of the RPM Tonto creek sites to the CCP and TCAP populations, they do not appear to have been closely related genetically.

Based on the phenetic similarities of the dental traits compared here, it appears that considerable genetic heterogeneity existed in the early Classic period populations living in Tonto Basin. It appears that Tonto Basin may indeed have been a "melting pot" where groups from a wide geographical area came together.

Conclusion

Many archaeological projects in Tonto Basin have recovered inhumations of the prehistoric inhabitants of the region (Bassett and Atwell 1985; Fink 2003; Hartman 1987; Minturn 2001; Regan et al. 1995, 1996; Regan and Turner 1997; Turner et al. 1994). Although there have been numerous burials recovered from Tonto Basin, only a few of the projects produced written reports with any comparable information about their dentitions. One of these projects, DAI's TCAP, excavated a number of moderately sized sites

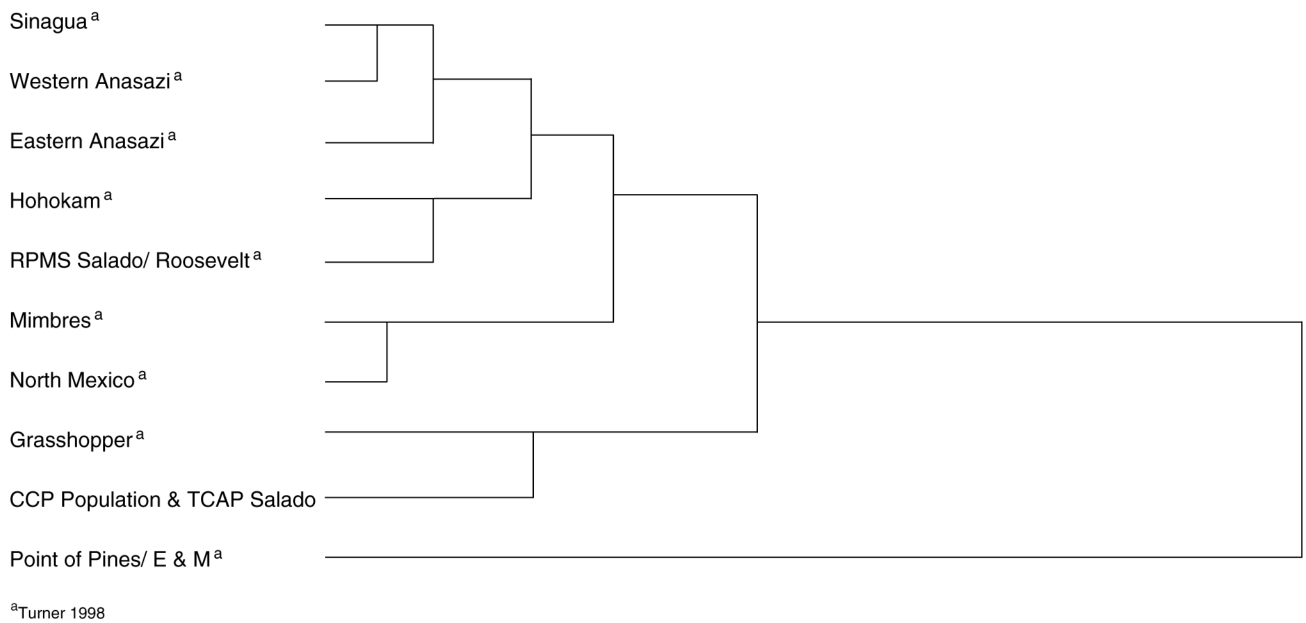

Figure 59. Dendrogram using 18 dental traits. CCP and TCAP populations are combined. Dental Traits: Winging, Shoveling UI1, Double Shoveling UI1, Interruption Groove UI2, Canine Mesial Ridge UC, Distal Accessory Ridge UC, Uto Aztecan Premolar UP1, Carabell'is Trait UM1, Cusp 5 UM1, Hypocone UM2, Parastyle UM3, Premolar Lingual Cusps LP2, Cusp # LM1, Deflecting Wrinkle LM1, Protostylid LM1, Cusp 7 LM1, Enamel Extension UM1, Groove Pattern LM2.

with burials contemporaneous with those of the Vegas Ruin and the Crane site.

Three of the TCAP sites (AZ U:3:5, AZ U:3:297, and AZ U:3:299) had very similar rates for caries and enamel hypoplasia as the Vegas Ruin population (Lincoln-Babb 2001). There are some minor differences between these populations, which suggest the people from the Vegas Ruin consumed more highly processed carbohydrates and less protein than the TCAP population but were perhaps less agriculturally dependent than Schoolhouse Mound people of the RPM (Regan et al. 1996).

Many of the individuals of the CCP population evinced carious anterior teeth or the antemortem loss of those teeth. Cervical caries, or caries at the cemento-enamel junction of teeth, were also encountered frequently. All of the observable alveolar bone supporting the molars demonstrated significant antemortem loss. These are characteristics of a carbohydrate-rich diet.

The enamel hypoplasia frequencies for the CCP populations, especially Group 3 of the Vegas Ruin, suggest signs of environmental stress and questionable health for some individuals in their early childhood. The nominal amount of porotic hyperostosis, however, suggests that diets were not, on average, nutritionally inadequate.

Caries and enamel hypoplasia are usually more prevalent for the females rather than males in agricultural populations (Larsen 1995). This was not the case for the CCP population. Ezzo (1992) reported that there may have been an unequal distribution of food resources for males and females of the Establishment and Aggregation phases at Grasshopper, with males having greater access to meat and cultigens. This may be the case for the CCP population, but the males have a higher enamel hypoplasia rate, which is problematical. Significant differences were observed in the number of male and female teeth with enamel hypoplasias, but one male, located in Feature 220, had 12 affected teeth, which certainly influenced this outcome. The observation in weaning studies that males often desire supplemented foods earlier than females may have some import here.

The amount of enamel chipping observed for the teeth of the CCP population nearly matched the rate for the TCAP population (3.1 percent). Although protein intake was possibly less than optimum, the faunal analysis of the CCP demonstrated that small animals and deer were included in the diets of these Tonto Basin populations (see Chapter 5).

Dental trait frequencies were used to suggest genetic affiliations among the CCP population and other prehistoric Southwest populations. The credibility of such analyses is, in part, dependent on having a sufficient sample size—a minimum sample of 100 is generally considered necessary for trait analyses. Although the CCP sample was considerably less than the optimum, the data from this population increase the overall trait data for the prehistoric Tonto Basin. These data suggest the CCP population was most closely related to the TCAP Salado and Mogollon populations. The results of the trait analyses also supports the theory of Tonto Basin as having been a prime area for groups to relocate during the pre-Classic and Classic periods of prehistoric Arizona.

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The Sedentary to Classic Period Transition in Tonto Basin presents the results of archaeological investigations on the eastern slopes of the Mazatzal Mountains at the boundary of the upper and lower Tonto Basins in central Arizona. The project involved nine small prehistoric sites and segments of the historical-period Globe-Payson Highway. The prehistoric sites include two limited-activity sites located along Hardt Creek near Jakes Corner, an early Classic period field house overlooking Gold Creek, and six late Sedentary–early Classic period sites near Cottonwood Creek. The latter include two small early Classic period compounds overlying smaller Sedentary period settlements.

The Sedentary to Classic period transition, a watershed event in the prehistory of Tonto Basin, has been the subject of considerable controversy for over a half century. Early investigators had argued that this transition was a time when Hohokam colonists abandoned Tonto Basin, leaving a cultural vacuum that was subsequently filled by groups who migrated from the Mogollon Rim and created a distinct Puebloan-related culture they called the Salado. Later investigators rejected the notion of a cultural hiatus and argued for direct continuity between the pre-Classic period Hohokam and Classic period Salado cultures. Still others have suggested that Tonto Basin was an area of cultural interaction between the three major cultures of the Southwest. The variable influences of the Hohokam, Mogollon, and Anasazi were manifested in architecture, ceramics, and mortuary practices at different times and in different places within the basin. The variety of chronologies, time periods, and phases developed for Tonto Basin reflect this debate.

The State Route 188–Cottonwood Creek Project provides important new information about chronology and cultural relations during this pivotal time period in Tonto Basin prehistory. In the second volume of this series, we present the results of detailed scientific analyses of artifacts, subsistence remains, and human bioarchaeological data recovered from the prehistoric sites.