The Lower Oak Creek Archaeological Project

Archaeological Data Recovery along State Route 89A: Cottonwood to Sedona, Yavapai County, Arizona

Volume 2: Material Culture and Environmental Analyses

Edited by
Rein Vanderpot, Carla R. Van West, and Stephanie M. Whittlesey

Technical Series 85
Statistical Research, Inc.
Tucson, Arizona

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MANAGEMENT SUMMARY

Report Title: The Lower Oak Creek Archaeological Project; Archaeological Data Recovery along State Route 89A: Cottonwood to Sedona, Yavapai County, Arizona; Volume 2: Material Culture and Environmental Analyses

Report Date: 2011

Agency: U.S. Forest Service, Coconino National Forest Supervisor's Office, Flagstaff, Arizona, served as lead agency for cultural resources. Cooperating agencies and institutions included the Arizona Department of Transportation, the Federal Highway Administration, the Arizona State Land Department, the Arizona State Historic Preservation Office, and the Arizona State Museum.

Project Sponsor: Arizona Department of Transportation (ADOT), Phoenix, Arizona. ADOT Contract Number: 98-47 (State Route [SR] 89A, Cottonwood to Sedona); ADOT TRACS Number 089A-YV-355 8034-01E; ADOT Funding Number: 71999.

Archaeological Consultants: Statistical Research, Inc. (SRI), 6099 E. Speedway Blvd., Tucson, AZ 85712; (520) 721-4309.
Principal Investigator: Jeffrey H. Altschul, Ph.D. (1998–2004), Stephanie M. Whittlesey, Ph.D. (2005–2007), Rein Vanderpot, M.A. (2008–2012)
Project Director: Carla R. Van West, Ph.D.
Field Director: Rein Vanderpot, M.A.

Cultural Resource Permits: Coconino National Forest Special Use/ARPA Permit (PL 96-961897); Arizona State Museum Project-Specific Excavation Permit (ASM 1998-91ps); Arizona State Museum Burial Agreement (ASM Case No. 98-13); ADOT Right-of-Way Permit (ADOT ROW Permit No. 75201), right-of-entry permission to work on private land near the intersection of SR 89A and Upper Red Rock Loop Road.

Project Title: The Lower Oak Creek Archaeological Project (LOCAP): Archaeological Data Recovery along State Route 89A, Cottonwood to Sedona, Yavapai County, Arizona.

Project Description: This data recovery project included mitigation of adverse effects to 13 sites eligible for listing in the National Register of Historic Places (NRHP) within the right-of-way of highway and bridge improvements along 15.6 miles of SR 89A, between Cottonwood and Sedona, Arizona (Mileposts 355.3–370.9) (Map 1).

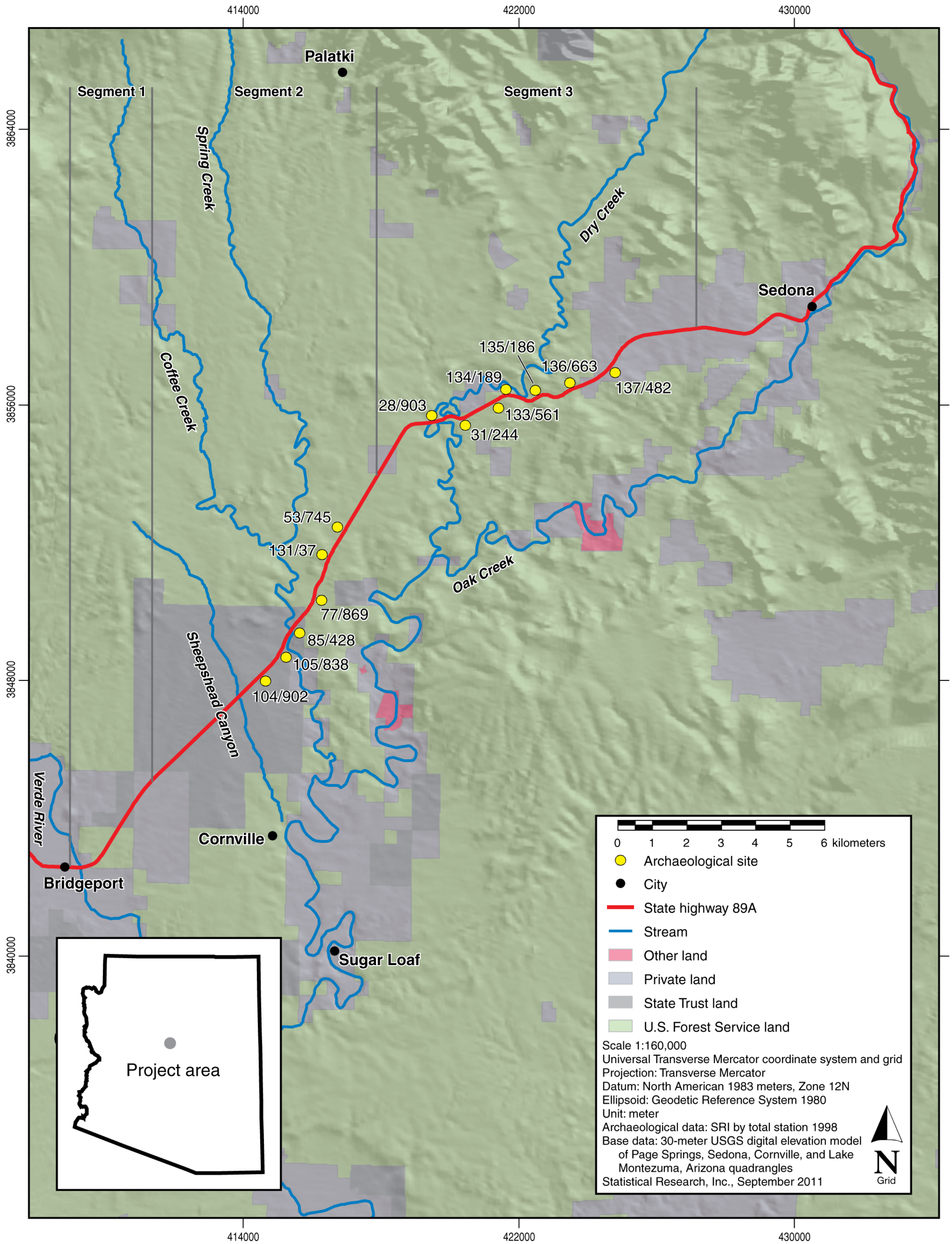
Fieldwork was conducted during the summer and autumn of 1998 beginning June 22 and November 15, 1998. A total of 5,644 hours (or 705.5 person-days) was expended over the course of the 5-month period to map, surface collect, test, and excavate archaeological remains associated with 13 prehistoric sites.

Land Status: Coconino National Forest, Arizona State Land Department, Arizona Department of Transportation, and Private.

Location: Project sites were located in two of the three SR 89A segments of unequal length. No NRHP-eligible sites were located within the first 2.1-mile long segment between Cottonwood and Cornville Road (Mileposts 355.3–357.4). Six NRHP-eligible sites were located within areas of potential effect (APEs) in the second 8.9-mile long segment between Cornville Road and Dry Creek (Mileposts 357.4–366.3). Seven NRHP-eligible sites were located within the APEs of the third 4.6-mile long segment (Mileposts 366.3–370.9). The locational information for sites investigated as part of the LOCAP is presented below in tabular format.

Sites Investigated as Part of the LOCAP

ASM Site No. (AZ O:1:__)	CNF Site No. (AR-03-04-06-__)	SR 89A Milepost Location	Land Owner	7.5-Minute USGS Quadrangle Map	Township	Range	Section (and 3 Sections)
104	902	361.30	ASLD	Page Springs	16N	4E	16 (SE)
105	838	361.43	ASLD	Page Springs	16N	4E	16 (SE)
85	428	361.66	ASLD	Page Springs	16N	4E	16 (SE)
77	869	362.34	CNF	Page Springs	16N	4E	15 (NW)
131	37	363.50	CNF	Page Springs	17N	4E	35 (SW)
53	745	363.95	CNF	Page Springs	17N	4E	35 (SE)
28	903	366.65	CNF	Page Springs	17N	4E	19 (SW)
31	244	367.14	CNF	Sedona	17N	4E	19 (SE)
133	561	368.00	CNF	Sedona	17N	5E	20 (NW)
134	189	368.20	CNF	Sedona	17N	5E	20 (NW)
135	186	368.53	CNF	Sedona	17N	5E	20 (NE)
136	663	369.40	CNF	Sedona	17N	5E	16 (SE)
137	482	369.86	private	Sedona	17N	5E	15 (SW)



Map 1. LOCAP area showing investigated sites and landownership.

LIST OF ABBREVIATIONS AND ACRONYMS

ADOT	Arizona Department of Transportation
AM	archaeomagnetic
AMS	accelerator mass spectrometry
AMSL	above mean sea level
APE	area of potential effects
ARIZ	University of Arizona Herbarium
ARS	Archaeological Research Services, Inc.
ASM	Arizona State Museum
CNF	Coconino National Forest
D_E	equivalent doses
EDXRF	energy dispersive X-ray fluorescence
GPS	Global Positioning System
I	isolated find
ID	(artifact) identification number
LOCAP	Lower Oak Creek Archaeological Project
LVAP	Lower Verde Archaeological Project
MNA	Museum of Northern Arizona
NISP	number of identified specimens
NIST	National Institute of Standards and Technology
NRHP	National Register of Historic Places
NSAS	nonsite artifact scatter
PD	provenience designation
ppm	parts per million
ROW	right-of-way
SARA	single aliquot regeneration additive dose
sd	standard deviation
SR	State Route
SRI	Statistical Research, Inc.
TL	thermoluminescence
TNF	Tonto National Forest
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VVAS	Verde Valley Chapter of the Arizona Archaeological Society
YEAP	Yavapai Ethnoarchaeology Project

CHAPTER 1

Introduction

Rein Vanderpot and Carla R. Van West

This document is the second of three volumes reporting the results of the Lower Oak Creek Archaeological Project (LOCAP) conducted by Statistical Research, Inc. (SRI).[1] This project was a two-phase data recovery effort associated with the improvement of a portion of alternate State Route (SR) 89A between Cottonwood and Sedona, Yavapai County, Arizona (Figure 1). The project was funded by the Arizona Department of Transportation (ADOT) and included testing and excavation at 13 archaeological sites along and adjacent to the right-of-way (ROW) of SR 89A. The archaeological work was part of a larger ADOT undertaking to reconstruct, widen, and upgrade the state highway and bridges in order to enhance safety and traffic flow along this busy transportation corridor.

To fulfill its obligations under a variety of state and federal historic preservation laws, ADOT contracted with Archaeological Research Services, Inc. (ARS), to survey, record, and evaluate cultural resources within areas of potential effects (APEs) associated with the SR 89A highway-improvement project (Stone and Hathaway 1997). The APEs included the 600-foot-wide ROW along 15.6 miles of SR 89A, from Mileposts 355.30 to 370.90; a 300-foot-wide ROW along approximately 1.8 miles of the alternate alignment of SR 89A, between Mileposts 361.69 and 363.46 (Dry Creek Bypass Alignment); and a 500-foot-wide ROW along approximately 3.5 miles of a potential bypass loop, between Mileposts 365.15 and 367.83 (Alternate N-4). ARS archaeologists identified 28 archaeological sites within or adjacent to these APEs, as well as 74 isolated finds (artifacts or features [I-1 through I-74]) and 21 nonsite artifact scatters (NSAS A through NSAS U). Of these 28 sites, 18 were determined to be eligible for listing in the National Register of Historic Places (NRHP). Of the 18 NRHP-eligible sites, 15 were within or adjacent to the final ROW for the LOCAP and warranted data recovery. In two cases, 2 adjacent, NRHP-eligible sites were combined into 1 site during fieldwork and are reported under the site number of the larger and more complex of the two cultural resources. AZ O:1:50/AR-03-04-06-901 (Arizona State Museum [ASM]/Coconino National Forest [CNF]) (Site 50/901) was subsumed into surrounding site AZ O:1:104/AR-03-04-06-902 (ASM/CNF) (Site 104/902). Similarly, AR-03-04-06-187 (CNF) was combined with adjacent site AZ O:1:134/AR-03-04-06-189 (ASM/CNF) (Site 134/189). Therefore, 13 sites were investigated by SRI (Table 1), representing 15 of the 18 sites recommended for data recovery by Stone and Hathaway (1997).

[1] Volume 1 contains the introductory and background information, field and analytic methods, and descriptions of the 13 sites, along with a LOCAP site summary. Volume 2, this document, sets forth the material-culture analyses; studies of faunal, pollen, and macrobotanical data; and geomorphological data and environmental studies associated with the 13 investigated sites. Volume 3 contains the synthetic and interpretive studies undertaken for the LOCAP and a research summary for the project.

Volume Contents and Research Domains

The chapters presented in this volume cover the description and analysis of artifactual, ecofactual, and environmental data. They include ceramics, flaked stone artifacts, ground stone artifacts, plant (macrobotanical and pollen) remains, faunal remains, and freshwater- and marine-shell artifacts (worked and unworked). We also present the results of geomorphological studies and a series of specialized analyses, including petrographic analyses of prehistoric and possible protohistoric or historical-period ceramics, thermoluminescence dating of ceramic artifacts, obsidian sourcing, and a reconnaissance of raw materials for flaked stone tools.

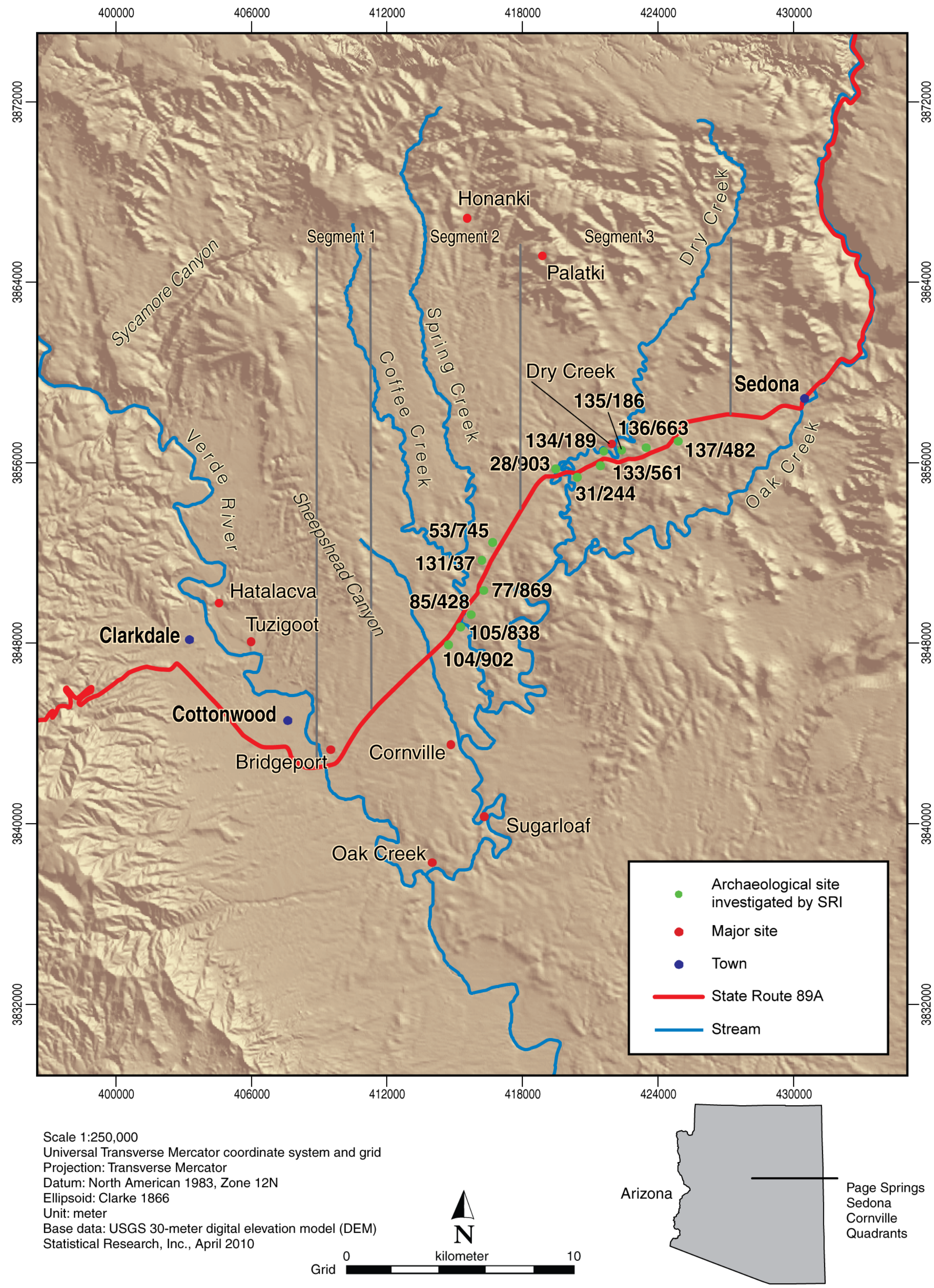


Figure 1. The locations of archaeological sites along SR 89A investigated by SRI for the LOCAP.

Table 1. Sites Investigated by Statistical Research, Inc., as Part of the Lower Oak Creek Archaeological Project

Site No. (ASM/CNF)	Site Description	Site Function	Site Age	Comments
104/902	Locus A: artifact scatter with masonry structure and rock cluster of unknown function; Locus B: artifact scatter; Locus C: historical-period rock alignment with associated artifacts	hunting camp (Archaic period), field house (Formative period), temporary habitation (historical-period component)	Archaic period, Formative period (A.D. 1350–1400), 1930s (Locus C)	Locus A rock cluster excavated.
105/838	Locus A: 3 pit structures and 5 thermal features; Locus B: 2 masonry structures and 12 rock features of uncertain function; Locus C: masonry structure	farmstead or field house in each locus	overall site: ca. A.D. 1–1450, pre-1900; Locus A: Squaw Peak phase (A.D. 1–650) (Feature 37), Camp Verde phase (A.D. 900–1125/1150); Loci B and C: Tuzigoot phase (A.D. 1350–1400/1425), possibly protohistoric period	Locus A entirely excavated; Locus B masonry structures and 2 rock clusters excavated by volunteers.
85/428	4 thermal features and an artifact scatter	hunting camp, food processing	Middle Archaic period, Formative period (Squaw Peak phase?)	All 4 features excavated.
77/869	artifact scatter with 2 rock berms (agricultural?)	food processing	Archaic period, Formative period (A.D. 1075–1180)	No features excavated.
131/37	artifact scatter and basalt quarry	lithic procurement, food processing	Formative period (A.D. 800–1200)	
53/745	multilocus site, including 7 cobble piles, 2 probable masonry structures, 7 cleared areas interpreted as possible wickiup clearings, 1 slab-lined pit, 1 thermal pit, 1 bedrock metate, 1 possible retaining wall, and a series of possible agricultural terraces	hunting camp, farmsteads/field houses, food-processing camps, possible agricultural area	Middle and Late Archaic period, Middle to Late Formative period (A.D. 640–1425), possibly protohistoric period	More than 8,000 surface artifacts point-located; 13 features tested during CNF volunteer project.
28/903	lithic scatter and subsurface thermal feature	Locus A: base camp; Locus C: hunting overlook?	Locus A: Late Archaic period; Locus C: Archaic and Formative periods	Late Archaic period thermal feature and associated activity area excavated in Locus A.
31/244	lithic scatter	lithic procurement, plant and animal processing	Middle and Late Archaic period hunting/plant-procurement camp, Formative period hunting camp	
133/561	Locus A: lithic scatter; Locus B: artifact concentration with possible subsurface midden; Locus C: roasting pit with artifact scatter	general site: lithic procurement; Locus A: camp for hunting and plant procurement and processing; Locus B: possible habitation; Locus C: plant roasting	Locus A: Middle and Late Archaic periods; Loci B and C: Formative period; roasting pit in Locus C may date to protohistoric period	Only Locus A tested by SRI; possible pit structure in Locus B found during geophysical subsurface survey was tested by volunteers and determined to be a midden or activity area.
134/189	artifact scatter (primarily lithics) and 4 rock features (including 2 possible structures)	hunting camp, possible habitation (field houses)	Middle and Late Archaic periods, Formative period (A.D. 1075–1125)	No features excavated.

Site No. (ASM/CNF)	Site Description	Site Function	Site Age	Comments
135/186	lithic scatter	food procurement and processing	Late Archaic period	
136/663	artifact scatter	hunting/gathering camp	late Camp Verde or early Hunanki phase (A.D. 1075–1200, based on 2 sherds and 1 projectile point)	
137/482	flaked stone scatter	hunting/gathering camp	Middle Archaic period	Site was badly disturbed and was incompletely documented because of its location on private land.

Key: ASM = Arizona State Museum; CNF = Coconino National Forest; SRI = Statistical Research, Inc.

Individual analysts were tasked to address the research questions appropriate to their data sets and to compare their results to what we know concerning the larger study area. It should be noted that, in their discussions, the various analysts were not always consistent in their dating terminology or accepted chronological sequences. Therefore, to help the reader navigate though the convoluted time-space systematics of the middle Verde River region, we have included a comprehensive cultural chronology for the region (Figure 2).

As detailed in Chapter 3, Volume 1, our overarching research theme was the identification of cultural landscapes—the modified physical and biological environments created by cultural perceptions, beliefs, and interactions. Within this theme, we delineated four research domains. The first research domain was the archaeology of mobile forager-farmer peoples: discovering solutions to the methodological and interpretive challenges presented by small sites used for farming, resource procurement, and other specific purposes. We were particularly interested in how archaeologists can identify ephemeral surface sites, such as the camps of the historical-period Yavapai peoples who occupied the study area and the aceramic locales used by Archaic period hunters and gatherers. Incorporated into this research domain were questions about chronology, data recovery methods, and cultural affiliation.

The second research domain was land-use practices. The LOCAP provided an excellent opportunity to study changes and consistency in land use over an extremely long interval of human occupation. What resources were used? To what degree were ancient populations dependent on cultivated food plants? Can we determine the seasons when sites were used and the functions of those sites? We were interested in assessing the sustainability of each group's land-use strategy and in comparing and contrasting the effectiveness of different strategies. Ancillary tasks included reconstructing ancient environments and studying the effects of human interactions with the land and resources, either positive or negative.

Related to land-use practices was the third research domain, that of early agriculture. When were cultigens and agriculture introduced to the middle Verde River region? How does the date of introduction compare to that for other regions of the U.S. Southwest? What effects did agriculture have on the established lifestyles of the Archaic period occupants of the region, particularly in terms of mobility vs. sedentism?

The fourth research domain was Native American history. The LOCAP was situated in an area overlapping the traditional territories of Northeastern Yavapai and Northern Tonto Apache peoples. Survey data suggested that some LOCAP sites may have been Yavapai or Apache campsites during the historical period. We were interested, therefore, in assessing archaeological evidence of occupation by these peoples and in determining, if possible, their settlement and subsistence practices; we were also interested in evidence of interactions among these groups and with their nonnative neighbors and the material characteristics of their lifestyles. When did these groups enter the region, and what was the nature of their overlap, if any, with established prehistoric peoples?

We have attempted to address the preceding questions in the analyses presented in this volume. In the following sections, we provide background information that includes a definition of the project area/study area, a description of the project setting, a summary of fieldwork, and an explanation of the site designations used for the LOCAP.

Project Area/Study Area Defined

The following terms are used in this report to identify the different physical areas discussed in relation this project. SRI refers to the entire data recovery project as the LOCAP. We refer to ADOT's SR 89A road-improvement-project corridor as the *project corridor*. Our specific *project area* (the LOCAP area) was the segment of the project corridor that contained the 13 sites investigated by SRI, as well as portions of those sites located outside the ADOT ROW. Because our sites were not representative of all periods or site types known to exist in the region, we also chose to examine—through archival means—a larger geographic area that would include a greater range of variation and would allow us to understand our sites in a larger spatial and temporal framework. To allow for a two-level hierarchy of detail, we defined two larger analytic units. The first was our *study area* and is referred to as the *LOCAP locality*. The LOCAP locality includes the northwestern portion of the middle Verde River valley and is depicted on 8 7.5-minute U.S. Geological Survey (USGS) quadrangle maps. The second was the *expanded study area* and is referred to as the *middle Verde River region.* The middle Verde River region is equivalent to the middle Verde River Basin, beginning at the confluence of the Verde River with Sycamore Creek to the northwest and ending at the confluence of the Verde River with Fossil Creek to the southeast. The middle Verde River region, as defined, is depicted on 18 7.5-minute USGS quadrangle maps, including the 8 maps that define the LOCAP locality (see Figure 1).

Project Setting

The SR 89A road-widening and road-improvement project links the Verde River valley near the modern town of

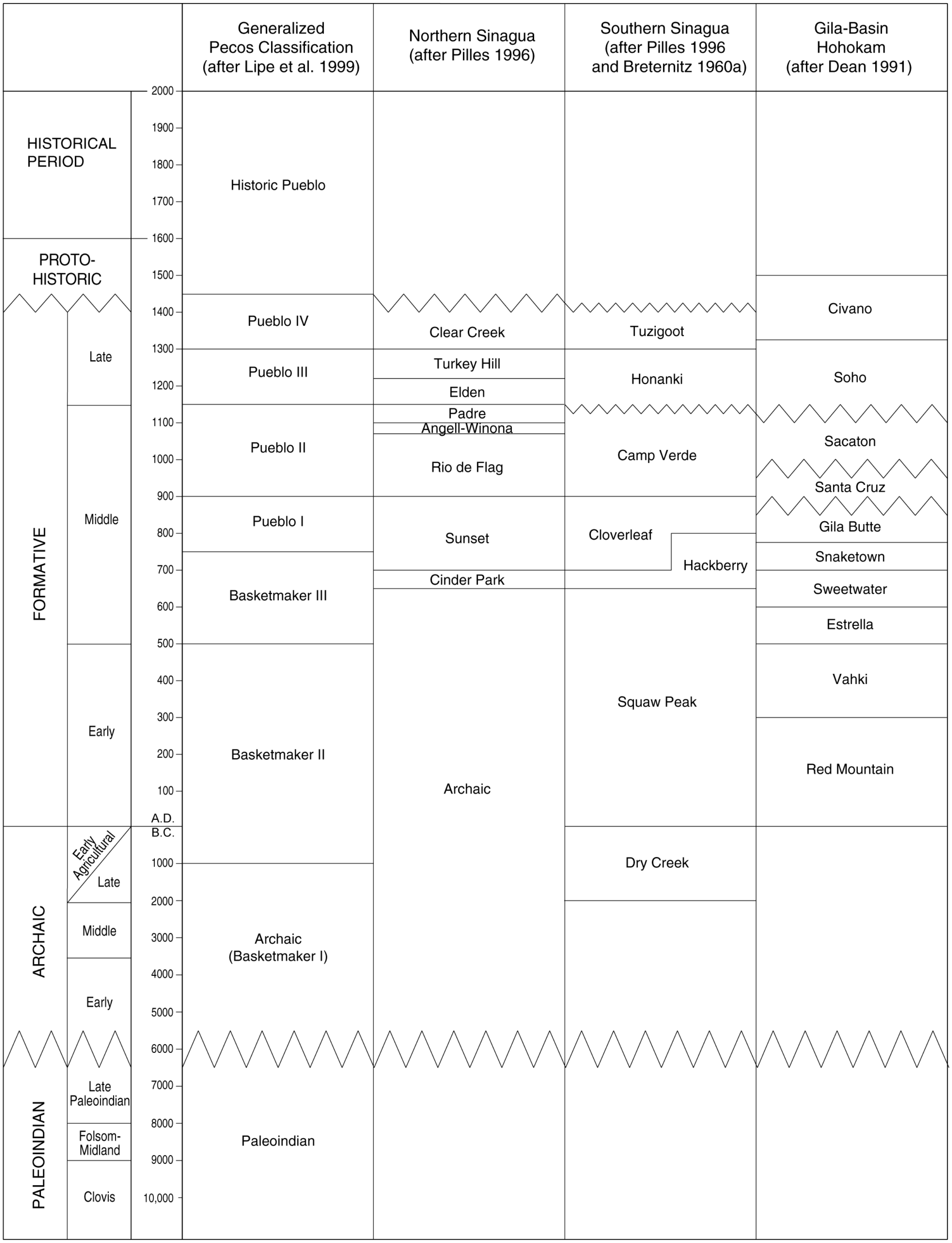


Figure 2. Cultural chronology for the middle Verde River region.

Cottonwood with the red rock formations of Sedona and provides a transect across one of Arizona's more rugged, environmentally diverse, and visually spectacular physical landscapes. The project area began in the upper portion of the middle Verde River valley (Figure 3), in the desert riparian setting of Cottonwood (994 m, or 3,260 feet, above mean sea level [AMSL]). It continued through some 11 miles of semidesert grasslands, rose through another 4.5 miles of conifer woodland, and ended in West Sedona (1,341 m, or 4,400 feet, AMSL), surrounded by the photogenic red rock formations that demarcate the receding edge of the Colorado Plateau.

Beginning at Milepost 355.3, in the community of Cottonwood, the SR 89A project corridor crossed the Verde River at Bridgeport. The project corridor continued northeastward through approximately 5 miles of lowland plains before the terrain begins to undulate as hills and tablelands. At this point, where juniper (*Juniperus*) and agave (*Agave*) appear within the assemblage of plant species, SRI encountered the first project sites. Six of the 13 project sites were located within the first 2.65 miles of this elevated terrain, in the vicinity of Spring Creek, between Mileposts 361.30 and 363.95: Site 104/902, AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428), AZ O:1:77/AR-03-04-06-869 (ASM/CNF) (Site 77/869), AZ O:1:131/AR-03-04-06-37 (ASM/CNF) (Site 131/37), and AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745). These sites, discussed in Chapters 5–10, Volume 1, formed a southern cluster.

By Milepost 366, the project area had gained sufficient elevation that scattered piñon (*Pinus* sp.), scrub oak (*Quercus* sp.), and a more diverse vegetative understory joined the mix of plant species. The remaining seven project sites were located in the hilly woodland terrain drained by Oak Creek and its tributary, Dry Creek: AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903), AZ O:1:31/AR-03-04-06-244 (ASM/CNF) (Site 31/244), AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561), Site 134/189, AZ O:1:135/AR-03-04-06-186 (ASM/CNF) (Site 135/186), AZ O:1:136/AR-03-04-06-663 (ASM/CNF) (Site 136/663), and AZ O:1:137/AR-03-04-06-482 (ASM/CNF) (Site 137/482). These sites were distributed along a 3.2-mile stretch between Mileposts 366.65 and 369.86, from the Dry Creek Bridge to Grasshopper Flat in West Sedona. Discussed in Chapters 11–17, Volume 1, these sites formed the northern cluster.

The ADOT road-widening and road-improvement project terminated at Milepost 370.9, near the intersection of SR 89A and Juniper Road, where the stunning red rock country begins. Deep in this country, a series of canyons carving the Munds Mountain Wilderness Area and the Red Rock–Secret Mountain Wilderness Area—which mark the northern boundary of the LOCAP study area—sheltered cliff dwellings, such as Honanki and Palatki, that were built in late prehistoric times.

The moderate climate and abundant water of the region drew farmers and settlers in ancient and historical-period times. Southern Sinagua and Hohokam peoples built agriculturally based communities. Pueblos, such as Tuzigoot National Monument and the Bridgeport Ruin, dot ridges and hilltops above the river. The copper minerals and other pigment stone, the salt deposits that formed in the geologically ancient playa of the Verde River valley, and argillite—prized for fashioning ornaments—were important resources found in the region.

The Yavapai and Western Apache peoples used the LOCAP study area during the historical period. The Yavapai and the Tonto Apache view Montezuma Well in the Verde River valley as their place of origin (Stein 1981). Hopi clan-migration stories place Palatkwapi, the Place of the Red Rocks, somewhere in the red rock country of the region. Fleeing the eventual destruction of Palatkwapi, Hopi peoples traveled northward along the route that Byrkit (1988) called the Palatkwapi Trail. The San Francisco Peaks, so integral to the Hopi sacred landscape, can be seen rising high above the Verde River valley. Mining and the promise of wealth drew Euroamericans to the region during the historical period. Today, the Verde River valley is one of the fastest-growing population centers in the state of Arizona, and its mild climate, perennial water sources, recreational opportunities, and natural beauty continue to attract settlers and visitors.

Fieldwork History

Phase 1 fieldwork began on June 22, 1998, and was complete by August 12, 1998. During this phase, all sites were mapped, surface collected, and tested for subsurface cultural deposits with exploratory units (hand-excavated units or backhoe trenches). Artifact collection encompassed each site in its entirety, but subsurface testing was confined to the ADOT ROW. Each site that we investigated was larger than the size reported by Stone and Hathaway (1997). In nearly all cases, the sites contained many more surface artifacts than originally estimated, and the surface distribution was spatially more extensive. On the basis of our findings, three sites were selected for further data recovery. These were Sites 105/838, 85/428, and 28/903.

Phase 2 fieldwork began on September 21, 1998, and was completed on November 15, 1998. During Phase 2, the excavation and documentation of features and other subsurface cultural deposits identified within the ADOT ROW were undertaken at the three sites selected for further data recovery. Supplemental Phase 1 testing was carried out at Sites 131/37 and 104/902 when ADOT expanded the ROW along two segments of SR 89A. Supplemental Phase 1 testing at Site 131/37 did not result in the location of subsurface deposits, but additional testing at Site 104/902 did result in the excavation of a rock cluster of unknown age and function.

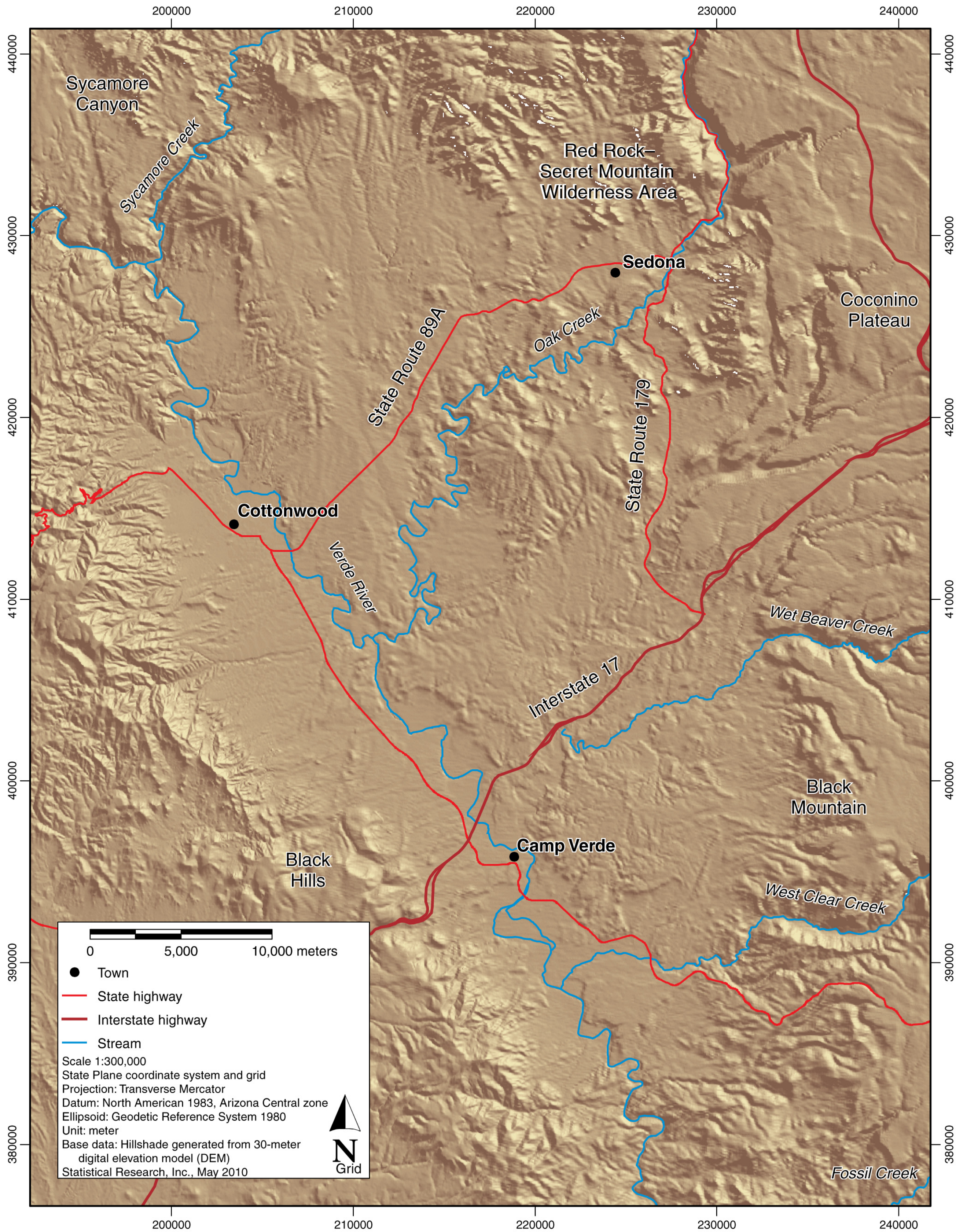


Figure 3. The portion of the Verde River valley of central Arizona containing the LOCAP area.

Site 105/838 was a multicomponent farmstead along Spring Creek dating to the Early Formative period (Squaw Peak phase) (A.D. 1–650) and the Camp Verde (A.D. 900–1125/1150) and Tuzigoot (A.D. 1300–1400/1425) phases. Three pit structures and several extramural features within the ADOT ROW were excavated. Additional structures and features dating to the later Tuzigoot phase were documented outside the ROW; many remain undisturbed. Several of the features outside the ROW were investigated after Phase 2 by amateur archaeologists from the Verde Valley Chapter of the Arizona Archaeological Society (VVAS), under SRI supervision. This work took place during two volunteer-staffed work weekends after Phase 2 investigations were completed.

Site 85/428 was a multicomponent hunting camp and food-processing locale dating to the Middle Archaic and Early Formative periods. The site was located along the ephemeral upper reaches of Spring Creek and contained four thermal features, all of which were located within the ROW and all of which were excavated. The features included the remains of a multiple-use roasting area and its cleanout debris, a rock-walled roasting pit with cleanout debris, and a slab-lined hearth.

Site 28/903 was a base camp dating to the Late Archaic period. The site was located along Dry Creek, adjacent to the Dry Creek Bridge. It contained a thermal feature and an extensive lithic scatter. The thermal feature, a subsurface hearth, was within the ROW, and it was excavated.

During and after completion of Phase 2 fieldwork, we conducted additional, VVAS-volunteer-aided investigations outside the ADOT ROW, at two sites. The volunteer-based efforts at Site 105/838 are summarized above. At Site 133/561, a possible feature in Locus B encountered during the subsurface geophysical survey was tested but did not result in a positive feature designation. We concentrated on the presumed Yavapai dwellings (wickiups, or *u-wá*) at Site 53/745. No conclusive information was obtained to support the inference that these were indeed structures. Results of the volunteer work at Site 53/745 are incorporated into the site description in Volume 1.

A Note on Site Designations

All project sites carry multiple site designations. These include registration numbers conforming to systems managed by ASM, CNF, and, in some cases, the Museum of Northern Arizona (MNA). Throughout this report, we identify sites by a composite number incorporating both the ASM and CNF designations but not including those used by MNA. The project area is encompassed by a single survey quadrangle map used by ASM—AZ O:1—and all project sites are located in the Sedona Ranger District of the CNF—AR-03-04-06. Therefore, in chapter headings and in the initial reference to a site within any chapter, we provide the full composite number, which includes the complete ASM site designation followed by the complete CNF site designation, concluding with the ASM/CNF suffix in parentheses (e.g., AZ O:1:137/AR-03-04-06-482 [ASM/CNF]). After establishment, we have chosen to abbreviate the official designations assigned to a site by using only its site-specific number (e.g., Site 137/482) within the text, figure captions, and table titles; only the numbers are used within tables and figures (e.g., 137/482).

CHAPTER 2

Ceramics from the Lower Oak Creek Archaeological Project

Margaret E. Beck and Andrew L. Christenson

Two partial or reconstructible vessels and 7,927 sherds were analyzed from 10 sites in the LOCAP area. These ceramics provide data that are crucial for addressing our research questions about chronology, site use, cultural affiliation, and social interaction and exchange. Standard wares and type classifications are useful for the temporal placement of sites and features and suggest the region of vessel manufacture. Vessel form and use-alteration data indicate probable vessel function, contributing to the assessment of site activities and site function. This information, combined with other lines of evidence, helps us to explore patterns of landscape use and regional social relationships. Of course, this is most easily done at sites with relatively substantial ceramic assemblages, either from one occupation or from repeated occupations. Ninety-six percent of the ceramic collection was recovered from two sites: AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745) (52 percent) and AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838) (44 percent).

In this chapter, methods are outlined first, including a discussion of recorded attributes and the criteria used for ceramic classification. The collection is then summarized by site, before questions about vessel function and regional interaction are addressed. Local Southern Sinagua ceramics were common at sites in the project area (53 percent of site collections, on average), but other identifiable sherds represented the Northern Sinagua (16 percent), Kayenta Anasazi (4 percent), or other groups or regions, such as the Cohonina, Hohokam, possible Yavapai, Prescott area, Hopi Mesas/Hopi Buttes, and Mesa Verde Anasazi (1–2 percent each). Additional discussion of ceramics possibly associated with the Yavapai is provided in Volume 3.

Methods

Sample and Types of Analysis

The analysis was conducted by three analysts: Christenson, Whittlesey, and Beck. Because of Christenson's previous experience in the region (Christenson 1994, 1995a, 1997a, 1999, 2000, 2003), he was asked to analyze the painted sherds and a sample of large, unpainted sherds and to create a type collection to be used afterward by other analysts. Christenson analyzed 1,619 sherds, including all painted and unpainted sherds from sites AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903), AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428), AZ O:1:104/AR-03-04-06-902 (ASM/CNF) (Site 104/902), AZ O:1:131/AR-03-04-06-37 (Site 131/37), AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561), AZ O:1:134/AR-03-04-06-189 (ASM/CNF) (Site 134/189), and AZ O:1:136/AR-03-04-06-663 (ASM/CNF) (Site 136/663) (a total of 310 sherds); all sherds belonging to painted wares from Sites 53/745 and105/838 (438 sherds); and a sample of unpainted sherds from Sites 53/745 and 105/838 (871 sherds).

Whittlesey and Beck examined the remaining unpainted sherds in the collection and identified them to ceramic ware and type, whenever possible. Whittlesey identified an additional 763 sherds from Site 53/745, and Beck identified 4,545 sherds from Sites 53/745 and 105/838. Beck's sample included 17 sherds recovered from excavations at Site 53/745 and first identified by Peter Pilles.

Seven sherds were submitted for thermoluminescence (TL) dating analysis to compare the ages of two chronologically uncertain ceramic types, Orme Ranch Plain and Tizon Wiped (see Appendixes C and D).

Ceramic Identification and Description

Rim sherds and all sherds larger than 1 cm^2 in size were examined under a 10×–30× binocular microscope. Ceramics were classified using the standard southwestern ware-type system, described in more detail in the section Ceramic Classification below; vessel form and the portion represented were also recorded, when possible. Sherd-size data were recorded by Christenson and Beck. Christenson recorded the interior-orifice diameter on rim sherds longer than 5 cm along the rim.

Use-Alteration Analysis

In his sample of large body sherds, Christenson observed erosion on many sherd interiors, ranging from scattered, small pits in the surface to the complete removal of the surface. When vessel form could be determined, the erosion seemed restricted to jar interiors and did not extend upward to the neck. Exterior surfaces were never pitted in this manner. In his sample, Christenson systematically examined all sherds larger than 5 cm^2 for erosion.

Patterned interior erosion has been observed on whole or reconstructible vessels from other archaeological projects in the U.S. Southwest (Beck 2001; Whittlesey 2004a). On one vessel from the West Branch site in the Tucson Basin, erosion began around 10 cm below the rim and removed the entire surface, "leaving virtually nothing but crumbly, friable inclusions" (Whittlesey 2004a:307). Simon (1994:667) has described differences between eroded and uneroded vessels from the Tonto Basin:

> Cooking vessels have heavy soot on the exteriors near their bases. The vessel interiors are often smudged and interior bases exhibit heavily blackened and eroded surfaces. In contrast, storage pots rarely have smudged interiors and do not exhibit sooting on the exterior bases. The interiors of these vessels appear clean and generally unworn [as] if these were used for dry storage . . . . Some vessels are unblackened, but have highly eroded interiors, and were probably used to store an acidic liquid made from wild plants or one of the agricultural crops.

Soot was present on some eroded sherds in the LOCAP collection but not on others, suggesting that similar cooking and liquid-storage vessels may have been represented. Relative frequencies of each could not be calculated, because interior carbon and exterior carbon were not systematically recorded in this study.

Skibo (1992:135–136) described how the erosion of cooking-vessel surfaces is caused by thermal spalling. In his sample of cooking vessels from Kalinga Province in the northern Luzon region of the Philippines, Skibo (1992) found that thermal spalls appeared only inside rice-cooking vessels. In the final stages of rice cooking, the water inside the vessel has been absorbed by the rice. If the vessel is heated too long afterward, water inside the vessel walls is driven through the interior wall and removes spalls from the surface (Skibo 1992:Figure 6.20). Such spalls are shallow, 1–3 mm in diameter, and roughly circular. On some vessels, spalling is so extensive that the entire surface is removed (Skibo 1992:139–140).

Thermal spalls on prehistoric vessels in the project area were not caused by rice preparation, of course, but these spalls may be produced whenever cooking water is boiled off or absorbed by the vessel contents. Possible cooking techniques that could cause spalling include steaming items within a vessel, during which the pot may accidentally be boiled dry. Preparation of foods that could produce the same effect includes cooking thick gruels that may be relatively dry along the vessel's interior surface.

Other possible causes of interior erosion are the preparation of alcoholic beverages and the alkali processing of maize. Among the Gamo of Ethiopia, vessels that contained yeast products, such as beer or yeast dough, exhibited considerable interior erosion from the yeast activity (Arthur 2000:203–206). Salts within the vessel wall, introduced by the use of salty solutions for the alkali treatment of maize or by reactions between acidic liquids and basic particles on or in the vessel wall, may also cause similar damage (Beck 2001).

Ceramic Classification

The LOCAP ceramics were classified into 14 defined ceramic ware types, as well as additional categories. Six of the defined wares are generally unpainted: Alameda Brown Ware, Awatovi Yellow Ware, Prescott Gray Ware, San Francisco Mountain Gray Ware, Tizon Brown Ware, and Tusayan Gray Ware. Additional unpainted types, such as Gila Plain, Wingfield Plain, and Orme Ranch Plain, have not been formally assigned to a ware, although Orme Ranch Plain has tentatively been placed in Yavapai Plain Ware category.

The six wares were dominated by unpainted types, and the additional unpainted types are described in Tables 2–9. Unpainted brown and gray ware types were distinguished primarily by paste-inclusion type, size, and density, although paste color was also significant for distinguishing brown ware from gray ware. The classification process for the unpainted types is summarized here in a flowchart (Figure 4).

Table 2. Tusayan Gray Ware, Tsegi Series

Ceramic Type	Description	TNF Typology
Lino Gray (as described by Colton and Hargrave [1937:191–192])	Constructed by coiling. Inclusions are “abundant medium fine to coarse quartz sand” visible on surface. The paste has a crumbling fracture. Surface color is gray; core is light to dark gray or black. Surface finish is rough to lightly smoothed; obvious scraping marks and deep pits are common. It is never slipped.	
Lino Fugitive Red (as described by Colton and Hargrave [1937:193])	The type is similar to Lino Gray, with the addition of a thin, red pigment on bowl interiors and the exterior upper bodies of jars. This pigment or wash is easily removed by weathering or washing but may remain in surface depressions.	
Lino Black-on-gray (as described by Colton and Hargrave [1937:194])	This type is similar to Lino Gray, with the addition of black carbon paint. The surface finish is moderately smooth (but not polished or slipped) where painted. Designs are “crudely executed” and often consist of narrow lines and bands of small dots.	
Kana’a Gray (as described by Colton and Hargrave [1937:195])	Constructed by coiling. Inclusions are “abundant medium fine to coarse quartz sand” visible on surface. The paste has a crumbling fracture. Surface color is gray; core is light to dark gray. Surface finish is scraped to lightly smoothed, with obvious scraping marks and deep pits common. Flattened coils, usually 4–8 mm wide, appear on exterior necks from rim to shoulder.	Kana’a Gray (Tusayan Series): “A coarse grey plainware, tempered with large-grained, rounded quartz sand, it is always rough, never polished. A band of coils just below the rims of jars was often left unfinished (neck-banded)” (Wood 1987:97).
Moenkopi Corrugated (as described by Colton and Hargrave [1937:197–198])	Constructed by coiling. Inclusions are “abundant moderately coarse quartz sand” visible on surface. The paste has a slightly crumbling fracture. Surface color is gray; core is light to dark gray or black. Interior surface finish is scraped to well smoothed but not polished. Coils cover most or all of the exterior. They are flattened and partially obliterated, usually 6–8 mm wide, but may range from 4 to 10 mm.	Moenkopi Corrugated (Tusayan Series): “A plain indented type similar to Tusayan Corrugated in paste, temper, and color. The flattened coils on this type are less like . . . overlapping clapboards . . . and are expressed more as irregular coil boundaries” (Wood 1987:97).
Tusayan Corrugated (as described by Colton and Hargrave [1937:196–197])	Constructed by coiling. Inclusions are “abundant moderately coarse quartz sand” visible on surface. The paste has a slightly crumbling fracture. Surface color is gray; core is light to dark gray or black. Interior surface finish is scraped. Coils cover most or all of the exterior and usually have regular, deep indentations, although some nonindented coils may appear. They are usually 5–7 mm wide but may range from 3 to 8 mm.	Tusayan Corrugated (Tusayan Series): “Paste and temper are similar to Kana’a but typically darker and carbon streaked . . . . Typically it is indented perpendicularly to coils and smoothed over . . . [resulting] in more of a smoothly rippled surface” (Wood 1987:97).
Kiet Siel Gray (as described by Colton and Hargrave [1937:198–199])	Constructed by coiling. Inclusions are “abundant opaque [gray and tan] angular fragments” visible on surface. The paste has a crumbling fracture. Surface color is gray; core is light to dark gray or black. Surface finish is rough and bumpy with deep pits and scraping marks. Often, “structural coils [are] not completely obliterated.” Rims may have a single rim coil or fillet.	
Medicine Gray (as described by Colton and Hargrave [1937:199–200])	Constructed by coiling. Inclusions are “abundant medium fine to coarse quartz sand,” sometimes with feldspar, and are visible on surface. The paste has a crumbling fracture. Surface color is gray; core is light to dark gray. Surface finish is rough, with obvious scraping marks and deep pits common. Coils, usually 3–5 mm wide, appear on neck exterior and are usually slightly indented.	

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Ceramic Type	Description	TNF Typology
O'Leary Tooled (as described by Colton and Hargrave [1937:200])	Constructed by coiling. Inclusions are "abundant medium fine to medium coarse quartz sand." The paste has a crumbling fracture. Surface color is gray; core is black to gray. Surface finish is well smoothed but not polished. Neck exteriors are decorated with rows of vertical, incised lines.	
Coconino Gray (as described by Colton and Hargrave [1937:201])	Constructed by coiling. Inclusions are "abundant medium fine to coarse quartz sand," sometimes with feldspar, and are visible on surface. The paste has a crumbling fracture. Surface color is gray; core is light gray. Surface finish is rough, with obvious scraping marks and deep pits common. Coils, usually 1.5–6 mm wide, appear on neck exteriors and "are emphasized by horizontal tooling marks."	
Plain gray	This general category includes body and base sherds of Lino Gray, Kana'a Gray, Medicine Gray, O'Leary Tooled, and Coconino Gray. These types cannot be distinguished without knowing the surface treatment on neck exteriors.	

Key: TNF = Tonto National Forest.

Table 3. Awatovi Yellow Ware Types

Ceramic Type	Description	TNF Typology
Jeddito Corrugated (as described by Colton and Hargrave [1937:143–144])	Inclusions are quartz-sand particles, and "occasionally reddish angular fragments" are visible on the surface. Surface color and core are similar in color, usually "yellow to cream," but may be pink or black in areas. Surface finish is corrugated on the exterior and scraped on the interior.	Jeddito Corrugated (Hopi Series):Paste is "dense, fine yellow clay" with "very coarse, rounded quartz sand" and often "crushed red sherd." Corrugation "is often partially smoothed over and sometimes obliterated" (Wood 1987:105).
Jeddito Plain (as described by Colton and Hargrave [1937:143–145])	Inclusions are quartz-sand particles visible on the surface. Surface color and core are both "yellowish to cream." Surface finish is scraped on the interior and exterior, never polished or slipped.	Jeddito Plain (Hopi Series): Paste is "dense, fine yellow clay" with "very coarse, rounded quartz sand" and often "crushed red sherd." Surfaces are "roughly smoothed or unfinished" (Wood 1987:105).
Jeddito Tooled (as described by Colton and Hargrave [1937:143–145])	Inclusions are quartz-sand particles visible on the surface. Surface color is yellow to cream; core is often yellow but may be black. Surface finish is scraped on the interior and exterior, never polished or slipped; the exterior surface has "various imprints made with tools; base of vessels sometimes have basket imprint."	Jeddito Tooled (Hopi Series): This type is "decorated with simple incised lines, fingernail impressions, or punctations" (Wood 1987:105).

Note: Alternative spellings for this ware type are Awatobi (Colton and Hargrave 1937:143) and Avat'ovi (Wood 1987).
Key: TNF = Tonto National Forest.

Table 4. San Francisco Mountain Gray Ware Types

Ceramic Type	Description	TNF Typology	Comparisons
Deadmans Gray (as described by Colton and Hargrave [1937:252]; similar description in Colton [1958])	Inclusions are "abundant fine quartz sand; occasional grains of dark angular fragments; abundant fine mica-like particles." Surface color is "light bluish gray"; the core is gray. The ware may also have a "characteristic pale tan-yellow color" (Keller 1993a:65). Surface finish is "polished and impacted; not slipped" on jar exteriors and bowl interiors; jar interiors are "fairly well smoothed."	Wood (1987:61) used existing typology for San Francisco Gray Ware, noting this ware "is rare on the Tonto."	Floyd Gray has similar inclusions and body surface treatment and is distinguished by a neck coil (Colton 1958; Colton and Hargrave 1937) or "corrugations on the neck and shoulder of the vessel" (Keller 1993a:65). Because they can only be distinguished from one another by their rim and neck sherds, body sherds of Deadmans Gray and Floyd Gray are generally lumped together in an "indeterminate" category.
Deadmans Fugitive Red (as described by Colton and Hargrave [1937:252–253]; similar description in Colton [1958])	This type is similar to Deadmans Gray, with the addition of "red fugitive paint on greater part of vessel; rims generally have red lip; no drawn design." The paint was apparently applied after firing and ranges from a "thick, deep red coat" to "a pinkish tint" depending upon weathering.		Deadmans Fugitive Red bowls may have black paint on the interior, similar to Deadmans Black-on-gray (Hays-Gilpin 2004).
Deadmans Smudged (as described by Keller [1993a:66])	This is "a Deadmans Gray type with a smudged interior and applies only to bowl sherds."		
Deadmans Black-on-gray (as described by Colton and Hargrave [1937:253–254]; similar description in Colton [1958])	This type is similar to Deadmans Gray with the addition of "dull, usually thin" black paint (Colton 1958). Decoration is added with a black organic paint and is similar to Black Mesa Black-on-white (Hays-Gilpin 2004; Keller 1993a:66). If Fugitive Red pigment is also present, the vessel is classified instead as Deadmans Fugitive Red (Hays-Gilpin 2004).		Floyd Black-on-gray has designs similar to Kana'a Black-on-white and also has "clear black paint that does not fade into the surface" (Keller 1993a:66).
Floyd Gray (as described by Colton [1958])	Inclusions are "abundant fine rounded quartz sand grains, occasional grains of black angular fragments, fine mica particles are visible on surface." Surface color is "gray, sometimes black." The core color is "gray or sometimes brown." Surface finish is smooth on the exteriors, and "mica particles glitter on surface." There is a neck coil (Colton 1958; Colton and Hargrave 1937) or "corrugations on the neck and shoulder of the vessel" (Keller 1993a:65).		Floyd Gray is "distinguished from Kana'a Gray by fine temper and mica flakes visible on surface. Distinguished from Deadmans Gray by presence of neck coil" (Colton 1958). Because they can only be distinguished from one another by their rim and neck sherds, body sherds of Deadmans Gray and Floyd Gray are generally lumped together in an "indeterminate" category.

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Ceramic Type	Description	TNF Typology	Comparisons
Floyd Black-on-gray (as described by Colton [1958])	Inclusions are "abundant fine rounded quartz sand grains, occasional grains of black angular fragments, fine mica particles, visible on surfaces." Surface color is "almost white to very light gray, to smoky or blue gray." The core color is "white to very light gray." Surface finish is polished and not slipped on jar exteriors and bowl interiors. Bowl exteriors may be "irregularly smoothed"; jar interiors may be irregularly smoothed, wiped, or scraped. Decoration is an organic black paint described as "a clear black, with distinct outlines." Bowl exteriors are "often fugitive red." Designs are similar to Kana'a Black-on-white.		

Key: TNF = Tonto National Forest.

Table 5. Alameda Brown Ware Types

Ceramic Type	Description	TNF Typology	Comparisons
Verde Brown (as described by Colton [1958:Ware 14, Type 25]; Verde Valley–Tonto Series [Colton 1958])	Quartz and feldspar inclusions are about 30–50 percent of the paste. These are angular but may include some rounded grains. Mica is occasionally visible on the surface. Surface color is reddish brown; core is usually reddish brown to dark brown but may be gray, black, or a "metallic copper color." Surface finish is smooth for jar exteriors and bowl interiors and exteriors. Scraping marks and irregular depressions are common. Jar interiors are scraped.	Tonto Plain, Verde variety (Gila-Tonto Series) (see Wood 1987:13–14, Figure 4).	Tonto Plain, Verde variety "is very similar to [the Gila-Salt basin type] Gila Plain, Salt variety but with more non-quartz elements (e.g., feldspar)" (Wood 1987:14). Tizon Brown Ware also contains "sub-angular to rounded opaque quartz, feldspar, and occasional mica flakes" (Dobyns and Euler 1958:Ware 15). Two Tizon Brown Ware types, Aquarius Brown (Ware 15, Type 5) and Sandy Brown (Ware 15, Type 4), may be "indistinguishable from . . . Gila Plain/Salt and Tonto Plain/Verde" (Wood 1987:53). Tizon Wiped is distinguished by intentional striations on exterior and/or interior surfaces (Dobyns and Euler 1958:Ware 15, Type 7).

Ceramic Type	Description	TNF Typology	Comparisons
Verde Brown (as described by Schroeder [1960:138])	Inclusions are primarily quartz sand with some feldspar. These are subangular and usually large. The few other inclusions are "small black inclusions" and some "copper colored mica." Surfaces are "roughly smoothed" or rough.	Tonto Plain, Verde variety (Gila-Tonto Series) (see Wood 1987:13–14, Figure 4).	The Mogollon Brown Ware type, Woodruff Brown, has "coarse to fine quartz sand" (Colton and Hargrave 1937:58); surfaces are "fairly well-smoothed" (Colton and Hargrave 1937:58) or polished (Hays-Gilpin and van Hartesveldt 1998:150). There is apparently no mica on surfaces of Woodruff Brown (Colton and Hargrave 1937:58). Sand-tempered Woodruff Brown is synonymous with Forestdale Brown (Hays-Gilpin and van Hartesveldt 1998:150).
Verde Brown (as described by Walsh-Anduze [1996:55])	Inclusions are "medium-to-coarse granitic rock, probably diorite, composed of feldspar, quartz, and hornblende . . . . A quartz-tempered variant of Verde Brown was also identified."	Tonto Plain, Tonto variety, Delshay subvariety (Gila-Tonto Series) (see Wood 1987:14–15, Figure 4).	"In comparison with Verde Brown, Tuzigoot Plain and its red and white-on-red variants were finely tempered" (Walsh-Anduze 1996:55).
Verde Red (as described by Colton [1958:Ware 14, Type 26]; Verde Valley–Tonto Series [Colton 1958]; and Schroeder [1960:138])	This type is similar to Verde Brown, except that it has a red slip. Surfaces may be polished.	Gila Red, Verde variety (Gila-Tonto Series) (see Wood 1987:30).	Gila Red, Salt variety is sand tempered with a dark- to bright-red slip and silver mica flakes on the surface (Wood 1987:29). Tonto Red is "red-fired" rather than slipped (Wood 1987:27; see also Colton 1958:Ware 14, Type 31). Most inclusions are large grains of quartz sand and feldspar, with some multicolored "opaque angular fragments" that are not present in Verde Red (Colton 1958:Ware 14, Type 31). Woodruff Red is similar to Woodruff Brown, with a dark red slip. Surfaces are "more or less polished" (Colton and Hargrave 1937:59).
Tonto Red (as described by Colton and Hargrave [1937:166] and Colton [1958])	Inclusions are "very abundant; predominantly large grains of quartz sand and crushed feldspar (?), with smaller amounts opaque angular fragments, gray, reddish, black or whitish." Surface color is "usually dull brick-red" on exteriors and "black, brown, gray, or buff" on interiors. The core is "gray, dark brown to brick red." There is no slip. Surface finish is "bumpy" and "usually gritty" on exteriors but may be lightly polished. Bowl interiors are often lightly polished.	Tonto Red (Gila-Tonto Series) (see Wood 1987:27).	Tonto Red, as defined by Colton and Hargrave (1937), Colton (1958), and Wood (1987), is not slipped. It is therefore not considered a red ware by most authors. Bruder and Ciolek-Torrello (1987:91) refer to the type instead as Tonto Brown. The temper is "a relatively fine version" of the temper in Tonto Plain, Verde variety (Wood 1987:27), or Verde Brown.

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Ceramic Type	Description	TNF Typology	Comparisons
Tonto Plain (as described by Doyel [1978:30, 88])	Inclusions are "medium to large opaque to white quartz grains and unidentified sand material" with mica particles (Doyel 1978:30). Surface color is "light brown to weak red" and paste color is "black to gray to light brown" (Doyel 1978:30). Surface finish on exterior is smoothed or wiped.		Doyel (1978:29) stated that his definition of Tonto Plain "will encompass types previously known as Tonto Red (in part), Tonto Brown, and Tonto Rough." Tonto Corrugated is similar to Tonto Plain, except for the surface finish.
Tuzigoot Plain/Red (as described by Colton and Hargrave [1937:169–170]; original name Tuzigoot Red for both slipped and unslipped ceramics [Colton and Hargrave 1937])	Inclusions are "variable proportions of medium-fine quartz or feldspar (?) sands and opaque angular fragments, usually reddish or tan, occasionally gray or black; also occasional micaceous particles." Color on exposed surfaces is brown or brick red. Jar interiors are "gray, purplish, tan, or reddish." Core colors are "reddish, pinkish, [or] yellowish-buff." Surface finish is "smoothed; often impacted and polished; often smudged . . . horizontal scraping marks visible." Jar exteriors are "sometimes coated (?) with thin slip."		
Tuzigoot Plain (as described by Colton [1958:Ware 14, Type 19]; Verde Valley–Tonto Series [Colton 1958])	Inclusions are "very fine (0.1 mm) quartz sand, sometimes slaglike. In this base are larger angular fragments, usually sparse or medium-abundant, of many different materials, which appear white, gray, tan, red, brown, or black." Surface colors are "buff, reddish brown, brown, [and] black." Cores are "gray, red, brown, [and] often carbon impregnated." Surface finish is smoothed and sometimes polished.	Tuzigoot Plain, Tuzigoot variety (Verde Series). Angular fragments are suggested to be "volcanic ash and dacite tuff" (Wood 1987:48).	Tuzigoot Plain is distinguished from Verde Brown by the presence of multicolored angular fragments. "Verde Brown has quartz and feldspar temper" (Colton 1958).
Tuzigoot Red (as described by Colton [1958:Ware 14, Type 20]; Verde Valley–Tonto Series [Colton 1958])	Inclusions are "variable proportions of medium-fine quartz or feldspar (?) sands and opaque angular fragments, usually reddish or tan, occasionally gray or black; also occasional micaceous particles." When Colton (1958) compared Tuzigoot Red to Tonto Red (Ware 14, Type 31), he noted that sand and "opaque angular fragments" were present in "about equal amounts" in Tuzigoot Red. Exposed surface colors are "brick-red," brown, or black. Jar interiors are "gray, purplish, tan, or reddish." Cores are "reddish, pinkish, [or] yellow-buff," occasionally with carbon streaks. Surface finish is "smoothed; often compacted, and polished; often smudged . . . horizontal scraping marks visible but not conspicuous; exterior surfaces [of] jars sometimes coated with thin slip; interior surfaces [of] jars, not smoothed; anvil and scraping marks conspicuous." Firing clouds are common.	Tuzigoot Red, Tuzigoot variety (Verde Series). Wood (1987:49) defined Tuzigoot Red as "the slipped red version of Tuzigoot Plain, found in the same range of varieties."	According to Colton (1958), Tuzigoot Red is not simply Tuzigoot Plain with the addition of a red slip. Both types contain quartz sand and opaque angular fragments, but feldspar and mica are also noted for Tuzigoot Red. Tuzigoot Red has a reddish surface color and only occasionally has a red slip. This definition is similar to Colton and Hargrave's (1937) definition of Tuzigoot Red. Tonto Red, as described by Colton (1958:Ware 14, Type 31), has a reddish surface color with no slip, like many examples of Tuzigoot Red as defined by Colton (1958). It is differentiated by a smaller amount of opaque angular fragments. "Anvil marks [are] less noticeable [in Tonto Red]; vessel walls [in Tonto Red are on] average somewhat thinner." Schroeder (1960) restricted Tuzigoot Red to slipped ceramics, categorizing unslipped Tuzigoot ceramics as Tuzigoot Plain. "The Verde and Tuzigoot varieties [of Tuzigoot Red] are similar in vessel form, color, and finish to Gila and Salt Red" (Wood 1987:49).

Ceramic Type	Description	TNF Typology	Comparisons
Tuzigoot Plain and Tuzigoot Red (as described by Christenson [2002])	"Most if not all of the red, gray, and brown inclusions in the Tuzigoot ceramics are crushed brownware sherds" (Christenson 2002:8).	Sunset Brown, Diablo variety (Flagstaff Series). Inclusions are "crushed brown sherds and quartz sand, sometimes with cinders, limestone, caliche, or crushed tuff or other rock" (Wood 1987:Figure 6; see also Wood 1987:57–58).	Inclusions in the Alameda Brown Ware type, Diablo Brown, are also crushed brown ware sherds and fine quartz sand (Wilson 1969). It is not clear how this type differs from Tuzigoot Plain (Christenson 2002:14). Tuzigoot Plain may lack free mica (Colton 1958) but is otherwise similar to Gila Plain, Gila Bend variety (Gila-Tonto Series), which may contain "finely crushed plainware sherds (grog)" (Wood 1987:13).
Diablo Brown, Yeager variety (as described by Wilson [1969:580–584])	Inclusions in this brown ware type are crushed white ware sherds.	Sunset Brown, Yaeger variety (Flagstaff Series). Inclusions are "crushed whiteware sherds and either cinders, quartz sand, or angular feldspar" (Wood 1987:57, Figure 6).	Woodruff Brown, white angular fragment variety, contains crushed white ware sherds and is polished (Hays-Gilpin and van Hartesveldt 1998:150).
Sunset Brown (as described by Colton [1958:Ware 14, Type 10]; Sunset Series [Colton 1958])	Inclusions are mostly "black volcanic sand; occasional grain quartz sand; some angular fragments, usually reddish or tan, sometime[s] angular fragments almost as abundant as volcanic sand." The volcanic material is described in the Key to Major Types (Ware 14) as "medium to fine black volcanic cinders." Exterior surface finish for bowls and jars is "scraped, smoothed, sometimes highly polished, polishing marks frequently conspicuous." Bowl interiors are usually smudged and polished. Jar interiors are "scraped [and] pitted" with conspicuous anvil marks.	Sunset Brown (Flagstaff Series), either Sunset A variety (with "crushed black cinders or black angular to rounded sand derived from weathered cinders") or Sunset B variety ("similar to Sunset A with the addition of quartz sand, limestone or indurated caliche, and/or angular feldspar") (Wood 1987:57, Figure 6).	
Winona Brown (as described by Colton [1958:Ware 14, Type 4]; Rio de Flag Series [Colton 1958])	Inclusions are "abundant very coarse rounded or crushed volcanic tuff, gray, white, buff, or reddish; occasional minute quartz crystals, sometimes few grains of volcanic sand." The tuff is described in the Key to Major Types (Ware 14) as "medium to coarse crushed angular, but sometimes water worn, gray volcanic tuff." Surface color is "buff, orange, to dark brown to dark gray." Cores are "gray to dark brown." Surface finish on exteriors is "smoothed . . . wiping marks often prominent; interiors almost never polished or finished, anvil marks conspicuous even in bowls."	Winona Brown (Flagstaff Series) (see Wood 1987:56, Figure 6).	

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Ceramic Type	Description	TNF Typology	Comparisons
Angell Brown (as described by Colton [1958:Ware 14, Type 5]; Rio de Flag Series [Colton 1958])	Inclusions are "not abundant" and are described as "fine angular fragments crushed volcanic tuff mostly individual crystals of sanidine, gray, white, buff, or reddish." The Key to Major Types (Ware 14) describes inclusions as "crushed gray volcanic tuff with many sanidine crystals." Surface finish on exterior is "smoothed, wiping marks often show. Interiors not well polished. Anvil marks conspicuous even in bowls." Firing clouds are common.	Angell Brown (Flagstaff Series) (see Wood 1987:56, Figure 6).	Angell Brown, according to Colton (1958), is "a Variety of Winona Brown" and "an Intergrade between Rio de Flag Brown and Winona Brown." It is distinguished "from typical Winona Brown in the temper being finer, less abundant and with more crystals."
Rio de Flag Brown (as described by Colton [1958:Ware 14, Type 1]; Rio de Flag Series [Colton 1958])	Inclusions are "fine to medium sparsely distributed fragments of clear crystalline sanidine and/or fine black crystals of hornblende, sometimes oxidized cinders" (Colton 1958:Ware 14, Key to Major Types). These are described elsewhere as "predominantly opaque angular fragments, gray, tan, or black, occasional grain quartz or feldspar (?)" (Colton 1958:Ware 14, Type 1). Surface colors are brown or brownish gray. Cores are "gray to black; brick-red to brown or buff; carbon streak, common." Surfaces are "usually bumpy, compacted; sometimes polished; anvil marks often conspicuous."	Rio de Flag Brown (Flagstaff Series) (see Wood 1987:56, Figure 6).	
Turkey Hill Red (as described by Colton [1958:Ware 14, Type 7]; Rio de Flag Series [Colton 1958])	Inclusions are "abundant" and are "predominantly opaque angular fragments of volcanic tuff, variable size, gray, white, or reddish; frequently some black volcanic sand; occasional isolated grain quartz sand." Surface color is "red, maroon, or brown" on exteriors and "black, red, [or] brown" on bowl interiors. Cores are "black, gray, dark brown to brick-red." Surface finish on exterior is "smoothed, compacted or coated with thin slip; slip sometimes slightly powdery; usually well-polished, polishing marks often conspicuous; interior bowl surfaces frequently not smoothed; anvil marks conspicuous."	Turkey Hill Red (Flagstaff Series) (see Wood 1987:60, Figure 6).	Colton (1958) observed that Turkey Hill Red is "essentially Winona Brown or Angell Brown with a red slip."

Key: TNF = Tonto National Forest.

Table 6. Prescott Gray Ware Types

Ceramic Type	Description	TNF Typology	Comparisons
Prescott Gray (Verde Gray as described by Colton [1958:Ware 17])	Inclusions are “quartz sand, crushed rock and mica; mica flakes always show on both surfaces; temper more than 50% of core.” Surface color ranges from gray and brown to reddish and may be variable across the vessel surface. Core color is “generally reddish.” Exterior surface finish is smoothed; interiors are “irregular and bumpy.”	Prescott Plain (Prescott Series) (see Wood 1987:52).	Wood (1987:52) divided the type into two varieties, based on temper. Prescott Plain, Sandy variety, is tempered with “quartz sand, feldspar, and silver mica,” and Prescott Plain, Micaceous variety, is tempered with “crushed micaceous schist.” He argued that the type is “very nearly identical to Gila Plain.”
Prescott Gray (Verde Gray as described by Keller [1993b:67])	Inclusions are “unmistakably abundant, gritty, and generally [include] . . . abundant silver mica.” The source is apparently “crushed granitic rock, usually having abundant mica inclusions as well as quartz and feldspar crystals.” Surface color is “gray to brownish”; core is gray. Surface finish is “generally well-smoothed but not polished. Striations are sometimes visible on interior sherd surfaces.”	Prescott Plain, Sandy variety (Prescott Series) (see Wood 1987:52).	San Francisco Gray Ware has a “generally bluish or brownish gray or tan-yellow sherd color with a fine sparkly temper showing on the sherd surface.” It also has a “sharp and well-defined system of fine striations usually found on both sherd surfaces” (Keller 1993b:65).
Prescott Gray (as described by Walsh-Anduze and Christenson [1998])	Inclusions are abundant, “poorly sorted, angular, granitic sand dominated by translucent quartz or arkosic sand” (Walsh-Anduze and Christenson 1998:3.30). Petrographic analysis indicates that “most of the sand-sized inclusions in the paste derive from crushed rock” (Walsh-Anduze and Christenson 1998:3.17). Surface color is mostly “reduced (black and gray)” or “neutral (brown),” although a few examples are “oxidized (orange, orange-brown, red, yellow)” (Walsh-Anduze and Christenson 1998:3.24, Table 3.12). Most cores are reduced (Walsh-Anduze and Christenson 1998:Table 3.13). Surface finish is usually “smooth (not polished)” but a few examples have some polishing or smudging (Walsh-Anduze and Christenson 1998:Tables 3.10–3.11).	Prescott Plain, Sandy variety (Prescott Series) (see Wood 1987:52).	Verde Brown “should be tempered with a fine-to-moderate amount of round or subangular yellow feldspar to distinguish it from Prescott Gray; gold mica was expected to be common. Additionally, Verde Brown should have a smoother surface than Prescott Gray pottery” (Walsh-Anduze and Christenson 1998:3.13). Verde Brown may also have a more uniform surface color and may lack visible temper on the surface (Dosh 1987).

continued on next page

Ceramic Type	Description	TNF Typology	Comparisons
Prescott Gray (as described by Hays-Gilpin [2004])	Inclusions are "moderate to abundant, poorly sorted, granitic material including quartz, arkosic sand, and feldspar . . . . When present, mica is usually silver . . . . When a fresh break is examined with a hand lens, Prescott Gray appears to have more temper than clay . . . . Temper particles tend to be . . . angular." Surface color is usually gray but may be brown or orange and may vary on a single sherd. The core is usually "gray to orange" and may have a carbon streak. Surface finish is "usually hand smoothed; occasionally lightly wiped, scraped, or both."	Prescott Plain, Sandy variety (Prescott Series) (see Wood 1987:52).	"Verde Brown is usually brown, and contains more feldspar than quartz. It usually has fine gold/copper-colored mica flakes . . . [and] has a moderate to coarse texture that is rarely as coarse as most Prescott sherds . . . . Temper particles tend to be more rounded in Verde Brown . . . . Temper seldom shows on the surface." Aquarius Brown "does not oxidize orange, as Prescott Gray does. It tends to be harder than Prescott Gray with a cleaner fracture; temper contains little to no mica and is usually somewhat finer than Prescott . . . . Aquarius Brown often has a scum surface."
Prescott Black-on-gray (Verde Black-on-gray, as described by Colton [1958:Ware 17, Type 1] and Keller [1993b])	This type is similar to Prescott Gray, with the addition of black organic paint, either thick or thin. Surfaces are "slightly rough to well smoothed, not polished" (Colton 1958). Decoration is in the Sosi style (Keller 1993b) and appears on bowl interiors and the interior necks of jars (Colton 1958).	Prescott Black-on-plain (Prescott Series) (see Wood 1987:53).	
Prescott Red	"Prescott Red is the red-slipped version of Prescott Gray" (Christenson, Appendix A, this volume). Prescott Red is listed as a type by Hays-Gilpin (2004), but no description is currently available.	Wood (1987:52) suggested that Prescott Red "may actually only be a misidentification of a Gila Red variant."	A red-slipped Prescott Gray Ware type has not been previously recognized (Colton 1958; Keller 1993b).
Aquarius Orange (as described by Colton [1958:Ware 17, Type 2])	Aquarius Orange is "an oxidized variant" of Prescott Black-on-gray (Colton 1958). It has "at least one surface that has an orange hue, and the presence of relatively coarse temper" (Keller 1993b:69). Surface color is "pink to orange"; the core is "grayish brown."	Wood (1987:52) defined Aquarius Orange as "a better and more consistently finished version of Prescott Plain."	Wood (1987:52) argued that Aquarius Orange "strongly resembles Tonto Red."
Aquarius Black-on-orange (as described by Colton [1958:Ware 17, Type 3])	This type is similar to Aquarius Orange with the addition of black paint. The decoration is like that of Prescott Black-on-gray.		

Key: TNF = Tonto National Forest.

Table 7. Tizon Brown Ware Types

Ceramic Type	Description	TNF Typology	Comparisons
Cerbat Brown (as described by Dobyns and Euler [1958])	Inclusions are "quartz, feldspar, occasionally mica," and "mostly opaque." Surface color is "brown to warm gray"; the core is "black, gray to brown." Surface finish is smoothed, "at times showing a locally fused float."		"Cerbat Brown and Aquarius Brown are not always objectively distinguishable" (Dobyns and Euler 1958). The inclusions in Cerbat Brown are finer than those in Aquarius Brown (see below) or Aquarius Orange (Prescott Gray Ware) and coarser than Sandy Brown (see below). Several authors (e.g., Keller 1993c; Whittlesey and Benaron 1998:155) have noted problems in distinguishing among the smoothed Tizon Brown Ware types.
Cerbat Red-on-brown (as described by Dobyns and Euler [1958])	This type is similar to Cerbat Brown, with the addition of red paint.		
Cerbat Black-on-brown (as described by Dobyns and Euler [1958])	This type is similar to Cerbat Brown, with the addition of black paint. Two sherds are known to exist (Dobyns and Euler 1958; Keller 1993c).		
Sandy Brown (as described by Dobyns and Euler [1958])	Inclusions are "water worn quartz feldspar" grains. Surface color is "light tan"; the core is "brown, tan." Surface finish is smoothed. Polishing also occurs (Keller 1993c:82).		Sandy Brown is distinguished "from Cerbat Brown by its tan color, lack of float, and finer temper and texture."
Aquarius Brown (as described by Dobyns and Euler [1958])	Inclusions are "opaque quartz, feldspar, occasionally mica." Surface color is "brown to gray, sometimes reddish." The core color is "gray to brown." Surface finish is smoothed, "at times showing a locally fused float."		Aquarius Brown "differs from Cerbat Brown only in that it has medium to coarse temper; from Aquarius Orange (Prescott Gray Ware) in having finer, more opaque, less angular temper, less mica, brown surface color, and a crumbling fracture."
Aquarius Black-on-brown (as described by Dobyns and Euler [1958])	This type is similar to Cerbat Brown with the addition of black paint.		
Tizon Wiped (as described by Dobyns and Euler [1958])	Tizon Wiped is the "same as Cerbat Brown and Aquarius Brown, plus . . . exterior and/or interior intentionally striated."	Wood (1987:115) grouped Tizon Wiped and Orme Ranch Plain into Yavapai Plain Ware.	

Key: TNF = Tonto National Forest.

Table 8. Yavapai Plain Ware Types

Ceramic Type	Description	TNF Typology
Orme Ranch Plain (as described by Breternitz [1960b])	Inclusions are "angular calcite crystals and pyroclastic material." Surface color is brown to black. Core color is not described, but firing is "uncontrolled." Surface finish is textured on the exterior; coils are pinched together in rows with scraped areas between. Interior surfaces are scraped.	Orme Ranch Plain is considered one variation of Yavapai Plain Ware, a type of "protohistoric and historic native pottery" (Wood 1987:113, 115).

Key: TNF = Tonto National Forest.

Table 9. Unpainted Hohokam Ceramic Types

Ceramic Type	Description	TNF Typology	Comparisons
Gila Plain (as defined by Haury [1965a:205–211, 1976:223–225])	Construction is paddle and anvil. Inclusions are crushed mica schist, often with angular or rounded quartz grains, and abundant mica particles appear on the surface. Surface color is light brown to gray, and firing clouds are common. The surface finish is smoothed, often with cursory, light polishing, producing striations that run down from the rim. Some bowl interiors are smudged but not well polished. One jar dating to the Santa Cruz phase had a stucco finish on the exterior base (Haury 1976:225, Figure 12.62).	Gila Plain, Gila variety (Gila-Tonto Series).	The preceding type, Vahki Plain, has a more polished surface, thinner vessel walls, and "less obvious" temper (Haury 1965a:211). Gila Plain was divided into three varieties: Gila variety, Salt variety, and Wingfield variety (Opfenring 1965; Weaver 1973). Gila Plain, Gila variety, matches the original definition of Gila Plain and is referred to here simply as "Gila Plain."
Wingfield Plain[a] (as defined by Colton [1941:46])	Construction is paddle and anvil. Inclusions are "crushed mica schist . . . . Very, very coarse mica schist temper distinguishes it from Gila Plain." Surface color is "brown to buff" and ceramics lack a carbon core. Surface finish is "rough and bumpy."	Wingfield Plain (Gila-Tonto Series) (see Wood 1987:18–19). Both Wood (1987) and Abbott and Gregory (1988) considered Wingfield Plain to be phyllite tempered and excluded ceramics with mica-schist temper.	Some authors (e.g., Colton 1941:46; Weaver 1974:53; Wood 1987:19) considered Wingfield Plain to be a Hohokam type, and it has also been referred to as Gila Plain, Wingfield variety (Opfenring 1965).
Wingfield Plain[a] (as described by Abbott and Gregory [1988:8])	Inclusions are "relatively large particles of aphanitic phyllite . . . typically a homogeneous dull gray or silver color, or rarely, reddish purple. Small quantities of rounded quartz sand also are sometimes present." Surfaces are infrequently smudged and polished.		Even though they classified Wingfield Plain as a distinct type, Abbott and Gregory (1988:10–11) emphasized that Wingfield Plain at the site of Las Colinas is clearly a Hohokam ceramic type and differs from Gila Plain only in temper and in the frequency of smudging and polishing.
Wingfield Red (as defined by Di Peso [1956:350])	"This type of redware was basically the same as Wingfield Plain save that a thin red slip was applied to the vessel exterior."	Wingfield Red (Gila-Tonto Series).	

Key: TNF = Tonto National Forest.

[a] Wingfield Plain appears primarily in two areas: in the lower Verde River and Agua Fria–New River drainages and in the Papaguería of southwestern Arizona (Weaver 1974). Within the Papaguería, the type is especially common in the Ajo Valley (Ezell 1955:369). Masse (1980:113) argued that Wingfield Plain, as seen in the Papaguería, "is a local manufacture and is not related to the Wingfield Plain in the Agua Fria and Verde Valleys."

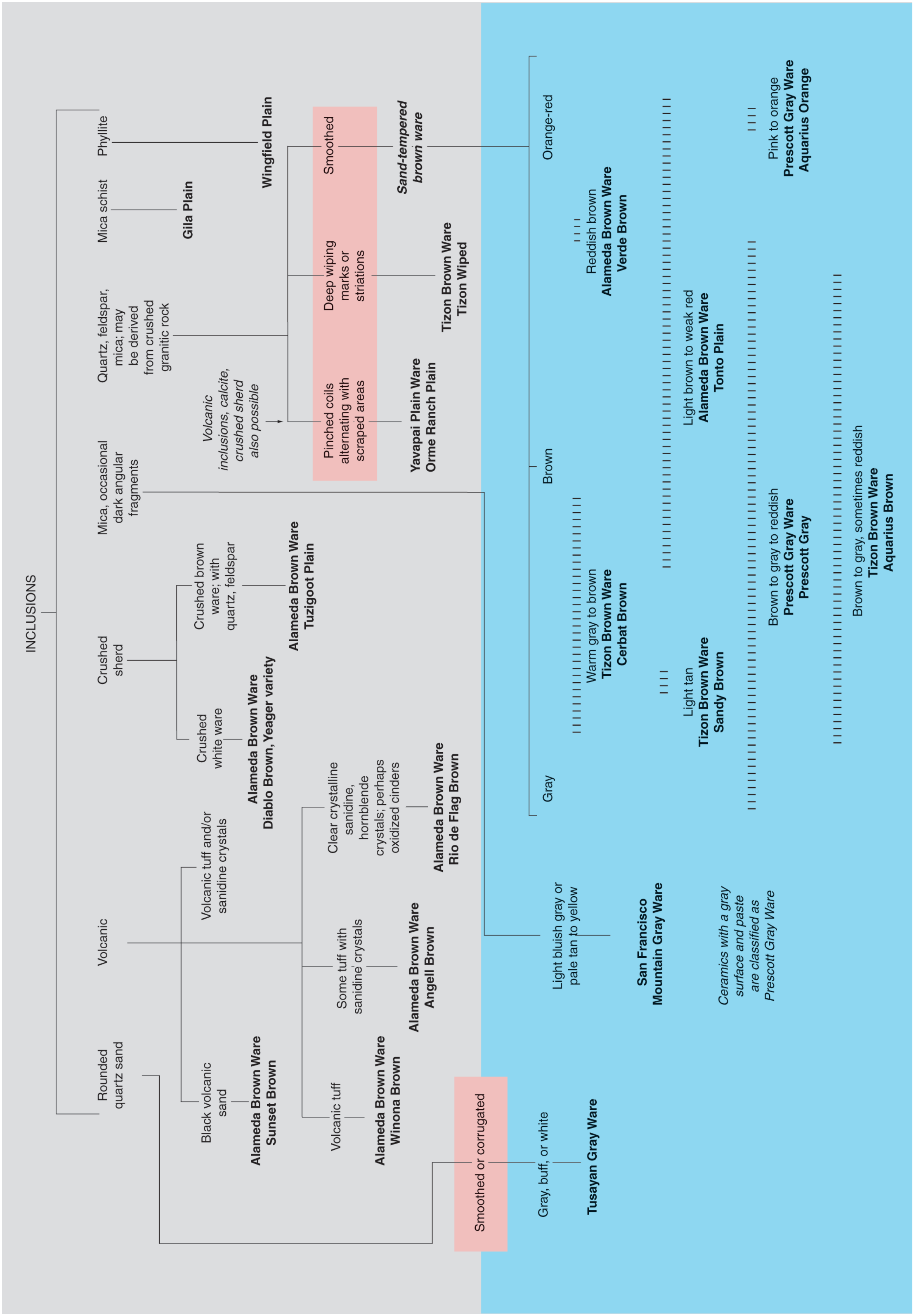

Figure 4. Plain brown and gray ware typologies used in the LOCAP.

The classification of unpainted, smooth-surfaced ceramics with quartz, feldspar, and mica inclusions, as shown in Figure 4, differed among the analysts. Christenson divided these ceramics into several Alameda Brown Ware, Tizon Brown Ware, and Prescott Gray Ware types. Whittlesey and Beck, who had smaller sherds in their samples, usually did not assign them to particular types but classified them instead as "sand-tempered brown ware." The formal types, defined in different regions, have overlapping definitions, and it would be misleading to assign a type name with cultural implications when several wares and types might apply. For example, Verde Brown is often difficult to distinguish from Prescott Gray (James 1974; Walsh-Anduze and Christenson 1998; Westfall and Jeter 1977) (see Appendix A). Verde Brown is also similar to Tonto Plain (McGuire 1977) and Gila Plain, Salt variety (Bruder 1982; Weaver 1973, 1974), as discussed by Whittlesey et al. (1998:10–11). Tizon Brown is not easy to distinguish from Prescott Gray or San Francisco Mountain Gray when temper is similar (Christenson 2000:161; Zedeño et al. 1993:208).

Five red ware types do not appear in the flowchart (see Figure 4). Four of these (Prescott Red, Sunset Red, Tuzigoot Red, and Verde Red) are similar to their brown or gray ware counterparts, with the addition of a red slip. The fifth, Turkey Hill Red, has either Winona or Angell Brown paste, with a red slip. Smudged vessel fragments were not assigned to separate types, following current practice in the region (see Kamp and Whittaker 1999:44–49; Stanislawski 1990).

The other eight wares in the collection were painted wares: Hohokam Buff Ware, Jeddito Yellow Ware, Little Colorado White Ware, Roosevelt Red Ware, San Juan Red Ware, Tsegi Orange Ware, Tusayan White Ware, and White Mountain Red Ware. Discussions of the painted wares follow, including references for complete descriptions of types in the LOCAP collection.

At least eight different geographic or cultural areas were represented by the unpainted and painted ceramics. Four unpainted Alameda Brown Ware types (Verde Brown, Verde Red, Tuzigoot Brown, and Tuzigoot Red) (see Table 5) are believed to be local Southern Sinagua types manufactured in the Verde River valley. Christenson conducted petrographic analyses on two Verde Brown and two Tuzigoot Plain sherds from the LOCAP collection (see Appendix A), and he described the history and manufacture of these types in more detail. The other areas or groups represented were the Mesa Verde Anasazi, the Kayenta Anasazi, the Hopi Mesas/Hopi Buttes, Cohonina, Northern Sinagua, possible protohistoric and historical-period Yavapai, and Hohokam. Some ceramic wares, such as Roosevelt Red Ware and White Mountain Red Ware, do not fit neatly into any of these categories.

The wares from each region or culture are presented below, in order from north to south and then from early to late, based on the ceramic date ranges (Table 10).

Mesa Verde Anasazi

San Juan Red Ware from the Mesa Verde region derived from the most geographically distant production area of any ceramics in the LOCAP area. Most San Juan Red Ware, at least those vessels classified as Bluff Black-on-red (A.D. 780–950), may have been manufactured in a limited number of communities in southeastern Utah (Hegmon et al. 1997).

San Juan Red Ware

San Juan Red Ware is thought to have been manufactured between A.D. 700 and 1100 (Wilson and Blinman 1995:55–57; see Abel 1955; Breternitz et al. 1974; Colton 1956:Ware 5A; Colton and Hargrave 1937; Hegmon et al. 1997). Colton (1956:Ware 5A) divided this ware into the San Juan Series and the Little Colorado Series. Types manufactured in the northern San Juan region contained crushed igneous rock, such as andesite, diorite, or granite (Oppelt 2001). In addition to crushed rock, quartz sand was also observed in some examples from northern Arizona (Goetze and Mills 1993:73). A slip is usually absent, except on the latest type, Deadmans Black-on-red (Breternitz et al. 1974). Tsegi Orange Ware is similar to San Juan Red Ware but contains crushed sherds (Colton 1956:Ware 5B).

Deadmans Black-on-Red

Although this type is assigned to the Little Colorado Series of San Juan Red Ware (Colton 1956:Ware 5A), it appears in lists of pottery types from the northern San Juan region (Breternitz et al. 1974; Hegmon et al. 1997). Deadmans Black-on-red has a thin, impermanent, well-polished, red slip and designs painted in black or purplish iron-manganese paint (Breternitz et al. 1974) (Figure 5a, b). The surface was polished over the painted design, which appears on bowl interiors (or, in rare cases, exteriors) and jar exteriors (Colton 1956:Ware 5A, Type 6). Parallel lines are common around rims. Other common motifs are nested chevrons and parallel lines in zigzag patterns or bilateral zones. This type is very similar to Middleton Black-on-red (Breternitz et al. 1974:62), a type in the Little Colorado Series distinguished by "hachures in panels" (Colton 1956:Ware 5B, Type 6).

All but one of the sherds in this type were from bowls. One bowl from Site 105/838 was painted on the exterior. Some sherds were noted as containing a high quantity of mica, mostly gold colored, on the surface. Any sherd having the characteristic rock inclusions and evidence of red slip was placed into this type, as it is the principal slipped type in the ware and the only type represented in the abundant painted examples present in the collection.

Kayenta Anasazi

During the Pueblo II period, the Kayenta Anasazi of northeastern Arizona exported large numbers of ceramic vessels

Table 10. Ceramic Date Ranges, by Ceramic Ware

Ceramic Type	Region or Culture	Date Range (A.D.)	Reference
	Alameda Brown Ware		
Angell Brown	Northern Sinagua	1075–1200	Downum n.d., cited in Kamp and Whittaker 1999
Diablo Brown, Yeager variety	Northern Sinagua	1050–1100	Wilson 1969
Rio de Flag Brown	Northern Sinagua	700–1125	Downum n.d., cited in Kamp and Whittaker 1999
Sunset Brown	Northern Sinagua	1064–1300	Downum n.d., cited in Kamp and Whittaker 1999
Sunset Red	Northern Sinagua	1064–1300	Downum n.d., cited in Kamp and Whittaker 1999
Turkey Hill Red	Northern Sinagua	1090–1200+	Breternitz 1966
Tuzigoot Plain	Southern Sinagua	1100–1400+	Wood 1987
Tuzigoot Red	Southern Sinagua	1150–1400+	Wood 1987
Verde Brown	Southern Sinagua	700–1400+	Wood 1987 (Tonto Plain, Verde Valley variety)
Verde Red	Southern Sinagua	1150–1400+	Wood 1987 (Gila Red, Verde Valley variety)
Winona Brown	Northern Sinagua	1075–1250	Downum n.d., cited in Kamp and Whittaker 1999
	Anasazi Gray Ware (Lower Oak Creek Archaeological Project)		
Indeterminate Anasazi Gray Ware	indeterminate Anasazi	unknown	
	Awatovi Yellow Ware		
Jeddito Corrugated	Hopi Mesas/Hopi Buttes	1300–1625	Colton and Hargrave 1937
Jeddito Plain	Hopi Mesas/Hopi Buttes	1300–1625	Colton and Hargrave 1937
Indeterminate Awatovi Yellow Ware	Hopi Mesas/Hopi Buttes	1300–1625	Colton and Hargrave 1937
	Hohokam Buff Ware		
Indeterminate red-on-buff	Hohokam	700–1150[a]	Whittlesey and Heckman 2000
Indeterminate buff (no paint)	Hohokam	700–1150[a]	Whittlesey and Heckman 2000
	Jeddito Yellow Ware		
Jeddito Black-on-yellow	Hopi Mesas/Hopi Buttes	1350–1500	Hays 1991
Indeterminate Jeddito Yellow Ware	Hopi Mesas/Hopi Buttes	1300–1500	Hays 1991
	Little Colorado White Ware		
Holbrook Black-on-white	Hopi Mesas/Hopi Buttes	1050–1150	Hays-Gilpin and van Hartesveldt 1998
Holbrook Black-on-white, Style A	Hopi Mesas/Hopi Buttes	1050–1150	Hays-Gilpin and van Hartesveldt 1998
Holbrook Black-on-white, Style B	Hopi Mesas/Hopi Buttes	1050–1150	Hays-Gilpin and van Hartesveldt 1998
Padre Black-on-white	Hopi Mesas/Hopi Buttes	1100–1250	Hays-Gilpin and van Hartesveldt 1998

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Ceramic Type	Region or Culture	Date Range (A.D.)	Reference
Walnut Black-on-white	Hopi Mesas/Hopi Buttes	1100–1250	Hays-Gilpin and van Hartesveldt 1998
Indeterminate Little Colorado White Ware	Hopi Mesas/Hopi Buttes	1050–1250[b]	Hays-Gilpin and van Hartesveldt 1998
		Prescott Gray Ware	
Aquarius Orange	Prescott area	1000–1400	Hays-Gilpin 2004
Prescott Gray	Prescott area	800–1400	Hays-Gilpin 2004
Prescott Red	Prescott area	unknown	Hays-Gilpin 2004
		Roosevelt Red Ware	
Indeterminate Roosevelt Red Ware	other	1280–1450+ (polychrome)	Whittlesey and Heckman 2000
		San Francisco Mountain Gray Ware	
Deadmans Black-on-gray	Cohonina	900–1100	Goetze and Mills 1993
Deadmans Black-on-gray, Fugitive Red	Cohonina	900–1100	Goetze and Mills 1993
Deadmans Fugitive Red	Cohonina	850–1150	Goetze and Mills 1993
Deadmans Gray	Cohonina	775–1200	Goetze and Mills 1993
Deadmans/Floyd Gray	Cohonina	700–1200	Goetze and Mills 1993
Indeterminate San Francisco Mountain Gray Ware	Cohonina	700–1200	Goetze and Mills 1993
		San Juan Red Ware	
Deadmans Black-on-red	Mesa Verde Anasazi	900–1100	Hegmon et al. 1997
		Sand-Tempered Brown Ware	
Basket-impressed interior	Southern Sinagua, probable	unknown	
Indeterminate corrugated	unknown	unknown	
Indeterminate	Southern Sinagua, probable	unknown	
		Tizon Brown Ware	
Sandy Brown	Upland Patayan	700–1890	Dobyns and Euler 1958
Tizon Wiped	possible Yavapai	protohistoric or prehistoric period	Dobyns and Euler 1958; Whittlesey and Benaron 1998
		Tsegi Orange Ware	
Tusayan Black-on-red	Kayenta Anasazi	1045–1240	Christenson 1994
Indeterminate Tsegi Orange Ware	Kayenta Anasazi	1050–1300	Hays 1991
		Tusayan Gray Ware	
Kiet Siel Gray	Kayenta Anasazi	1220–1320	Christenson 1994

Ceramic Type	Region or Culture	Date Range (A.D.)	Reference
Lino Black-on-gray	Kayenta Anasazi	640–820	Christenson 1994
Moenkopi Corrugated	Kayenta Anasazi	1130–1250	Christenson 1994
Tusayan Corrugated	Kayenta Anasazi	1020–1210	Christenson 1994
Tusayan or Moenkopi Corrugated	Kayenta Anasazi	1020–1250	Christenson 1994
Indeterminate gray corrugated	Kayenta Anasazi	800–1300+	Hays-Gilpin and van Hartesveldt 1998
Indeterminate gray plain	Kayenta Anasazi	400–1350	Hays-Gilpin and van Hartesveldt 1998
Indeterminate Tusayan Gray Ware	Kayenta Anasazi	400–1300+	Hays-Gilpin and van Hartesveldt 1998
	Tusayan White Ware		
Black Mesa Black-on-white	Kayenta Anasazi	900–1160	Christenson 1994
Black Mesa or Sosi Black-on-white	Kayenta Anasazi	900–1180	Christenson 1994
Dogoszhi Black-on-white	Kayenta Anasazi	1050–1190	Christenson 1994
Kana'a Black-on-white	Kayenta Anasazi	800–1050	Christenson 1994
Kana'a or Wepo Black-on-white	Kayenta Anasazi	800–1060	Christenson 1994
Sosi Black-on-white	Kayenta Anasazi	1050–1180	Christenson 1994
Wepo Black-on-white	Kayenta Anasazi	850–1060	Christenson 1994
Indeterminate Tusayan White Ware	Kayenta Anasazi	800–1330	Christenson 1994
	Unpainted		
Gila Plain	Hohokam	400–1350+	Wood 1987
Indeterminate Orme Ranch Plain or other corrugated	other	unknown	
Indeterminate unpainted	unknown	unknown	
Orme Ranch Plain	possible Yavapai	protohistoric or prehistoric period	Whittlesey and Benaron 1998
Sand-tempered red ware	unknown	unknown	
Wingfield Plain	Hohokam	300–1300+	Wood 1987
Wingfield Red	Hohokam	1100–1450	Abbott and Walsh-Anduze 1995
	White Mountain Red Ware		
Klageto Black-on-yellow	other	1250–1300/1325	Hays-Gilpin and van Hartesveldt 1998

[a] No evidence of Casa Grande Red-on-buff in the region.

[b] St. Joseph Black-on-white (A.D. 825–1050) is very rare.

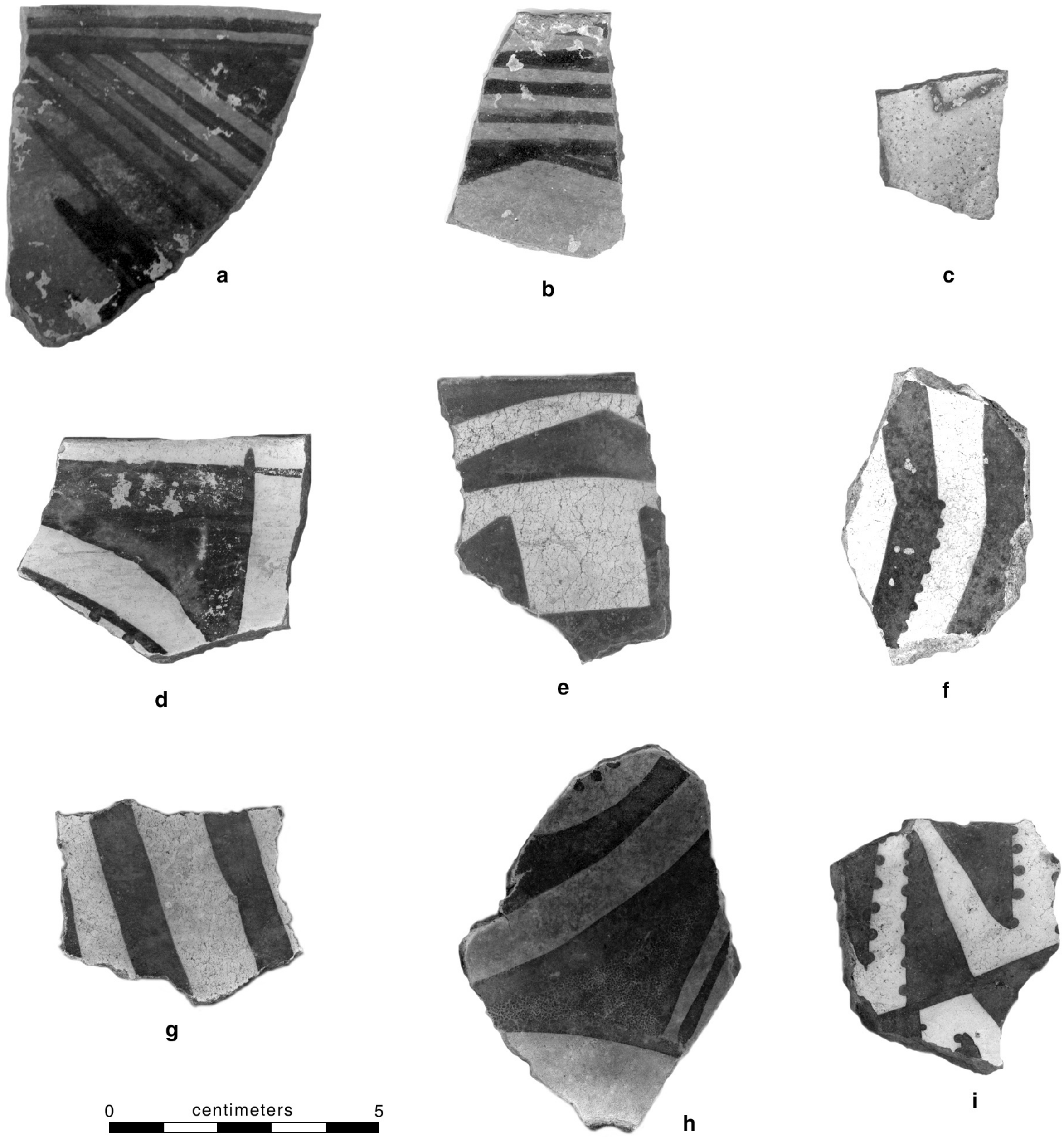

Figure 5. Views of bowl interiors: (*a* and *b*) Deadmans Black-on-red; (*c*) Lino Black-on-gray; (*d*) Wepo Black-on-white; (*e* and *f*) Black Mesa Black-on-white; (*g*) Sosi Black-on-white; (h) Little Colorado White Ware, unnamed Wepo Black-on-white equivalent; and (*i*) Holbrook Black-on-white, Style A.

(Blinman and Wilson 1993:82). Most of the nonlocal ceramics in the LOCAP collection were Tusayan White Ware, Tusayan Gray Ware, and Tsegi Orange Ware ceramics from this area. These vessels may have been brought into the LOCAP area by mobile populations or may have come to the Verde River valley from the northern Sinagua area, along with northern Sinagua pottery. The nature of this potential trade, which may have included trading of vessels (bowls) as well as commodities in vessels (mostly jars), is not well understood (see Blinman and Wilson [1993:78–82] for a discussion).

Tusayan Gray Ware

See Table 2 for descriptions and Tonto National Forest (TNF) typologies of the various different ceramics. The painted type Lino Black-on-gray (see Figure 5c) dates to A.D. 640–820 (Christenson 1994) and was recovered from Sites 53/745 and 104/902.

Tusayan White Ware

Tusayan White Ware contains moderate quantities of quartz sand in a white paste that may have a carbon streak. Early types lack a slip; later types usually have a thin, white slip. Vessels are decorated with organic, gray to black paint, and different design styles distinguish the different types (Ambler 1985; Colton 1955:Ware 8B; Colton and Hargrave 1937; Hays-Gilpin and van Hartesveldt 1998; Pepoy and Linford 1982).

Little Colorado White Ware intergraded with Tusayan White Ware at the eastern edge of its range, producing a sherd-tempered variety of Tusayan White Ware, as well as a sand-tempered variety of Little Colorado White Ware (Kojo 1991:139–141). Four Tusayan White Ware sherds in the LOCAP collection belonged to the sherd-tempered variety, including three indeterminate Tusayan White Ware sherds and one Black Mesa or Sosi Black-on-white sherd. Sand-tempered Little Colorado White Ware sherds are discussed below with the other Little Colorado White Ware ceramics.

Another variety of Tusayan White Ware, the Hopi Buttes variety, has black volcanic sand mixed with the usual quartz-sand inclusions (Kojo 1991:133–138). This variety was manufactured, not in the Kayenta Anasazi area, but instead in the area of the Hopi Mesas and south to the Hopi Buttes. Six sherds belonged to the Hopi Buttes variety, including two Black Mesa Black-on-white, one Black Mesa or Sosi Black-on-white, one Sosi Black-on-white, and two indeterminate Tusayan White Ware sherds. Two of the sherd-tempered variety (one Black Mesa or Sosi Black-on-white and one indeterminate) also contained black volcanic sand.

Kana'a Black-on-White

Kana'a Black-on-white (A.D. 800–1050) (Christenson 1994) has polished, unslipped surfaces and thin (1–2-mm), painted lines characterized by sloppy junctures and short brush strokes. White space was dominant. Lines have tick marks, rather than pendant dots, and parallel lines, stepped terraces, and elongated triangles are common design elements.

Kana'a or Wepo Black-on-White

One sherd was placed in this category. It had a painted line falling between the average Kana'a Black-on-white and Wepo Black-on-white line widths.

Wepo Black-on-White

Wepo Black-on-white (A.D. 850–1060) (Christenson 1994) falls stylistically between Kana'a Black-on-white and Black Mesa Black-on-white. It is identified by lines that are wider and black designs that are bolder than those of Kana'a Black-on-white and lines that are narrower than those of Black Mesa Black-on-white (Gumerman et al. 1972:247–248) (see Figure 5d).

Black Mesa Black-on-White

Black Mesa Black-on-white (A.D. 900–1160) (Christenson 1994) is polished, with a white slip that may vary in thickness and texture. Designs are similar to Kana'a Black-on-white, with abundant white space, but are bolder, with broader and more-even lines in comparison to that type. Stripes, rectilinear or curvilinear solids, interlocking scrolls, checkerboard patterns, and negative squares with dots are common. Lines and other solids, including triangles, often have pendant dots (see Figure 5e, f).

Two of the Black Mesa Black-on-white sherds from Site 105/838 were classified as the Hopi Buttes variety of Tusayan White Ware.

Sosi Black-on-White

Sosi Black-on-white (A.D. 1050–1180) (Christenson 1994) is polished and usually has a white slip. Black, painted designs, which are almost equal in area to the white space, are wide (5–7-mm), painted lines with acute angles, elongated right triangles, and interlocking hooks. The style is similar to Escavada Black-on-white in the Cibola White Ware series and Holbrook Black-on-white, Style B, in the Little Colorado White Ware series (see Figure 5g).

One Sosi Black-on-white sherd from Site 105/838 was classified as the Hopi Buttes variety of Tusayan White Ware.

Black Mesa or Sosi Black-on-White

This category was used for a sherd with a single wide line or other characteristics consistent with both types. One sherd from Site 53/745 contained black volcanic sand and was classified as the Hopi Buttes variety of Tusayan White Ware. Another sherd from AZ O:1:77/AR-03-04-06-869 (ASM/CNF) (Site 77/869) contained crushed-sherd and black-volcanic-sand inclusions.

Dogoszhi Black-on-White

Dogoszhi Black-on-white (A.D. 1050–1190) (Christenson 1994) has oblique, hatched designs with framing lines and hatching lines that are usually of the same width. Designs are similar to Gallup Black-on-white in the Cibola White Ware series and Padre Black-on-white in the Little Colorado White Ware series.

Indeterminate Tusayan Gray Ware or White Ware

One sherd had the sand inclusions typical of the Tusayan wares but could not be placed into a specific ware. The early pottery of these wares can commonly be distinguished by minor differences in inclusion coarseness or surface texture, but this distinction is not always possible (Reed 1981).

Tsegi Orange Ware

Tsegi Orange Ware was defined by Colton and Hargrave (1937:92–96). It has primarily sherd temper, although some sand may be present, and is painted with mineral paint. It may have an orange to red slip that does not contrast with the paste (Colton 1956:Ware 5B; Colton and Hargrave 1937:92–93; Goetze and Mills 1993; Hays-Gilpin and van Hartesveldt 1998:Table 5). Only one sherd in this ware could be assigned to a type.

Tusayan Black-on-Red

A single bowl sherd with a red slip and black, hachured designs was the only example of this type.

Hopi Mesas/Hopi Buttes

Little Colorado White Ware, the Hopi Buttes variety of Tusayan White Ware (containing black volcanic sand); Awatovi Yellow Ware; and Jeddito Yellow Ware were produced in the area of the Hopi Mesas and south to the Hopi Buttes. Down-the-line exchange with groups near Flagstaff in the eleventh century or mobile populations may account for the presence of Little Colorado White Ware and the Hopi Buttes variety of Tusayan White Ware in the project area. After A.D. 1300, the intrusive ceramics from the Hopi Mesas area are plain and painted yellow wares. Given the apparent depopulation and abandonment of the San Francisco Mountains area at this time (Colton 1946), the later yellow wares probably did not come through settlements there and may reflect direct contact.

Little Colorado White Ware

This ware is identified by the presence of a light-gray core, white-sherd temper mixed with quartz sand, and thick, white slip (Colton 1955:Ware 9B). Like Tusayan White Ware, designs are painted with organic, black paint, but Little Colorado White Ware is distinguished by its darker paste, thicker slip, and sherd temper (Hays-Gilpin and van Hartesveldt 1998). The sand may also include fragments of volcanic rock (Douglass 1990:143, 145, 147). This ware was produced in the Hopi Buttes area, south of the Hopi Mesas (Douglass 1990:189).

One variety, termed quartz-tempered Little Colorado White Ware by Kojo (1991:139), contains sand inclusions rather than crushed sherds (see also Colton 1955). Underneath the slip, the paste is white with a dark-gray core. The difference in core color from other Little Colorado White Ware suggests that this variety may have been fired differently. This variety is an intergrade with Tusayan White Ware.

As noted below, 16 Little Colorado White Ware sherds were of the sand-tempered variety, including sherds in the following types or categories: unnamed Wepo-equivalent black-on-white (1 sherd), Holbrook Black-on-white (6 sherds), Padre Black-on-white (1 sherd), Walnut Black-on-white (3 sherds), and indeterminate Little Colorado White Ware (5 sherds).

Unnamed Wepo-Equivalent Black-on-White

The early pottery of Little Colorado White Ware is poorly documented. One bowl sherd from Site 105/838 (see Figure 5h) had the medium line width characteristic of the Tusayan White Ware type, Wepo Black-on-white. Wepo Black-on-white is a stylistic intergrade between Kana'a Black-on-white (A.D. 725/825–950/1000) and Black Mesa Black-on-white (A.D. 1000–1100) (Gumerman et al. 1972; Hays-Gilpin and van Hartesveldt 1998:111, 113). The sherd belonged to the sand-tempered variety of Little Colorado White Ware and contained black sand. No Little Colorado White Ware equivalent of Wepo Black-on-white has been named.

Holbrook Black-on-White

This type, although dated to between A.D. 1050 and 1150, has a thick, chalky slip, with moderate to poor polish and gray to black, organic paint (Colton 1955; Colton and Hargrave 1937; Douglass 1990; Hays-Gilpin and van Hartesveldt 1998:101; Mera 1934). It is divided into two styles. Style A (see Figure 5i) has designs similar to those of Red Mesa Black-on-white in the Cibola White Ware series (A.D. 900–1050) (Hays-Gilpin and van Hartesveldt 1998:67) and Black Mesa Black-on-white in the Tusayan White Ware series (A.D. 900–1160) (Christenson 1994). Style B has designs similar to Sosi Black-on-white in the Tusayan White Ware series (A.D. 1070–1180) (Hays-Gilpin and van Hartesveldt 1998:115) (Figure 6).

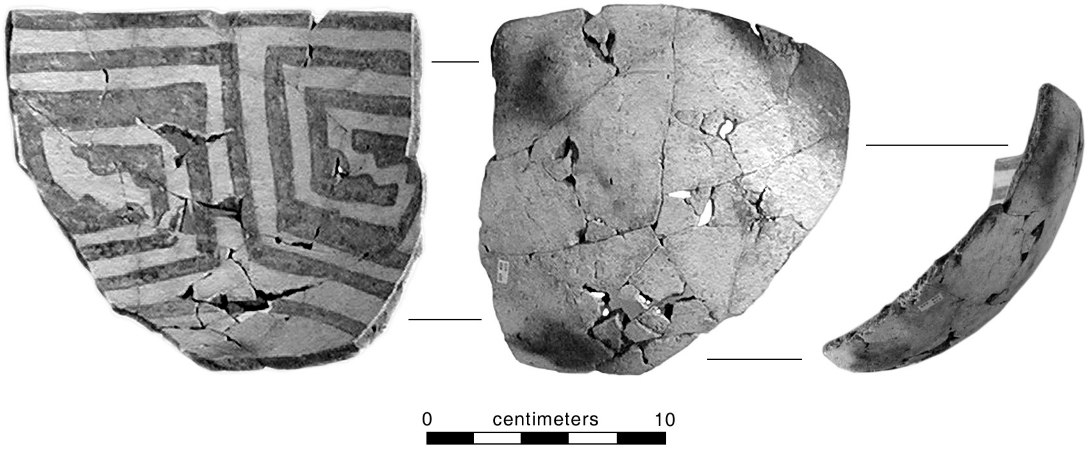

Figure 6. Partial Holbrook Black-on-white, Style B, subhemispherical bowl from Site 105/838, Feature 23.

Various authors have provided different date ranges for the two styles. Here, we use the date range of A.D. 1050–1150 for both styles, as proposed by Douglass (1990:367, 370) and used by Hays-Gilpin and van Hartesveldt (1998:101–102), although Downum n.d., cited in Kamp and Whittaker 1999:46, suggested A.D. 1025–1150 for Style A (Black Mesa) and A.D. 1075–1200 for Style B (Sosi).

One sherd from Site 53/745 and five sherds from Site 105/838, including four Style A sherds, belonged to the sand-tempered variety of Little Colorado White Ware. Two of the Site 105/838 sherds contained black sand.

A partial Holbrook Black-on-white, Style B, bowl was excavated from the fill/roof-fall level (Level 1) of Feature 23 at Site 105/838 (see Figure 6). The vessel had an inside-rim diameter of 23 cm and a height of at least 12 cm.

Padre Black-on-White

This type, dated to A.D. 1100–1250, has a thick, chalky slip, with moderate to poor polish and organic, gray to black paint (Colton 1955; Colton and Hargrave 1937; Douglass 1990; Hays-Gilpin and van Hartesveldt 1998:105). The oblique-hatched designs on this type are similar to those of Gallup Black-on-white in the Cibola White Ware series (A.D. 1030–1125) (Hays-Gilpin and van Hartesveldt 1998:71) and Dogoszhi Black-on-white in the Tusayan White Ware series (A.D. 1050–1190) (Christenson 1994) (Figure 7a). One Padre Black-on-white sherd from Site 105/838 belonged to the sand-tempered variety.

Walnut Black-on-White

This type, dated to A.D. 1100–1250 (Hays-Gilpin and van Hartesveldt 1998:106), has a thick, chalky slip, with moderate to poor polish and organic, gray to black paint (Colton 1955; Colton and Hargrave 1937; Douglass 1990; Hays-Gilpin and van Hartesveldt 1998; Mera 1934). Douglass (1990) divided Walnut Black-on-white into two types (Walnut A and Walnut B), based on differences in design style. Following Hays-Gilpin and van Hartesveldt (1998), these are treated here as varieties of one type.

Three sherds from Site 53/745 were classified into the sand-tempered variety. The sherds from the single jar in this category corresponded to the Style B of Walnut Black-on-white, with the wavy-line design.

Jeddito Yellow Ware

This ware has a fine, yellow paste and brownish-black paint (Colton 1956:Ware 7B; Hays 1991; Smith 1971). Unpainted vessels with similar paste are classified instead as Awatovi Yellow Ware (Colton 1956:Ware 7A). Jeddito Yellow Ware was manufactured on the Hopi Mesas, and examples from the site of Homol'ovi II have been linked to Awatovi on Antelope Mesa (Bishop et al. 1988; Hays 1991).

Jeddito Black-on-Yellow

This type includes sherds from bowls and jars that have brownish-black, painted designs and temper that is rarely visible (see Figure 7b).

Awatovi Yellow Ware

See Table 3 for descriptions and TNF typologies of the various different ceramic types.

Cohonina

San Francisco Mountain Gray Ware, associated with the Cohonina culture, was manufactured somewhere to the north or west of the Flagstaff region. Petrographic and clay-oxidation studies suggested that the ware was made

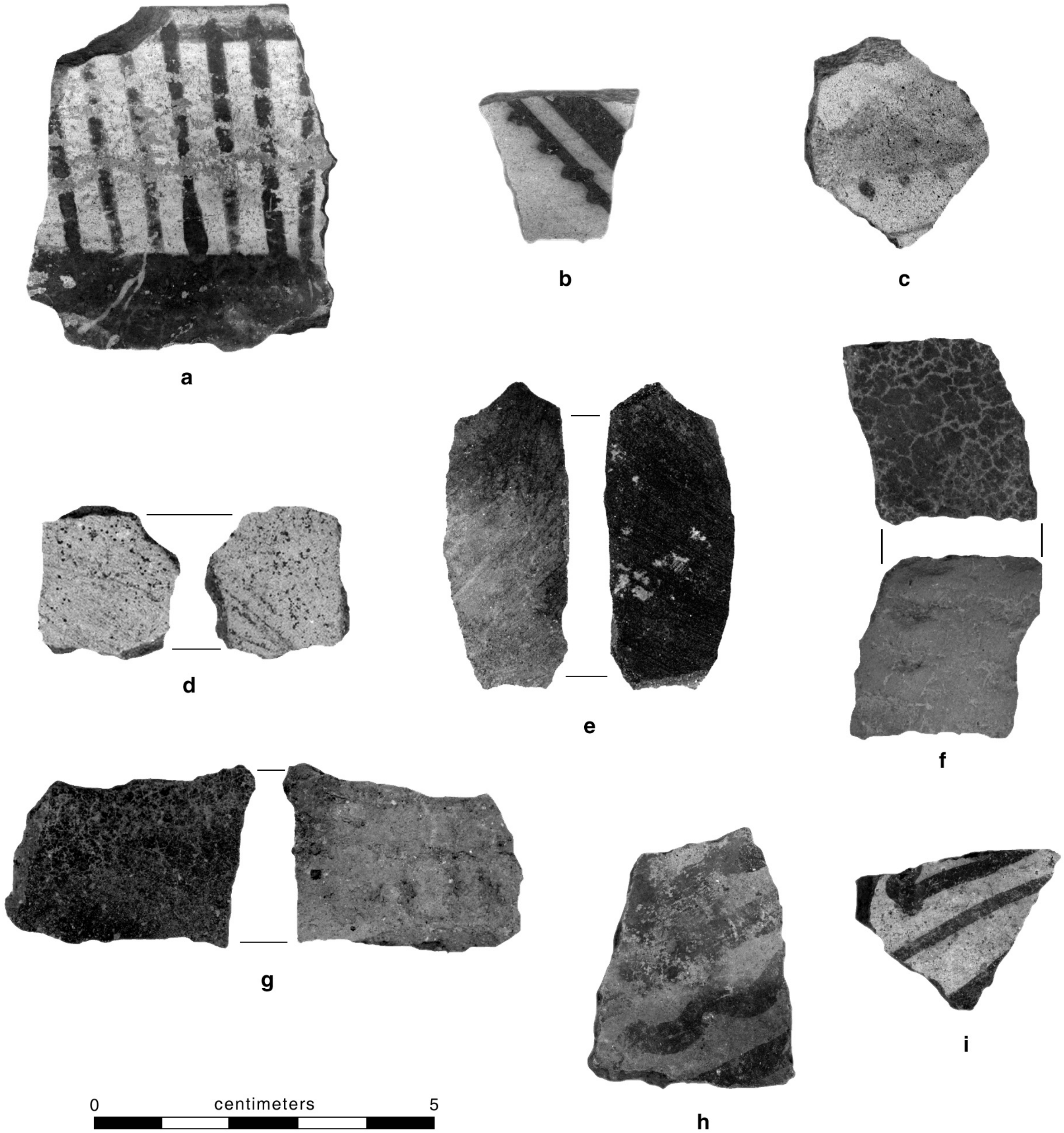

Figure 7. Ceramic wares: (*a*) Padre Black-on-white; (*b*) Jeddito Black-on-yellow; (*c*) Deadmans Black-on-gray; (*d* and *e*) Tizon Wiped; (*f* and *g*) Orme Ranch Plain; and (*h* and *i*) indeterminate Hohokam Buff Ware. Views are (*a–c, h*) bowl interiors; (*i*) jar exteriors; and (top or left) both interior and exterior view for (*d–g*) vessels of indeterminate form.

from residual clays of a different origin than the volcanic-rock-tempered Alameda Brown Ware of the Flagstaff region (Bubemyre and Mills 1993:275; Zedeño et al. 1993:207), although no specific manufacture location has been suggested.

San Francisco Mountain Gray Ware

See Table 4 for descriptions and TNF typologies of the various different ceramic types. The painted type, Deadmans Black-on-gray (see Figure 7c), dates to A.D. 900–1100 (Christenson 1994) and was recovered from Sites 53/745 and 104/902.

Northern Sinagua

Alameda Brown Ware types with cinder, tuff, or black-basalt inclusions are assumed to have been manufactured in the San Francisco Peaks area near Flagstaff, where these volcanic rocks are found.

Alameda Brown Ware

See Table 5 for descriptions and TNF typologies of the various different ceramic types.

Prescott Area

Prescott Gray Ware is part of the local ceramic tradition in the Prescott area to the west of the Verde River, although potters here probably also made Southern Sinagua types, such as Tuzigoot Plain and Verde Brown (Higgins 2000; James 1974).

Prescott Gray Ware

See Table 6 for descriptions and TNF typologies of the various different ceramic types.

Possible Protohistoric and Historical-Period Yavapai

Tizon Brown Ware (see Figure 7d, e) and Orme Ranch Plain (see Figure 7f, g) may represent Yavapai ceramics (Breternitz 1960b; Dobyns and Euler 1958; Euler and Dobyns 1985; Wood 1987), although the connection to the Yavapai is not certain (Whittlesey and Benaron 1998:154–160). Two Tizon Brown Ware types were identified in the LOCAP collection: Tizon Wiped and Sandy Brown. The wiped or striated surface on Tizon Wiped and Apache Plain vessels (Whittlesey and Benaron 1998:155, 176) is often believed to indicate manufacture during the protohistoric or historical period. Sandy Brown is known to have a broad date range (A.D. 700–1890) (Dobyns and Euler 1958) and is simply referred to here as "Upland Patayan." Christenson presents petrographic-analysis results for Tizon Wiped and Orme Ranch plain sherds from the LOCAP and nearby areas in Appendix B.

Tizon Brown Ware

See Table 7 for descriptions and TNF typologies of the various different ceramic types.

Yavapai Plain Ware

Breternitz (1960b:28) tentatively assigned the type Orme Ranch Plain to this ware, assuming a connection with the Northeastern Yavapai could be demonstrated.

Orme Ranch Plain

See Table 8 for descriptions and TNF typologies of the various different ceramic types.

Upland Patayan

Sandy Brown was one of two Tizon Brown Ware types identified in the LOCAP collection. Most Tizon Brown Ware types, including Sandy Brown, were produced as early as A.D. 700 or 900 and continued until ca. A.D. 1900 (Rogers 1936; Waters 1982), when ceramic manufacture was abandoned by upland Yuman-speaking groups (Dobyns and Euler 1958).

Tizon Brown Ware

See Table 7 for descriptions and TNF typologies of the various different ceramic types.

Southern Sinagua

As discussed further by Christenson (see Appendix A), the Verde and Tuzigoot types of Alameda Brown Ware were apparently manufactured by Southern Sinagua groups in the upper and middle Verde River valley and nearby areas. The smooth-surfaced "sand-tempered brown ware" recorded by Whittlesey and Beck was similar to Verde Brown, among other types, and was probably of local manufacture. Its group affiliation in this study is "Southern Sinagua, probable."

A partial plain ware jar with a hand-smoothed exterior and interior and quartz, feldspar, and biotite-mica inclusions was excavated from the roof-fall level (Level 3) of Feature 23 at Site 105/838 (Figure 8). The vessel had an inside-rim diameter of 24 cm.

Alameda Brown Ware

See Table 5 for descriptions and TNF typologies of the various different ceramic types.

Hohokam

The production of Hohokam Buff Ware was probably concentrated in the middle Gila River valley, where outcrops of Pinal Schist, a coarse-grained mica schist, are located (Abbott et al. 2001; Miksa 2001). This ware is usually tempered with crushed-mica schist and varying amounts of sand.

This ware is rare in the Verde River valley. Fish et al. (1980:Table 1) found that Hohokam Buff Ware sherds made up only 2.7 percent of sherds in contexts dating to A.D. 700–900, dropping to 1.1 percent in the A.D. 900–1100 period. Hohokam Buff Ware was not present after A.D. 1100, although the emulation of Hohokam vessel shapes in Tuzigoot Plain and Red vessels at Tuzigoot Ruin suggests continued interaction (Caywood and Spicer 1935:Plate 9). A similar pattern has been noted in the Prescott region, where Hohokam Buff Ware appeared as a minor trade item in the pre–A.D. 1200 period, and an emulation of Hohokam vessel shapes and decoration techniques (but not designs) occurred in the post–A.D. 1200 period (Higgins 1997:35; James 1974:121).

Hohokam Buff Ware

A "porous, rosy pink paste" is considered "the defining attribute of Hohokam Buff Ware" (Whittlesey and Heckman

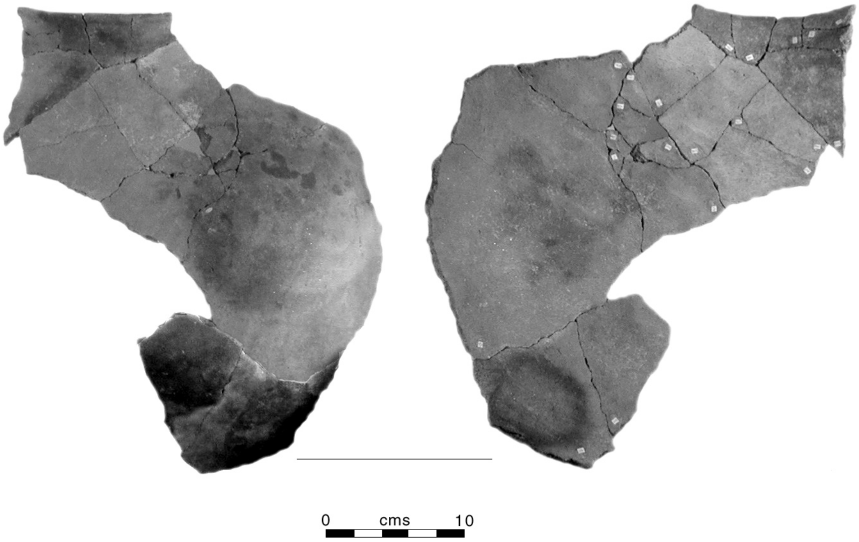

Figure 8. Partial sand-tempered plain ware jar from Site 105/838, Feature 23.

2000:98). Type descriptions (Haury 1965a, 1976; Wallace 2001) and associated date ranges are based on materials from the middle Gila River valley. They are used here with the understanding that stylistic attributes and the dating of these attributes may differ slightly for vessels manufactured outside the middle Gila River valley area. Unfortunately, none of the Hohokam Buff Ware sherds recovered from this project (see Figure 7h, i) could be assigned to a type.

Unpainted

The unpainted utility ceramics of the Hohokam were not formally assigned to a ware.

Gila Plain

See Table 9 for descriptions and TNF typologies of the various different ceramic types.

Wingfield Plain

See Table 9 for descriptions and TNF typologies of the various different ceramic types.

Other

Some wares, such as Roosevelt Red Ware and White Mountain Red Ware, have widespread manufacture locations.

Roosevelt Red Ware

Roosevelt Red Ware was named by Colton and Hargrave (1937:86–91), who placed it under Mogollon Brown Ware. Roosevelt Red Ware vessels have a "raspberry-red" slip over a fine, sand-tempered, brown paste; a white slip and black paint may also be present (Whittlesey and Heckman 2000:112). The three polychrome types within this ware, also known as the Salado Polychromes, had a broader distribution than other Roosevelt Red Ware types and have been recovered throughout Arizona and Sonora, Mexico (Crown 1994). The following descriptions are based on Whittlesey and Heckman (2000:111–113).

The earliest polychrome type, Pinto Polychrome, appeared in the late A.D. 1200s (Montgomery and Reid 1990). All vessels of this type are bowls with a red slip on the exterior and a white slip on the interior. Interior designs, painted in black, lack a rim band and have framing lines and hachure lines of similar widths. The next type, Gila Polychrome, dates after A.D. 1350 (Reid and Whittlesey 1992) and includes bowls and jars. Gila Polychrome bowls have an interior-rim band, and hachure is thinner than the framing lines. The latest type, Tonto Polychrome, is poorly dated. It is similar to Gila Polychrome, except that red paint is used within designs.

A single sherd of unidentified type was recorded in this ware.

White Mountain Red Ware

Colton and Hargrave (1937) originally defined White Mountain Red Ware, grouping together existing types. Surfaces are covered with a thick, red slip and are polished; temper includes crushed sherds and sand. Carlson (1970) and Hays-Gilpin and van Hartesveldt (1998) have provided criteria for distinguishing types.

Klageto-series and Kintiel-series types were once included within White Mountain Red Ware (Colton and Hargrave 1937:123–127), although Colton (1956) later moved the types to Tsegi Orange Ware. Hays-Gilpin and van Hartesveldt (1998:143) argued that the Klageto-Kintiel material is one of several "regionally distinct outgrowths of St. Johns Polychrome" in the White Mountain Red Ware sequence, reflecting Kayenta Anasazi influence, and that it belongs within White Mountain Red Ware, for technological and stylistic reasons. It is therefore included within White Mountain Red Ware in this study.

Klageto Black-on-Yellow

Hays-Gilpin and van Hartesveldt (1998:172–173) described this material within White Mountain Red Ware but lumped it with Kintiel Black-on-orange in a "Kintiel-Klageto tradition black-on-orange" category and did not distinguish individual types.

Klageto Black-on-yellow was represented by a single bowl sherd with a gray core, sherd temper, and a yellowish slip. The sherd had no paint, but the only type with which it could be confused is Kintiel Black-on-orange, which has mica-like particles on the surface.

Results

Site Collections

Of the 7,927 sherds recovered, the largest collections were from Sites 53/745 (4,107 sherds) and 105/838 (3,510 sherds). Both reconstructible vessels were recovered from Site 105/838. The remaining 8 sites yielded collections ranging from 2 to 103 sherds each. The wares and types are summarized by date ranges (Figure 9; see Table 10), sites (Table 11), and ceramic-production areas (Table 12). Tables 13–24 present counts by feature, where applicable, and vessel form by site for the 10 sherd collections.

Both reconstructible vessels from the LOCAP area were recovered from Feature 23 at Site 105/838. One was a Holbrook Black-on-white, Style B, subhemispherical-bowl fragment tempered with quartz sand and crushed sherds; roughly 20–25 percent of the vessel was represented (see Figure 6). The interior-rim diameter was 23 cm. The other vessel was a globular, sand-tempered, brown ware jar with an interior-rim diameter of 24 cm (see Figure 8). The vessel was at least 50 percent complete and was recovered from roof fall. The rim was slightly flaring, and the interior and exterior surfaces were smoothed.

Vessel Function and Site Function

Vessel Form

As noted above in the site summaries, jar sherds outnumbered bowl sherds at all sites (Tables 25 and 26). The ratios of bowls to jars presented in Table 26 provide only a general sense of the vessel forms at each site, because on average, only 27 percent of the sherds could be identified as to vessel form. Bowls made up the largest part of the vessel collections at Sites 53/745 and 105/838, the two largest sites with the most evidence of extended occupation.

Bowl and jar frequencies were directly related to the frequencies of painted types, because painted vessels tended to be bowls in this collection. The ratios of bowls to jars was 3.8 to 1 for painted types and 0.3 to 1 for unpainted types.

Use Alteration

Most eroded sherds were classified as Verde Brown (Table 27), although a few eroded sherds were found within three other brown ware types. One Deadmans/Floyd Gray sherd exhibited such wear. If interior erosion does indeed occur primarily on older cooking vessels, then such vessels were apparently in use at five sites in the LOCAP area: Sites 53/745, 77/869, 104/902, 105/838, and 133/561.

Movement, Interaction, and Exchange

It was rare for a site in the project area to have only one culture or region represented in its ceramic collection. Of the 10 sites with ceramic collections, only Sites 28/903 and 85/428, containing two sherds each, fell into this category (see Table 12). At least two to nine different cultures or regions were represented at each of the other 8 sites. Southern Sinagua ceramics made up most of the collections (averaging 53 percent) and were present at 8 sites. Northern Sinagua ceramics were the next-most-numerous category (averaging 16 percent) and appeared at 7 sites. Kayenta Anasazi ceramics represented 4 percent of the sherds, on average, and appeared at 8 sites. Ceramics from other groups or regions—such as the Cohonina, Hohokam, possible Yavapai, Prescott area, Hopi Mesas/Hopi Buttes, and Mesa Verde Anasazi—were 1–2 percent of the sherds, on average, and were recovered from 2–4 sites.

Temporal and Regional Variation

To put sites in the LOCAP area in context, we reviewed published data for sites surrounding the LOCAP area (Figure 10) and compiled presence-absence data for ceramic types (Table 28). All sites but Hidden House had Southern Sinagua plain ware, often Verde Brown or Tuzigoot Plain, but the painted ceramics represented a variety of regions. (In his description of Hidden House ceramics, Dixon [1956] only mentioned painted ceramics and the Tusayan Gray Ware type, Moenkopi Corrugated.)

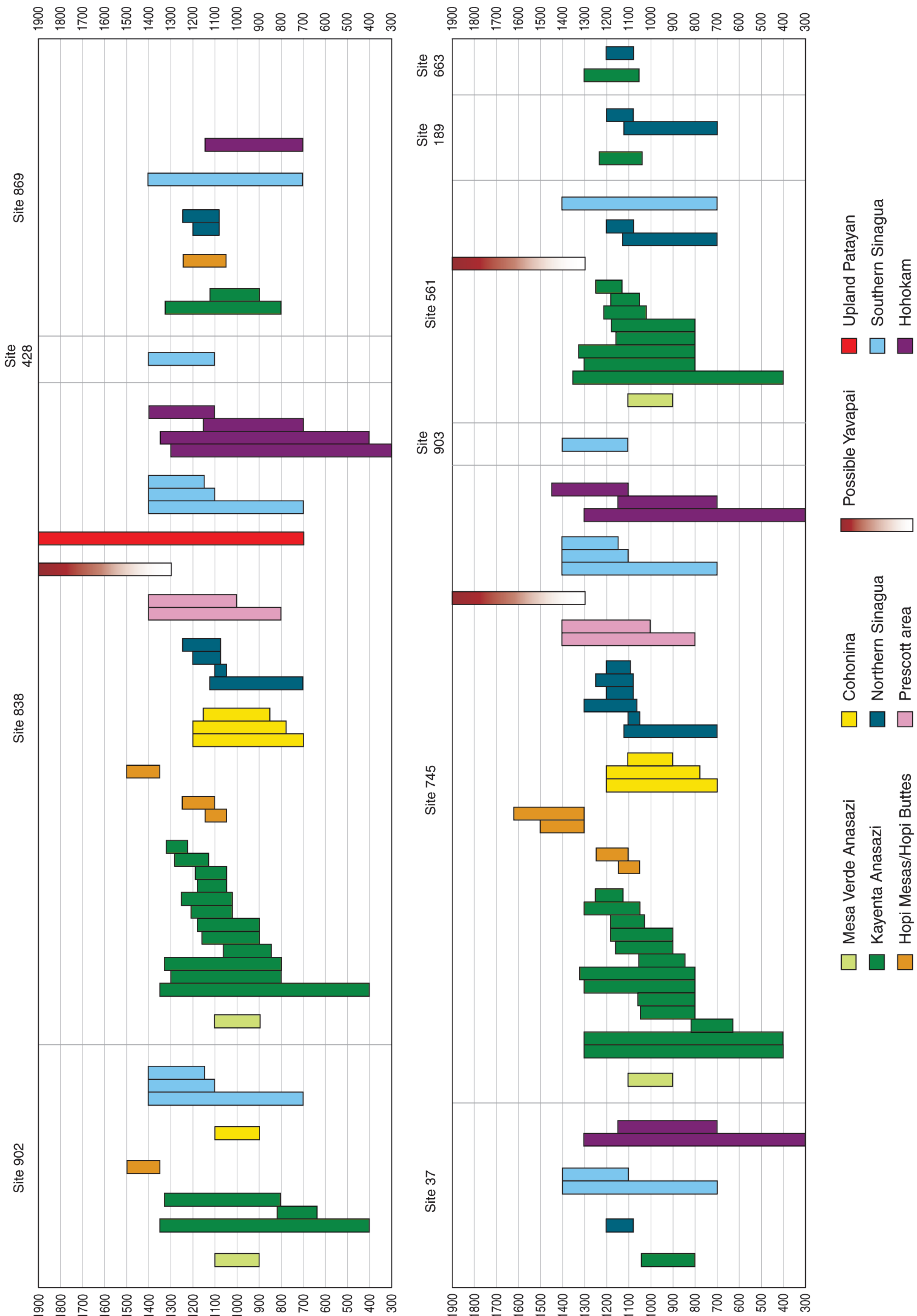

Figure 9. Date ranges by site.

Table 11. Ceramic Wares and Types in the Lower Oak Creek Archaeological Project Sherd Collection, by Cultural Group or Region

Ceramic Ware and Type	Date Range (A.D.)	Site No. 104/902	105/838	85/428	77/869	131/37	53/745	28/903	133/561	134/189	136/663	Total
		Mesa Verde Anasazi										
San Juan Red Ware												
Deadmans Black-on-red	900–1100	1	82	—	—	—	22	—	8	—	—	113
		Kayenta Anasazi										
Tusayan Gray Ware												
Indeterminate Tusayan Gray Ware	400–1300+	—	—	—	—	—	4	—	—	—	—	4
Indeterminate gray plain	400–1350	2	7	—	—	—	7	—	6	—	—	22
Lino Black-on-gray	640–820	1	—	—	—	—	1	—	—	—	—	2
Indeterminate gray corrugated	800–1300+	—	2	—	—	—	11	—	1	—	—	14
Tusayan Corrugated	1020–1210	—	3	—	—	—	—	—	5	—	—	8
Tusayan or Moenkopi Corrugated	1020–1250	—	4	—	—	—	—	—	—	—	—	4
Moenkopi Corrugated	1130–1250	—	1	—	—	—	14	—	1	—	—	16
Kiet Siel Gray	1220–1320	—	5	—	—	—	—	—	—	—	—	5
Tusayan White Ware												
Kana'a Black-on-white	800–1050	—	—	—	—	2	6	—	—	—	—	8
Kana'a or Wepo Black-on-white	800–1060	—	—	—	—	—	2	—	—	—	—	2
Indeterminate Tusayan White Ware	800–1330	4	62	—	2	—	69	—	1	—	—	138
Wepo Black-on-white	850–1060	—	1	—	—	—	1	—	—	—	—	2
Black Mesa Black-on-white	900–1160	—	41	—	—	—	9	—	4	—	—	54
Black Mesa or Sosi Black-on-white	900–1180	—	5	—	1	—	5	—	2	—	—	13
Sosi Black-on-white	1050–1180	—	7	—	—	—	2	—	1	—	—	10
Dogoszhi Black-on-white	1050–1190	—	6	—	—	—	—	—	—	—	—	6
Tsegi Orange Ware												
Tusayan Black-on-red	1045–1240	—	—	—	—	—	—	—	—	1	—	1

continued on next page

Ceramic Ware and Type	Date Range (A.D.)	Site No. 104/902	105/838	85/428	77/869	131/37	53/745	28/903	133/561	134/189	136/663	Total
Indeterminate Tsegi Orange Ware	1050–1300	—	—	—	—	—	35	—	—	—	1	36
Indeterminate painted or unpainted												
Indeterminate Tusayan White Ware or Gray Ware	unknown	—	1	—	—	—	—	—	—	—	—	1
						Indeterminate Anasazi						
Anasazi Gray Ware (LOCAP)												
Indeterminate Anasazi Gray Ware	unknown	—	—	—	—	—	2	—	—	—	—	2
Indeterminate painted or unpainted												
Indeterminate white ware or gray ware	unknown	—	1	—	—	—	3	—	—	—	—	4
Indeterminate white ware												
Indeterminate black-on-white	unknown	—	5	—	—	—	14	—	—	—	—	19
						Hopi Mesas/Hopi Buttes						
Little Colorado White Ware												
Holbrook Black-on-white	1050–1150	—	1	—	—	—	2	—	—	—	—	3
Holbrook Black-on-white, Style A	1050–1150	—	8	—	—	—	—	—	—	—	—	8
Indeterminate Little Colorado White Ware	1050–1250	—	9	—	2	—	13	—	—	—	—	24
Padre Black-on-white	1100–1250	—	2	—	—	—	—	—	—	—	—	2
Walnut Black-on-white	1100–1250	—	—	—	—	—	3	—	—	—	—	3
Jeddito Yellow Ware												
Indeterminate Jeddito Yellow Ware	1300–1500	—	—	—	—	—	2	—	—	—	—	2
Jeddito Black-on-yellow	1350–1500	5	9	—	—	—	—	—	—	—	—	14
Awatovi Yellow Ware												
Jeddito Corrugated	1300–1625	—	—	—	—	—	10	—	—	—	—	10
Jeddito Plain	1300–1625	—	—	—	—	—	18	—	—	—	—	18

Ceramic Ware and Type	Date Range (A.D.)	Site No.										Total
		104/902	105/838	85/428	77/869	131/37	53/745	28/903	133/561	134/189	136/663	
Indeterminate Awatovi Yellow Ware	1300–1625	—	—	—	—	—	35	—	—	—	—	35
						Cohonina						
San Francisco Mountain Gray Ware												
Deadmans/Floyd Gray	700–1200	—	35	—	—	—	61	—	—	—	—	96
Indeterminate San Francisco Mountain Gray Ware	700–1200	—	1	—	—	—	22	—	—	—	—	23
Deadmans Gray	775–1200	—	3	—	—	—	41	—	—	—	—	44
Deadmans Fugitive Red	850–1150	—	4	—	—	—	—	—	—	—	—	4
Deadmans Black-on-gray	900–1100	1	—	—	—	—	7	—	—	—	—	8
Deadmans Black-on-gray, Fugitive Red	900–1100	2	—	—	—	—	—	—	—	—	—	2
						Northern Sinagua						
Alameda Brown Ware												
Rio de Flag Brown	700–1125	—	153	—	—	—	208	—	12	1	—	374
Diablo Brown, Yeager variety	1050–1100	—	7	—	—	—	9	—	—	—	—	16
Sunset Brown	1064–1300	—	—	—	—	—	47	—	—	—	—	47
Sunset Red	1064–1300	—	—	—	—	—	10	—	—	—	—	10
Angell Brown	1075–1200	—	393	—	12	5	203	—	27	2	1	643
Winona Brown	1075–1250	—	41	—	3	—	56	—	—	—	—	100
Turkey Hill Red	1090–1200+	—	—	—	—	—	42	—	—	—	—	42
						Prescott Area						
Prescott Gray Ware												
Prescott Gray	800–1400	—	27	—	—	—	72	—	—	—	—	99
Aquarius Orange	1000–1400	—	2	—	—	—	23	—	—	—	—	25
Prescott Red	unknown	—	3	—	—	—	—	—	—	—	—	3
						Possible Yavapai						
Tizon Brown Ware												

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Ceramic Ware and Type	Date Range (A.D.)	Site No. 104/902	105/838	85/428	77/869	131/37	53/745	28/903	133/561	134/189	136/663	Total
Tizon Wiped	protohistoric or prehistoric period	—	3	—	—	—	4	—	8	—	—	15
Yavapai Plain Ware												
Orme Ranch Plain	protohistoric or prehistoric period	—	—	—	—	—	121	—	—	—	—	121
Upland Patayan												
Tizon Brown Ware												
Sandy Brown	700–1890	—	1	—	—	—	—	—	—	—	—	1
Southern Sinagua												
Alameda Brown Ware												
Verde Brown	700–1400+	34	257	—	32	10	152	—	18	—	—	503
Tuzigoot Plain	1100–1400+	30	62	2	—	9	35	1	—	—	—	139
Tuzigoot Red	1150–1400+	6	14	—	—	—	9	—	—	—	—	29
Verde Red	1150–1400+	—	7	—	—	—	1	—	—	—	—	8
Southern Sinagua, Probable												
Sand-tempered brown ware												
Basket-impressed interior	unknown	—	4	—	—	—	—	—	—	—	—	4
Indeterminate sand-tempered brown ware	unknown	—	2,068	—	—	—	1,442	—	—	—	—	3,510
Hohokam												
Hohokam Buff Ware												
Indeterminate red-on-buff	700–1150	—	1	—	—	—	6	—	—	—	—	7
Indeterminate buff (no paint)	700–1150	—	—	—	1	1	—	—	—	—	—	2
Unpainted												
Wingfield Plain	300–1300+	—	68	—	—	2	63	—	—	—	—	133
Gila Plain	400–1350+	—	7	—	—	—	—	—	—	—	—	7
Wingfield Red	1100–1450	—	7	—	—	—	2	—	—	—	—	9
Other												
Roosevelt Red Ware												

Ceramic Ware and Type	Date Range (A.D.)	Site No. 104/902	105/838	85/428	77/869	131/37	53/745	28/903	133/561	134/189	136/663	Total
Indeterminate Roosevelt Red Ware	1280–1450+ (polychrome)	—	1	—	—	—	—	—	—	—	—	1
Unpainted												
Indeterminate Orme Ranch Plain or other corrugated	unknown	—	—	—	—	—	11	—	—	—	—	11
White Mountain Red Ware												
Klageto Black-on-yellow	1250–1300/1325	—	1	—	—	—	—	—	—	—	—	1
Unknown												
Indeterminate painted or unpainted	unknown	—	9	—	—	—	1,113	—	—	—	—	1,122
Indeterminate brown ware	unknown	—	—	—	—	—	1	—	—	—	—	1
Indeterminate corrugated sand-tempered brown ware	unknown	—	1	—	—	—	—	—	—	—	—	1
Indeterminate gray ware or brown ware	unknown	—	—	—	—	—	20	—	—	—	—	20
Indeterminate unpainted	unknown	12	32	—	4	13	29	1	9	—	—	100
Sand-tempered red ware	unknown	—	36	—	—	—	7	—	—	—	—	43
Total		98	3,510	2	57	42	4,107	2	103	4	2	7,927

Key: LOCAP = Lower Oak Creek Archaeological Project.

Table 12. Ceramic Production Areas Represented in the Lower Oak Creek Archaeological Project Collection

Region or Culture	Site No. 104/902		105/838		85/428		77/869		131/37		53/745		28/903		133/561		134/189		136/663		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%[a]
Mesa Verde Anasazi	1	1	82	2.3	—	—	—	—	—	—	22	0.5	—	—	8	7.8	—	—	—	—	113	1.4
Kayenta Anasazi	7	7.1	145	4.1	—	—	3	5.3	2	4.8	166	4.0	—	—	21	20.4	1	25.0	1	50.0	346	4.4
Indeterminate Anasazi	—	—	6	0.2	—	—	—	—	—	—	19	0.5	—	—	—	—	—	—	—	—	25	0.3

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Region or Culture	Site No. 104/902		105/838		85/428		77/869		131/37		53/745		28/903		133/561		134/189		136/663		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%[a]
Hopi Mesas/Hopi Buttes	5	5.1	29	0.8	—	—	2	3.5	—	—	83	2.0	—	—	—	—	—	—	—	—	119	1.5
Cohonina	3	3.1	43	1.2	—	—	—	—	—	—	131	3.2	—	—	—	—	—	—	—	—	177	2.2
Northern Sinagua	—	—	594	16.9	—	—	15	26.3	5	11.9	575	14.0	—	—	39	37.9	3	75.0	1	50.0	1,232	15.5
Prescott area	—	—	32	0.9	—	—	—	—	—	—	95	2.3	—	—	—	—	—	—	—	—	127	1.6
Possible Yavapai	—	—	3	0.1	—	—	—	—	—	—	125	3.0	—	—	8	7.8	—	—	—	—	136	1.7
Upland Patayan	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Southern Sinagua	70	71.4	340	9.7	2	100.00	32	56.1	19	45.2	197	4.8	1	50.0	18	17.5	—	—	—	—	679	8.6
Southern Sinagua, probable	—	—	2,072	59	—	—	—	—	—	—	1,442	35.1	—	—	—	—	—	—	—	—	3,514	44.3
Hohokam	—	—	83	2.4	—	—	1	1.8	3	7.1	71	1.7	—	—	—	—	—	—	—	—	158	2.0
Other	—	—	2	0.1	—	—	—	—	—	—	11	0.3	—	—	—	—	—	—	—	—	13	0.2
Unknown	12	12.2	78	2.2	—	—	4	7.0	13	31.0	1,170	28.5	1	50.0	9	8.7	—	—	—	—	1,287	16.2
Total	98		3,510		2		57		42		4,107		2		103		4		2		7,927	100

[a] Percentage represents percentage of collection.

Table 13. Ceramic Wares and Types at Site 104/902, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Mesa Verde Anasazi			
San Juan Red Ware				
Deadmans Black-on-red	—	1	—	1
	Kayenta Anasazi			
Tusayan Gray Ware				
Indeterminate gray plain	—	2	—	2
Lino Black-on-gray	1	—	—	1
Tusayan White Ware				
Indeterminate Tusayan White Ware	4	—	—	4
	Hopi Mesas/Hopi Buttes			
Jeddito Yellow Ware				
Jeddito Black-on-yellow	4	1	—	5
	Cohonina			
San Francisco Mountain Gray Ware				
Deadmans Black-on-gray	1	—	—	1
Deadmans Black-on-gray, Fugitive Red	2	—	—	2
	Southern Sinagua			
Alameda Brown Ware				
Verde Brown	—	4	30	34
Tuzigoot Plain	3	23	4	30
Tuzigoot Red	—	5	1	6
	Unknown			
Indeterminate unpainted	—	—	12	12
Total	15	36	47	98

We then summarized production areas and date ranges to show which regions or groups were represented in the ceramic collections and how this changed through time (Table 29). In the following discussion, we exclude ceramics with date ranges that exceed two time periods, with the exception of the Cohonina types. Because these ceramics all have broad date ranges, excluding them would eliminate the Cohonina from the discussion entirely. We note that the presumed date ranges for wares and types are based on variable and often untested chronological evidence. Therefore, our interpretations must be considered highly tentative.

Pre–A.D. 900

Kayenta Anasazi and Hohokam painted ceramics appeared at this time, although not at the same sites. At least some painted and unpainted Cohonina ceramics may also date to this period, although given their broad date ranges, it is difficult to tell. Plain ware, such as Verde Brown and Wingfield Plain, may be contemporaneous with these ceramics.

Kayenta Anasazi interaction may have started as early as A.D. 500–700, as indicated by Lino Black-on-gray (A.D. 640–820) from Sites 53/745 and 104/902 in the LOCAP area. Slightly later Tusayan White Ware types—such as the Pueblo I–II types, Kana'a Black-on-white and Wepo Black-on-white—may predate A.D. 900 and were found at additional sites, including Tuzigoot, Verde View, Verde Terrace, Verde Ball Court, AR-03-04-06-703, and Calkins Ranch. Contemporaneous uncorrugated body sherds of Tusayan Gray Ware were not recovered.

Snaketown Red-on-gray (A.D. 650–750) is the earliest Hohokam type and was recovered at Verde Ball Court and Calkins Ranch. Gila Butte (A.D. 750–850), Santa Cruz Red-on-buff (A.D. 850–950), or both appeared at Verde View, Verde Terrace, Verde Ball Court, Calkins Ranch, Montezuma Well, and Fitzmaurice Ruin. The Hohokam plain ware type, Gila Plain, was only encountered at Verde

Table 14. Ceramic Wares and Types at Site 105/838, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Incurved Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
				Mesa Verde Anasazi				
San Juan Red Ware								
Deadmans Black-on-red	—	4	—	78	—	—	—	82
				Kayenta Anasazi				
Tusayan Gray Ware								
Indeterminate gray plain	—	—	—	1	—	2	4	7
Indeterminate gray corrugated	—	—	—	—	—	2	—	2
Tusayan Corrugated	—	—	—	—	—	3	—	3
Tusayan or Moenkopi Corrugated	—	—	—	—	—	4	—	4
Moenkopi Corrugated	—	—	—	—	—	1	—	1
Kiet Siel Gray	—	—	—	—	—	4	1	5
Tusayan White Ware								
Indeterminate Tusayan White Ware	—	—	—	42	1	17	2	62
Wepo Black-on-white	—	1	—	—	—	—	—	1
Black Mesa Black-on-white	—	7	—	22	1	11	—	41
Black Mesa or Sosi Black-on-white	—	—	—	5	—	—	—	5
Sosi Black-on-white	—	2	—	4	—	1	—	7
Dogoszhi Black-on-white	—	—	—	6	—	—	—	6
Indeterminate painted or unpainted								
Indeterminate Tusayan White Ware or Gray Ware	—	—	—	—	—	—	1	1
				Indeterminate Anasazi				
Indeterminate painted or unpainted								
Indeterminate white ware or gray ware	—	—	—	—	—	—	1	1
Indeterminate white ware								
Indeterminate black-on-white	—	—	—	4	—	1	—	5
				Hopi Mesas/Hopi Buttes				
Little Colorado White Ware								
Holbrook Black-on-white	—	—	—	1	—	—	—	1

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Incurved Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
Holbrook Black-on-white, Style A	—	2	—	6	—	—	—	8
Indeterminate Little Colorado White Ware	—	—	—	9	—	—	—	9
Padre Black-on-white	—	1	—	1	—	—	—	2
Jeddito Yellow Ware								
Jeddito Black-on-yellow	—	—	1	7	—	1	—	9
Cohonina								
San Francisco Mountain Gray Ware								
Deadmans/Floyd Gray	—	—	—	3	—	9	23	35
Indeterminate San Francisco Mountain Gray Ware	—	—	—	1	—	—	—	1
Deadmans Gray	—	—	—	—	2	—	1	3
Deadmans Fugitive Red	—	—	—	—	—	1	3	4
Northern Sinagua								
Alameda Brown Ware								
Rio de Flag Brown	—	1	—	43	1	20	88	153
Diablo Brown, Yeager variety	—	—	—	6	—	—	1	7
Angell Brown	—	—	—	4	1	64	324	393
Winona Brown	—	—	—	—	—	4	37	41
Prescott Area								
Prescott Gray Ware								
Prescott Gray	—	—	—	1	—	5	21	27
Aquarius Orange	—	—	—	1	—	1	—	2
Prescott Red	—	—	—	3	—	—	—	3
Possible Yavapai								
Tizon Brown Ware								
Tizon Wiped	—	—	—	—	—	3	—	3

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Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Incurved Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
Upland Patayan								
Tizon Brown Ware								
Sandy Brown	—	—	—	—	—	—	1	1
Southern Sinagua								
Alameda Brown Ware								
Verde Brown	—	1	—	21	15	99	121	257
Tuzigoot Plain	—	1	—	1	4	26	30	62
Tuzigoot Red	—	—	—	3	2	5	4	14
Verde Red	1	1	—	2	1	—	2	7
Southern Sinagua, Probable								
Sand-tempered brown ware								
Basket-impressed interior	—	—	—	—	—	—	4	4
Indeterminate sand-tempered brown ware	—	—	—	56	—	220	1,792	2,068
Hohokam								
Hohokam Buff Ware								
Indeterminate red-on-buff	—	—	—	1	—	—	—	1
Unpainted								
Wingfield Plain	—	—	—	24	—	15	29	68
Gila Plain	—	—	—	—	—	4	3	7
Wingfield Red	—	—	—	2	—	2	3	7
Other								
Roosevelt Red Ware								
Indeterminate Roosevelt Red Ware	—	—	—	—	—	—	1	1
White Mountain Red Ware								
Klageto Black-on-yellow	—	—	—	1	—	—	—	1
Unknown								
Indeterminate painted or unpainted	—	—	—	2	—	4	3	9
Indeterminate corrugated sand-tempered brown ware	—	—	—	—	—	—	1	1

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Incurved Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
Indeterminate unpainted	—	—	—	—	1	2	29	32
Sand-tempered red ware	—	—	—	3	—	15	18	36
Total	1	21	1	364	29	546	2,548	3,510

Table 15. Ceramic Wares and Types in Features at Site 105/838, by Cultural Group or Region

Ceramic Ware and Type	Date Range (A.D.)	Feature No.															Total
		13	21	23	25	26	27	28	29	30	31	33	34	35	37	40	
		Mesa Verde Anasazi															
San Juan Red Ware																	
Deadmans Black-on-red	900–1100	—	4	19	1	—	24	—	23	—	1	—	—	—	—	—	72
		Kayenta Anasazi															
Tusayan Gray Ware																	
Indeterminate gray plain	400–1350	—	—	1	—	—	—	—	4	—	—	—	—	1	—	—	6
Tusayan Corrugated	1020–1210	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	2
Tusayan or Moenkopi Corrugated	1020–1250	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	4
Moenkopi Corrugated	1130–1250	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Kiet Siel Gray	1220–1320	—	—	1	—	—	—	—	4	—	—	—	—	—	—	—	5
Tusayan White Ware																	
Wepo Black-on-white	850–1060	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Black Mesa Black-on-white	900–1160	2	—	9	1	—	8	1	11	—	—	—	1	—	—	2	35
Black Mesa or Sosi Black-on-white	900–1180	1	—	2	—	—	—	—	1	—	—	—	—	—	—	—	4
Sosi Black-on-white	1050–1180	—	—	3	—	—	—	—	3	—	—	—	—	—	—	—	6
Dogoszhi Black-on-white	1050–1190	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	4
Indeterminate Tusayan White Ware	800–1330	1	2	19	1	—	17	—	16	—	—	—	—	—	—	1	57
Indeterminate painted or unpainted																	
Indeterminate Tusayan White Ware or Gray Ware	unknown	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1

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Ceramic Ware and Type	Date Range (A.D.)	Feature No. 13	21	23	25	26	27	28	29	30	31	33	34	35	37	40	Total
Indeterminate Anasazi																	
Indeterminate white ware																	
Indeterminate black-on-white	unknown	—	1	—	—	—	1	—	3	—	—	—	—	—	—	—	5
Indeterminate painted or unpainted																	
Indeterminate white ware or gray ware	unknown	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Hopi Mesas/Hopi Buttes																	
Little Colorado White Ware																	
Holbrook Black-on-white, Style A	1050–1150	—	—	2	—	—	4	—	1	—	—	—	—	—	—	—	7
Indeterminate Little Colorado White Ware	1050–1250	2	1	1	1	—	2	—	2	—	—	—	—	—	—	—	9
Padre Black-on-white	1100–1250	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Jeddito Yellow Ware																	
Jeddito Black-on-yellow	1350–1500	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Cohonina																	
San Francisco Mountain Gray Ware																	
Deadmans/Floyd Gray	700–1200	—	—	16	2	—	12	—	4	—	—	—	—	—	—	—	34
Deadmans Gray	775–1200	—	—	1	—	—	1	—	1	—	—	—	—	—	—	—	3
Deadmans Fugitive Red	850–1150	—	—	1	—	—	—	—	3	—	—	—	—	—	—	—	4
Northern Sinagua																	
Alameda Brown Ware																	
Rio de Flag Brown	700–1125	—	5	23	1	—	13	—	74	—	—	—	—	—	—	34	150
Diablo Brown, Yeager variety	1050–1100	—	—	5	—	—	1	—	1	—	—	—	—	—	—	—	7
Angell Brown	1075–1200	5	3	34	2	—	253	—	86	—	—	—	—	—	—	1	384
Winona Brown	1075–1250	—	—	21	—	—	1	—	17	—	—	—	—	—	—	—	39
Prescott Area																	
Prescott Gray Ware																	
Prescott Gray	800–1400	—	2	10	—	—	—	—	13	—	—	—	—	—	—	1	26
Aquarius Orange	1000–1400	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	2

Ceramic Ware and Type	Date Range (A.D.)	Feature No.															Total
		13	21	23	25	26	27	28	29	30	31	33	34	35	37	40	
Prescott Red	unknown	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
		Possible Yavapai															
Tizon Brown Ware																	
Tizon Wiped	protohistoric or prehistoric period	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—	3
		Upland Patayan															
Tizon Brown Ware																	
Sandy Brown	700–1890	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
		Southern Sinagua															
Alameda Brown Ware																	
Verde Brown	700–1400+	10	—	93	—	—	—	—	148	—	—	—	—	—	6	—	257
Tuzigoot Plain	1100–1400+	54	—	2	—	—	—	—	1	—	—	—	—	—	—	—	57
Tuzigoot Red	1150–1400+	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
Verde Red	1150–1400+	5	—	1	—	—	—	—	1	—	—	—	—	—	—	—	7
		Southern Sinagua, Probable															
Sand-tempered brown ware																	
Basket-impressed interior	unknown	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	3
Indeterminate sand-tempered brown ware	unknown	7	42	478	16	3	461	1	813	13	1	5	1	—	—	149	1,990
		Hohokam															
Hohokam Buff Ware																	
Indeterminate red-on-buff	700–1450	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
		Unpainted															
Wingfield Plain	300–1300+	2	—	26	—	—	18	—	19	—	—	—	—	—	—	—	65
Gila Plain	400–1350+	—	—	—	—	—	5	—	2	—	—	—	—	—	—	—	7
Wingfield Red	1100–1450	—	—	1	—	—	1	—	4	—	—	—	—	—	—	—	6
		Other															
Roosevelt Red Ware																	

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Ceramic Ware and Type	Date Range (A.D.)	Feature No. 13	21	23	25	26	27	28	29	30	31	33	34	35	37	40	Total
Indeterminate Roosevelt Red Ware	1280–1450+ (polychrome)	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
White Mountain Red Ware																	
Klageto Black-on-yellow	1250–1300/1325	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Unknown																	
Indeterminate painted or unpainted	unknown	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	6
Indeterminate corrugated sand-tempered brown ware	unknown	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Indeterminate unpainted	unknown	3	—	21	—	—	—	—	8	—	—	—	—	—	—	—	32
Sand-tempered red ware	unknown	—	1	5	1	—	14	—	8	—	—	—	—	—	—	—	29
Total		113	61	803	26	3	846	2	1,283	14	2	5	2	1	7	188	3,356

Table 16. Ceramic Wares and Types at Site 85/428, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Southern Sinagua			
Alameda Brown Ware				
Tuzigoot Plain	—	1	1	2
Total	—	1	1	2

Table 17. Ceramic Wares and Types at Site 77/869, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Kayenta Anasazi			
Tusayan White Ware				
Indeterminate Tusayan White Ware	2	—	—	2
Black Mesa or Sosi Black-on-white	1	—	—	1
	Hopi Mesas/Hopi Buttes			
Little Colorado White Ware				
Indeterminate Little Colorado White Ware	2	—	—	2
	Northern Sinagua			
Alameda Brown Ware				
Angell Brown	2	4	6	12
Winona Brown	—	2	1	3
	Southern Sinagua			
Alameda Brown Ware				
Verde Brown	1	26	5	32
	Hohokam			
Hohokam Buff Ware				
Indeterminate buff	—	1	—	1
	Unknown			
Indeterminate unpainted	—	—	4	4
Total	8	33	16	57

Terrace, Site 105/838 in the LOCAP area, Kittredge Ruin, and Montezuma Well. We tentatively consider Wingfield Plain a Hohokam ceramic type, and it is more common in the region than Gila Plain.

A.D. 900–1150

Painted types most securely associated with this period represent the Mesa Verde Anasazi (Deadmans Black-on-red) and the Hohokam (Sacaton Red-on-buff). Deadmans Black-on-red apparently has a much broader distribution than the preceding San Juan Red Ware type, Bluff Black-on-red, which does not appear in the Verde River valley or nearby areas. Deadmans Black-on-red was found at Tuzigoot, Verde View, Verde Terrace, Verde Ball Court, four sites in the LOCAP area (Sites 53/745, 104/902, 105/838, and 133/561), AR-03-04-06-703, Calkins Ranch, and Fitzmaurice Ruin. Sacaton Red-on-buff was recovered from four of these sites (Verde Terrace, Verde Ball Court, Calkins Ranch, and Fitzmaurice Ruin), as well as from Montezuma Well. The contemporaneous Hohokam types, Sacaton Buff and Sacaton Red, were also present at Fitzmaurice Ruin.

The Mesa Verde Anasazi ceramics do not necessarily indicate direct relationships with groups in the northern

Table 18. Ceramic Wares and Types at Site 131/37, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Kayenta Anasazi			
Tusayan White Ware				
Kana'a Black-on-white	2	—	—	2
	Northern Sinagua			
Alameda Brown Ware				
Angell Brown	—	4	1	5
	Southern Sinagua			
Alameda Brown Ware				
Verde Brown	—	2	8	10
Tuzigoot Plain	—	5	4	9
	Hohokam			
Hohokam Buff Ware				
Indeterminate buff	1	—	—	1
	Unpainted			
Wingfield Plain	1	1	—	2
	Unknown			
Indeterminate unpainted	1	3	9	13
Total	5	15	22	42

San Juan region and may have been transported to the project area by other groups, such as the Kayenta Anasazi. Kayenta Anasazi interaction probably continued in this period, as indicated by the presence of ceramic types dating to Kayenta Pueblo I and II and Pueblo II and III at all sites with San Juan Red Ware and at other sites throughout the region. The Pueblo II–III types co-occur with Kayenta Anasazi utility ceramics dating to Pueblo II and later, such as Tusayan Corrugated and Moenkopi Corrugated. Other types that date to around A.D. 1100–1200 suggest that interaction with the Cibola region, the Hopi Mesas/Hopi Buttes area, Northern Sinagua, and the Mogollon area may have begun during this period. The Cibola-area and Hopi-area ceramics are exclusively painted; all of the Northern Sinagua ceramics and some of the Mogollon vessels are utility ceramics. As noted earlier, at least some painted and unpainted Cohonina ceramics may also date to this period.

A.D. 1150–1300

Painted types most securely dated to this period are associated with the Kayenta Anasazi, the Hopi Mesas/Hopi Buttes area, the Cibola region, and the Mogollon area. Mogollon ceramics also include the slipped red ware type, Salado Red.

Two additional categories of painted ceramics, White Mountain Red Ware and painted types from the Winslow area, may date to the end of this period or later. White Mountain Red Ware appeared in the region during this period at four sites: Tuzigoot, Site 105/838 in the LOCAP area, Montezuma Castle, and Fitzmaurice Ruin. Two sites, Tuzigoot and Montezuma Castle, also contained painted ceramics from the Winslow area. Additional ceramics, primarily unpainted, that may postdate A.D. 1150 include types manufactured by the Kayenta Anasazi, Cohonina, Northern Sinagua, Prescott-area, Southern Sinagua, and Hohokam groups.

A.D. 1300–1450 and Later

The ceramics most securely dated to after A.D. 1300 are Jeddito Yellow Ware (painted) and Awatovi Yellow Ware (unpainted utility ceramics) from the Hopi area. Other painted ceramics from this period include two painted Southern Sinagua types, Tuzigoot Black-on-brown and Tuzigoot White-on-red, as well as Roosevelt Red Ware and White Mountain Red Ware. Some Winslow-area painted ceramics may be contemporaneous.

Definite post–A.D. 1300 ceramics were recovered at Tuzigoot, Montezuma Castle, and Fitzmaurice Ruin, as well as from Sites 53/745 and 105/838 in the LOCAP area. Some Tusayan Gray Ware in the region may postdate A.D. 1300, and other utility types, such as Tuzigoot Plain, Verde Brown, and Wingfield Plain, may also have been deposited during late occupations.

Among the reviewed sites (see Table 28), the only possible Yavapai ceramics were reported from the LOCAP area. Tizon Wiped sherds were recovered from Sites 53/745, 105/838, and 133/561; Orme Ranch Plain appeared only at Site 53/745.

Table 19. Ceramic Wares and Types at Site 53/745, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
				Mesa Verde Anasazi			
San Juan Red Ware							
Deadmans Black-on-red	—	3	17	—	—	2	22
				Kayenta Anasazi			
Tusayan Gray Ware							
Indeterminate Tusayan Gray Ware	—	—	—	—	2	2	4
Indeterminate gray plain	—	—	—	—	6	1	7
Lino Black-on-gray	—	—	—	—	—	1	1
Indeterminate gray corrugated	—	—	—	—	11	—	11
Moenkopi Corrugated	—	—	—	—	14	—	14
Tusayan White Ware							
Kana'a Black-on-white	—	—	5	—	1	—	6
Kana'a or Wepo Black-on-white	—	—	2	—	—	—	2
Indeterminate Tusayan White Ware	—	—	39	—	14	16	69
Wepo Black-on-white	—	1	—	—	—	—	1
Black Mesa Black-on-white	—	—	8	—	1	—	9
Black Mesa or Sosi Black-on-white	—	—	5	—	—	—	5
Sosi Black-on-white	—	—	2	—	—	—	2
Tsegi Orange Ware							
Indeterminate Tsegi Orange Ware	—	—	—	—	30	5	35
				Indeterminate Anasazi			
Anasazi Gray Ware							
Indeterminate Anasazi Gray Ware	—	—	—	—	—	2	2
Indeterminate painted or unpainted							
Indeterminate white ware or gray ware	—	—	1	—	2	—	3
Indeterminate white ware							
Indeterminate black-on-white	—	—	7	—	1	6	14

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Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
			Hopi Mesas/Hopi Buttes				
Little Colorado White Ware							
Holbrook Black-on-white	—	—	2	—	—	—	2
Indeterminate Little Colorado White Ware	—	—	13	—	—	—	13
Walnut Black-on-white	—	—	—	3	—	—	3
Jeddito Yellow Ware							
Indeterminate Jeddito Yellow Ware	—	—	1	—	—	1	2
Indeterminate Awatovi Yellow Ware	—	—	—	2	1	32	35
Jeddito Corrugated	—	—	—	—	10	—	10
Jeddito Plain	—	—	—	—	18	—	18
			Cohonina				
San Francisco Mountain Gray Ware							
Deadmans/Floyd Gray	—	—	2	3	18	38	61
Indeterminate San Francisco Mountain Gray Ware	—	—	—	—	—	22	22
Deadmans Gray	—	—	37	1	1	2	41
Deadmans Black-on-gray	—	—	7	—	—	—	7
			Northern Sinagua				
Alameda Brown Ware							
Rio de Flag Brown	—	1	39	5	54	109	208
Diablo Brown, Yeager variety	—	—	1	—	3	5	9
Sunset Brown	—	—	8	—	4	35	47
Sunset Red	—	—	—	—	8	2	10
Angell Brown	—	—	48	8	50	97	203
Winona Brown	—	—	8	—	14	34	56
Turkey Hill Red	—	—	5	—	15	22	42
			Prescott Area				
Prescott Gray Ware							
Prescott Gray	—	—	2	—	12	58	72
Aquarius Orange	—	—	6	—	13	4	23

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
Possible Yavapai							
Tizon Brown Ware							
Tizon Wiped	—	—	—	—	4	—	4
Yavapai Plain Ware							
Orme Ranch Plain	—	—	—	—	10	111	121
Southern Sinagua							
Alameda Brown Ware							
Verde Brown	1	—	22	19	51	59	152
Tuzigoot Plain	—	—	3	1	7	24	35
Tuzigoot Red	—	—	2	—	6	1	9
Verde Red	—	1	—	—	—	—	1
Southern Sinagua, Probable							
Sand-tempered brown ware							
Indeterminate sand-tempered brown ware	—	—	27	—	191	1,224	1,442
Hohokam							
Hohokam Buff Ware							
Indeterminate red-on-buff	—	—	—	—	6	—	6
Unpainted							
Wingfield Plain	—	—	1	2	32	28	63
Wingfield Red	—	—	1	—	—	1	2
Other							
Indeterminate Orme Ranch Plain or other corrugated	—	—	—	—	—	11	11
Unknown							
Indeterminate painted or unpainted	—	—	2	—	1	1,110	1,113
Indeterminate brown ware	—	—	—	—	—	1	1
Indeterminate gray ware or brown ware	—	—	—	—	—	20	20
Indeterminate unpainted	—	—	5	—	7	17	29
Sand-tempered red ware	—	—	2	—	4	1	7
Total	1	6	330	44	622	3,104	4,107

Table 20. Ceramic Wares and Types at Site 53/745, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
				Mesa Verde Anasazi			
San Juan Red Ware							
Deadmans Black-on-red	—	3	17	—	—	2	22
				Kayenta Anasazi			
Tusayan Gray Ware							
Indeterminate Tusayan Gray Ware	—	—	—	—	2	2	4
Indeterminate gray plain	—	—	—	—	6	1	7
Lino Black-on-gray	—	—	—	—	—	1	1
Indeterminate gray corrugated	—	—	—	—	11	—	11
Moenkopi Corrugated	—	—	—	—	14	—	14
Tusayan White Ware							
Kana'a Black-on-white	—	—	5	—	1	—	6
Kana'a or Wepo Black-on-white	—	—	2	—	—	—	2
Indeterminate Tusayan White Ware	—	—	39	—	14	16	69
Wepo Black-on-white	—	1	—	—	—	—	1
Black Mesa Black-on-white	—	—	8	—	1	—	9
Black Mesa or Sosi Black-on-white	—	—	5	—	—	—	5
Sosi Black-on-white	—	—	2	—	—	—	2
Tsegi Orange Ware							
Indeterminate Tsegi Orange Ware	—	—	—	—	30	5	35
				Indeterminate Anasazi			
Anasazi Gray Ware							
Indeterminate Anasazi Gray Ware	—	—	—	—	—	2	2
Indeterminate painted or unpainted							
Indeterminate white ware or gray ware	—	—	1	—	2	—	3
Indeterminate white ware							
Indeterminate black-on-white	—	—	7	—	1	6	14

Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
				Hopi Mesas/Hopi Buttes			
Little Colorado White Ware							
Holbrook Black-on-white	—	—	2	—	—	—	2
Indeterminate Little Colorado White Ware	—	—	13	—	—	—	13
Walnut Black-on-white	—	—	—	3	—	—	3
Jeddito Yellow Ware							
Indeterminate Jeddito Yellow Ware	—	—	1	—	—	1	2
Indeterminate Awatovi Yellow Ware	—	—	—	2	1	32	35
Jeddito Corrugated	—	—	—	—	10	—	10
Jeddito Plain	—	—	—	—	18	—	18
				Cohonina			
San Francisco Mountain Gray Ware							
Deadmans/Floyd Gray	—	—	2	3	18	38	61
Indeterminate San Francisco Mountain Gray Ware	—	—	—	—	—	22	22
Deadmans Gray	—	—	37	1	1	2	41
Deadmans Black-on-gray	—	—	7	—	—	—	7
				Northern Sinagua			
Alameda Brown Ware							
Rio de Flag Brown	—	1	39	5	54	109	208
Diablo Brown, Yeager variety	—	—	1	—	3	5	9
Sunset Brown	—	—	8	—	4	35	47
Sunset Red	—	—	—	—	8	2	10
Angell Brown	—	—	48	8	50	97	203
Winona Brown	—	—	8	—	14	34	56
Turkey Hill Red	—	—	5	—	15	22	42
				Prescott Area			
Prescott Gray Ware							
Prescott Gray	—	—	2	—	12	58	72

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Ceramic Ware and Type	Flare-Rimmed Bowl	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Indeterminate Jar	Indeterminate	Total
Aquarius Orange	—	—	6	—	13	4	23
Possible Yavapai							
Tizon Brown Ware							
Tizon Wiped	—	—	—	—	4	—	4
Yavapai Plain Ware							
Orme Ranch Plain	—	—	—	—	10	111	121
Southern Sinagua							
Alameda Brown Ware							
Verde Brown	1	—	22	19	51	59	152
Tuzigoot Plain	—	—	3	1	7	24	35
Tuzigoot Red	—	—	2	—	6	1	9
Verde Red	—	1	—	—	—	—	1
Southern Sinagua, Probable							
Sand-tempered brown ware							
Indeterminate sand-tempered brown ware	—	—	27	—	191	1,224	1,442
Hohokam							
Hohokam Buff Ware							
Indeterminate red-on-buff	—	—	—	—	6	—	6
Unpainted							
Wingfield Plain	—	—	1	2	32	28	63
Wingfield Red	—	—	1	—	—	1	2
Other							
Indeterminate Orme Ranch Plain or other corrugated	—	—	—	—	—	11	11
Unknown							
Indeterminate painted or unpainted	—	—	2	—	1	1,110	1,113
Indeterminate brown ware	—	—	—	—	—	1	1
Indeterminate gray ware or brown ware	—	—	—	—	—	20	20
Indeterminate unpainted	—	—	5	—	7	17	29
Sand-tempered red ware	—	—	2	—	4	1	7
Total	1	6	330	44	622	3,104	4,107

Table 21. Ceramic Wares and Types at Site 28/903, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Southern Sinagua			
Alameda Brown Ware				
Tuzigoot Plain	—	—	1	1
	Unknown			
Indeterminate unpainted	—	1	—	1
Total	—	1	1	2

Table 22. Ceramic Wares and Types at Site 133/561, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Hemispherical Bowl	Indeterminate Bowl	Jar with Neck	Neckless Jar	Indeterminate Jar	Indeterminate	Total
				Mesa Verde Anasazi			
San Juan Red Ware							
Deadmans Black-on-red	1	7	—	—	—	—	8
				Kayenta Anasazi			
Tusayan Gray Ware							
Indeterminate gray plain	—	—	—	—	6	—	6
Indeterminate gray corrugated	—	—	—	—	1	—	1
Tusayan Corrugated	—	—	4	—	1	—	5
Moenkopi Corrugated	—	—	—	—	1	—	1
Tusayan White Ware							
Indeterminate Tusayan White Ware	—	1	—	—	—	—	1
Black Mesa Black-on-white	1	2	—	—	1	—	4
Black Mesa or Sosi Black-on-white	—	2	—	—	—	—	2
Sosi Black-on-white	—	1	—	—	—	—	1
				Northern Sinagua			
Alameda Brown Ware							
Rio de Flag Brown	—	—	—	1	10	1	12
Angell Brown	—	1	—	—	23	3	27
				Possible Yavapai			
Tizon Brown Ware							
Tizon Wiped	—	—	—	—	8	—	8
				Southern Sinagua			
Alameda Brown Ware							
Verde Brown	—	—	2	—	6	10	18
				Unknown			
Indeterminate unpainted	—	—	—	—	—	9	9
Total	2	14	6	1	57	23	103

Table 23. Ceramic Wares and Types at Site 134/189, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Kayenta Anasazi			
Tsegi Orange Ware				
Tusayan Black-on-red	1	—	—	1
	Northern Sinagua			
Alameda Brown Ware				
Rio de Flag Brown	—	1	—	1
Angell Brown	—	2	—	2
Total	1	3	—	4

Table 24. Ceramic Wares and Types at Site 136/663, by Vessel Form and Cultural Group or Region

Ceramic Ware and Type	Indeterminate Bowl	Indeterminate Jar	Indeterminate	Total
	Kayenta Anasazi			
Tsegi Orange Ware				
Indeterminate Tsegi Orange Ware	—	—	1	1
	Northern Sinagua			
Alameda Brown Ware				
Angell Brown	—	1	—	1
Total	—	1	1	2

Table 25. Vessel Form, by Lower Oak Creek Archaeological Project Site

Site No.	Flare-Rimmed Bowl	Hemispherical Bowl	Incurved Bowl	Indeterminate Bowl	Jar with Neck	Neckless Jar	Indeterminate Jar	Indeterminate	Total
104/902	—	—	—	15	—	—	36	47	98
105/838	1	21	1	364	29	—	546	2,548	3,510
85/428	—	—	—	—	—	—	1	1	2
77/869	—	—	—	8	—	—	33	16	57
131/37	—	—	—	5	—	—	15	22	42
53/745	1	6	—	330	44	—	622	3,104	4,107
28/903	—	—	—	—	—	—	1	1	2
133/561	—	2	—	14	6	1	57	23	103
134/189	—	—	—	1	—	—	3	—	4
136/663	—	—	—	—	—	—	1	1	2
Total	2	29	1	737	79	1	1,315	5,763	7,927

Table 26. Ratio of Bowls to Jars, by Site

Site No.	All Bowl Sherds	All Jar Sherds	Bowl:Jar (*x*:1)	Percent of Total Sherds from Site Identified to Form
104/902	15	36	0.42	52
105/838	387	575	0.67	27
85/428	—	1	—	50
77/869	8	33	0.24	72
131/37	5	15	0.33	48
53/745	337	666	0.51	24
28/903	—	1	—	50
133/561	16	64	0.25	78
134/189	1	3	0.33	100
136/663	—	1	—	50
Total	769	1,395	0.55	27

Table 27. Frequency of Sherd Interior Erosion

Type	Site No.						Total	Percent of Type
	104/902	105/838	77/869	131/37	53/745	133/561		
Verde Brown	1/1	23/63	1/3	0/1	7/38	6/9	38/115	33
Tuzigoot Plain	0/1	3/6					3/7	43
Rio de Flag Brown		0/3			1/15	0/3	1/21	5
Angell Brown		1/4			1/8	0/3	2/15	13
Other		0/2			0/8		0/10	0
Total	1/2	27/78	1/3	0/1	9/69	6/15	44/168	26
Percentage at site	50	35	33	0	13	40	26	

Note: Frequencies among brown ware sherds larger than 5 cm^2 in Christenson's sample. Results are reported as *x*/*y*, where *x* = the number of sherds with interior erosion and *y* = the number of sherds in the analyzed sample.

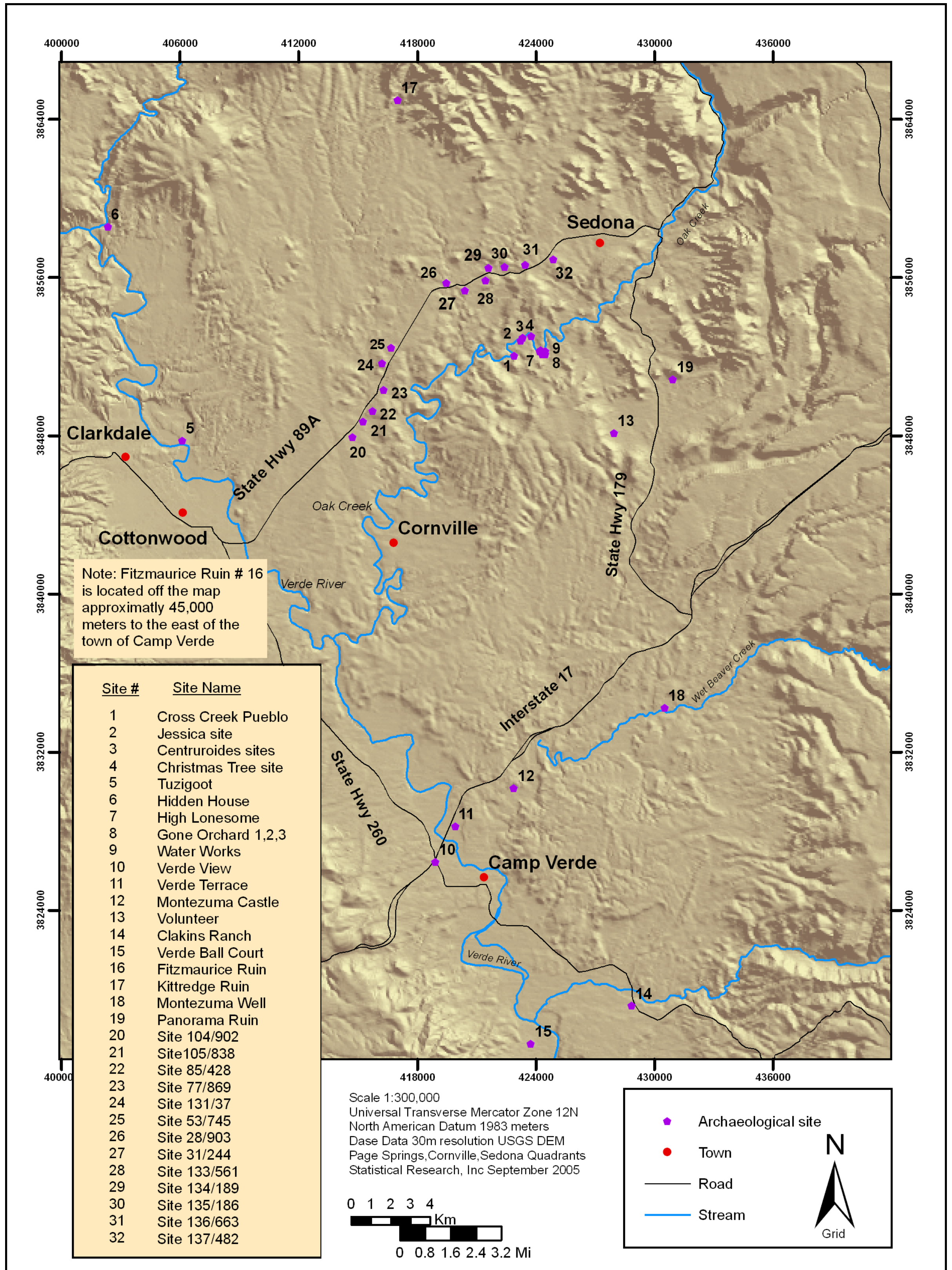

Figure 10. Sites used in regional comparisons.

Table 28. Local and Nonlocal Ceramics Identified in the Study Region, by Cultural Group or Region

Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites: Entire Collection[a]	LOCAP Sites: Site 105/838	LOCAP Sites: Site 53/745	Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
Mesa Verde Anasazi																	
Mesa Verde White Ware																	
Indeterminate Mesa Verde White Ware																	X
San Juan Red Ware																	
Deadmans (La Plata) Black-on-red		X	X	X	X	X	X	X				X				X	X
Indeterminate San Juan Red Ware												X					X
Kayenta Anasazi																	
Tsegi Orange Ware																	
Cameron Polychrome															X		
Citadel Polychrome											X		X	X			
Kayenta Polychrome		X															
Kiet Siel Polychrome											X						
Tusayan Black-on-red	X	X		X		X			X		X		X	X	X	X	X
Tusayan Polychrome		X											X				
Indeterminate Tsegi Orange Ware						X		X				X					X
Tusayan Gray Ware																	
Kiet Siel Gray						X	X										
Lino Black-on-gray						X		X									
Moenkopi Corrugated	X	X				X	X	X					X				
Tusayan Corrugated		X		X		X	X		X			X	X	X	X		
Tusayan or Moenkopi Corrugated						X	X										
Indeterminate Tusayan Gray Ware						X		X				X	X				
Tusayan White Ware																	
Black Mesa (Deadmans) Black-on-white		X		X	X	X	X	X		X		X	X		X	X	
Black Mesa or Sosi Black-on-white						X	X	X									
Dogoszhi Black-on-white						X	X						X	X			X
Flagstaff Black-on-white											X		X	X			X
Kana'a Black-on-white		X	X	X	X	X		X				X				X	
Kana'a or Black Mesa Black-on-white				X													
Kana'a or Wepo Black-on-white						X		X									
Kayenta Black-on-white		X												X			
Sosi Black-on-white				X		X	X	X				X					

Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites: Entire Collection[a]	LOCAP Sites: Site 105/838	LOCAP Sites: Site 53/745	Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
Sosi or Dogoszhi Black-on-white																X	
Tusayan Black-on-white		X								X		X					
Tusayan Black-on-white, Kayenta variety																	X
Tusayan Black-on-white, Tusayan variety																	X
Wepo Black-on-white						X	X	X									
Wupatki Black-on-white											X	X	X				
Indeterminate Tusayan White Ware				X		X	X	X		X	X	X	X				X
Hopi Mesas/Hopi Buttes																	
Awatovi Yellow Ware																	
Jeddito Corrugated						X		X									
Jeddito Plain						X		X									
Indeterminate Awatovi Yellow Ware						X		X									
Bidahochi White Ware																	
Bidahochi Black-on-white		X															
Jeddito Yellow Ware																	
Bidahochi Polychrome		X												X			
Jeddito Black-on-orange														X			
Jeddito Black-on-yellow		X				X	X						X	X			
Indeterminate Jeddito Yellow Ware						X		X									
Little Colorado White Ware																	
Holbrook Black-on-white				X	X	X	X	X	X				X		X		
Holbrook Black-on-white, Style A				X		X	X										
Holbrook Black-on-white, Style B				X													
Chevelon Black-on-white														X			
Leupp Black-on-white																	X
Padre Black-on-white						X	X										X
Walnut Black-on-white	X	X				X		X			X	X	X	X			X
Walnut Black-on-white, Style A																	
Walnut Black-on-white, Style B	X																
Indeterminate Little Colorado White Ware						X	X	X				X	X				X
Winslow Area																	
Winslow Orange Ware																	

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Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites			Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
						Entire Collection[a]	Site 105/838	Site 53/745									
Chavez Pass Black-on-orange		X															
Chavez Pass Polychrome		X															
Homolovi (Winslow) Polychrome		X												X			
Cibola Region																	
Cibola White Ware																	
Reserve Black-on-white																	X
Tularosa Black-on-white		X															
Indeterminate Cibola White Ware												X					
Zuni White Ware																	
Early Zuni Polychrome		X															
Northern Sinagua																	
Alameda Brown Ware																	
Angell Brown						X	X	X				X					
Chavez Brown													X				
Diablo Brown												X					X
Diablo Brown, Yeager variety						X	X	X				X					
Diablo Red												X					X
Diablo Black-on-brown												X					
Grapevine Brown												X					X
Grapevine Red																	X
Kinnikinnick Brown												X	X				X
Kinnikinnick Red												X					X
Rio de Flag Brown						X	X	X		X		X					X
Rio de Flag Red												X					
Sunset Brown						X		X			X	X	X				
Sunset Red						X		X			X	X	X				X
Turkey Hill Red						X		X									
Winona Brown						X	X	X				X					
Youngs Brown				X								X					
Cohonina																	
San Francisco Mountain Gray Ware																	
Deadmans Black-on-gray		X				X		X				X		X			X
Deadmans Black-on-gray, Fugitive Red						X											
Deadmans Fugitive Red						X	X										X
Deadmans Gray						X	X	X		X	X	X	X			X	X
Deadmans/Floyd Gray						X	X	X									

Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites			Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
						Entire Collection[a]	Site 105/838	Site 53/745									
Floyd Black-on-gray			X	X												X	
Indeterminate San Francisco Mountain Gray Ware						X	X	X									
Southern Sinagua																	
Alameda Brown Ware																	
Beaver Creek Brown												X					
Beaver Creek Red												X					X
Clear Creek Brown											X	X	X				X
Clear Creek Red												X					
Hartley Plain (brown)																	X
Pine Brown																	X
Tonto Plain and Tonto Red											X		X				X
Tuzigoot Plain (brown) and Tuzigoot Red		X		X		X	X	X	X	X	X	X		X	X	X	X
Tuzigoot Black-on-brown																	X
Tuzigoot Black-on-gray		X															
Tuzigoot Red-on-brown																	X
Tuzigoot White-on-red		X										X	X	X			X
Verde Brown		X	X	X	X	X	X	X	X	X	X	X		X		X	X
Verde Black-on-brown																	X
Verde Red-on-brown																	X
Verde White-on-brown																	X
Verde Red				X		X	X	X	X					X			X
Verde Red-on-buff[c]		X												X			X
Verde White-on-red																	X
Prescott Area																	
Prescott Gray Ware																	
Aquarius Orange						X	X	X									
Prescott Black-on-brown		X															
Prescott (Verde) Black-on-gray	X	X									X	X	X				X
Prescott Black-on-orange												X					
Prescott (Verde) Gray		X				X	X	X			X	X					X
Prescott Polychrome		X															
Prescott Red						X	X										
Mogollon																	
Mogollon Brown Ware																	
Alma Plain																	
Elden Corrugated		X									X	X		X			X

continued on next page

Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites			Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
						Entire Collection[a]	Site 105/838	Site 53/745									
Salado Red														X			
Salado White-on-red														X			
Showlow Black-on-red		X															
Woodruff Brown																	X
Hohokam																	
Hohokam Buff Ware																	
Gila Butte Red-on-buff				X	X											X	
Sacaton Red-on-buff				X	X										X	X	X
Sacaton Buff																	X
Santa Cruz Red-on-buff			X		X											X	X
Snaketown Red-on-gray					X											X	
Indeterminate red-on-buff			X	X		X	X	X									
Indeterminate buff (no paint)						X											
Unpainted																	
Gila Plain				X		X	X				X				X		
Sacaton Red																	X
Salt Red																	X
Wingfield Plain			X	X	X	X	X	X	X	X	X	X	X		X	X	X
Wingfield Red				X		X	X	X									X
Upland Patayan and Possible Yavapai																	
Tizon Brown Ware																	
Cerbat Brown												X					X
Sandy Brown						X	X										
Tizon Wiped						X	X	X				X					
Other																	
Kirkland Black-on-gray																	X
Kirkland Gray (Yavapai Plain)												X					X
Orme Ranch Plain						X		X									
Other																	
Roosevelt Red Ware																	
Gila Black-on-red		X															
Gila Polychrome		X															
Tonto Polychrome														X			
Indeterminate Roosevelt Red Ware						X	X										
White Mountain Red Ware																	
Fourmile Polychrome		X												X			
Little Colorado or St. Johns Polychrome		X															

Ceramic Ware and Type	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites: Entire Collection[a]	LOCAP Sites: Site 105/838	LOCAP Sites: Site 53/745	Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
Pinedale Polychrome		X															
Klageto Black-on-orange		X															
Klageto Black-on-yellow						X	X										
St. Johns Polychrome																	X
Indeterminate White Mountain Red Ware														X			
Unpainted																	
Indeterminate Orme Ranch Plain or other corrugated						X		X									

Note: Information compiled from Breternitz (1960a), Dixon (1956), Halbirt et al. (1984), Horton and Hattendorf (2000), Jackson and Van Valkenburgh (1954), James (1974), McGuire (1977), Shutler (1951), Shutler and Adams (ca. 1949), and Weaver (2000).
[a] At least one ceramic artifact of this type was represented in the project collection.
[b] Red Rock State Park sites AR-03-06-126, AR-03-06-128, AR-03-06-535, AZ O:1:12 (ASM), AZ O:1:15 (ASM), AZ O:1:27 (ASM), AZ O:1:37 (ASM), and AZ O:1:38 (ASM) and general park provenience (Weaver 2000:Table 34).
[c] See Colton and Hargrave (1937) and James (1974:112).
Key: ASM = Arizona State Museum; LOCAP = Lower Oak Creek Archaeological Project.

Table 29. Cultural Groups or Regions Represented, by Time Period

Ceramic Ware and Type, by Cultural Group or Region	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites: Entire Collection[a]	LOCAP Sites: 105/838	LOCAP Sites: 53/745	Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
A.D. 500–900																	
Kayenta Anasazi						X		X									
Hohokam					X											X	
A.D. 700–900																	
Hohokam				X	X											X	
A.D. 700–1150																	
Kayenta Anasazi		X	X	X	X	X		X				X				X	
Hohokam			X		X	X	X	X								X	X
A.D. 700–1300																	
Cohonina		X	X	X		X	X	X		X	X	X	X	X		X	X
A.D. 900–1150																	
Mesa Verde Anasazi		X	X	X	X	X	X	X				X				X	X
Hohokam				X	X										X	X	X
A.D. 900–1300																	
Kayenta Anasazi	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cibola region																	X
Hopi Mesas/Hopi Buttes	X	X		X	X	X	X	X	X		X	X	X	X	X		X
Northern Sinagua						X	X	X			X	X	X				X
Prescott area		X															
Mogollon		X									X	X		X			X

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Ceramic Ware and Type, by Cultural Group or Region	Hidden House	Tuzigoot	Verde View (AZ O:5:12)	Verde Terrace (AZ O:5:6)	Verde Ball Court (NA3528)	LOCAP Sites			Volunteer Site (NA17244)	Red Rock State Park (Multiple Sites[b])	Kittredge Ruin (NA4490)	AR-03-04-06-703	Panorama Ruin (NA5111)	Montezuma Castle	Montezuma Well (NA4616)	Calkins Ranch (NA2385)	Fitzmaurice Ruin (NA4031)
						Entire Collection[a]	105/838	53/745									
A.D. 1150–1300																	
Kayenta Anasazi		X								X	X	X	X	X			X
Cibola region		X															
Hopi Mesas/Hopi Buttes																	X
Mogollon														X			
Unaffiliated White Mountain Red Ware																	X
A.D. 1150–1450																	
Kayenta Anasazi						X	X										
Cibola region		X															
Winslow area		X												X			
Prescott area	X	X									X	X	X				X
Southern Sinagua		X		X		X	X	X	X	X	X	X		X	X	X	X
Hohokam																	X
Unaffiliated Roosevelt Red Ware[c]						X	X										
Unaffiliated White Mountain Red Ware[c]		X				X	X										
A.D. 1300–1450																	
Southern Sinagua		X										X	X	X			X
Unaffiliated Roosevelt Red Ware[c]		X												X			
Unaffiliated White Mountain Red Ware[c]		X												X			
A.D. 1300–1600																	
Hopi Mesas/Hopi Buttes		X				X	X	X					X	X			
Post–A. D. 1600																	
Possible Yavapai						X	X	X				X					

[a] At least one ceramic artifact of this type was represented in the project collection.
[b] Red Rock State Park sites AR-03-06-126, AR-03-06-128, AR-03-06-535, AZ O:1:12 (ASM), AZ O:1:15 (ASM), AZ O:1:27 (ASM), AZ O:1:37 (ASM), and AZ O:1:38 (ASM) and general park provenience (Weaver 2000:Table 34).
[c] These ceramic wares cannot be definitively assigned to a specific region or culture.
Key: ASM = Arizona State Museum; LOCAP = Lower Oak Creek Archaeological Project.

CHAPTER 3

Flaked Stone

Bruce A. Bradley, Christian R. Vermeer, Rein Vanderpot, and Bradley J. Vierra

Introduction

In this chapter, we present the results of the analysis of the flaked stone artifacts collected from 13 sites in the LOCAP area. The project provided a welcome opportunity to study the use of local lithic resources by people in the Verde River valley over a long span of time and across different cultures. Although the project corridor was limited to the ADOT ROW along SR 89A, it cut a 25-km transect through an area characterized by abundant chert and other resources used to make flaked stone tools. Data from the project sites indicate that the area was occupied from the Middle Archaic through the Late Formative period. An intriguing component of our study was the possibility that one or more of the sites were associated with Yavapai groups. The archaeology of protohistoric and early-historical-period hunting-and-gathering groups in the U.S. Southwest is poorly understood, in particular the associated flaked stone technology.

Most LOCAP sites were artifact scatters without features, representing simple locales for the procurement and processing of plants and animals. One site, AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), was a habitation site occupied throughout the Formative period. Late Formative period structures were recorded at three other sites, the largest of which was AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), a multilocus artifact scatter with several masonry rooms, possible wickiup clearings, and other types of features. These two large sites received the most attention in the field and yielded the greatest numbers of artifacts.

Unfortunately, all project sites were located in the open, and with the possible exception of burned remains inside structures, there was little chance of finding the perishable artifacts that constituted the bulk of the objects that ancient people used in their everyday lives. As determined from observations of hunting-and-gathering groups in the western United States, most of their material culture, such as baskets, digging sticks, atlatls, and cradleboards, was made from plant parts that would be preserved only in caves or other types of shelters. Animal products, such as hide for leather and sinew for fibers, are even more perishable (Adovasio 1999). Even though durable items, such as stone and pottery, probably made up a very small proportion of the ancient inventory, they are the largest proportion of artifacts available to us. Because of this, we attempted to glean as much information as possible from these preserved materials.

Another circumstance that greatly affected our ability to determine who used the area—and when it was used—was the location of the project area along a major highway. Access to the sites had been unrestricted, and we know that the area has been popular among artifact collectors for many years. As a collecting locale, it must have been quite productive, and certainly, most of projectile points and bifaces that were once on the surface were removed before this project began. This was one of the main reasons that we attempted to determine whether there were characteristics of flaked stone artifacts, other than projectile points, that were diagnostic in terms of periods and archaeological cultures.

Of four basic research themes identified for the project in the LOCAP treatment plan (SRI 1998:9–17), two are best addressed by studying flaked stone: land-use practices and the archaeology of mobile forager-farmers.

We identified three major topics that we wished to address using the information yielded by the flaked stone collection. The first was temporal and cultural affiliation—specifically, determining when people used or occupied the sites and who these people were. The second was land use and subsistence, focusing on how people made their living and used the land and its resources. The third was an examination of technology, such as the types of flaking techniques that were used and the resulting artifact types. Other issues that we explore, in the discussion of the site collections below, concern ancient inhabitants' trade practices or long-distance interactions and the ways in which specific areas, features, or structures were used within sites.

To answer any of these questions, we first had to establish a chronology of the sites and identify specific technological markers ("diagnostics") for the various archaeological cultures known to have occupied the area. Because only a small proportion of the materials came from buried contexts, it was generally not possible to directly date artifacts to a specific period. With few exceptions, we had to rely on projectile point styles to provide a broad temporal range for a given site's occupation. Once an approximate chronology was established, we could start addressing questions about site use, subsistence strategies, and resource exploitation and how these activities may have differed among cultural groups.

This chapter is organized into five main sections. Following this introduction, we provide a research context in which we briefly review previous flaked-stone-related research in the Verde River valley. Next, we discuss our analysis approach and methods, followed by discussion of the flaked stone collection from each site. In our concluding section, we interpret the results of our analysis in terms of the use of the project area and regional patterns, evaluate the success of our strategy, and suggest productive approaches for future work.

Previous Research

Although the U.S. Southwest has been intensively researched by archaeologists for more than a century, much of this work has focused on areas that supported concentrations of farming peoples who produced visible architecture and made attractive pottery, such as the Hohokam of southern Arizona, the Mogollon of east-central Arizona, and the Anasazi of the Four Corners region. Although this focus has led to edifying conclusions about many aspects of these cultures, we lack, unfortunately, a similar level of understanding concerning earlier and later cultures, partly because it is difficult to tease critical information about hunter-gatherers from the archaeological record. For many, this kind of research is less interesting; therefore, it has received less attention. This general trend in the history of U.S. Southwest archaeological research is certainly true for the region in which the LOCAP area is located. Numerous archaeological excavations have been undertaken in the Verde River valley, but few detailed reports have been produced. The best-known sites—such as Montezuma Castle, Montezuma Well, and some of the large pueblos, such as Tuzigoot (Caywood and Spicer 1935)—date to the later part of the Formative period. Three Early and Middle Formative period sites have been reported by Breternitz (1960a), but other than a few projects, such as Dry Creek (Shutler 1950) and others undertaken because of impending construction (see Chapter 3, Volume 1), little is known about the "lesser," earlier sites.

Archaeological work in the area is generally typical, in that artifacts made from flaked stone have been described with only minimal interpretation and little attention paid to the bulk of the evidence: the debitage, or "waste," of the manufacturing and use processes. Only a few projects have produced technological information that is available for comparison with our data. Previous collections did, to a certain extent, describe flakes and formal tools (Logan and Horton 1996, 1997; Shutler and Adams ca. 1949; Weaver 1995), but the only flakes included were those they described as "utilized." A few studies have included debitage analysis (Bergland 1982; Califf 1977; Dosh and Weaver 1979), but only two used the results to interpret human behavior (see Greenwald and Keller 1989). Most attention focused on projectile points, not only because many archaeologists like to work with attractive artifacts but also because projectile points offer a relatively reliable way of establishing general dates.

Because our main goal was to analyze the temporal and cultural affiliations of the flaked stone collections, it was appropriate to first assess what is already known about the area. In the following sections, we briefly review the relevant data identified in the Verde River valley for the Paleoindian, Archaic, Formative, and protohistoric periods.

Paleoindian Period (ca. 10,000–6500 B.C.)

One Clovis point fragment was found in the Verde River valley (Fish and Fish 1977); since then, a few more isolated Paleoindian period points in the region have been reported (see Chapter 3, Volume 1). Otherwise, there is little evidence of Paleoindian period occupation in the area, a paucity that may be partly the result of the deep alluvial deposition in the valley. The remains of late-Pleistocene animals, such as horses, mastodons, and mammoths, have been found (Chenault and Greenwald 1989:19), but without associated artifacts. In the greater region, the kinds of flaked stone artifacts typically found in Paleoindian period contexts are highly formalized and well made, usually from high-quality materials. Because of the highly mobile lifeways of Paleoindian groups, nonlocal materials, especially for projectile points, dominate the inventories.

Archaic Period (ca. 6500 B.C.–A.D. 1)

Evidence of Archaic period peoples in the Verde River valley is far more common than evidence of Paleoindian period peoples. Early, Middle, and Late Archaic period designations have been made in the surrounding regions, based almost exclusively on temporally diagnostic projectile point styles. Little similar research has been conducted in the Verde River valley, however. A notable exception is the Dry Creek site (Shutler 1950), which was located immediately adjacent to our project area and is the type site for the Late Archaic period in the region, the Dry Creek phase. Nevertheless, the broad stylistic trends seen in the region probably hold true for the project area.

Archaic period groups are thought to have formed small, mobile bands of seasonal hunter-gatherers who used stone scrapers, choppers, and knives (Weaver 1995). The presence of basin metates and one-handed manos indicates that plant products, especially seeds, were collected and processed. Projectile points are consistently identified as having been used on darts in conjunction with spear throwers, called atlatls. Amargosa and Cochise projectile points have previously been noted in the Verde River valley (Fish 1974). Archaic period projectile points found during the present project included Pinto/San Jose (Brown 1993; Holmer 1980; Irwin-Williams 1973), Mallory (Brown 1993; Frison 1991; Holmer 1980), San Pedro (Brown 1993; Sliva 2005), Gypsum (Harrington 1933; Holmer 1980), Elko Corner-notched (Brown 1993; Holmer 1980; Thomas and Bierwirth 1983), and possible Lerma (Frison 1991; Holmer 1980) styles.

Formative Period (ca. A.D. 1–1400/1425)

In the U.S. Southwest, the term "Formative" refers to cultures that adopted agriculture and a more or less sedentary lifestyle. In most cases, Formative period cultures constructed permanent architecture and produced pottery. Of the artifact classes in this region, ceramics generally provide the best data on temporal and cultural affiliation, but projectile point styles and methods of manufacture can also be informative. Early Formative period cultures in central Arizona continued to use dart points with atlatls but switched to arrow points by at least A.D. 300, when bow-and-arrow technology was introduced.

By far, most of the evidence of Formative period habitation and use of the Verde River valley is for the Southern Sinagua, who lived in the area from about A.D. 1000 to 1425 (Weaver 1995). Although the valley was already settled between A.D. 600 and 1000 (see Pilles 1996), this occupation has been poorly documented. Furthermore, there seems to be significant influence from, or actual use by, Hohokam immigrants, whose cultural center was in the lower desert areas to the south (Fish and Fish 1977). Other than the few formal flaked-stone-tool types, such as projectile points and other bifaces, Formative period groups employed an expedient flaked stone technology. Formal-tool forms were few, and most cutting and scraping tasks were accomplished with simple flake edges. To date, it has not been possible to distinguish among the various groups or periods on the basis of the traits of this simple technology; although overlap in arrow point styles among the different groups is considerable, a few styles are culturally diagnostic. These include the elongated, serrated points of the Hohokam (Haury 1976); the expanded-base, side-notched, serrated points of the Sinagua (Colton 1946); and the side- and corner-notched Pueblo points of the Anasazi (Bradley 2000).

Protohistoric Period (ca. A.D. 1400/1425–1600)

Yavapai people may have appeared in the Verde River valley shortly before the disappearance of the Southern Sinagua, around A.D. 1400 (Pilles 1981a), although this is not clear from archaeological evidence (Euler 1958); they used the area until early in the twentieth century. These people were predominantly nomadic, subsisting on hunting, collecting wild plants, and harvesting garden plants that were presumably left unattended (Gifford 1936). Their lifestyle approximated that of Archaic period peoples, but their use of pottery and horticulture was similar to that of Formative period groups. There is little documentation of Yavapai flaked stone materials. Although Yavapai mobility and subsistence were reminiscent of those of the Archaic period groups, it is not known whether their flaked stone technology was similar. The few documented Yavapai collections that do exist suggest that tool use was expedient and curated and that formal Desert Side-notched and Cottonwood arrow points were manufactured (Fish and Fish 1977). Lithic materials from previous occupations may have been recycled. We do know that Archaic period people used the atlatl as a weapon, whereas Yavapai people used the bow and arrow.

Analysis Approach

The first author has worked with flaked stone artifacts—both as an archaeologist and as a maker and user of stone tools—for more than 35 years. This experience has shaped this analysis and guided the selection of observations. The underlying principle of this study is that each flaked stone artifact is a direct expression and indicator of a specific set of human actions. These actions can be deciphered for any given flaked stone collection, potentially revealing what took place at a settlement. A traditional perspective suggests that there were a number of ways to perform a desired task using stone tools (such as making buckskin by scraping a deer hide); the choices made were, for the most part, within a culturally acceptable range of options. On the other hand, an organizational perspective views technology in regard to understanding the relationships among raw-material procurement, production, use, maintenance, and eventual discard of exhausted items (Binford 1973, 1977; Nelson 1991; Torrence 1989). This process is conditioned by a variety of factors, primarily including the foraging strategy (what people eat) and the foraging tactic (how people procure it) implemented by the group. Other factors include raw-material availability, scales of mobility/sedentism, and regional exchange (Andrefsky 1994; Brown 1990; Parry and Kelly 1987).

One aspect of flaked stone technology that can be greatly influenced by local factors is the availability of suitable stones for the tasks at hand. In the course of exploring and interacting with their environment, people gathered knowledge that informed and broadened their choices about what they could do and, more importantly, when they could do it. In other words, they could plan their future. For hunter-gatherers, the availability of game animals and plants in a specific area varied significantly from season to season and from year to year. Stone resources tend to remain constant, however, and can be depended on over time. There are, of course, rare circumstances under which a highly limited source is depleted. The greater project area includes numerous sources of usable chert and quartzite (see Appendix F), which invites speculation about various issues.

We questioned how various people used and depended on lithic resources as they moved in and out of the area and whether there was evidence confirming that people were drawn to the area by the presence of stone that could be flaked. The area might have been considered a more attractive destination than others because people could rely on not having to bring their own stone tools. We also wondered whether variations in stone tool technology could be distinguished among the various groups occupying the project area.

Projectile points are often used as temporal markers and are closely linked to the foraging tactics used by prehistoric groups. These points also reveal information about other technological changes, such as the introduction of the bow and arrow, the movement of people, and raw-material preferences. As useful as projectile points are, however, there is a wealth of information about past peoples that resides in the other, perhaps more mundane, waste products that constitute the bulk of the stone artifacts we have found. For many sites—and for most studied during this project—the other artifacts consist of simple tools, flakes, cores, and other flaking debris. What might these artifacts reveal to us, and how do we go about studying them? This returns us to the observations that were selected—on the basis of prior work and personal experience—because we considered them useful for exploring the topics that we focused on for this project. We can all agree that projectile point styles are the best artifacts to use for assigning general temporal associations and cultural affiliations, but we wished to determine whether these point types were accompanied by any specific technologies that could be distinguished. We wanted to see if a detailed examination of the so-called waste products could help us gather information about temporal and cultural affiliation, land use and subsistence, and technology and artifact types, in the cases of sites that did not yield projectile points, either because none was left behind or because they had been removed. We believe that it may be possible to gain a better understanding of the flaked stone technology through a closer-than-usual examination of the artifacts.

The Collections

To make useful comparisons among the different site collections or between specific areas within a single site, it was important that we establish consistent analysis procedures. Although our analysis was indeed uniform for all project sites, varying collection methods were used at different sites; therefore, the information was not always grouped in consistent ways (see Chapter 4, Volume 1). For example, at some sites, every artifact was carefully mapped, but the information connecting a single artifact to a specific place (i.e., point-provenience) was not recorded, except in cases of diagnostic artifacts, such as tools and pieces of obsidian. For these collections (all labeled Provenience Designation [PD] 1), we have a good sense of the overall distributions and concentrations of flaked stone debitage, as well as overall site function, but we cannot evaluate the kinds of activities that took place in specific areas with any precision. At other sites, flaked stone debitage and cores were sampled by means of collection units instead of being mapped individually. Usually, temporally or functionally diagnostic artifact types—such as projectile points, bifaces, tools, cores, and retouched flakes—were individually mapped and cataloged. In the case of Site 53/745, virtually all of the 4,617 flaked stone artifacts (including debitage) were individually mapped, and an individual location was recorded for each artifact.

Our methods were developed in response to the large size and great complexity of the site, the seemingly nonrandom distribution of other artifacts (in particular, pottery), and the likelihood that the site was the location of multiple uses over a long time. The goal of such intensive mapping was to attempt to identify where groups from different periods and cultures were living and whether there were behavioral differences among these areas. (We also hoped that analysis of flaked stone at other sites could define culturally distinct technologies that could then be applied to our interpretations for Site 53/745. This particular collection strategy is ideal, but unless there is a strong possibility that something significant can be learned about the people who produced a site, it is incredibly time-consuming, both in the field and in the laboratory.

Each recovery method was carefully evaluated for each site before it was applied, on the basis of available resources and an assessment of the potential for significant results.)

Another factor that limited our ability to make useful comparisons among sites was the great difference in sample sizes, which ranged from a low of 80 items, at AZ O:1:77/AR-03-04-06-869 (ASM/CNF) (Site 77/869), to a high of 4,617 artifacts, at Site 53/745 (Table 30). More than 58 times as many flaked stone artifacts were encountered at Site 53/745 as at Site 77/869. This discrepancy obviously affected how the collections could be compared, although it posed some interesting questions. We wanted to explore why some sites had significantly more artifacts than others, whether the densest concentrations were located at good stone sources, and whether sites with higher concentrations of flaked stone were located in better settings for farming, at overviews for hunting, or closer to water in especially well-sheltered places. These questions are explored in the final, interpretive section of this chapter.

We present our interpretations with a caveat: the flaked stone artifacts have been vulnerable to the collecting and recycling practices of ancient inhabitants and could have been relocated by modern collectors. They have also been subjected to the effects of many natural and cultural disturbance factors, ranging from construction activities to erosion. These effects may have compromised the contexts and condition in which the artifacts were found, with the result that the distributions and associations that we found may not reflect the original depositional environment, location, or distributions that would shape some of our interpretations. Although we acknowledge that these factors introduce a measure of uncertainty, we must consider the recovered materials representative.

Artifact Analysis

The collections from the LOCAP area included 18,645 flaked stone artifacts, all of which were analyzed (see Table 30). Figure G.1 (see Appendix G) shows the analytical process and the variables that were recorded as analysis progressed. This work was a joint effort: Bruce Bradley recorded and typed the projectile points and bifaces, and Chris Vermeer made the observations for all other artifacts, with assistance from Dr. Bradley, who made periodic checks and helped to make decisions regarding questionable characteristics. All observations were entered into a Microsoft Access database. We have relied heavily on the excellent work of Slaughter et al. (1992) to guide our research. This study, which focused specifically on what may be learned from stone artifacts, summarized what is known about flaked stone technologies, raw-material sources, terminology, site types, and culture history for Arizona.

Our first step in the analysis was to separate the artifacts from each collection into four basic categories: bifaces/projectile points, tools, cores, and debitage. Bifaces are stone items that have been intentionally flaked on both margins but do not exhibit the notches or other hafting that is seen on projectile points. Projectile points are pressure-flaked bifaces that include a hafting element.

Tools are items exhibiting characteristics that indicate they were made specifically for a certain use. Also included in this category are pieces that were manufactured to serve as tools but were never used, such as an unfinished biface fragment that was broken during manufacturing. In the LOCAP collections, most tools were made on flakes, but some were flaked cobbles or cores that were later modified for use.

Cores are pieces of flaked stone from which flakes have been removed, evidently to produce usable flakes or flake blanks. When not used as a tool, a core is a by-product, like debitage. An artifact may initially have been a discarded core and later may have been used as a tool (e.g., as a pecking stone). In these cases, the artifacts were considered tools and were analyzed as such. On occasion, people made tools directly from pieces of raw material without first making flake blanks. These were classified as core tools, which are different from cores turned into tools. The distinction is subjective, but we tried to apply the categories consistently.

Debitage comprises everything else that results from the flaking process, including intended or identifiable items, such as flakes, and unintended fragments or shatter (termed "debris" during the present analysis) produced during flaking. In our analysis, we recorded pieces of debitage that had damaged edges, possibly resulting from use, but we did not use this information to identify them as tools. In the absence of detailed use-wear analysis, which preferably would be microscopic, this category is, at best, subjective. We decided not to expend resources on conducting intensive use-wear analyses because most of the collections came from the ground surface, where artifacts had been exposed to various forms of weathering, trampling (by nonhuman animals and people), damage from vehicles, and erosion. Exposure can compromise evidence of use.

In the following sections, we provide more-detailed definitions of the four artifact classes and of the recorded attributes for each class. As a rule, each artifact was provided with the basic provenience information, such as site, PD, and identification number (ID), followed by specific attributes for each artifact type. We begin with a discussion of the various stone types present in the collection.

Material Type

Stone types were recorded for all artifacts (except for most of the debris) for three main reasons: (1) to determine to what degree people relied on locally available sources;

Table 30. Lower Oak Creek Archaeological Project Flaked Stone Counts, by Site

Site No.	Projectile Points and Bifaces	Tools	Cores	Debitage	Total
104/902	12	25	32	1,385	1,454
105/838	13	12	30	2,745	2,800
85/428	3	4	3	234	244
77/869	2	—	2	76	80
131/37	9	9	40	1,386	1,444
53/745	34	66	137	4,380	4,617
28/903	11	19	52	2,004	2,086
31/244	17	26	75	1,759	1,877
133/561	17	16	47	2,623	2,703
134/189	9	12	27	470	518
135/186	2	2	13	321	338
136/663	2	1	11	256	270
137/482	3	3	8	200	214
Total	134	195	477	17,839	18,645

(2) to determine whether we could distinguish site, cultural, or activity preferences; and (3) to assess whether trade or exchange was taking place or material was directly procured from other regions. It is clear that local stone sources, such as chert, quartzite, and fossil sponge (see Appendix F for a detailed description of these materials and their geological origins), were important throughout time for all cultural groups in the area. Although we hoped that distinct material preferences of different cultural groups would emerge, this does not seem to have been true, but the presence in the collections of nonlocal materials (in particular, obsidian and fine-grained basalt) does indicate that people using the project area either interacted with neighbors to the north or incorporated areas to the north in their gathering territory. It is also possible that, at times, people made long-distance collecting trips to well-known sources, such as Government Mountain and Partridge Creek (Figure 11).

Analysis focused on the proportions of local- versus nonlocal-stone types and the forms that corresponded to these types. Finished, worn-out projectile points made from nonlocal sources would indicate that people were moving into the area, bringing their tools with them. Small retouch flakes and biface flakes of nonlocal stones could indicate that tools were already made when they arrived and that the only flaking performed on nonlocal stone was the resharpening or refurbishing of tools. If trade or exchange had been the main process by which nonlocal stones were introduced, we would expect to find cores and other types of waste materials at the sites.

A heavy reliance on local stones may reveal a number of things. Perhaps the people who occupied the area interacted minimally with other areas. Alternatively, if people knew that there was good stone in the area before they moved in, they may have brought few stone tools with them. It is also possible that people came to the area, in part, to obtain good toolstone to take away. If this were true, we would expect to find intensively exploited sources. We did not find this type of site, but there may be intensively used stone-procurement locales in the area outside the project boundaries.

Local Stones

Coarse Basalt

Basalt is a porous, igneous volcanic rock that is typically dark gray to black. Much of this material in the LOCAP collection consisted of vesicular basalt, which is found locally and throughout the region. Sources of this material are present on some of the sites, and direct evidence of concentrated exploitation has been found at one site, AZ O:1:131/AR-03-04-06-37 (ASM/CNF) (Site 131/37). This material was not suited for cutting tools, and most artifacts made from it were manos and other grinding tools.

Chert

A vitreous sedimentary stone known locally as Kaibab chert is found on the uppermost stratum of the plateau overlooking the Verde River valley to the north and also along streams that enter the valley from that direction (Shutler and Adams ca. 1949). As raw material, it was particularly common at and around two sites in the northern half of the project area, AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561) and AZ O:1:134/AR-03-04-06-189 (ASM/CNF) (Site 134/189). The nodules are formed

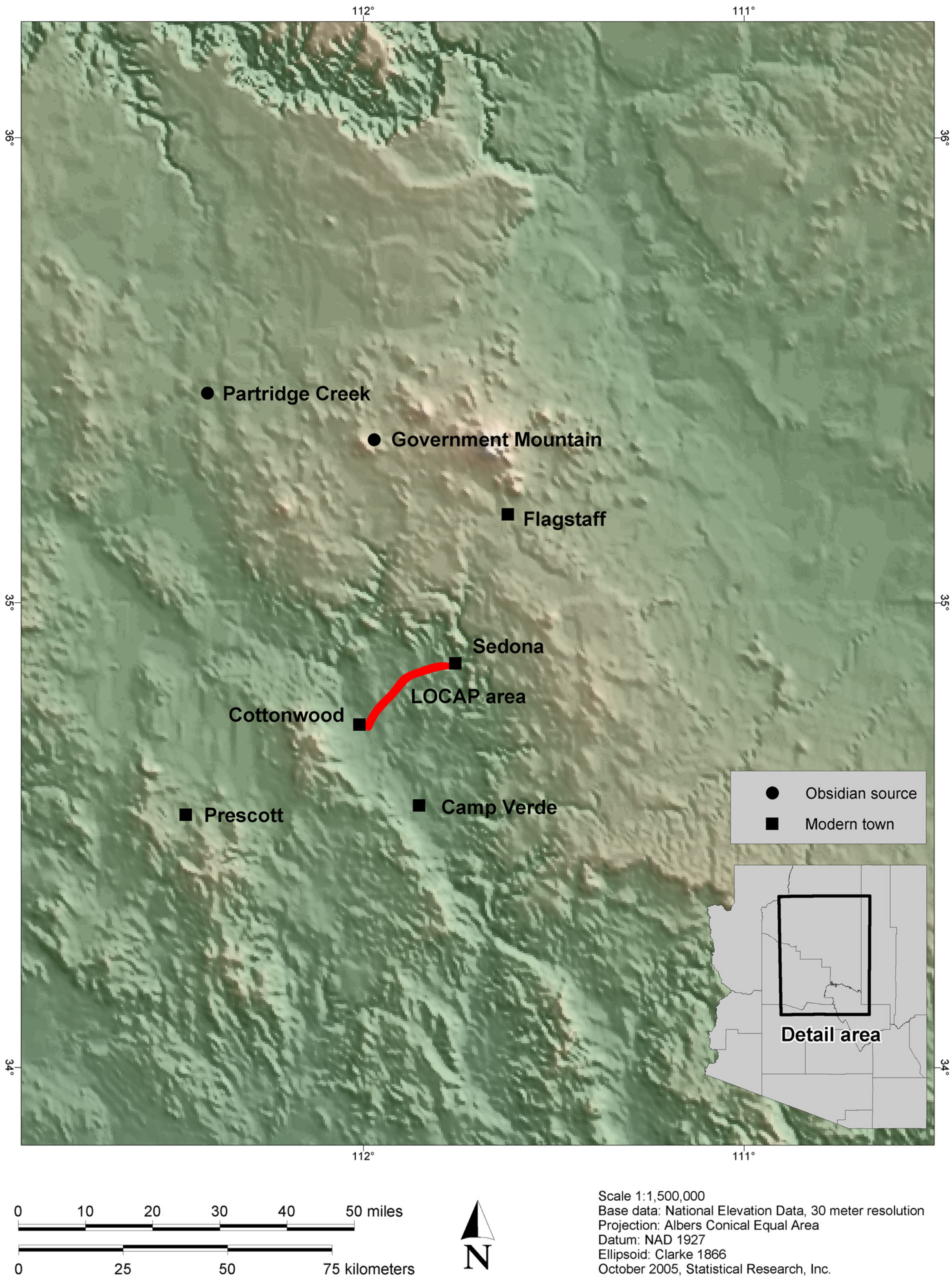

Figure 11. Sources of obsidian in the U.S. Southwest.

as part of a chemical process in which silica (chalcedony) replaces limestone. Although the pieces available in the project area were relatively small and highly variable in flaking quality, tools made from chert were durable and sharp. As a toolstone, it rates as good to excellent. Even so, it was not suited for the most-delicate flaking, and there is evidence that it was sometimes exposed to low-temperature, controlled heating to improve its flaking quality. This process is known as heat tempering (or heat treatment), and it was a distinctive technological practice associated with specific peoples, places, and periods throughout the U.S. Southwest.

Chert Sponge

Chert sponge is basically the same as chert, except that the source of the silica was ancient marine sponge. Much of this type of stone retains the distinctive structure of a sponge. Also named "cherty sponge" or "sponge chert," it is typically white with yellow to red spots throughout the interior of the nodule. The formation process of this chert creates small fractures in the material, making it less desirable, although the material is locally available and was commonly used. This stone could also be improved by heat tempering, and, in a few cases, we have evidence that it was pretreated in this way.

Chert/Quartzite

Chert/quartzite is another variety of local chert. The only distinguishing feature is that it has a fine, crystalline structure. It was extensively used in the project area, and we separated it from the normal chert in our analysis to determine whether, perhaps, there was differential selection.

Quartzite

Another locally available stone that was quite extensively used is a true quartzite, presumably of metamorphic origin. It is found as cobbles and is a common constituent in the abundant gravel deposits on ridgetops and in stream terraces and streambeds. Flaking quality ranges from poor (coarse) to fair (medium grained). Although this quartzite may be considered inferior for the production of delicate stone tools, such as projectile points, it is excellent for the production of simple, durable cutting tools. Quartzite of this type is excellent when used for cutting fleshy materials, such as meat and soft plant parts, but is less useful for woodworking. Therefore, quartzite flakes might be expected to be present primarily in areas where meat and plants were being processed.

Nonlocal Stones

Obsidian

Obsidian is a volcanic, extrusive glass that is brittle and easy to flake. A fresh edge is extremely sharp. Because of its brittleness and softness relative to chert, it tends to damage easily and to wear down quickly. Given that it is difficult to hold a sharp tool in a bare hand, obsidian tools are especially dangerous to use for wet procedures, such as animal butchering. Because of these attributes, obsidian is best for projectile points and light cutting tools. Another quality of obsidian that should not be underestimated is its exotic, almost unnatural appearance. Although it appears in many color combinations, obsidian is usually opaque black. This black is so striking that, in at least one southwestern language, Keresan, the term for obsidian is the same as that used for the color black.

Obsidian-source analysis of 50 items from 12 of the 13 project sites indicates that most of the material is from Government Mountain (northwest of Flagstaff); a small amount derives from RS Hill/Sitgreaves (near Government Mountain), Presley Wash, and Partridge Creek (the last two are from the Mount Floyd volcanic field) (see Appendix E). This is not surprising, because these are the closest sources, but it is an indication that people were interacting with the area to the north (50–60 km distant), either through travel to obtain the materials or through trade, via intermediaries.

Fine-Grained Basalt

Fine-grained basalt is a semivitreous, igneous volcanic rock that is dark gray to black. The materials found in the collection resembled olivine basalt porphyry, in which phenocrysts are enclosed in a fine-grained, igneous mass that may be crystalline or glassy. The source of this material is unknown, although it appears to be similar to the material found at Jacks Canyon, which was identified to be from the Wagner flows near Ash Fork (Bergland 1982). There are probably other small sources in the volcanic areas to the north (Lesko 1989; Shackley 1988). This material is similar in flaking quality to obsidian, but it tends to be a bit stronger and to hold an edge longer and is not as sharp. It, too, seems to have been used mostly for projectile points.

Other Chert

In the collection, the designation Other Chert was used for unusual-looking chert that was assumed to be nonlocal. Sources for the materials are unknown, but in light of their excellent quality, the fact that these materials were scarce indicates that they were a rare commodity. Some of these materials resemble Perkinsville jasper, which is a high-quality, fine-grained stone found near Clarkdale (Slaughter and Rickard 1994).

Other

The Other category includes all materials encountered in the LOCAP collection that are not listed above. They appeared in such low numbers that they were not categorized separately. Most were jasper or quartz.

Debitage

Debitage, as defined by Crabtree (1982), is residual lithic material resulting from tool manufacture. These artifacts exhibit well-defined manufacturing traits that make them useful for determining flaking technology. As used in this report, the debitage category includes all stone flakes (complete, incomplete, or fragment) and debris. Below, we discuss the criteria used for the various types of debitage, the research potential of each type, and the recorded attributes. To learn something from this data set, we looked at diverse combinations of variables. Because different variables are evident on different pieces in different ways, each piece is not represented in all counts. For example, debris (n = 10,813) made up almost 61 percent of the total project debitage counts (n = 17,839), yet material type was not recorded for most debris. Therefore, the total number of pieces of debitage used to determine relative frequencies of stone materials (n = 7,685) differed from the total number of pieces of debitage. We also were aware that sample size influences how collections could or should be compared. It was clear that our collections were in accord with the general finding that large collections exhibit more diversity in artifact types than do small collections. For these reasons, we relied primarily on proportional comparisons (i.e., percentages).

Debitage Type

The definitions that we used for classifying flaked stone artifacts are, for the most part, commonly used by other archaeologists and analysts in North America. From among the hundreds of possible observations, we selected only the few that were most relevant to answering the questions posed in our general research design. The following categories offer insight into the types of stone tools that were produced or reworked at the sites. We deviated from traditional analyses—among them much of the previous research in the Verde River valley—that used the categories of primary, secondary, and tertiary flakes. These previous analysts assumed that technological "stages" could be inferred from these designations, based solely on the percentage of cortex remaining on a flake. This method assumes an invariant sequence, when, in actuality, each of the flake types may be removed at one of many points in core reduction. The highly subjective nature of this method and the consequent variation in its application by analysts, which thereby reduces comparability between studies (Sullivan and Rozen 1985:762), is problematic. Rather than employ these categories, we recorded technological attributes that might allow us to make technological and behavioral inferences.

Flake

A flake is defined as any piece of stone that exhibits a striking platform and a conchoidal fracture, which creates a smoothly carved surface. It is characteristic of such stone types as quartz and obsidian. We assume, for the sake of argument, that all flakes were produced by humans. This general category was used for all flakes that did not exhibit characteristics of bifacial manufacture or unifacial tool retouch.

Core Flake

Core flakes are flakes that have been detached from a core. They exhibit cortex or have few flake scars on their dorsal surfaces, have a nonmarginal platform with angles of about 75°, are thick, often have a pronounced bulb of percussion, and usually have a straight ventral surface.

Biface Flake

Biface flakes are indicative of the manufacture of bifacial tools, often for use as knives and projectile points. The flakes usually exhibit multiple flake scars on their dorsal surfaces, have a prepared marginal platform with angles of about 50°, and are thin and, often, curved. Cortex is usually not present. These flakes are particularly suited for identifying specific activity areas, such as those dedicated to the manufacture or resharpening of projectile points and knives.

Uniface Flake

Uniface flakes, which typically are very small, are less distinctive than biface flakes, but if they are recognized and recovered, they may identify specific activity areas, such as those used for hide preparation and woodworking. They are produced by the unifacial flaking of edges in the production of tools, such as scrapers. They have plain platforms and pronounced curves and are typically less than 18 mm in length. The cortex is normally absent, except on the distal ends. It is probable that some of these flakes were produced as by-products of core flaking rather than of tool manufacture or resharpening.

Debris

Also referred to as shatter, this type encompasses most of the collection. Debris is a piece of flaked stone that may have resulted from conchoidal fracture but does not have a platform or a bulb of applied force. Often angular and blocky, debris is representative of stone-procurement areas and generalized flaking, especially when a hammerstone is used. Because debris does not exhibit any other traits of a flake, it was recorded only by count in this analysis. At sites where the stone artifacts were collected as PD 1, they were all assigned the same ID in analysis, but at sites where all artifacts were given unique PD numbers, they were also given unique IDs.

Platform Type

A platform on a flake is the surface that received the force necessary to detach the flake from the core. We recognized two platform types (marginal and nonmarginal) that we expected would vary among different times and cultural groups.

Marginal Platform

Marginal platforms typically are associated with bifacial thinning in formal-stone-tool manufacture. A marginal platform results when a core is struck along an edge (margin) and the point of impact overlaps with the edge. This technique allows for the creation of long, thin, uniform flakes, which leave an even flake scar on the core or flake. A notable result of this process is that it produces thin flakes that run across the surface of the artifact. Marginal flaking is performed to reduce the thickness of the piece from which flakes are being removed, to produce usable thin flakes, or both. To control this process, platforms have to be carefully selected, and the preparation of the edge, especially if it is sharp, greatly enhances the success of the outcome. This flaking method demands more control and skill than nonmarginal flaking, and it was frequently accomplished with tools made of materials softer than the stone, such as an antler. Our expectation was that sites where bifaces and projectile points were being produced commonly would yield flakes with marginal platforms.

Nonmarginal Platform

A nonmarginal platform results when a core is struck behind the edge and the flaking tool has complete contact with the surface. This platform type is the most common and is typically associated with core flaking, the desired result of which is a relatively thick, usable flake. Generally speaking, the thicker the platform is, the thicker the resulting flake. Nonmarginal platform flakes are usually produced with a hammerstone.

Termination Type

As a flake is struck, the fracture forms from the point where the force is applied and travels through the material until a flake is detached. This is a complex process, influenced by many factors, such as material quality, the technique used, and the knapper's control of the material. Although there are instances in which it is evident that the desired result is not typical, a knapper usually intends to produce flakes with sharp ends. For the sake of this analysis, we assumed this was true. We recorded two flake-termination types (feather and hinge) to see if there were any differences in control among periods and cultural groups.

Feather

A feather termination is one in which the end of the flake opposite the platform is sharp. Although this effect is not always desired, it is especially beneficial for the production of flakes used for cutting without further modification. One of the drawbacks to feather terminations is that they typically result in flakes that curve. This is not always desired in a cutting tool.

Hinge

A hinge termination is created when the flake ends by curving away from the core surface, leaving a rounded end on the flake. This is caused by the combination of a number of factors, such as insufficient force applied at impact or a striking angle that drives too directly into the core. Hinge terminations are rarely desired, partly because the resulting flake does not have a sharp, usable end and partly because the resulting core surface is difficult to use for further flake removals. But hinge fractures can produce a desirable effect, in that these flakes tend to be straight. In some areas in the U.S. Southwest, a highly specialized form of hinge flaking was used to produce very thin bifaces, but we did not observe this technique—sometimes referred to as "diving flaking"—in the LOCAP collection.

Condition (Completeness)

Flake completeness was recorded to examine several factors. A variety of factors can affect the breakage patterns of flakes, including material type, core reduction vs. tool production, tool use, and postdepositional processes (Mauldin and Amick 1989; McBrearty et al. 1998; Prentiss and Romansky 1989; Whittaker 1994). Given the large sample, the flake-fragment designation was used only for biface and uniface flakes. All other flake fragments were included in the Debris category. Completeness can also indicate flake use and postoccupational site use, such as trampling (pedestrian and nonhuman animal) and vehicular damage.

Complete

A flake must contain a platform, a termination, and intact lateral margins to be considered complete.

Incomplete

An incomplete flake must contain a platform or termination, and most of the platform still must be present. This designation was applied to flakes for which one small corner was missing.

Fragment

For a piece to be categorized as a flake fragment, it must clearly have been a biface or uniface flake and retain at least some of both the dorsal and bulbar surfaces.

Cortex

We considered cortex the natural exterior surface of a stone, whether it was stream-tumbled or chemically weathered or retained a layer of the parent material. We recorded three categories of cortex remaining on the dorsal surface of a flake: total, partial, and absent. In general, stones used for flaking would be partly flaked at their source, to test for quality and to eliminate surplus weight. This would be particularly true for nomadic people who had to carry everything with them on their travels. This results in the presence of higher proportions of flakes with cortex at and near a lithic source and lower proportions farther away. As distance from the source increases, one can expect materials to become more intensively used, resulting in increasingly fewer flakes that retain cortex. There are, of course, exceptions to this general trend, such as when a lithic source was within a day's walk from the settlement. In this case, stones would have to be carried only a short distance, and the effort would have been minimal enough that, if some unsuitable stones were brought from the source, the waste of energy would not have been great.

Dimensions

Dimensions were recorded (in millimeters) for all complete flakes. The length was taken along the flake axis (from point of percussion to termination), and the maximum width perpendicular to the axis was recorded. This was done for two primary reasons: (1) to determine the size(s) of flakes that were made and used and (2) to evaluate what kind of flaking was taking place. Larger flakes were expected to be found at or near stone sources and at sites with short-term, low-intensity use. Smaller flakes were expected to be present where tools were manufactured, at sites farther from stone sources, and at sites characterized by intensive, long-term, and multiple occupations.

Comments

The Comments category was used for additional observations on all artifacts, including debris. For debitage, the following characteristics were included, where applicable.

Edge Damage

Evaluation of edge damage was made visually, with the naked eye, and through touch. The goal was simply to determine whether damage was present, not to document whether the flake had been used as a tool. As with flake size, evidence of edge damage could help determine whether a settlement was intensively used.

Burned

Characterization of an artifact as burned was based on the presence of charring on all materials and of pot-lid fractures on the cherts and quartzites. Pot lids result from the intentional heating of a cryptocrystalline silicate to make the material easier to flake or from the unintentional heating of stone (Slaughter et al. 1992:79). The resulting heat spalls look like the tops of pot covers, hence the name "pot lid." Because most artifacts were recovered from the present ground surface, burning may have been the result of natural processes, such as grass fires.

Multiple Strike

An observation of a multiple strike identifies a flake that has more than one area of impact on the platform. If this feature is observed with regularity, it may be an indication of a lack of flaking skill, depending, of course, on the quality of the stone.

Heat Treatment

We did not undertake experimental heat treatment of the cherts found in the area. Therefore, we relied on the premise that the exterior surface of the heated material would not show textural change and that the interior, when freshly flaked, would appear glossy (Wegener et al. 2005). This method applies only if a comparison can be made between a flaked, preheated surface and a postheated surface on the same piece. This approach undoubtedly results in an undercount when heat tempering was part of the flaking process, but it eliminates the subjectiveness of basing a conclusion of heat treatment solely on glossiness. As indicated above, heat tempering of stone to improve flaking quality was a distinctive manufacturing technique employed selectively by some, but not all, cultural groups. In the project area, the question is who, if anyone, was employing this technique. Heat treatment has been noted in the region but has not yet been directly associated with a particular time or group.

Cores

A core is defined as a piece of stone from which one or more flakes have been removed with the intention of producing a flake or flakes. At least one of the flake scars must contain a negative bulb of percussion (the swelling that occurs directly below the point of applied force that produced the flake). The differences between cores and core tools will be further defined in the discussion of tools. For the LOCAP collection of 477 cores, a set of specific attributes was employed to determine (1) raw-material source, (2) material availability, (3) procurement activities, and (4) material preferences.

The first recorded attribute was the "core form," which was the original form of the stone before it was flaked. The purpose was to identify possible sources, as well as form preference. In the LOCAP collection, we distinguished between cobbles and nodules. Cobbles are stones that have been rounded through erosion, usually in high-energy environments, such as fast-flowing rivers or streams. Nodules are stones formed by rounding caused by the filling of solution cavities in the parent stone, which usually is a limestone. We suspect that, in the LOCAP area, there may have been a preference for one over the other at specific times or by specific people. All cores could be assigned to one of these two categories, unless the original form was lost because the core had been flaked all around its circumference, removing the entire cortex. In these cases of intensive utilization, cores were identified as discoidal.

Although core forms may be culturally determined, they tend to depend on the natural form of the available stone in areas with abundant flaking stone.

Core potential, or state, was a subjective assessment of how much usable stone was left on a core. This contrasts with studies that estimate the amount of flaking evident on a core. We used the classifications of (1) good potential, (2) some potential, (3) exhausted, and (4) tested. These were based on our assessments of the available margins, remaining volume, and quality of material. To document overall size, we recorded maximum length and width. The Comments field included miscellaneous information, such as burning or evidence of heat treatment.

The intent was to use this information to examine site function, intensity of occupation, and material preferences. It is expected that sites at or close to a source will have higher proportions of tested cores and cores with good potential and that sites farther away from sources will have greater numbers of cores with some potential and exhausted cores. This is, of course, based on the concept of "economizing behavior." As pointed out by Odell (1996:62), "behavior that economizes stone tools is a conservational response to either a current dearth of tool raw material or a projected future need" (see also Andrefsky 1994; Bamforth 1986). In addition, the intensity of tool use, maintenance, and recycling can be a result of site function, duration of occupation, and site reoccupation (Schlanger 1991).

Tools

In total, 195 pieces of flaked stone were identified as tools in the LOCAP collection. For our purposes, a tool is defined as any flaked stone artifact that was intentionally and individually shaped into a form that was either used or intended to be used for manual tasks, such as cutting, chopping, or sawing. Flake tools and core tools are subclasses. A flake tool was identified as any flake that had retouch flakes removed from any of the margins. Similarly, cores with a carefully shaped edge were identified as core tools. Specific categories of formal-tool types include drill, scraper, retouch flake, and chopper. For this analysis, we recorded condition, the form of the blank from which the final tool was made (when it could be determined), edge type, flaking type, degree of flaking, and dimensions, and we provided comments. These attributes were the same for projectile points and bifaces (see below).

Condition

Tools were recorded as complete, incomplete, or fragment. We used these observations to evaluate the degree of use, in particular whether the tool had been exhausted. For example, an impact fracture on a projectile point (incomplete or fragment) indicates that it was used as a projectile. A biface broken in manufacture indicates that it probably was never completed and therefore was not used as a tool. Sites with many tools broken in manufacture probably were mainly stone-tool-making workshop areas; sites containing tools broken during use probably were locations where other manufacturing activities took place.

Form

Cobble
A cobble is an alluvial, rounded stone.

Core (Core Tool)
A core tool is a core with a carefully shaped edge that probably was made to be used as a tool.

Flake (Flake Tool)
A flake tool is any implement made on a flake. This could be through simple edge retouch, or it could include more-extensive surface modification. For example, some projectile points retained evidence that they were made on flakes.

Unknown/Fragment
The Unknown/Fragment category was most often applied to tools that had flaking across all surfaces, so that the blank form could not be determined. Many projectile points and bifaces fell into this category.

Edge Type

The edge type is useful in inferring a tool's use or intended use. The edge type was identified by observing all modified and shaped edges.

Denticulate
A denticulate (exhibiting toothlike serrations) edge is present if any area on an edge has one or more intentional, sharp projections. This edge is unsuitable for many scraping activities but is very useful for cutting and sawing.

Even
An even edge has no sharp points and is uniformly even.

Flaking Type

The flaking type may give an indication of the tool's use, as well as divulging technological information. The classification used was based on the flaking type that was employed on the same margin.

Unifacial
Unifacial flaking occurred only on one face, usually creating a sharp but steep edge angle.

Bifacial

Bifacial flaking pertains to a single edge that produced two adjacent flaked surfaces. Although bifacial flaking frequently extended around the entire edge of an implement, it did not always do so. For example, some cobble choppers had short, bifacially flaked edges at only one end per chopper.

Degree of Flaking

Observation of the degree of flaking was intended to estimate the amount of effort invested in the forming of a tool. The designation used was obtained by estimating the proportion of margin that was modified (0–25, 26–50, 51–75, or 76–100 percent). For example, a projectile point (in most cases) has been flaked over 100 percent of its margin.

Size

Dimensions were recorded as maximum length and width for a complete piece.

Comments

The Comments field was used for recording additional observations, including information on burning, heat tempering, and manufacture break.

Projectile Points and Bifaces

We have focused on projectile points to determine when sites were in use, whether there were multiple uses of the same place at different times, and who used the sites. In addition to identifying styles, we closely examined the manufacturing technology and the raw materials used to make tools. Because projectile points were primarily used as hunting tools, they, more than all other flaked stone items, may be expected to be found at a distance from where they were originally made. This is especially true for projectile points associated with hunting-and-gathering groups that ranged over large territories in their annual movements. Consequently, the stone types used to make projectile points provide important information.

Recorded attributes for projectile points were similar to those used for the basic tool category. We looked at the condition of the projectile points, whether they were complete or broken, and, if incomplete, what portions were present. This can suggest the circumstances under which points might have been lost and discarded. For example, it was common practice to retrieve broken projectile tips and shafts for repair when they were broken during hunting activities. Often, the damaged pieces were brought back to camp, where they were either reworked into usable weapons or tools or discarded and replaced with new ones. Where broken portions were not recycled, archaeologists tend to recover incomplete or fragmented tools, particularly projectile bases damaged beyond repair. Therefore, in this study, we interpreted sites that contained mainly damaged projectile point bases as hunting camps.

Figure 12 illustrates the LOCAP projectile point styles, organized by period and cultural affiliation. There were many other pieces of points not shown in this figure, many of which were unidentifiable beyond a general period (e.g., Archaic or Formative). These general designations were based mainly on whether the pieces were deemed to be dart or arrow points.

Because of the abundance of information about culture and activities inherent in these artifacts, additional analysis was performed for projectile points and bifaces. This analysis was designed to elicit basic typological and technological information, so that data would be uniform for all specimens. A number of the same observations used for the other tools (see above) were applicable to projectile points, except that they were made in greater detail. Subsequently, each was identified to type. The choices were limited. For projectile points, we included type (dart or arrow) and style (by type name, such as San Jose, or by form, such as corner-notched).

Next, we attempted to identify temporal or cultural affiliation, based on the individual object and not considering context. We wanted to avoid circular reasoning. For example, a San Jose point might indicate that a site had a Middle Archaic period component; therefore, another point of a less obvious style might be identified as Middle Archaic, which would result in that component's becoming better represented. By assigning affiliation to individual pieces, we avoided this problem. This practice also meant that many of the pieces were not assigned affiliations.

Each piece was also assessed for its technological characteristics. This assessment began with the basic flaking method, such as percussion or pressure, followed by an assessment of the tool used (e.g., hammerstone or antler) and the form of the blank (e.g., flake or biface). A blank is defined as a usable piece of lithic material that is mostly unmodified, given that it reflects the initial stages of the tool-production process. In contrast, a preform is an unfinished, retouched tool that reflects the initial shaping of the item (Crabtree 1982).

Stone types recorded for projectile points were the same as those used in the rest of the flaked stone analysis. In this case, some of the designations were shortened, so that basalt meant fine-grained basalt, chert meant local chert, and sponge indicated local chert sponge.

We also considered it important to have a record of the condition of each piece, based on the portion that was present. Once again, we used the designations of complete, incomplete, and fragment. For fragments, we recorded base,

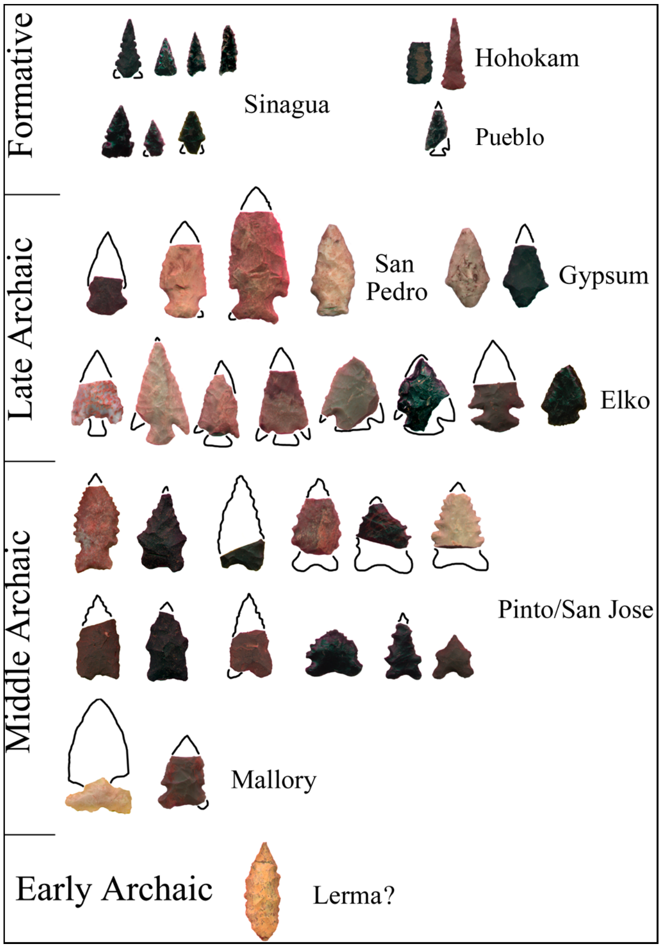

Figure 12. Diagnostic projectile points collected from the LOCAP area.

midsection, or tip. For each piece, regardless of completeness, we recorded maximum length, width, and thickness.

Finally, we recorded additional comments concerning special shape observations, such as the presence of serrated edges or evidence of breakage in manufacture or use. Although these observations varied by the piece, we tried to be consistent in our wording, so that the database could be efficiently and thoroughly searched.

Site Discussions

In the individual site discussions below, we avoid repeating information provided in the site descriptions in Volume 1. We confine ourselves to information that contributes to our understanding of the flaked stone collections. Certain site characteristics have been described again only when they pertain to overall site layout and locus designations. In this analysis, we consider these loci separately, and where a distinction appears in their flaked stone assemblages, these artifacts are discussed separately. We also take into account the covariation of the flaked stone with archaeological features and other artifacts, especially when these are temporally and culturally diagnostic, such as pottery.

For easy reference, the site discussions are presented in the same order as in Volume 1, in which they were organized from south to north. Although each site analysis resulted in four separate databases, each with multiple observations, the details are not repeated here. Only observations that are relevant to our interpretations are presented.

We also have made independent evaluations of cultural affiliation based primarily on projectile point styles. These evaluations often correspond well to other indications, but there are instances in which the projectile points seem to be out of place with other artifact classes. There are several possible explanations for this kind of discrepancy, and these are addressed in the individual discussions.

A note on the designation of individually discussed artifacts is appropriate. Whereas, in Volume 1, these artifacts were designated by their PD numbers (i.e., the places from which they were collected), in the following discussions and in the illustrations, they are referred to by their IDs (i.e., the unique numbers that we assigned to them during the analysis). For the projectile points and bifaces, a PD/ID concordance is provided in Appendix G:Table G.1. Appendix G:Table G.2 provides comparable information for the flaked-stone-tool collection.

For site-specific summaries of artifact counts by class and raw material, the reader is referred to Appendix G:Tables G.3–G.28.

AZ O:1:104/AR-03-04-06-902 (ASM/CNF)

AZ O:1:104/AR-03-04-06-902 (ASM/CNF) (Site 104/902) was an artifact scatter with several rock features, one of which was interpreted to be a field house. The site had two distinct prehistoric loci, one around the top and extending to the east of a prominent knoll (Locus B) and another to the west of and below the knoll (Locus A). Although the two areas were nearly adjacent, they were distinguished by a significant falloff in artifact density. The unexpectedly large size of the site necessitated collecting the debitage identified on the surface as PD 1, and all these artifacts were bagged together. Diagnostic artifacts (i.e., tools, bifaces, projectile points, and obsidian) were point-located, cataloged, and bagged separately. The flaked stone collection consisted of 1,454 artifacts, of which 1,376 were collected as PD 1 (see Appendix G:Tables G.3 and G.4).

Projectile Points and Bifaces

Twelve projectile points and bifaces were collected from Site 104/902 (see Appendix G:Table G.1), all from Locus B. Point styles were indeterminate, because the points either were not finished or were of nondiagnostic, unstemmed, and unnotched forms (Figure 13). Judging from technology, we are confident in placing five of them in general periods. Two (IDs 1405 and 1411) were Archaic period dart points or blanks, and both were made of fine-grained basalt. The other three (IDs 1427, 8632, and 8638) were Formative period arrow points or blanks, two of which were made of obsidian and one of which was made of local chert. The remaining seven pieces were equivocal bifaces and could have been from either period. Three (IDs 1179 [not illustrated], 1414, and 8634) were local chert, one (ID 1145) was quartzite, one (ID 1317) was sponge, and two (IDs 1409 and 1417) were fine-grained basalt. Considering the general paucity of fine-grained-basalt artifacts in any of the Formative period sites in the project area, we are reasonably certain that these last two bifaces corresponded to the Archaic period use of the site.

It is unclear what activities would be indicated by the presence of the points and bifaces. They were not clearly hunting losses, and manufacture breaks were also not obvious. The lack of identifiable projectile points is curious, and we think it may relate to collecting in more-recent times. The site contains ample evidence of historical-period activity, especially in Locus C, a temporary historical-period habitation area located on the knoll top. On the other hand, some of the earlier Archaic tools could have been removed from the site when abandoned, or discarded items could have been scavenged and reused by later Formative period groups.

Tools

Whereas projectile points and bifaces were relatively uncommon, other tool forms were fairly well represented. Twenty-five flaked stone implements were found scattered across the site (see Appendix G:Table G.2). All but 1 were made of local material. Eighteen tools were made of flakes; 11 were retouched to form denticulate edges, and 7 exhibited even edge retouch. Twelve of these tools were designated formal types, including 8 scrapers, 1 graver, 1 graver-spokeshave, 1 chopper, and 1 knife-scraper. One of the scrapers (ID 8633) was interesting, because it was made on a biface (see Figure 13g). It had a typical convex working end that was made with unifacial percussion retouch, which is commonly observed in end scrapers, but the base was straight and had slightly flaring basal corners, with the dorsal side exhibiting a distinct, basal-thinning flake scar that would be called a flute on a projectile point. The sides above the base had been lightly ground. When we first saw this piece, we thought it might be a Paleoindian Clovis point that had been reworked into an end scraper. This is still a possibility, but the bifacial-flaking technology is not reminiscent of Clovis work. It will remain an enigma until similar implements are found in a good archaeological context or we know more about local Clovis technology.

Formal and informal tools indicate that many different tasks were conducted. What exactly these tasks were and why this particular location was chosen are not clear from the flaked stone tools. The site setting provided little insight into what attracted people to this particular spot.

Cores

Cores were similarly scattered across the site without exhibiting any evident concentrations. Thirty-two cores were collected (see Appendix G:Table G.3), of which 5 were of nonlocal material and 27 were of local stones. Overall, the cores exhibited fairly intensive flaking, with 7 exhausted, 14 with some potential, 9 with good potential, and 2 only tested (1 or 2 flakes removed). Another indication of intensive use was the presence of 9 discoidal cores. The 5 nonlocal cores did not reflect intensive reduction; these included 2 with good potential, 2 with some potential, and a tested cobble. Because 4 of the 5 artifacts were classified as Other Chert, these may indeed have been local materials. The remaining core was made of fine-grained basalt.

Debitage

In total, 482 flakes and 903 pieces of debris were collected (see Appendix G:Table G.3). This is a fairly high debris-to-flake ratio (65 to 35 percent) and supports the interpretation of intensive use. There were 387 flakes and 27 cores of local material, yielding an average of 14.3 flakes per core. This is not a particularly high ratio, but it does indicate that significant core reduction was taking place.

Local materials accounted for 387 flakes (80.3 percent), and 95 nonlocal flakes (19.7 percent) made up the rest. This was one of the highest ratios of nonlocal to local flakes from any of the project sites. Within the category of 95 nonlocal flakes, 14 were obsidian (14.7 percent), 33 were fine-grained basalt (34.7 percent), and 39 were Other Chert (41.1 percent); the remaining 9 were in the Other category of materials (9.5 percent). Based on distributions of material for diagnostic projectile points, it is likely that most of the obsidian flakes were of Formative period origin and that most, if not all, of the fine-grained-basalt flakes were representative of the Archaic period use of the site. The period during which the nonlocal chert was used remains unknown.

Summary

Site 104/902 encompassed a broad area with clear evidence of intensive use. It appears that there were two distinct

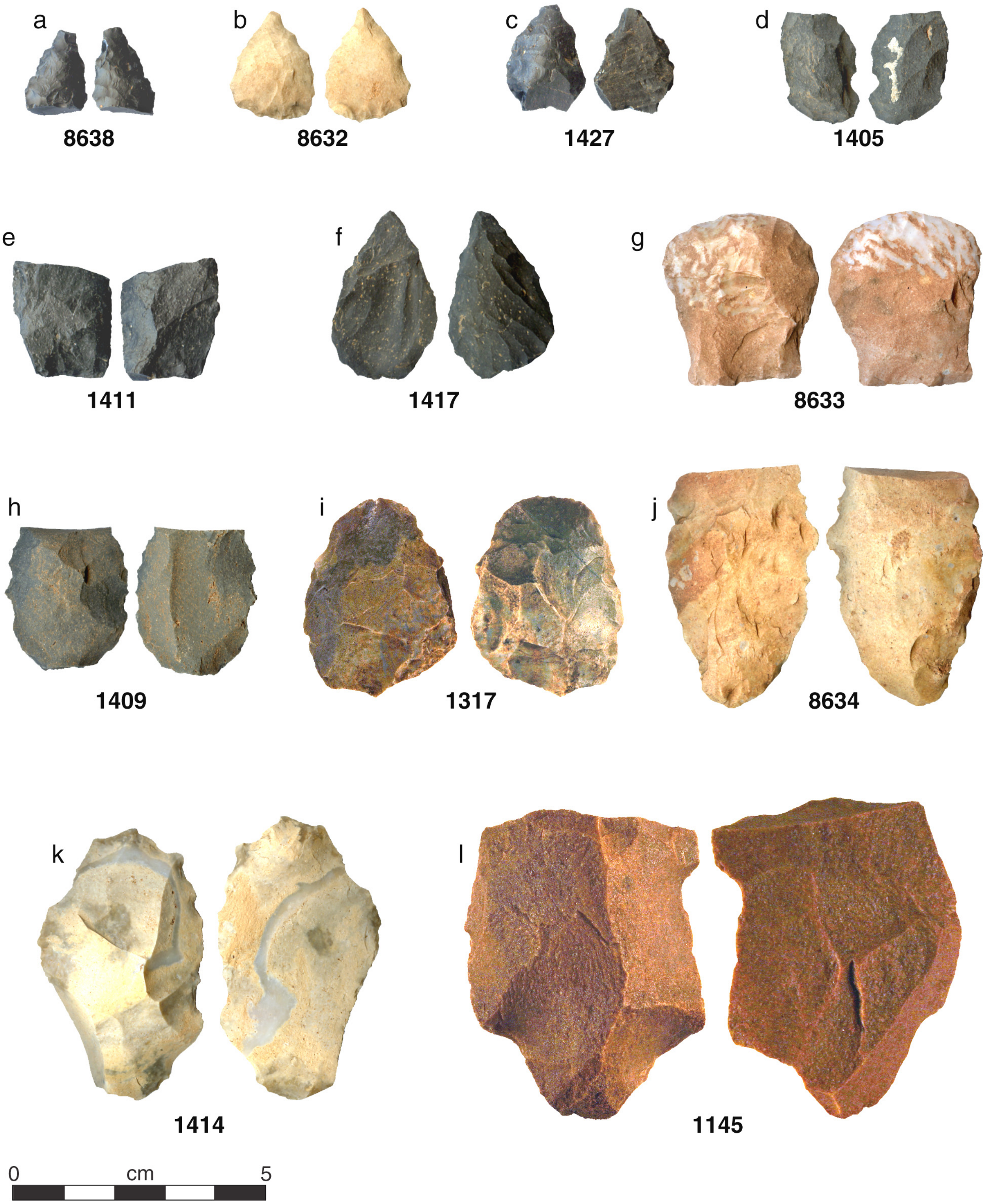

Figure 13. Flaked stone tools from Site 104/902: (*a–e*) projectile points; (*f–l*) bifaces.

times of occupation: one during the Archaic period and another during the Formative period. Locus A, which contained the field house and most of the pottery, seems to have been used exclusively during the Formative period, whereas Locus B was occupied during both periods. The site was located relatively close to Spring Creek, which holds permanent water in this area. The site's proximity to available water, together with the fact that the knoll may have been a good location for game monitoring, may have made this location very attractive to hunter-gatherers, as well as farmers.

AZ O:1:105/AR-03-04-06-838 (ASM/CNF)

Site 105/838 was one of two sites in the project area at which architecture was excavated: three pit structures in Locus A and two masonry rooms in Locus B. Several additional masonry rooms were left unexcavated in Loci B and C. Although much of the flaked stone debitage on the surface was collected as a single unit (PD 1), the excavations produced substantial collections directly associated with the occupations in Loci A and B, specifically the subsurface architecture. Therefore, our analysis has been able to distinguish and compare these collections. We also examined the site as a whole, because, with the exception of 3 Archaic period dart points, there was little evidence of significant pre–Formative period use of the locality. The flaked stone collection consisted of 2,800 artifacts, of which 550 were collected from the surface; the rest were collected from the excavations. Of the artifacts, 2,745 were debitage, 30 were cores, 13 were bifaces and projectile points, and 12 were tools (see Appendix G:Tables G.5 and G.6).

Projectile Points and Bifaces

Site 105/838 yielded a total of 13 artifacts classified as projectile points or bifaces (Figure 14) (see Appendix G:Table G.1). Four were fragments of arrow points that were broken during manufacture (see Figure 14c–f). Considering the size, complexity, and intensity of occupation, it is interesting to note that all of these pieces came from the same context, specifically the upper fill of a cobble-lined pit room in Locus B (Feature 13). Broken projectile points often provide more information about manufacturing techniques than complete ones. In this case, thin obsidian flakes were being selected and then shaped into points by pressure flaking. It is not clear whether flakes were being struck from cores specifically to produce points or whether the points were being made from the by-products of another manufacturing process. We believe the latter to be true, because no obsidian cores were found at this site or at any other site in the project area. The production of obsidian bifacial knife blades from large blanks produces precisely the kind of flake used for the type of arrow point found at Site 105/838. The only problem with this hypothesis is that no obsidian knife blades, not even broken pieces, were recovered from any of the sites (although one may have been observed during an earlier survey on AZ O:1:137/AR-03-04-06-482 [ASM/CNF] [Site 137/482], at the opposite end of the project area [see below]).

One way to determine whether knife blades were being made at Site 105/838 is to examine the inventory of obsidian flakes. In total, 72 pieces of obsidian debitage were recorded, but only 7 of these have been classified as biface flakes. An additional 15 were classified as flakes, and the rest were debris. If bifaces were being made at Site 105/838, and even if some flakes were being selected to make arrow points, there should have been many more obsidian biface flakes. The origin of the flake blanks for arrow points is difficult to identify with any certainty. Site 133/561 yielded a dense concentration (140 pieces) of obsidian debitage in a very tight cluster (see below), but this concentration did not contain a single core or biface.

It is conceivable, then, that a knapper could have come across a pile of waste flakes at another site and selected a few to make arrow points or, alternatively, that some form of exchange was taking place. It is also conceivable that Formative period knappers scavenged Archaic period sites for flake blanks to make arrow points. It is evident that an arrow point maker was living at Site 105/838, probably late in its occupation, and that this knapper met with quite a few failures in the process. The results of these failures were clustered in the upper fill of the cobble-lined room.

Fragments broken in manufacture are not ideal for stylistic analysis, but in this case, it appears that only one of these fragments was intended to be notched. The rest were intended to be triangular, conforming well to Sinagua forms. The single exception (see Figure 14c) is perhaps significant. Although it was broken during the notching process and only a small remnant of the notch was left, it was apparent that the notch came in from an angle. This is indicative of corner-notching, which is more difficult to achieve than side-notching. It is unlikely that the angle was an accident. In Figure 15, we have reconstructed how it probably would have looked had it been completed. What emerged in the reconstruction is a classic example of a Pueblo II notched point (see Bradley 2000). This is not a form typically associated with Sinagua sites. If it had been found in another association, even at Site 105/838, we would hardly have been surprised. There is ample evidence of eleventh-century use of the project area by people connected to, or interacting with, Pueblo peoples who made this style of arrow point.

The projectile points further included three Archaic period dart points, all found in Locus A. Two points (see Figure 14j and k) were essentially complete and functional,

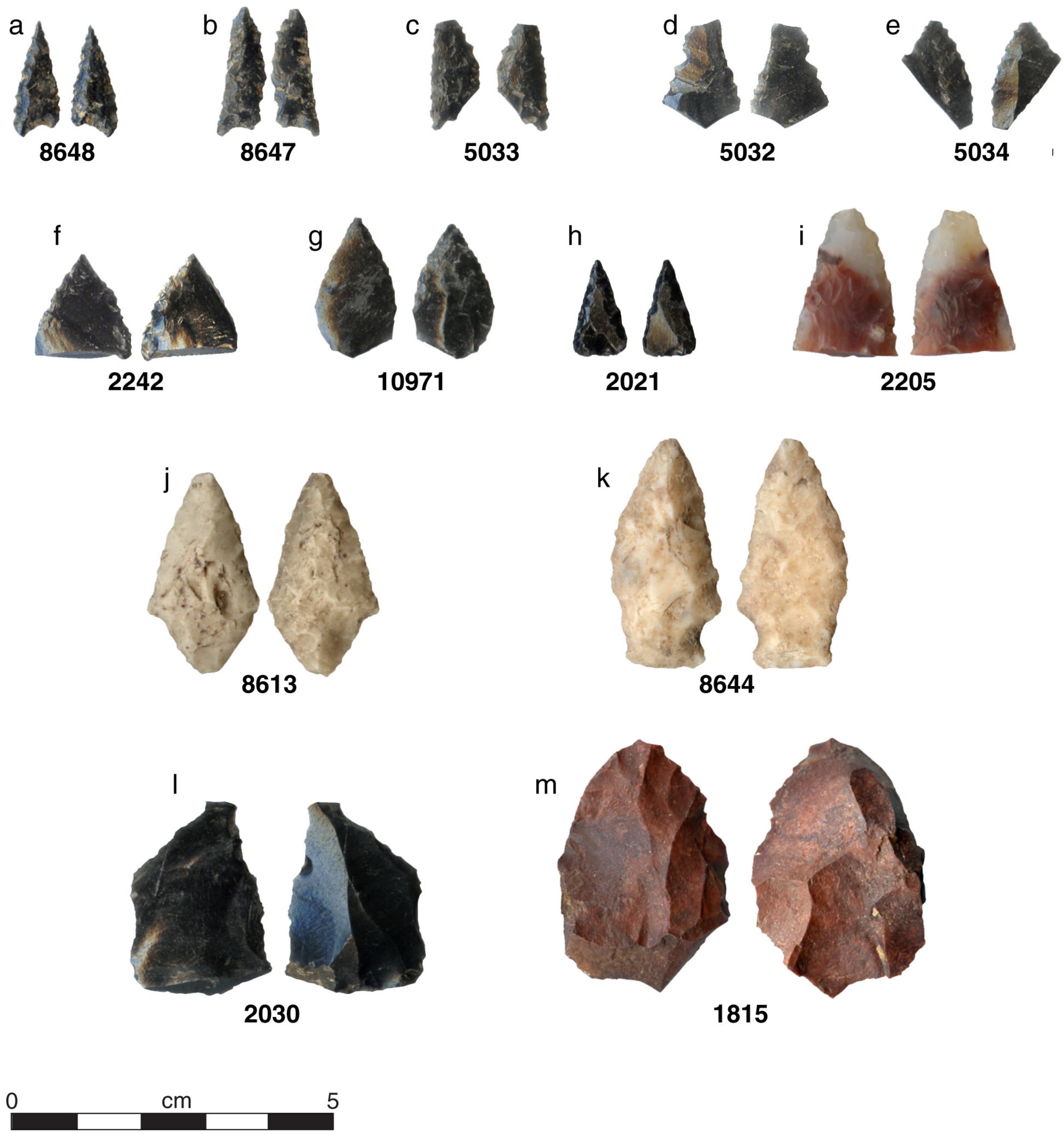

Figure 14. Flaked stone tools from Site 105/838: (*a–k*) projectile points; (*l* and *m*) bifaces.

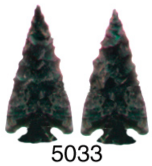

Figure 15. Reconstruction of corner-notched arrow point from Site 105/838.

whereas the third was a tip and not further identifiable (see Figure 14i). All three pieces were of local chert. One (ID 8644) (see Figure 14k) was a San Pedro point found in the fill of a pit structure (Feature 37) probably dating to the Squaw Peak phase, the local variant of the Early Formative Agricultural period (A.D. 1–650). The presence of a Late Archaic period–style point in this structure is in keeping with its temporal context. The other identifiable piece was a Gypsum-style point (ID 8613) from Test Pit 258 (see Figure 14j). The third dart point (ID 2205), a tip made of agate (see Figure 14i), was found in Feature 23, a Camp Verde phase pit structure. These last two points probably were picked up by the Sinagua inhabitants of the site.

The collection of earlier projectile points by Pueblo people is well documented for both the prehistoric and the historical period (Bradley 2000), but this collecting behavior seems to be absent in Archaic period cultures. The reasons for collecting points are many, and we can only speculate about which among them would explain behaviors in the past. Old points, as well as newly made ones, are commonly used by modern Pueblo peoples and other groups throughout North America for ritual and symbolic purposes. Considering the number of Archaic period dart points found during this project—despite the concentrated collecting efforts of amateurs—they must have been commonly encountered during the Formative period.

The single chert biface (ID 1815) (see Figure 14m) could not be classified to any particular period, although the nonmarginal, percussion flake scars suggest that it was probably Formative period in age. The presence of nine local-chert biface flakes at the site supports this interpretation, if one rules out an Archaic period occupation. In any case, this single item reveals little about the use of the site.

Tools

Only 12 artifacts have been classified as tools (see Appendix G:Table G.2). When one considers the intensive use of the site and the great occupational time depth (perhaps as long as A.D. 1–1500), this appears to be a rather paltry number. Two tools were made from cobbles, and another 4 were considered core tools. Only 3 were made from flakes, and the remaining 3 could not be classified to blank form. Edge forms were divided between denticulate (n = 6) and even (n = 6). Although there were few retouched tools, they consisted primarily of formal-tool types, like scrapers (n = 4), a chopper, a drill/spokeshave, a graver, a knife/scraper, and a scraper/biface. In our experience, low proportions of retouched tools are a characteristic of Formative period flaked stone assemblages throughout the U.S. Southwest (see Vierra 1993).

Cores

It did not surprise us to find a relatively large number of cores (n = 30). The architecture and pottery clearly indicated that the site was used, if only intermittently, over several centuries and that habitation was, at times, intensive. These are exactly the circumstances that would lead us to expect to find many cores. Even so, it seems that cores were underrepresented. There was an average of 26.1 core flakes for every core. Although there were some cores (n = 7) that were considered to have good potential for more flakes, they numbered only 23.3 percent of the cores. More cores (n = 15) exhibited only some potential (50 percent), and there were 5 (16.7 percent) that we considered exhausted. In addition, only 3 cores were tested (2 nodules and 1 cobble). Considering the ready access to suitable raw material, these proportions indicate site use that was intensive, long-term, or both. Only 2 of the cores may have been made of nonlocal material, and these were classified as Other Chert.

Debitage

Debitage consisted of 1,916 pieces of debris, 782 core flakes, 11 uniface flakes, and 36 biface flakes. The debris-to-flake ratio (70 to 30 percent) at Site 105/838 was high, further supporting our interpretation of intensive use of the site. The biface flakes were distributed fairly evenly across the various contexts, although the highest ratios were found in two features: Feature 37 (the Early Formative period pit structure in Locus A) and Feature 13 (the Tuzigoot phase masonry room in Locus B). This is not surprising, because (1) the emphasis on bifacial technology that was characteristic of the Archaic period continued during the Early Formative period, and (2) Feature 13 clearly was a location where arrow points were manufactured.

Material

There were no appreciable differences found in raw-material uses among the loci; therefore, we evaluated the whole site as a single unit. The proportions of use of local vs. nonlocal raw material at Site 105/838 were similar to those at most other sites in the project area, although the site yielded a slightly greater proportion of nonlocal stone. Of the flaked stone artifacts whose material types were identified, local stone made up 82.9 percent. Of the nonlocal stone, obsidian was 52.5 percent, fine-grained basalt was 11.4 percent, Other Chert was 32.3 percent, and stone in the Other category made up the final 3.8 percent. These percentages rank almost squarely in the middle of those for all sites in the project area. The other site consisting only of a Formative period component, Site 131/37, revealed very different proportions: obsidian was scarce, and Other Chert dominated. This is curious, because Site 105/838 is several kilometers farther south than Site 131/37 and therefore farther from the northern obsidian sources and closer to the sources of Other Chert, which consists primarily of Perkinsville jasper.

Summary

Site 105/838 was a Formative period habitation site that represented at least three temporally distinct occupations, as based on dated architecture and ceramics. The Tuzigoot phase (A.D. 1300–1400/1425) component of the site probably was associated with a large Honanki and Tuzigoot phase pueblo, the Spring Creek site, located nearby on private land (Colton and Bartlett 1949). Of the temporally diagnostic flaked stone artifacts, a San Pedro dart point corroborates the Early Formative period age of a pit structure (Feature 37) suggested by archaeomagnetic (AM) evidence, whereas post–A.D. 1200 Sinagua arrow points corroborate the Tuzigoot phase assignment, based on ceramic evidence, of a masonry-lined pit room in Locus B.

The one notable difference between this site and many others in the project area was the relatively high proportion of debris, but this probably is the result of the recovery method (1/4-inch-mesh screening of subsurface materials at this site, as opposed to surface collecting at most other sites) rather than cultural processes. The use of raw materials was similar to that at many other sites, but the relatively high proportion of obsidian in comparison to that of the southern valley location is more likely to be a result of cultural ties than of mere proximity.

AZ O:1:85/AR-03-04-06-428 (ASM/CNF)

AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428) was a dispersed scatter of flaked stone artifacts along the west bank of Spring Creek, immediately opposite Site 105/838. The flaked stone collection consisted of 244 artifacts (see Appendix G:Tables G.7 and G.8), of which 196 were collected from the surface; the others were collected from the excavation units. The site included a Middle Archaic and an Early Formative period component, the latter represented by a series of roasting pits and other thermal features from which maize (*Zea mays*) was recovered. The presence of 2 small pieces of pottery indicated that the site was visited during later times.

Projectile Points and Bifaces

Three projectile points were recovered from Site 85/428 (Figure 16) (see Appendix G:Table G.1). All were point-located on the surface. Two (IDs 3406 and 8621) were nearly complete Pinto/San Jose dart points with only small portions of the tips missing. The third (ID 3407) was a tip fragment that probably came from another Pinto/San Jose point. All three were made of fine-grained basalt. The two nearly complete points could have been retipped with little loss of length and probably would still have been usable. One point was recovered from the north end of the scatter, the fragment was recovered from the south end, and the other point was recovered from near the features, which were located in the central portion of the site, close to the creek. No bifaces were found at this site.

Tools

Four unifacially retouched tools were recovered, two from the site surface and the others from the excavations (see Appendix G:Table G.2). Two were core tools, and the other two were made on flakes. Three had denticulate edges, and the fourth exhibited evidence of even retouch, designating it a scraper. Three of the tools were made from local chert, and one was classified as Other Chert. The flake tools could have been used for cutting or scraping activities, and the core tools could have been used for processing fibrous plants, such as agave.

Cores

Three cores were found, all of local chert and chert/quartzite. Two retained some potential for additional flake removal, and one had only been tested, as indicated by one or two flake removals.

Debitage

Eighty-nine flakes and 145 pieces of debris made up the debitage collection. Although this number is low, it equals nearly 30 flakes per core, and if the tested core produced only a couple of flakes, there were approximately 45 flakes for each of the other cores. This is an extremely high ratio. The ratio of debris (62 percent) to flakes (38 percent) is also high. These ratios suggest that more flaking took place at the site than is represented by the cores. That 2 of the tools were made on cores suggests that additional core tools were manufactured on-site but were discarded elsewhere after use.

Most of the 89 flakes (94.4 percent) were core flakes; only 4 biface flakes and 1 uniface flake were present. One of the biface flakes was of the same fine-grained basalt

Figure 16. Projectile points (*a–c*) from Site 85/428.

from which the projectile points were made, 2 were of Other Chert, and the fourth was of local chert. Although the number of flakes made from nonlocal material was small (n = 18), the overall proportion in the collection was relatively high (20.2 percent). They consisted of 1 obsidian flake (5.6 percent), 8 fine-grained-basalt flakes (44.4 percent), 6 Other Chert flakes (33.3 percent), and 3 flakes classified as Other (16.7 percent).

Summary

As determined from the two definite and one probable Pinto/San Jose–type dart points, Site 85/428 included a Middle Archaic period component that appears to have been restricted to the surface. This earlier component was poorly defined, and aside from the three dart points, we were unable to separate the associated artifacts from those of the later occupation. The site probably served as a hunting and butchering camp. The near lack of evidence of the manufacture of projectile points or bifaces, coupled with the fine-grained basalt used for the dart points, is suggestive of a small, family-sized group coming from the north, with "weapons in hand." The subsequent component focused on a roasting area that was used primarily for plant processing. The presence of maize indicated use by agriculturists. As determined from the absence of ceramics and the results of AM dating and dating by accelerator mass spectrometry (AMS), this site component dated to the Early Formative period (Squaw Peak phase).

AZ O:1:77/AR-03-04-06-869 (ASM/CNF)

Site 77/869 was a sparse scatter of flaked stone, ground stone, and pottery at the base of a hill. Flaked stone debitage was collected as PD 1, and all other flaked stone artifacts were given unique PD numbers and collected individually. The flaked stone collection consisted of 80 artifacts, including 2 projectile points, 2 cores, 34 flakes, and 42 pieces of debris (see Appendix G:Tables G.9 and G.10).

Projectile Points and Bifaces

One of the projectile points was a dart point midsection made of local chert (ID 8636) (Figure 17) (see Appendix G:Table G.1). It was pressure flaked and had deep serrations on both edges, lending it a sawlike appearance. This piece clearly dated to the Archaic period but could not be placed into a finer time sequence. As determined from overall style, it may have been Middle Archaic period in age. A second dart point fragment (ID 8635) was made of obsidian and was probably corner-notched (see Figure 17). It was well made and finished by pressure flaking. Though fragmentary, it appears to have been an Elko Corner-notched point, a style that dates to the Late Archaic period. No bifaces were found at this site.

Tools

No flaked stone tools were found at this site.

Cores

The two cores were made from local material. One retained some potential, and the other exhibited good potential, for further flake production.

Debitage

Thirty-four flakes and 42 pieces of debris constituted the entire debitage collection. No biface or uniface flakes were

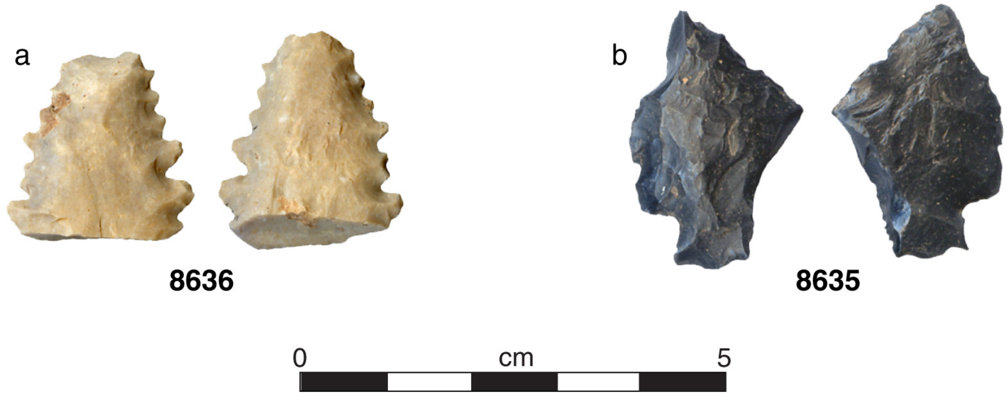

Figure 17. Projectile points (*a* and *b*) from Site 77/869.

present. All but 4 flakes were made from local materials; the flakes made from nonlocal materials included 1 of obsidian, 1 of Other Chert, and 2 in the Other category.

Summary

Little can be said about this site on the basis of the small flaked stone collection. The projectile points indicate use during the Late (and possibly Middle) Archaic period. The ceramics suggest a subsequent occupation during approximately A.D. 1075–1180.

AZ O:1:131/AR-03-04-06-37 (ASM/CNF)

Site 131/37 was an extensive artifact scatter located on the top and slopes of a low basalt ridge. Based on physiography and types of artifacts present, three different localities (Loci A–C) were identified. Locus A occupied the flat, central portion of the site, on the lower west slope, and had the greatest artifact diversity; Locus B was a basalt quarry located on the top and southeast flank of the ridge; and Locus C was on the northwest slope and primarily contained ceramics. All debitage was collected as PD 1, and diagnostic flaked stone artifacts were collected individually and assigned unique PD numbers. As an exception, the basalt quarry in Locus B was sampled by means of 16 contiguous 5-by-5-m collection units, although, again, all diagnostic flaked stone artifacts were collected individually. The flaked stone collection consisted of 1,444 artifacts, including 3 projectile points, 6 bifaces, 9 tools, 40 cores, and 1,386 pieces of debitage (see Appendix G:Tables G.11 and G.12).

Projectile Points and Bifaces

Two obsidian projectile point preforms were found at Site 131/37, one (ID 5585) in Locus B and the other (ID 5699) in Locus A (see Appendix G:Table G.1). The first was complete, and the second was a fragment. Both appeared to be unfinished and never used as projectiles (Figure 18). This is curious, because there is no evidence to suggest that they were manufactured at the site. Although their exact forms could not be reconstructed, their manufacturing technology and size indicated that they probably were from the Formative period. A third projectile point (ID 5700) (not illustrated) was unifacially flaked from local chert and also could not be matched to a specific style.

Six direct-percussion bifaces were also recovered from the site (see Figure 18). Only two of these (IDs 5698 and 5705) were complete, but it appeared that neither was a finished tool. One (ID 5705) was only slightly modified from a flake blank. The rest were fragments and represented different degrees of flaking, although all exhibited direct, probably hard-hammer, percussion. The use of a hard-hammer percussion technique indicates that the bifaces may have been in an early stage of reduction, with flakes removed for initial thinning of the artifact. All were recovered from Loci A and B. Only six chert biface flakes were identified in the debitage, one flake per biface. Clearly, there must have been additional biface flakes, but the hard-hammer flaking technique may have rendered them indistinguishable from small core flakes. Either the bifaces were not being made at the site, which seems unlikely, or the debitage that resulted from their manufacture was not distinctive.

Tools

The nine tools included four scrapers, a spokeshave, and four simple, retouched pieces (see Appendix G:Table G.2). Two exhibited bifacial edge retouch, and the rest had unifacial retouch. Seven were made on flakes, one was made on a piece of debris, and one was a modified core. Six of the tools exhibited even edges, and three exhibited denticulate edges. The denticulate edges were situated on two scrapers and the spokeshave. Raw materials consisted of local

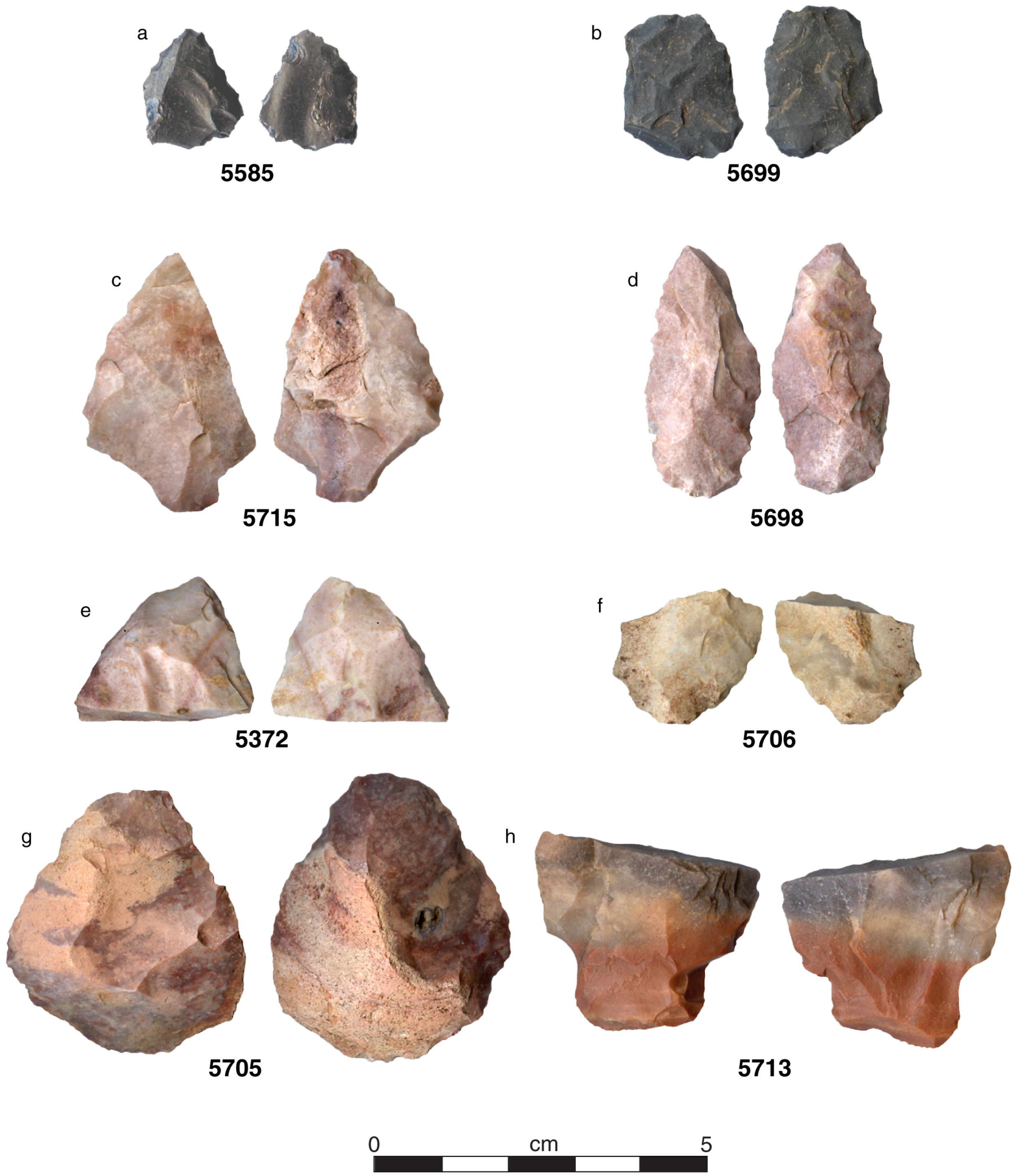

Figure 18. Flaked stone tools from Site 131/37: (*a* and *b*) projectile points; (*c–h*) bifaces.

chert (n = 5), chert sponge (n = 2), obsidian (n = 1), and Perkinsville jasper (n = 1). These tool types indicate that scraping and cutting activities took place at the site. The small number of tools does not indicate a long or intensive use of the area, and their haphazard distribution across the site did not identify specific activity areas.

Cores

Locus B was an area of naturally present, coarse basalt that had been exploited, probably for the manufacture of manos and metates. Because of the large number of modified pieces of basalt and the lack of finished tools, the locus was sampled by means of 16 5-by-5-m collection units, which yielded 485 pieces of debris, 137 flakes, and 29 cores. These cores were large pieces of basalt from which large flakes and pieces had been removed. The investigators at the site estimated that there were probably more than 5,000 coarse-basalt artifacts in the area (see Chapter 9, Volume 1).

The remainder of the site yielded 11 additional cores. Two were of nonlocal material (1 of fine-grained basalt and 1 of Perkinsville jasper), 2 were of coarse basalt, 4 were of local chert, 1 was of quartzite, and 2 were of chert sponge. Only 1 local-chert core was considered exhausted, whereas the rest retained either some or good potential. This core collection indicates that raw material was not difficult to obtain and that the site probably was used intermittently over a long period.

Debitage

Including the coarse-basalt artifacts associated with the quarry area in Locus B, we analyzed 1,386 pieces of debitage. Debris (n = 929) constituted 67 percent of the debitage, and the remainder (n = 457) consisted of flakes. Of these, only 6 were biface flakes and 3 were uniface flakes. This indicates that tools were not being manufactured in any quantity at the site and that most probably were brought to the site already made, with the possible exception of the small bifaces discussed above.

Raw Material

Excluding the coarse basalt, most (88.4 percent) of the flakes at the site were of locally available stone (n = 274). The collection was dominated by chert (76.3 percent), followed by chert sponge (18.2 percent) and quartzite (5.5 percent). These proportions were typical of those for many of the other sites in the project area and probably reflect the approximate proportions of the stone types available in the nearby geological deposits. If this is true, there seems to be no evidence of preference for any given stone at this site.

Nonlocal materials were also represented in the flaked stone collection. Excluding the coarse basalt, they made up 13.3 percent of the assemblage. Nonlocal chert (mostly Perkinsville jasper) constituted 51.1 percent, followed by fine-grained basalt at 31.1 percent, obsidian at 13.3 percent, and Other at 4.4 percent. There was also one core each of the fine-grained basalt and jasper; neither was considered exhausted. The relative paucity of obsidian is interesting, because it is well represented at other sites and originates from the same general area as the fine-grained basalt. If anything, there seems to have been a selection against it at this site.

Summary

The flaked stone collection from Site 131/37 was mostly the result of intensive use of a natural outcropping of coarse basalt in Locus B. The remaining tools, projectile points, and debitage indicate a short-term use of the area, although a reasonably wide range of activities was represented. When the pottery is considered, it is clear that most or all of the activity took place during the Formative period, between approximately A.D. 800 and 1200. The transient nature of the assemblage and the distributions and clusters of artifacts may indicate that the cultural materials accumulated over a long period, possibly as the result of camps related to coarse-basalt quarrying. The presence of nonlocal materials that originated to the south (jasper) and to the north (fine-grained basalt) indicates that the groups using the site may have approached it from different directions and probably at different times. The paucity of projectile points probably is the result of intensive collecting during more-recent times, or the coarse-grained basalt may not have been conducive to projectile point manufacturing.

AZ O:1:53/AR-03-04-06-745 (ASM/CNF)

Of all the project sites, Site 53/745 was by far the most interesting and most challenging in terms of artifact interpretation. First, it covered a very large area and clearly represented multiple periods and archaeological cultures. Second, it was located in a strategic position in relation to surrounding resources, both for hunter-gatherers and for farming people. That virtually all recovered artifacts derived from surface contexts presented us with a challenge, in that there was significant potential for mixing through natural erosion, as well as through occupational overlap. Furthermore, the site had been known for a long time and was easily accessible to collectors. For these reasons, we decided that each artifact had to be point-located, to recover data in a manner that would allow the clearest understanding of the site's cultural and use history. In this way, individual objects, groups of objects, features, and the land surface could be associated. This decision was made shortly after beginning fieldwork at the site, at which time a relatively small number of artifacts had already been collected in different ways. This manner of collecting and recording artifacts will allow the archived data from this site to continue to be used as new questions arise in the future, not only in the project area but in the larger Verde River valley area, and perhaps even in the U.S. Southwest.

The site's flaked stone collection consisted of 4,617 artifacts (see Appendix G:Tables G.13 and G.14), of which 4,318 were individually point-located on the site surface. In total, 187 were collected from the Locus A surface as PD 1, 102 were derived from collection units in Locus E, 4 were point-located on the surface of the features, and 6 came from a test pit and a trench in the ADOT ROW.

Site Layout

Site 53/745 covered a low, broad, irregular-shaped, basalt-covered hill. Based on distinct artifact concentrations and particular land surfaces, 14 loci (A–N) were defined at the site. For the purposes of our analysis, we grouped the artifact information for each locus into a separate database, so that direct comparisons could be made (Figure 19). A few scattered artifacts were not located within any of the loci.

The loci grouped into two major areas of the site, the northeast and southwest. Locus A was a small area on a hillslope, just north of a small saddle in the approximate center of the northeast area. Locus B was a small area on the saddle, adjacent to and south of Locus A. Locus C was the southern equivalent of Locus A, although it was spatially less discrete and there was no obvious break from Loci D and E. Located on the hillslope, below the saddle and to the south, Loci D and E covered relatively large areas. The boundary between them was fairly arbitrary but corresponded to a shallow rill. The separation between Loci E and L was arbitrary. Locus F was a medium-sized area on the lower hillslope, to the northwest of the saddle. It had fairly well-defined artifact-density boundaries, except where it was adjacent to Locus L. Locus L was a large but low-density artifact scatter situated on the hillslope, to the southwest of the saddle; it was the southwesternmost cluster in the northeast site area. Its boundaries were defined by a slight drop-off in artifacts. Loci M and N were located on the hillslopes, to the east and northeast of the saddle. They had reasonably well-defined boundaries.

Loci in the southwestern area were distributed around a small rise in the land surface. Locus G was located directly on the high point, and its boundaries were defined mainly by the upper contour of the hill. Loci G, I, and J were situated on the surrounding hillslopes and were also mainly distinguished by their locations rather than by any distinctive separations in artifact density. Locus K was another large area characterized by a relatively sparse artifact density, like Locus L.

When interpreting these artifact distributions, we first questioned whether the loci represented anything cultural in terms of either types or times of use. Because no absolute dates were derived from the site, it was not possible to determine when these loci were produced, except by examining the artifact types that could be assigned to general periods. Most relevant were the pottery sherds and projectile points.

Projectile Points and Bifaces

Projectile points (n = 18) were well represented in the Site 53/745 collection (Figure 20) (see Appendix G:Table G.1). Considering the relatively common presence of Middle Archaic period points at other sites in the project area, it is curious that only two were found at this large site. This is difficult to explain in terms of site location and relation to resources. There is no apparent reason why this would not have been a desirable camp location during these times. The two points dating to this period were a Gypsum-style point (ID 8623) and a Pinto/San Jose–style point (ID 10533).

Projectile points from the Late Archaic period through the late prehistoric period were recovered from around the site (Figure 21). Late Archaic period points were found in Loci A, C, E, G, and K and possibly in Loci F, L and M. This distribution covered most of the site, including the northeast and southwest areas. The two styles of Late Archaic period dart points that were recovered, Elko Corner-notched (IDs 7699, 8283, 8619, 8628, and 10,520) and San Pedro (IDs 7729 and 8627), may represent different groups entering the area from different directions (north and south, respectively), but their distribution on the site should have overlapped rather than been separate. An Archaic period point of indeterminate type (ID 8625) also was recovered. A unifacially flaked piece of dacite (ID 8045) was a projectile point preform.

Formative period arrow points, although widely distributed, were concentrated in just a few of the artifact loci. Of seven points and fragments, two were Hohokam (IDs 8626 and 8645), two were Sinagua (IDs 8624 and 8643), and the remaining three could be assigned only to the late prehistoric period (IDs 6395, 6616, and 9692). The two Hohokam points probably dated to the Sacaton phase (approximately A.D. 900–1100) (see Gladwin et al. [1965] for point typology and Haury [1976] for dating) and were found in Loci C and K. Only a few Hohokam sherds were recovered from the site, and they also came from the Locus C area. A Hohokam presence is clearly evident at the site, and this joint presence of pottery and arrow points may indicate that the occupation consisted of more than a short visit by an individual.

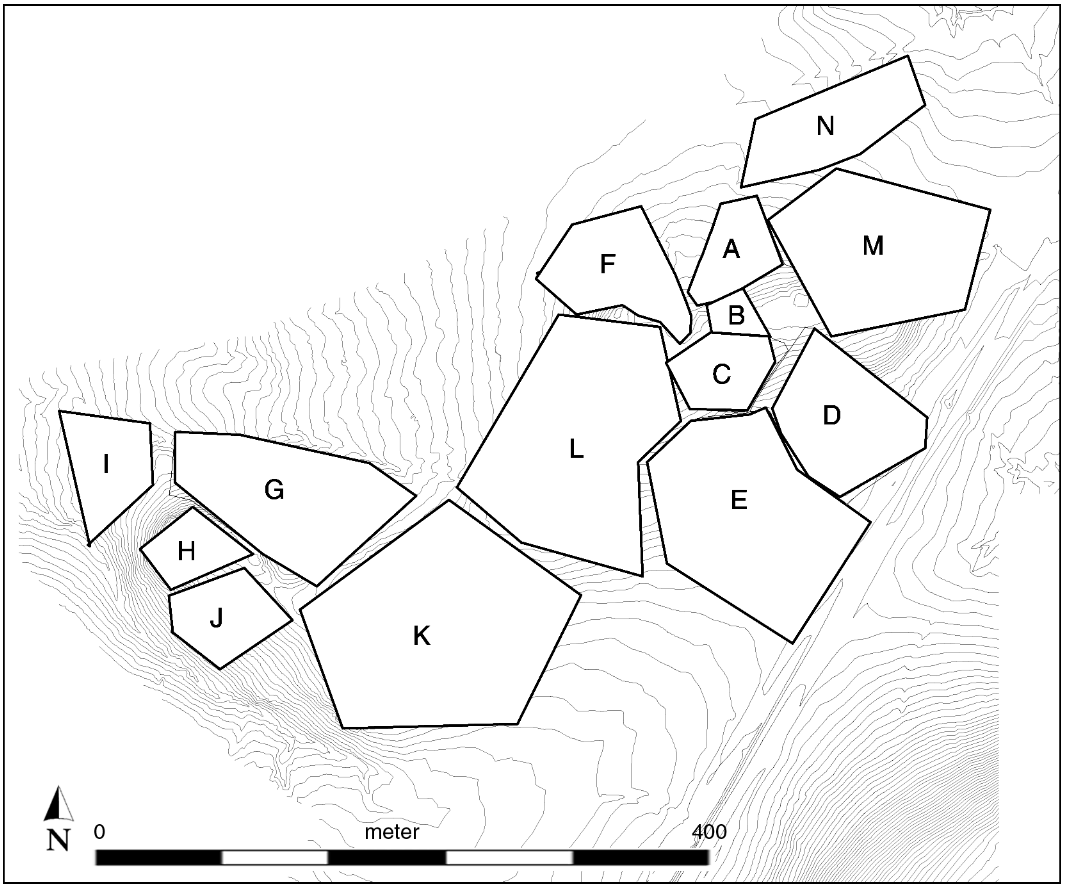

Figure 19. Loci identified at Site 53/745.

Although recovered from different artifact clusters (Loci A and E), the Sinagua points both came from the hill on the east side of the site. This is also an area where a fair amount of pottery was found, some of which was clearly Sinagua. Like the Hohokam evidence, the joint presence of pottery and projectile points probably indicates more than a single visit by a hunter.

Sometimes, the lack of items is also suggestive of what did and did not take place at a site. Of particular interest in this case is the absence of projectile points diagnostic of Pueblo people, because Pueblo pottery was relatively common at the site. This ranges from at least Pueblo II (A.D. 900–1150) to Pueblo IV, in the fifteenth century. It is possible that this pottery was present at the site because of exchange or some other type of interaction and not because the site was used by Pueblo people.

Another instance of point types that we expected to find but did not involved the Desert Side–notched and Cottonwood styles, usually attributed to Numic-speaking peoples—in this case, Yavapai. Oral histories indicated that this group probably used the area, and on the basis of earlier reconnaissance, we expected to encounter evidence of their presence at this site (Pilles 2001). Unfortunately, there were no projectile points to confirm this. Of course, this does not mean the site was never visited by Yavapai people, only that their presence is not evident in the flaked stone artifacts.

Sixteen bifaces were distributed across much of the site, with the notable exceptions of the saddle and the hillslope to the northeast, where the Hohokam and Late Archaic period points were found; why bifaces would not be present in these two areas is unknown. Several of the bifaces were small and mostly percussion flaked, and they did not conform to any known, finished artifact style of any period in size or detail. Similar artifacts were found elsewhere in the project area, and it is unlikely that these were quarry blanks. Originally, we thought they might be aborted Archaic period points, but they had a higher correlation with Formative period contexts. Although microscopic traceological, or use-wear, analysis has not been conducted on these artifacts, none appeared to have been utilized.

Tools

Tools (n = 66) in the collection took several basic forms, based on the source item: cobbles, cores, and flakes (see Appendix G:Table G.2). Nine (13.6 percent) were cobble

Figure 20. Flaked stone tools from Site 53/745: (*a–r*) projectile points; (*s–cc*) bifaces.

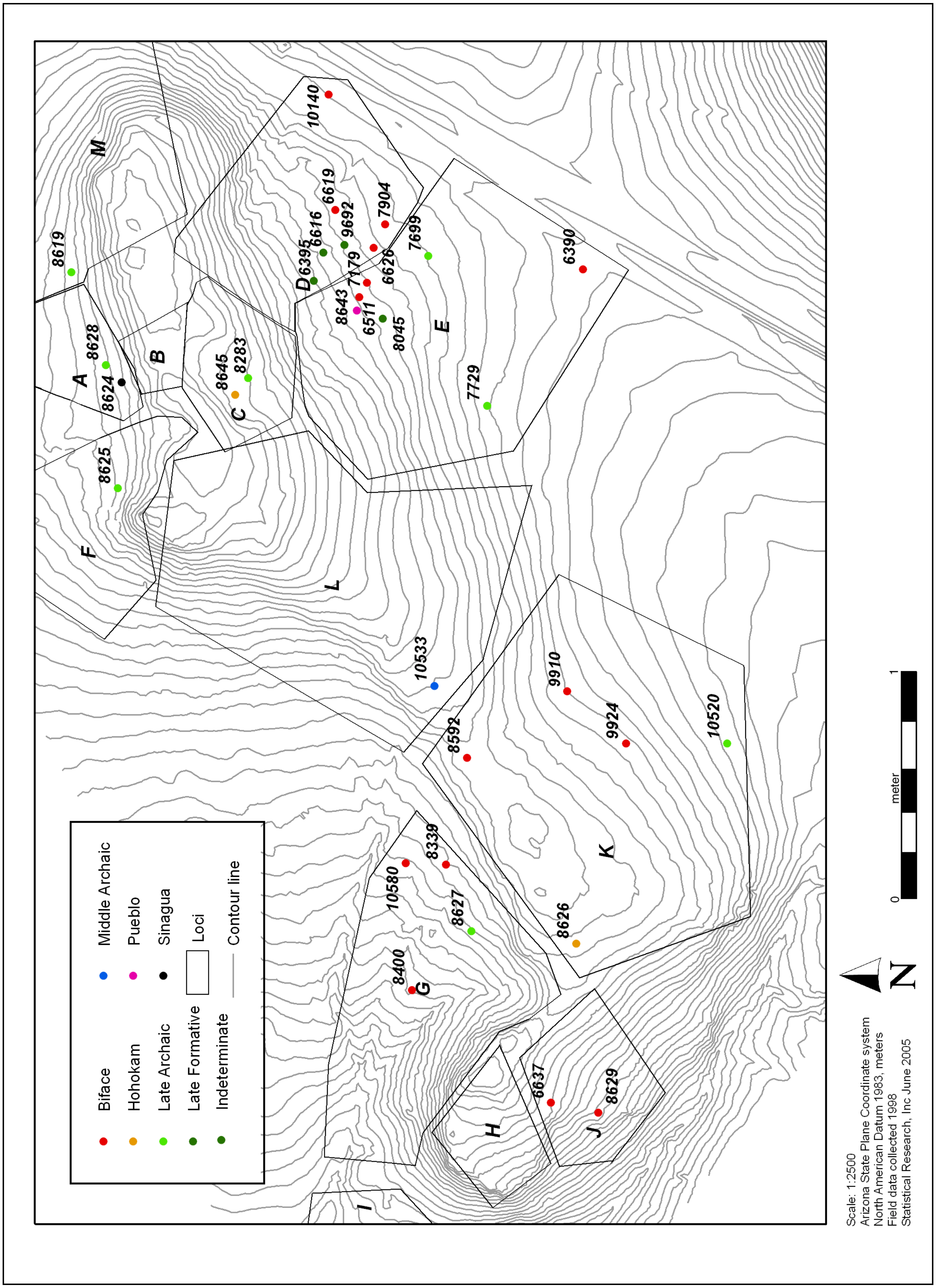

Figure 21. Distribution of projectile points and bifaces at Site 53/745.

tools, 15 (22.7 percent) were core tools, 41 (62.1 percent) were flake tools, and 1 (1.5 percent) was of an unknown type. Thirty-three of the tools exhibited even edges, 30 exhibited denticulate worked edges, and 3 were indeterminate. Cobble and core tools probably were used for heavy-duty tasks, such as chopping, woodworking, plant collecting, pounding, flaking (as hammers), and dismembering carcasses, whereas flake tools probably were used as light-duty knives, hide scrapers, and meat-processing tools and for perforating and carving/whittling. Together, these tools would meet the range of daily needs for peoples not using metals. The distribution of these tool types across the site is neither equal nor random (Figure 22a). Loci A–C, F, and N contained only light flake tools; Loci H and J yielded only heavy tools; and Loci D, E, G, and K–M had both. The saddle and the adjacent slopes to the north and south were used for light-duty tasks, whereas the southwest corner of the site on the hillslope was used for heavy-duty tasks. The remaining areas were used for both types of tasks.

As indicated above, light tools are mainly flakes that have been retouched along an edge. Although this process may result in the production of many retouch flakes, they would mostly be very small, and it is unlikely that they would have been recovered. On the other hand, the production of heavy tools, such as choppers and core choppers, would result in the production of larger core flakes. Therefore, one would expect a spatial relationship between heavy tools and dense flake clusters—that is, assuming that other core flakes were evenly distributed across the site and that heavy tools were used and discarded near their places of manufacture. Figure 22b reveals that the distribution of flake densities does not correlate well with the tool distributions, except in the southwestern area (Loci H and J), where many of the heavy tools were found. This may indicate that the southwestern area of the site was the location of heavy-tool manufacture and use. This in turn may imply that heavy-tool use was expedient, in that the tools were made, used, and discarded as part of a single activity.

Flaking hammerstones were noted only in Loci G and H (all in the southwestern area of the site), which were also areas that had relatively high flake-to-tool ratios. This indicates that flaking, as well as heavy-tool manufacture, may have been a main activity in these loci. No detailed traceological analysis was performed on these artifacts, and it is possible that some were misidentified as tools. The main criteria for the identification of core tools are the relatively low edge angles (<65°) and edge battering. Cores with these attributes can result from the work of inexperienced knappers, especially the battering. Because many of the flaking hammerstones were also found in these loci, it is reasonable to infer that this was a primary area for flaking and that this activity may have included at least some inexperienced knappers. Only additional analysis, specifically traceological, will determine whether the southwestern area was primarily a knapping area or an area of manufacture, use, and discard of heavy tools, or both.

Cores

We examined the provenience of the cores, the proportion of core flakes to cores (Figure 23a), their potential for more flake production (see Figure 23b), and the presence of cores of nonlocal materials, by locus. The distributions of these attributes proved interesting. Cores (n = 137) were distributed over the whole site, with the exception of Loci H and I on the western margin. The proportion of flakes per core varied greatly among loci. Four loci (Loci C, E, F, and N) had 15 or more flakes per core, four (Loci A, D, L, and M) had around 10 flakes per core, four (Loci B, G, J, and K) had fewer than 10 flakes per core, and two (H and I) had flakes but no cores. A high proportion of flakes to cores tends to indicate areas of intensive occupation or long-term use, because people were maximizing the cores at hand. Three of the four loci with high flake proportions were located just below the saddle, in the northeast area of the site, and the remaining adjacent slopes had medium-range flake-to-core ratios. Curiously, the saddle itself (Locus B) had a low flake-to-core ratio, but it should be noted that only 20 flakes came from there.

The southwestern area of the site also had low flake-to-core ratios. This might indicate that the area witnessed low-intensity use. Another way of evaluating the intensity of area use, in terms of flaking, is to examine the degree to which the cores were used up. Intense use may be indicated by a relatively high proportion of cores that had only some remaining potential or were exhausted altogether. Also, areas with high proportions of discoidal cores tend to indicate intensive use. Once again, we see that the area around the saddle contained well-used cores and a high proportion of discoidal cores. This reinforces the interpretation that this area was intensively used.

Debitage

We also evaluated the types of flakes and raw materials present within each locus, to see if there were any significant differences. We divided the flakes into the following main types: core flakes, biface flakes, and uniface flakes. Core flakes were abundant (n = 2,105), constituting 45.6 percent of the site's flaked stone collection. Biface (n = 98, or 2.1 percent) and uniface (n = 20, or 0.4 percent) flakes made up only a small portion of the collection. These general ratios hold true for many of the loci, with some notable exceptions, especially absences. Biface flakes were not present in Loci H, I, and J (Figure 24a), and uniface flakes were absent in Loci B, F, H, and I. This is not surprising, because there were no bifaces found in Loci H and I (see Figure 24b), although there were biface flakes in fairly high proportions (3.3–6.2 percent) in Loci A–C, where there were no bifaces. A concentration of bifaces was recovered just downhill and to the east, in Loci D and E. The lack of a high correlation between where bifaces

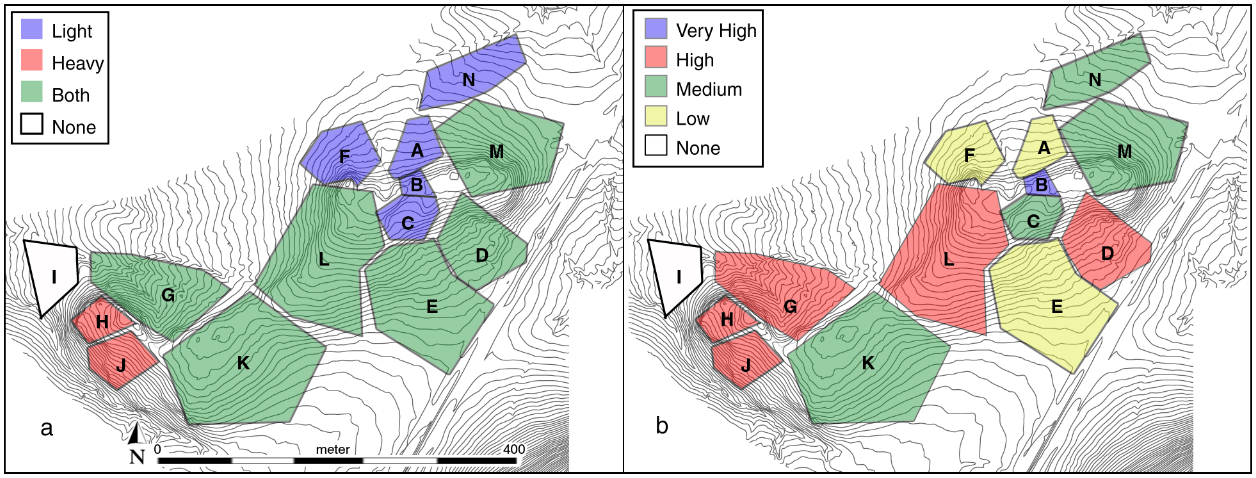

Figure 22. Site 53/745 spatial distributions of (*a*) tools and (*b*) flake-to-tool ratios.

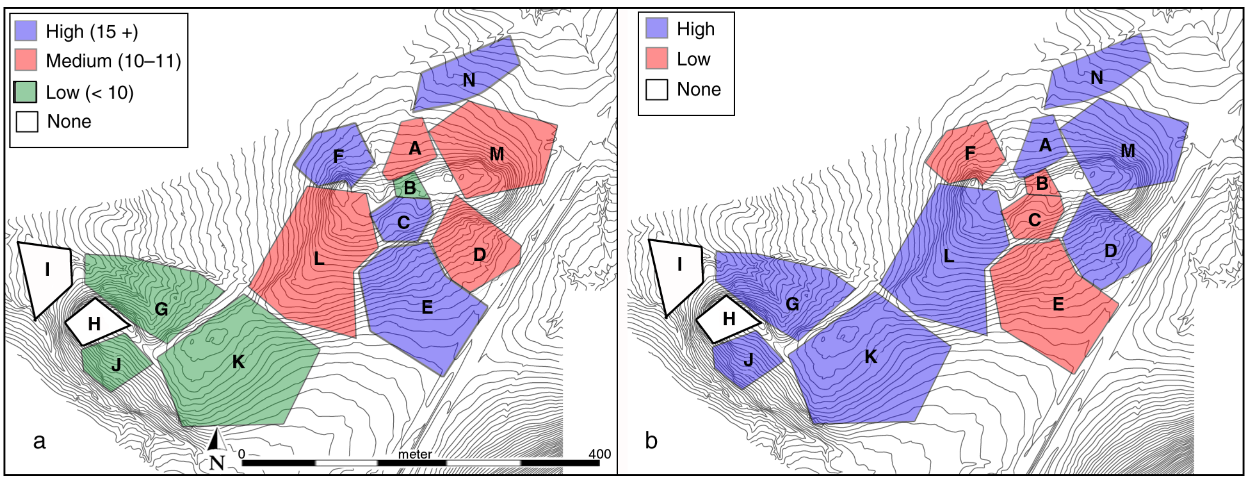

Figure 23. Site 53/745 spatial relationships between (*a*) flake-to-core ratios and (*b*) high-potential-yield cores.

were found and where biface flakes were found may support the idea that the bifaces were being used away from, but near, the location of their manufacture.

Uniface flakes, by definition, are thought to result from the manufacture or resharpening of tools. Uniface flakes tend to be quite small; they probably were seldom used for anything, and their location probably indicates an area where tools were being made or reworked. The highest proportion (3 percent) of these flakes was found in Locus H, yet this area contained only two heavy tools and no flake tools. There are two possibilities: the tools may have been made or reworked in Locus H and taken elsewhere, or we may have misidentified these flakes. We believe the former is more likely.

Material

The presence of cores made from nonlocal stone may indicate that people were entering the site from outside the area (Figure 25a). Unfortunately, the number of cores made from nonlocal stone (n = 9) was so small as to be almost meaningless. We did note that Locus A contained a core and also a relatively high percentage of flakes representing nonlocal material (see Figure 25b).

The distribution in each locus of the ratio of flakes from local and nonlocal stones is depicted in Figure 25b. Nonlocal stones were not a significant portion of the assemblage in any locus. This is no surprise, as good flaking stone was available at the base of the hill. The ratios ranged from no nonlocal stone, in Locus I, to 10 percent, in Locus D. Six of the loci (Loci A, B, D, E, J, and N) contained 5+ percent nonlocal stone. The only pattern that emerges is that most of the higher proportions of nonlocal-stone materials corresponded to the northeastern area of the site. The most common nonlocal stone was obsidian; Other Chert, Other, and fine-grained basalt followed, in descending order. In the project area, obsidian was most popular during the Middle Archaic and Formative periods, especially in Sinagua components. This seemed to a

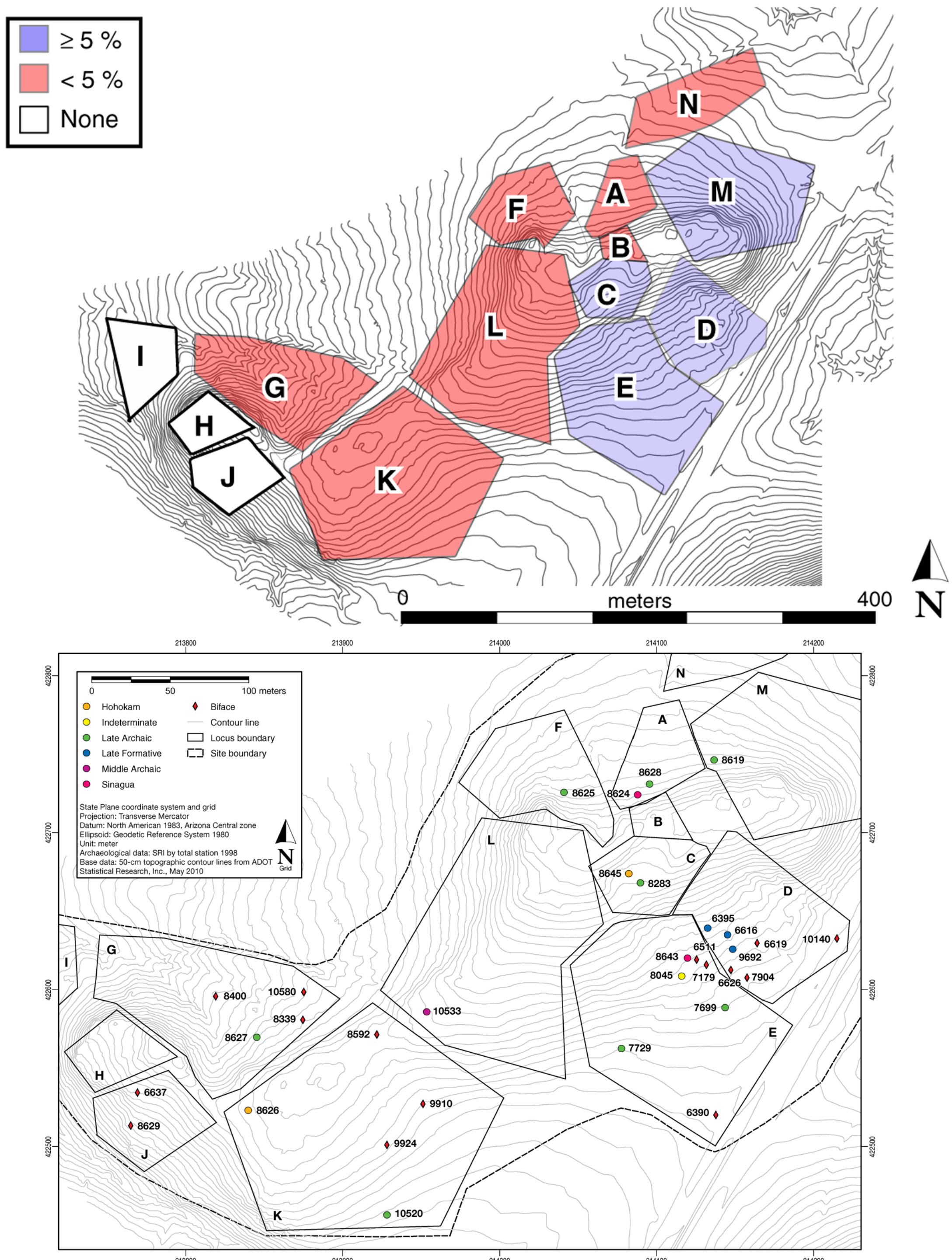

Figure 24. Site 53/745 spatial distributions of (*a*) biface flakes and (*b*) bifaces and projectile points.

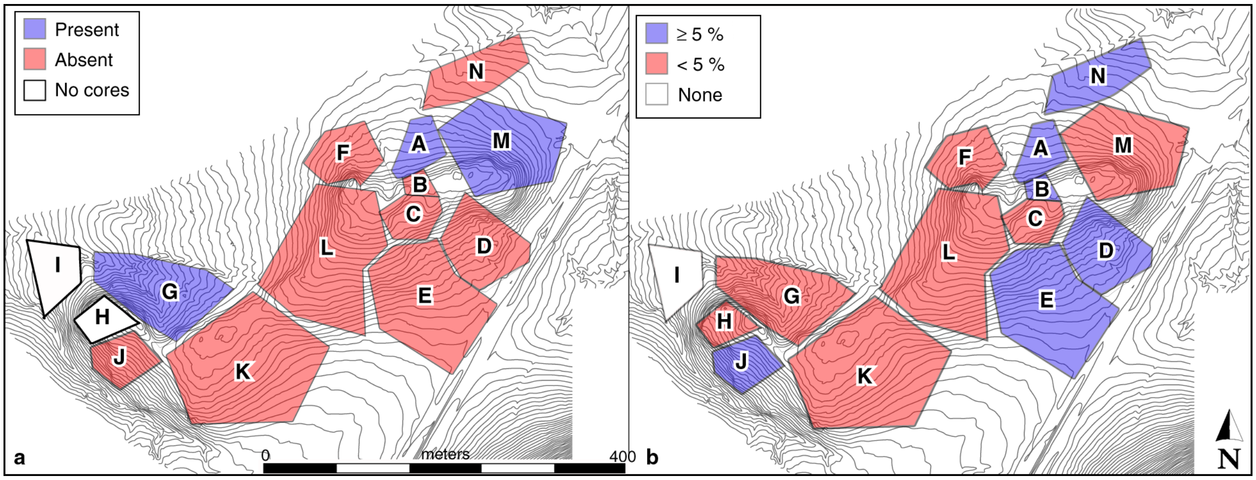

Figure 25. Site 53/745 spatial distributions of nonlocal stones: (*a*) cores and (*b*) debitage.

hold true for this site, as well, but raw-material type does not provide any particularly interesting insights into its use or formation.

Interpretation

A key focus of our investigations was to determine if any of the loci differed in the way in which they were used. This may be approached by looking at patterns of projectile point breakage, distribution of nondiagnostic tools, and debitage evidence. The numbers of projectile points and fragments were so low in every locus that to draw functional conclusions from them would be spurious, at best. Nevertheless, if each locus were considered a separate site, just like the rest of the sites in the project area, speculation based on small samples might be in order. To this end, we have used the general criteria discussed earlier to assess what different portions of projectile points might indicate. Tips and midsections are most often found at sites where animals were hunted and initially butchered (fragments resulting from impact breaks). Broken bases are to be expected mainly at temporary campsites where weapons were being replaced and refurbished. Various by-products of tool production and maintenance would be expected at base camps where meat processing and weapon refurbishing were taking place.

For this simple analysis, because of the small sample sizes, we have disregarded the periods associated with the points. Using the above criteria, three loci (Loci A, K, and L) were indicated to have been hunting/processing areas: one was a camp area (Locus G), two were base camps (Loci C and E), and two may have been hunting/processing (Loci I and M) and camp areas. If we assume that mostly light flakes are found at limited-activity sites and a mix of light and heavy-duty tools is found at base camps, then we see a mixed result with this interpretation. That is, Locus A contained mostly light flake tools, whereas Loci K and L contained a mix of light and heavy-duty tools. On the other hand, Locus C contained mostly light flake tools, and Locus E contained a mix of light and heavy-duty tools. Locus M also contained a mix of light and heavy-duty tools. These latter cobble and core tools could have been used for lithic reduction or heavy-duty processing. Lithic reduction appeared to be most heavily represented in Locus C, with most of the cores reflecting intensive reduction. Overall, there was a roughly even mix of denticulate and even-worked edges for flake tools, with somewhat more denticulate edges for cobble tools and even edges for core tools. Locus A contained flakes with denticulate edges. Most of the flake tools in Loci K and L also exhibited denticulate edges, with fewer even-shaped edges, but all the heavy-duty cobble tools in Locus K exhibited denticulate edges. Lastly, Locus C had the same number of denticulate and even flake-tool edges.

All but Locus C were on hillslopes, albeit gentle slopes. The one interpretation that does seem to make sense, in terms of location, is a base camp for Locus C. It was situated near the top of the hill, in a protected area, with a slight southern aspect. It would be a good place to inhabit, especially in the winter. Locus C also yielded the only good evidence of a Hohokam presence, although without identified architecture.

In terms of chronology, the temporally diagnostic flaked stone artifacts (i.e., projectile points) indicate that the entire site area was used continuously during the Late Archaic period and sporadically during the Formative period. The use of a specific area by a specific group is clearly indicated only in Locus C, where evidence suggests a more intensive Formative period occupation.

Summary

The intensive recording of individually point-located artifacts at Site 53/745 has allowed for a detailed analysis of their spatial distribution, in terms of chronology as well as behavior. Comparisons of flaked stone data among loci have enabled us to formulate some interpretations about when the site was occupied, who occupied it, and, equally important, which areas were intensively used and which were marginal. Unfortunately, it has not been possible to tease out who used what areas of the site intensively, with the exception of a distinct Hohokam presence in the area of the saddle. Hillslopes in the northeastern area witnessed a range of uses, including core reduction, material processing and tool manufacture, and possibly hunting and butchering. The location was popular during the Late Archaic and the Middle through Late Formative periods, and little to no use was indicated during the Middle Archaic, protohistoric, and early historical periods. People were coming to the site from outside the area, from the north and the south, but for the most part, local stones were being used to make tools. Site 53/745 also was used by groups—especially Sinagua peoples—who had set up nearby habitations, possibly as seasonal horticultural and stone-procurement camps.

AZ O:1:28/AR-03-04-06-903 (ASM/CNF)

AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903) was an extensive lithic scatter located along the west side of Dry Creek. Three loci were defined. Locus A occupied a low bench on a terrace immediately adjacent to the creek; Locus B was on a slightly higher portion of the same terrace, farther west; and Locus C was located on a high ridge to the north. Low densities of artifacts were found between loci. All diagnostic flaked stone artifacts, including obsidian flakes, were point-located and collected individually. The debitage in the loci was collected by means of contiguous 5-by-5-m collection units (in Loci A and C) or 20-by-20-m collection units (in Locus B). Debitage found between loci was collected as PD 1 and bagged together. Additional artifacts were collected from the excavation of a hearth (Feature 1) and surrounding activity area in Locus A. The stratigraphic position of Feature 1 and associated deposits identified Locus A as dating to the Late Archaic period. The flaked stone collection consisted of 2,086 pieces (see Appendix G:Tables G.15 and G.16), of which 784 were derived from the excavation units and the remainder were collected from the site surface.

Projectile Points and Bifaces

Seven projectile points and four bifaces were found at Site 28/903 (Figure 26) (see Appendix G:Table G.1). All but one of the projectile points were recovered from Locus A, either on the surface or in the excavation units. The single exception (ID 2946) also was the only Formative period point; it was point-located high on the hillside, southwest of Locus C. Five other points dated to the Archaic period. Of these, a single specimen (ID 2558) was the nub of a Middle Archaic period Pinto/San Jose point, and three were Late Archaic period, including two San Pedro styles (IDs 8615 and 8641) and one Elko (ID 8617) style. A fifth point was unstemmed and triangular (ID 8614); it was recovered from Locus A, on the buried use surface associated with Feature 1. It is possible that this was a finished point, but if so, it was not of a style that has been associated with any particular Archaic period. If it was not completed, its shape is closer to Elko than to any other style, and it may therefore date to the Late Archaic period. Three of the Archaic period points were made of chert, one of fine-grained basalt, and one of obsidian. The Formative period point also was made of obsidian. The seventh point (ID 2700) was a fragment made of obsidian, possibly an ear or stem of a dart point.

The four bifaces were recovered from various locations in Locus A, and all were made of chert. Two were complete (IDs 2758 and 2858), and two were fragments (IDs 2556 and 3067). All except ID 2858 exhibited marginal (soft-hammer) bifacial flaking, but none displayed evidence of pressure flaking. The fragments probably were broken during manufacture. Given its flaking mistakes (step fractures) and small size, ID 2858 appears to have been an abandoned early-stage projectile point. ID 2758 was either an exhausted bifacial core or, just as likely, a whole but unfinished projectile point that had the potential for being completed.

Tools

Nineteen retouched tools were recovered from Site 28/903 (see Appendix G:Table G.2), 16 of which were located in Locus A. Two came from the hillside between Loci A and C, and only 1 was located in Locus C. Sixteen of the tools were made from either cobbles or cores, and only 3 were made on flakes. This composition differs from that at the other sites in the project area. In addition, 16 of the 19 tools exhibited denticulate edges; only 3 tools had even worked edges. Whatever activity took place in Locus A focused mainly on heavy cutting tasks, such as butchering and tough-plant processing. It may not be a coincidence that one of only two places where agave grows in the project area today is near this site.

Cores

Fifty-two cores were encountered, 48 from Locus A and 4 from the hillslope between Loci A and C. None was found in Loci B and C. Only 4 (7.7 percent) were considered exhausted, 29 (55.8 percent) retained some potential, 16 (30.8 percent) had the potential to produce several more

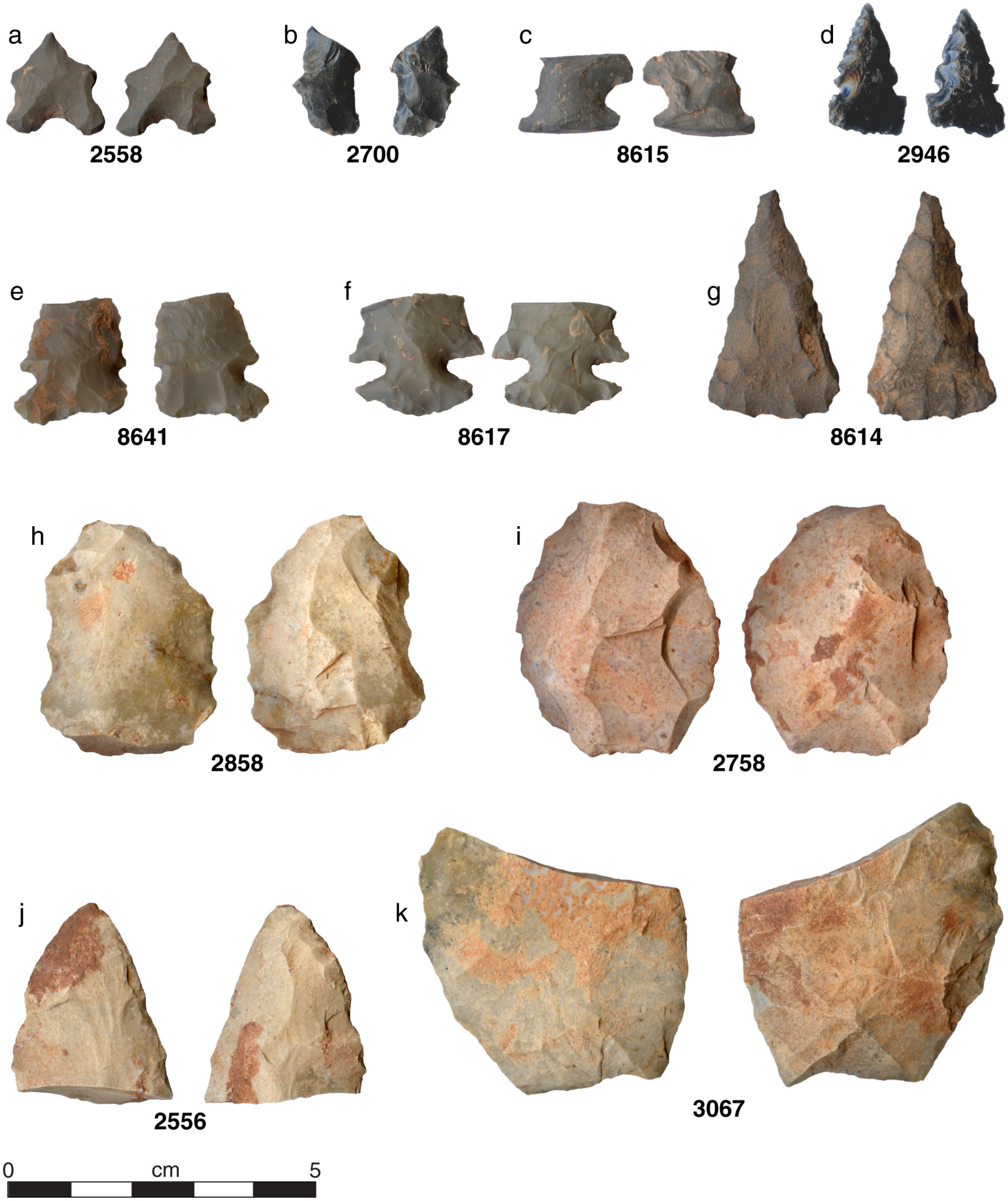

Figure 26. Flaked stone tools from Site 28/903: (*a–g*) projectile points; (*h–k*) bifaces.

usable flakes, and 3 (5.8 percent) were only tested. This distribution fits well with a location where raw material is abundant but where site use was fairly intense and sustained. Even with ample access to good stone, cores that had already been used to produce usable flakes would be selected again for flake manufacture if they were close at hand. Why start a new core when a proven piece was already available and could be recycled?

Debitage

Six hundred nine flakes and 1,395 pieces of debris were collected and analyzed. Although debitage collection from the three loci was controlled by means of collection units, we made no comparisons among the loci. The following discussion addresses the site as a whole. Flakes made up nearly 30 percent—and debris nearly 70 percent—of the collection. Curiously, these are the same proportions found at Site 105/838, a Formative period habitation site excavated to the south, along Spring Creek (see above). Both sites were subjected to extensive subsurface excavation, and artifacts were recovered by sifting sediments through 1/4-inch-mesh hardware cloth. It is clear to us that this method of artifact recovery significantly increases the collection of debris. Flake types were typically heavily weighted to core flakes (94.9 percent) over biface flakes (4.3 percent) and uniface flakes (0.8 percent). Once again, these are nearly identical to the proportions at Site 105/838, although it is apparent that different periods and different site uses were represented. The similarities extend to the number of biface flakes for each biface: 2.4 for Site 28/903 and 2.8 for Site 105/838.

The ratio of local to nonlocal materials was also similar. Site 28/903 yielded 84.2 percent local and 15.8 percent nonlocal materials, and Site 105/838 contained 83.9 percent local and 16.1 percent nonlocal material. There is a slightly greater difference between the sites in the proportions of nonlocal materials. Of the artifacts found at Site 28/903, 58.8 percent were obsidian, whereas this material constituted 51.4 percent of the collection at Site 105/838. The greatest difference appeared between the proportions of fine-grained basalt; it constituted 12.9 percent of the nonlocal debitage at Site 105/838 vs. only 6.9 percent at Site 28/903. None of the other debitage attributes distinguished flaked stone assemblages among sites that were clearly different, culturally and functionally. This is a bit disconcerting, as our expectation had been that the collections should be significantly different.

Summary

In terms of flaked stone and Archaic period occupation, Site 28/903 was one of the more interesting sites in the project area. Locus A was a Late Archaic period base camp, including a buried cooking area and surrounding use surface, and it probably was occupied seasonally. The presence of cores and heavy-duty tools could reflect the importance of lithic reduction or heavy-duty processing activities at this location. Most of the cores were still usable, which reflects the temporary nature of the campsite. Locus C was an ideal overlook area for tracking the movements of animals, especially deer (*Odocoileus*), on the hillslopes along Dry Creek. The flaked stone in this locus consisted exclusively of flakes that could have resulted from tool maintenance, especially for dart points. There were no grinding stones and no features.

Between the Locus A base camp and the overlook was a hillslope that would have been a natural pathway for deer, especially if they were startled or wary of the base camp. This would have been an ideal ambush site. If we had been able to separate out the flaked stone from the hillside between the two loci, we might have seen stone flakes used for dressing animals in the field. An argument against this reconstruction is that projectile point fragments, especially tips and midsections, were not found there. Nevertheless, with the possibilities for hunting and for collection of plants, including agave, the site layout would have provided an excellent seasonal Archaic period camp area. The presence of obsidian and fine-grained-basalt projectile points indicated that people were traveling to the camp, at least in part, from the north, bringing their weapons with them. They must have known about the abundance of locally available cherts and quartzites, because they did not bring their other tools from outside the area. The Formative period arrow point found on the hillslope above probably was an isolated hunting loss and not associated with the activities taking place in the area below.

AZ O:1:31/AR-03-04-06-244 (ASM/CNF)

AZ O:1:31/AR-03-04-06-244 (ASM/CNF) (Site 31/244) was located in an eroding area on the south side of a shallow valley, about 300 m west of Dry Creek. The flaked stone collection consisted of 1,877 artifacts (see Appendix G:Tables G.17 and G.18). In total, 1,741 artifacts were collected as PD 1. All diagnostic flaked stone found on the surface (n = 130) was point-located and collected individually, an additional 5 flakes were collected from various strata within the excavation units, and 1 core was located on the surface of Shovel-Test Pit 26. The site map reveals several clusters of flaked stone artifacts, but some of these clusters may have been the result of natural erosional and depositional processes. It does appear that there were two main concentrations, one on each side of a low rise that more or less bisects the site in a southeast–northwest direction.

Projectile Points and Bifaces

Twelve projectile points but only four bifaces were found (Figure 27) (see Appendix G:Table G.1). Except for a complete arrow point and three complete bifaces, all artifacts were fragments. Of the projectile points, nine were Archaic period dart points and three were Formative period arrow points. The three arrow points were all made of obsidian and were probably of Sinagua affiliation (IDs 803, 805, and 8646).

Of the dart points, five dated to the Middle Archaic period and two to the Late Archaic period, and two were Archaic but not identifiable to a specific style. The Archaic period pieces were curious, in that a wide diversity of styles was represented. The most complete point (ID 8616) was made of local chert and had wide side notches and a deeply serrated blade. It exhibited evidence of selective pressure flaking. We identified it as an atypical Pinto/San Jose point (Middle Archaic period), but it appeared to be a cross between the aforementioned style and the Late Archaic period San Pedro point style. It could be either. There were two Pinto/San Jose bases (IDs 821 and 8637), both of fine-grained basalt, and both had impact breaks on their tips. The fourth Pinto/San Jose point (ID 795) was an obsidian midsection with its identification based on serration. The base of a fifth Middle Archaic period point that we identified as a Mallory point (ID 271) (Frison 1991) was also present. Mallory points are wide, thin, deeply side-notched dart points with straight to concave bases. They usually are very well made and exhibit evidence of excellent pressure flaking. The base was broken through the notches on the fragment, and it was made of a chalcedony of unknown origin that was not represented at any of the other sites in the project area. This style is usually associated with the High Plains and Rocky Mountain Regions, but we have also seen it in collections from the Colorado Plateau (see Chapman 1977; Holmer 1980). Mallory points have been found with San Jose points in southwestern Colorado.

Two dart point fragments (IDs 798 and 8622) were Late Archaic period styles, the former an atypical San Pedro style and the latter probably an Elko Corner-notched point. The San Pedro point was made of obsidian, and the Elko point was made from local chert sponge. The two remaining Archaic period pieces were a tip fragment of local chert (ID 729) and an obsidian base (IDs 780).

The Middle Archaic and unassigned Archaic period points were found in both artifact concentrations, but the Late Archaic period points all came from the northeastern concentration. All three Sinagua points came from the southwestern concentration. Curiously, no pottery was found with the Formative period points. Of the bifaces, three (IDs 205, 743, and 766) were made of chert and appeared to have been unfinished. The fourth biface (ID 768) was made of sponge and may have served as a finished tool.

Tools

Twenty-six tools were recovered (see Appendix G:Table G.2). Seven were manufactured on cobbles, 10 on cores, and 9 on flakes, with 12 denticulate and 14 even worked edges. The tools were mostly made of local material (13 of chert, 9 of quartzite, and 2 of chert sponge), but 2 were made of nonlocal chert. Whereas nearly all the tools were of local stone, 9 of the 12 projectile points were of nonlocal materials. The tools indicated that a wide variety of tasks were taking place at the site, including butchering and heavy-duty processing.

Cores

The site collection included 75 cores, nearly all made of local material. Of these, 12 (16 percent) were considered exhausted, 36 (48 percent) exhibited some potential, and 27 (36 percent) retained good potential for producing more flakes. There were nearly 8 flakes in the collection for each core. This is fewer than average for the sites in the project area. The degree of exploitation of the local raw materials was variable but clearly not intense.

Debitage

Debitage at Site 31/244 consisted of 1,759 artifacts. The site had a relatively high proportion of debris (n = 1,102, 62.6 percent) compared to that of flakes (n = 657, 37.4 percent). Flake-type proportions were in keeping with those from other sites, although the percentage (9.6) of biface flakes (n = 63) is the third-highest in the project area, and 18 (28.6 percent) of these were obsidian. Identified raw-material use represented in the debitage was heavily weighted toward local materials (93 percent), with the highest proportion of quartzite (27.5 percent) for any of the project sites. We suspect that this does not indicate that there was more quartzite in the on-site gravel but, rather, that this material was selected intentionally.

Based on his extensive experience with stone tools used for many different tasks, the first author considers the texture of quartzite found in the project area optimal for manufacturing simple flaked butchering tools. It is strong and holds an edge for a long time, is easier to grasp than glassier materials, and has natural, fine, serrated edges that are excellent for cutting through tough connective tissue, such as sinew. We decided to investigate whether appreciable differences between the quartzite flakes and the chert or chert sponge flakes might reflect differential manufacture. The first attribute that we examined was flake termination. Generally speaking, flakes that end in hinge fractures tend to have straighter edges than those that have sharp (feather) terminations. We would expect straighter-edged flakes to be superior to curved flakes for

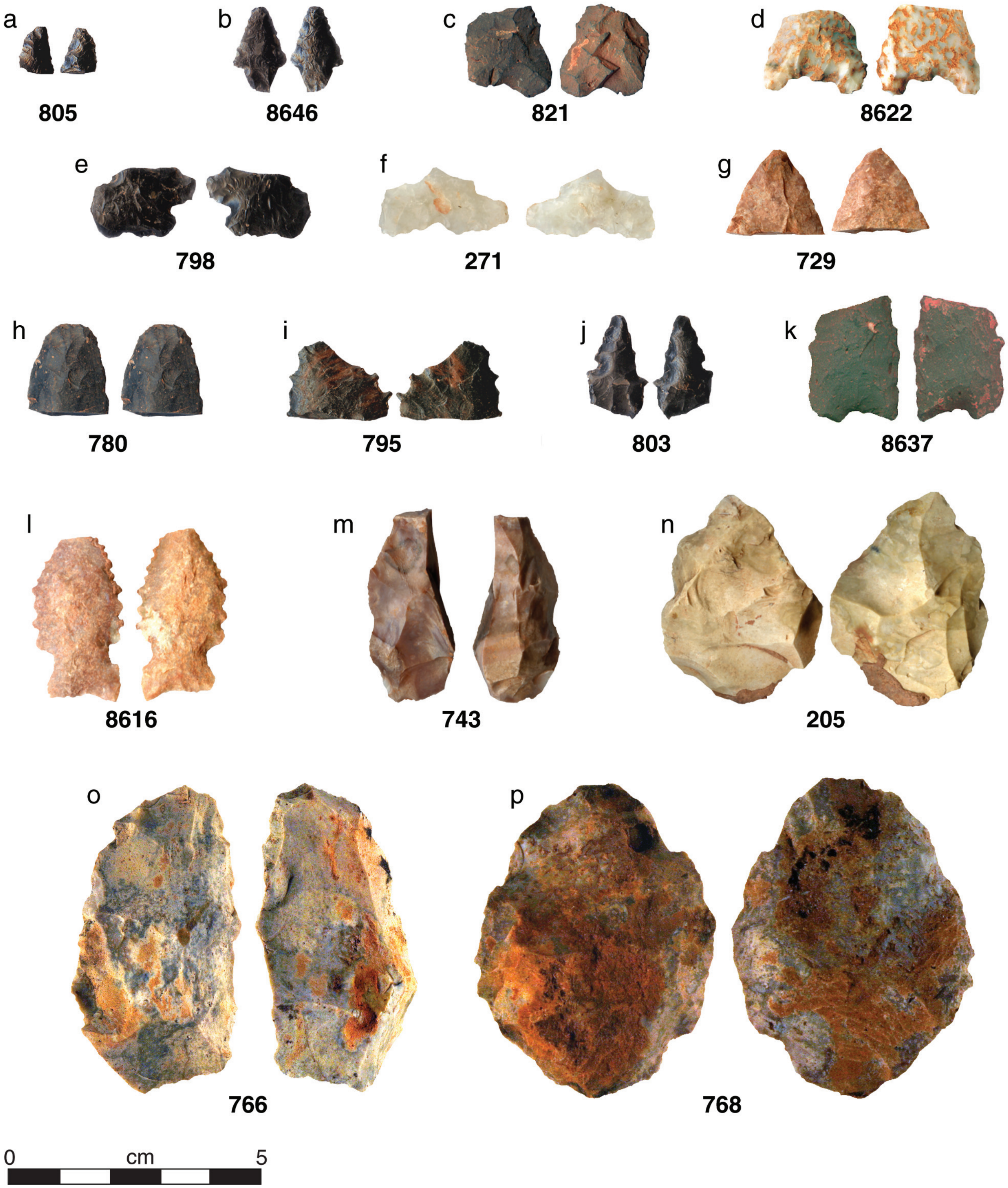

Figure 27. Flaked stone tools from Site 31/244: (*a–l*) projectile points; (*m–p*) bifaces.

butchering tasks. There was a slightly higher proportion of hinged flakes made of quartzite than of either chert or chert sponge, but the difference was only 3.1 percent. This is not great enough to be significant; this small difference could simply reflect that quartzite tends to be more difficult to flake than chert.

Next, we sought to determine whether there might be a significant difference in average flake length (of complete flakes only) between feather and hinge terminations among the various materials. Quartzite flakes were, on average, slightly longer than chert and chert sponge flakes, whether they had feather or hinge terminations. But the differences were small and could simply reflect the slightly larger size of quartzite cobbles when compared to chert and chert sponge cobbles and nodules. We tested this by calculating the average lengths of cores for each of the materials, assuming that they would reflect differences in the sizes of unworked cobbles and nodules. On average, quartzite cores were 63.6 mm long, chert cores were 56.3 mm long, and chert sponge cores were 46.1 mm long. Although these differences are not very great, they do support the notion that quartzite flakes were longer because the raw material itself is larger. Quartzite cores were generally larger on the LOCAP sites, with a mean length of 77.3 mm (standard deviation [sd] = 21.1), vs. local chert (58.3 mm, sd = 15.9) and chert sponge (53.5 mm, sd = 13.8). The pattern on this site may also be related to the degree of reduction represented by each material type. For example, 30 percent of the chert sponge cores were exhausted, vs. 14 percent for chert and 9 percent for quartzite.

Summary

The current setting of Site 31/244 is in an open piñon-juniper forest, including many shrubs and plants that are useful to people but also attractive to game animals, such as deer. The general topography offers a good hunting locality. The higher surrounding areas could have served as overlooks, and there was enough on-site relief to allow stalking. Evidence of hunting is apparent in the number of projectile points and in their fragmentation. At least six points had impact fractures that resulted from striking a hard object, such as a bone, in the case of a successful shot, or a stone, if the shot missed its target. These breaks indicate hunting. The large numbers of flakes and debris (particularly the dominance of quartzite), the predominance of point bases, and the presence of bifacial retouch flakes all indicate that lithic reduction, tool manufacturing, and retooling were also taking place. It appears that flakes were being produced as needed, rather than as part of more-focused and intensive flaking or tool-manufacturing activities. When reliable, abundant flaked stone resources were available, there would have been little need to pre-manufacture the simple cutting tools that are sharpest when first made. We can easily imagine that, for any given use of the site, only one or two flakes might have been struck from a core, which was then discarded, only to be used on another visit to the site. The presence of ground stone indicates that seed processing was another activity that took place at the site.

The lack of pottery or architecture indicates that this location was visited only sporadically by Formative period people.

AZ O:1:133/AR-03-04-06-561 (ASM/CNF)

Site 133/561 covered a large area to the west and along the base of a high ridge. Three separate loci centered on discrete concentrations of artifacts were identified during the field investigations. Locus A contained a high concentration of flaked stone artifacts—many exposed in shallow erosion channels or rills—as well as some ground stone. Locus B was a discrete sherd and flaked stone concentration exposed in another eroded area. Locus C consisted of another concentration of flaked stone and ceramics and was associated with an exposed roasting pit (Feature 1) at the base of the ridge. Locus A represented Archaic period use of the area; Loci B and C clearly were Formative period localities. Large quantities of naturally present chert and quartzite were noted on the slopes and on top of the ridge that surrounds the site on the north, east, and south. In fact, the site boundaries are unclear in these areas because this large, arch-shaped area served as a vast lithic-procurement locale that also overlapped with another site (Site 134/189) to the north. In this area, an additional locus (Locus D) was initially included as part of Site 133/561 but was subsequently eliminated because it was found to be part of a vast lithic-procurement area overlapping with several of the project sites.

The flaked stone collection consisted of 2,703 pieces of flaked stone (see Appendix G:Tables G.19 and G.20), including 789 flaked stone artifacts from a series of collection units placed in Locus D, which is presently not considered part of Site 133/561. These additional artifacts, primarily debitage and cores, are included in the following discussion. The main reason for the inclusion was that comparison of the two flaked stone collections might inform us about the relationship between the site and the overlapping lithic-procurement area. With the exception of 96 artifacts found in excavation units, all artifacts derived from the site surface.

Projectile Points and Bifaces

The Site 133/561 flaked stone collection included 10 projectile points and 7 bifaces (Figure 28) (see Appendix G:Table G.1). At most project sites where both

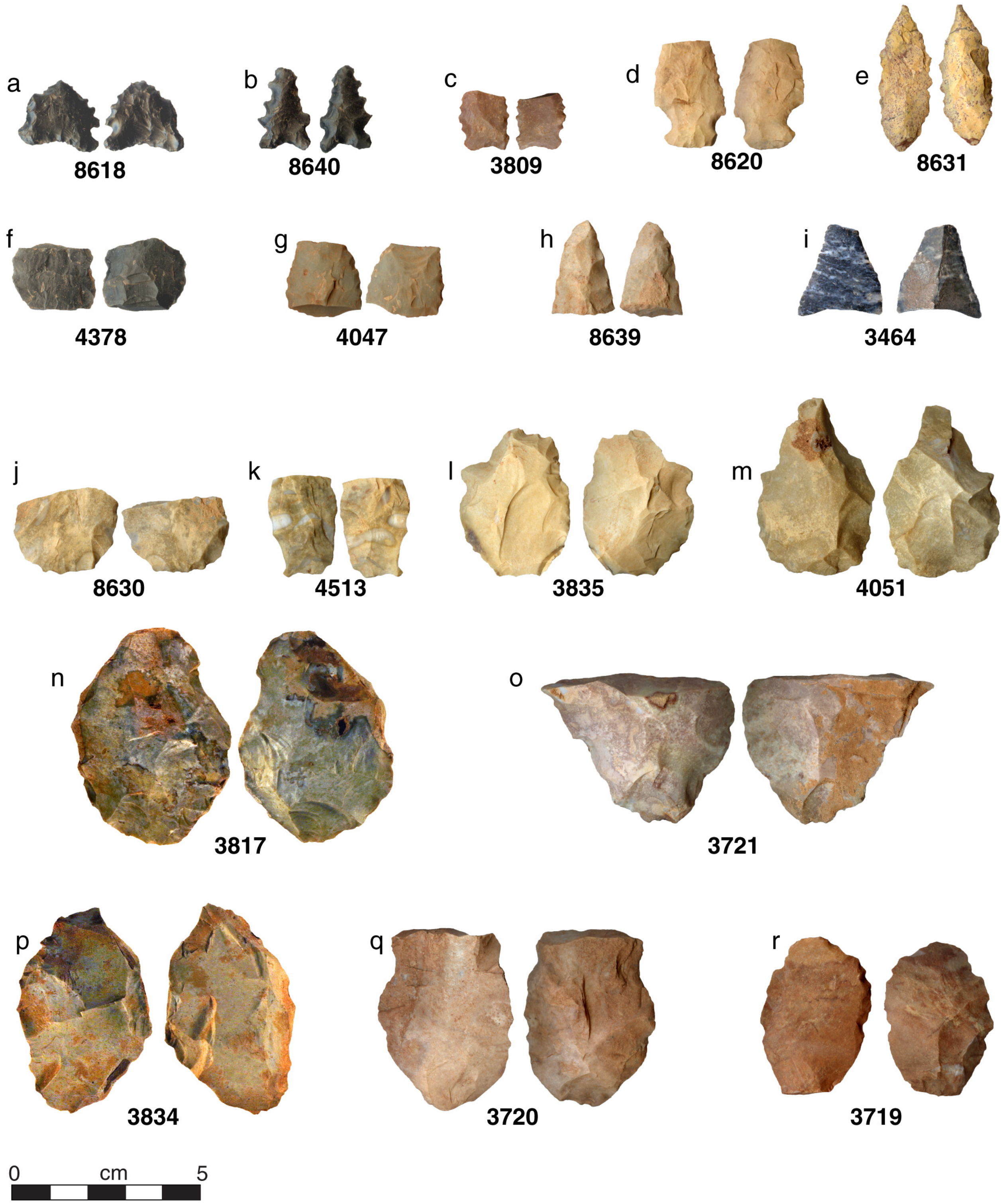

Figure 28. Flaked stone tools from Site 133/561: (*a–i*) projectile points; (*j–p*) bifaces; (*q* and *r*) retouched flakes.

bifaces and projectile points were found, these artifact classes were not spatially separated. This is not true at Site 133/561; all but 1 of the bifaces were recovered from Locus C, and all projectile points were located in Locus A. Nine dart points, or fragments thereof, and a single fragmentary specimen that may have been an arrow point (but was just as likely to have been a dart point) were found in Locus A.

Four of the dart points represented styles that can be assigned to specific times within the Archaic period sequence. Two obsidian points (IDs 8618 and 8640) were probably variants of Middle Archaic period Pinto/San Jose points, but both were small and exhausted. Two other points were Late Archaic period San Pedro types. One was the basal two-thirds of a point made of local chert (ID 8620). The other was a complete point made of basalt (ID 4036) (not illustrated). A fifth point was a partly serrated, lozenge-shaped, chert point (ID 8631) that resembled a Lerma point typically found in Early Archaic period sites in the greater U.S. Southwest. This may indicate the earliest use of the project area, but it is equally likely that the point is an unusual form produced during the Middle or Late Archaic period use of the site.

Three indeterminate dart points were fragments: an obsidian basal portion (ID 4378), a chert midsection (ID 4047), and a chert tip made of local materials (ID 8639). The ninth point was a small base fragment of local chert (ID 3809). Although it had the technological characteristics (pressure flaking on a thin flake blank) of a Formative period point, its form was reminiscent of a Pinto/San Jose point. Considering that it was found in the concentration of the Archaic period points, and not in Locus B or C, it may well have been an Archaic period point. Finally, Locus A also yielded a fragment of a chert uniface that appeared to be a projectile point preform (ID 3464). We were unable to classify it to a specific type.

Seven bifaces were found, all made of local chert and exhibiting varying degrees of reduction (see Figure 28). The only specimen not found in Locus C (ID 3835) came from the southwest end of Locus A, in an area well separated from the major concentration. It probably dated to the Archaic period and had the potential to become a dart point. Of the other six bifaces, three (IDs 4513, 8630, and 4051) were associated with the Formative period or protohistoric materials in Locus C. They were different from the biface in Locus A and other Archaic period bifaces found in the project area. As previously mentioned in the discussion of Site 131/37, the trait that distinguished the project area's Formative period bifaces from those dating to the Archaic period was the flaking method. However, in this case only one (ID 4051) was flaked with direct percussion using a hammerstone and primarily exhibited nonmarginal flake removals, whereas two (IDs 4513 and 8630) showed soft-hammer direct percussion. By contrast, the Archaic period bifaces often exhibited soft-hammer, marginal flake removals and, occasionally, pressure flaking. Most of the Archaic period examples were probable dart points at various stages of completion. The final, intended form of these non–Archaic period bifaces is unclear. No finished examples have been found in the project area's Formative period contexts to clarify this. Given the context of Locus C, which included a protohistoric roasting pit, these bifaces may have been made by protohistoric groups. The three other bifaces were collected from the general site surface (IDs 3721, 3817, and 3834) and lacked characteristics linking them to a specific period. All were made of local chert.

Tools

Of the 16 tools recovered from the site (see Appendix G:Table G.2), 13 were found in Locus A in association with the Archaic period points, 2 came from the general site surface (PD 1), and 1 was recovered from Collection Unit 475, outside the defined loci. All tools exhibited evidence of retouch and were made from local materials. Four were shaped from flakes (for examples, see Figure 28:IDs 3719 and 3720), and the remaining 12 were core tools made from cobbles or nodules. Five of the tools had bifacially retouched edges; the others were unifacial. Edge types were divided between denticulate (n = 9) and even (n = 7). Tool forms were varied and included a scraper/preform, scrapers, a scraper/chopper, and choppers. Most of these tools were designed for moderate to heavy use, such as butchering and tough-plant processing.

Cores

We expected to find a large number of cores representing local material, considering the abundance of sources on and adjacent to the site. This was confirmed by the presence of 47 cores, 5 of which were of nonlocal stone (1 of fine-grained basalt and 4 of Other Chert). Two of these were interpreted to be exhausted, and the other 3 exhibited only some potential for producing additional usable flakes. The condition of the cores made of local material indicated more-intensive use than was expected, as 12 (28.6 percent) were exhausted, 18 (42.9 percent) retained some potential, 9 (21.4 percent) exhibited good potential, and 3 (7.1 percent) were tested. In addition, 20 cores were classified as discoidal, a form that indicates intensive utilization.

Debitage

The collection included 2,623 pieces of debitage, of which 1,708 were debris, 868 were core flakes, 38 were biface flakes, and 9 were uniface flakes. The debitage was more or less typical for the sites in the project area. Core flakes made up 94.8 percent, biface flakes 4.2 percent, and uniface flakes 1 percent of the nondebris debitage. About one-third of the debitage was flakes, and two-thirds was debris. The site did contain a relatively high proportion of nonlocal (15.9 percent) vs. local (84.1 percent) flakes (those for which material type was identified). In the case of nonlocal materials, obsidian (n = 144) made up 66.1 percent, fine-grained basalt 0.9 percent, Other Chert 32.1 percent, and Other 0.9 percent of the total. Of the 63 obsidian flakes found at Site 133/561, 37 (58.7 percent) were core flakes, 24 (38.1 percent) were biface flakes, and 2 (3.2 percent) were uniface flakes.

In some respects, these numbers are misleading. A compact cluster of obsidian debitage was found in the middle of Locus A, constituting 140 of the 144 pieces of obsidian debitage at the site. This tight cluster probably represents a single reduction sequence, given that two-thirds of the pieces were debris. It appears that the obsidian represents the manufacture of a single biface that was initially worked with a hammerstone (nonmarginal flaking), and then, at some point in the process, the knapper switched to a soft hammer (marginal flaking), producing biface flakes. Because there were no biface fragments in the cluster, we have to conclude that the production was successful. The resulting tool was probably carried away from the site for use elsewhere or was removed by a prehistoric or modern collector.

If the site's flaked stone artifacts are considered without this cluster, some information about the composition of the collection changes, especially concerning the source of nonlocal stone. The percentages of flakes vs. debris and the flake types remain about the same, but the percentages of obsidian and nonlocal chert shift from 66.1 percent to 5.1 percent and from 32.1 percent to 89.7 percent, respectively. Once again, this may reflect material preference rather than the direction in which cultural contacts were located. But, at least in this instance, it suggests that the Archaic period groups explored the area to the south.

Summary

It is tempting to interpret Site 133/561 as an opportunistic stone-procurement area, but it is more appropriate to understand it as an intensively used camp locale. This is supported by the sheer number of finished points, tools, and items of nonlocal stone (including cores). The three loci were spatially, functionally, and temporally distinct and should be treated separately. The activities in Locus A took place primarily during the Middle and Late Archaic periods. The absence of cooking and roasting features suggests that Locus A was a plant-collecting and plant-processing site, although these plants may not necessarily have been used for food. Yucca (*Yucca*) grows in this locus today, and it may have been harvested and prepared using heavy chopping and cutting tools. Yucca was very useful for fibers and basketry, in particular during the Archaic period. Another important plant that provided fiber (and food) was agave, which is abundant on the ridge above the site. On the basis of the pottery, Locus B dated to the Formative period; it may simply have been an area where flaking stone was obtained. Excavations exposed a midden area or activity surface, and we consider it likely that more activities were taking place than those suggested by the surface material. Locus C was Formative period, protohistoric, or both, in age. In addition to ceramics and flaked stone, the locus included a roasting pit and ground stone artifacts suggestive of food-plant processing. This area yielded the six locally produced bifaces, which indicate specialized stone procurement and manufacture.

AZ O:1:134/AR-03-04-06-189 (ASM/CNF)

Site 134/189 was located on a gravel-and-sand terrace close to Dry Creek. The gravels contain numerous cobbles of chert, quartzite, and other material. The site consisted of a scatter of flaked stone containing a small number of ground stone and ceramic artifacts. There also were several rock features, two of which were possible masonry rooms. No flaked stone concentrations were found in direct association with the features. During previous fieldwork, Site 134/189 had been recorded as two separate sites; these were combined into a single site for the LOCAP. Surface-collection methods were different for the two portions of the site. The eastern portion was collected completely, and each artifact was point-located on the map and bagged individually. The western portion was treated only partially in this manner; unexpected mass quantities of chert artifacts made it necessary to sample this area by means of three 20-by-20-m collection units, but for the collection of diagnostic artifacts, we applied the same strategy used for the eastern site portion. The flaked stone collection consisted of 518 pieces of flaked stone (see Appendix G:Tables G.21 and G.22), of which 459 were point-located on the site surface, 1 was collected as PD 1, 44 were derived from the collection units, and 14 were derived from the excavations.

Projectile Points and Bifaces

Three projectile points were recovered from Site 134/189 (Figure 29) (see Appendix G:Table G.1). One (ID 8642) was complete, and the other two were fragments. Of the fragments, one (ID 5243) was a base, and the other (ID 5245) was a midsection. All three represented finished implements. The single complete specimen (ID 8642) was a corner-notched, obsidian dart point, probably Late Archaic period in origin. It was fairly small and somewhat

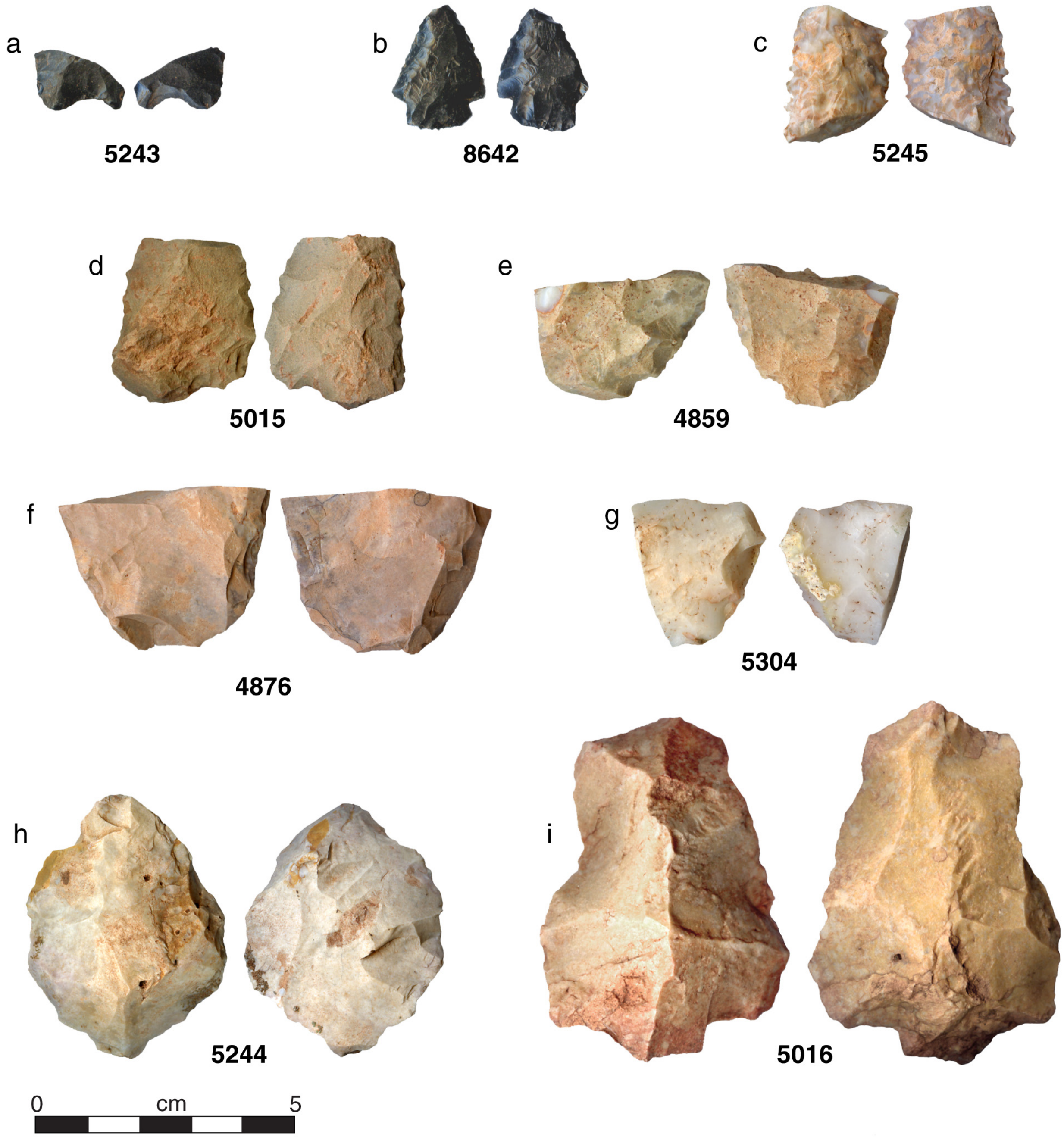

Figure 29. Flaked stone tools from Site 134/189: (*a–c*) projectile points; (*d–i*) bifaces.

asymmetrical, suggesting that it was used up and intentionally discarded. Alternatively, it might have been a hunting loss. The second point (ID 5243), represented by a base only, also was an obsidian dart point, but the form was typical of Middle Archaic period San Jose points. It was broken diagonally, a type of fracture that can occur within the hafted portion when the point collides with something resistant. The midsection (ID 5245) was made from local chert sponge and was serrated on both edges. Although it lacked the base, which is used to define types, it was fairly thin and regular. This conforms to dart point styles of the Late Archaic period. The breaks were of unknown origin. All three points may have been hunting losses, or they may have been discarded after being broken during hunts.

There were six bifaces in the collection, and these appear to have been discarded during various stages of the reduction process, from initial rough-outs to preforms (see Figure 29). All were of local materials, and all but the complete pieces appeared to have been broken during manufacture. It is likely that all but the complete pieces were destined to become dart points. The flaking method consisted mostly of direct percussion, including marginal platforms, indicating the use of a soft flaking tool.

Tools

Twelve tools were recovered (see Appendix G:Table G.2). All were of local chert, with the exception of one specimen made of local chert sponge. It is interesting to note that all but one had a denticulate working edge, and seven were made from core or cobble blanks. The presence of cobble and core blanks, as well as the relatively large size of these tools, also indicates that heavy, rather than delicate, tasks were intended. Tough, succulent plants, such as yucca and agave, are the most likely candidates.

Cores

In total, 27 cores were collected. One was coarse basalt, and 2 were identified as Other Chert. The remainder were local chert (n = 16), chert/quartzite (n = 3), chert sponge (n = 1), and quartzite (n = 4). Only 1 core was considered exhausted, 15 had some potential, and 11 had good potential. This indicates that raw material was abundant and that site use probably was not intensive or long-term.

Debitage

Debitage consisted of 470 artifacts. Flakes outnumbered debris: 282 (60 percent) to 188 (40 percent). This indicates that intensive flaking probably did not take place at the site. Only 8 flakes (2.8 percent) exhibited the traits of those struck from bifaces, and only 3 (1.1 percent) appeared to have resulted from unifacial-tool retouching. Based on the presence of 6 bifaces (4 of which were probably broken in manufacture), we would have expected to find more than the small number of biface flakes that were present.

Local materials accounted for 90.4 percent of the flakes; the remaining 9.6 percent were of nonlocal stones. All the nonlocal flakes were obsidian (n = 6) or Other Chert (n = 21). Fine-grained basalt and Other types were not recovered from this site.

Summary

Site 134/189 had Archaic and Formative period components. The flaked stone artifacts are the best indicators of what took place during the earlier occupation. Projectile points indicate that both Middle and Late Archaic period occupations were represented. They also indicate that hunting took place—either on-site or off-site—or that the site served as a hunting camp where weapons were refurbished, or both. Overall site occupation was never intensive. Most tools were types that would best serve in plant procurement, although some also could have been used for butchering animals.

AZ O:1:135/AR-03-04-06-186 (ASM/CNF)

AZ O:1:135/AR-03-04-06-186 (ASM/CNF) (Site 135/186) was a small surface scatter of flaked and ground stone located on a low bench on the south side of Dry Creek. Abundant chert, chert sponge, and quartzite pieces in the sediments and gravel on the site surface would have made this an attractive raw-material-procurement area. The site was located only a short distance from the well-documented Dry Creek site—the type site for the local variant of the Late Archaic period, the Dry Creek phase (Shutler 1950)—and may have been associated with it.

During fieldwork, all surface artifacts were point-located, cataloged, and collected separately. The flaked stone collection consisted of 338 artifacts (see Appendix G:Tables G.23 and G.24), of which 261 were point-located on the site surface and 77 were derived from the excavations.

Projectile Points and Bifaces

One projectile point fragment (ID 4612) and one biface fragment (ID 4829) (Figure 30) were recovered from this site (see Appendix G:Table G.1), but no finished projectile points were found. Both were made from the local Kaibab chert and appeared to have broken during manufacture. Flaking was performed by direct percussion, and the presence of at least some marginal striking platforms indicates

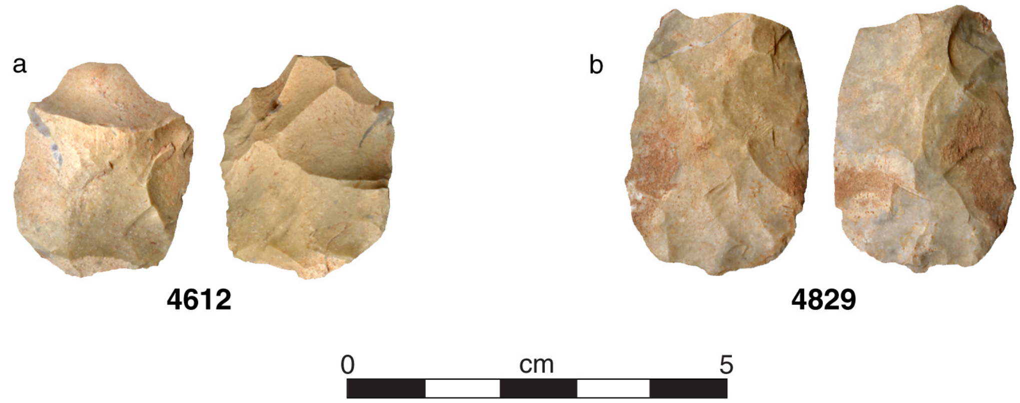

Figure 30. Projectile point (*a*) and biface (*b*) from Site 135/186.

the use of a soft-hammer flaking tool. Although both fragments were bases, one (ID 4612) appeared to have broken as the result of end shock, whereas the other (ID 4829) had an unidentified break. The flaking, size, proportions, and shape of ID 4829 suggest that it was intended to be another dart point.

Tools

Only two tools were recovered from the site (see Appendix G:Table G.2). One (ID 4572) was made from a core of local chert, had an even edge, and exhibited characteristics of a scraper. The other implement (ID 4643) was made from a flake blank of Other Chert, had a denticulate edge made by unifacial retouch, and was probably used for cutting and scraping. The denticulate edge precluded it from being a hide scraper in its final form.

Cores

Twelve of the 13 cores from Site 135/186 were local chert (1 was chert sponge), and the thirteenth was classified as Other Chert. Only 2 were considered to have good potential for further removal of usable flakes, whereas 7 had some potential, and 4 appeared to be exhausted. Intensive use of the material was further supported by the discoidal form of 6 of these cores, often considered characteristic of the end of the flake-production process. It is curious that the cores should be relatively used up if the site was a procurement area. We would expect source areas to contain many more cores that were only slightly modified as a result of material testing, which would consist of removing only one to a few flakes to check quality.

Another way to evaluate the site as a possible source area is to examine the core-to-flake ratio. Highly worked cores should leave a relatively high ratio of flakes to cores. At Site 135/186, there were 96 local chert flakes and 11 local chert cores. This is a ratio of roughly 9 flakes per core. Even if a few flakes from each were taken away for use elsewhere, we could still expect a higher ratio. Another expectation is that the location of extensive flaking activity should yield a fairly high ratio of shatter to flakes. This is also not true at Site 135/186. There were 178 flakes and only 143 pieces of debris. The exposed position and amount of recent disturbance to the site might have contributed to these unexpected results, but we believe that this was not a critical factor.

Debitage

Debitage consisted of 143 pieces of debris and 178 flakes. The flake types were consistent with core reduction and with biface manufacture. Of the flakes, 17 (9.6 percent) were biface flakes, only 2 (1.1 percent) were uniface flakes, and 159 (89.3 percent) were core flakes. The single uniface flake may have resulted from core or biface flaking rather than unifacial-tool manufacture.

The proportions of local and nonlocal stones argue against identifying the site primarily as a stone-procurement locale. Of the 183 pieces of debitage, 39 (21.3 percent) were nonlocal. These consisted of 7 (17.9 percent) obsidian, 1 (2.6 percent) fine-grained-basalt, and 31 (79.5 percent) Other Chert artifacts. It is difficult to evaluate these proportions in terms of the activities that took place and the people who brought the material to the site. We would have expected a higher proportion of obsidian if it came in during the Middle Archaic period (on the basis of the high proportion of obsidian Middle Archaic period points in the project area and beyond); therefore, it is more likely to be Late Archaic period in origin.

Summary

The presence of one dart point and a possible dart point preform suggests that Site 135/186 dated to the Archaic period. Local raw materials were used primarily for intensive core reduction; some tool production also occurred. In addition, the presence of manos indicates that seed-processing activities also occurred at the site; there is no obvious evidence that indicates that any hunting or meat processing was undertaken at this location.

AZ O:1:136/AR-03-04-06-663 (ASM/CNF)

AZ O:1:136/AR-03-04-06-663 (ASM/CNF) (Site 136/663) was a small scatter of flaked stone, ground stone, and two collected sherds. It was immediately adjacent to the SR 89A roadbed, and an informal pullout had severely impacted the southern quarter of the site. The disappearance of a sandstone metate recorded before this project is an indication that artifact collecting has occurred here (Stone and Hathaway 1997:58–59). During fieldwork, SRI conducted a complete surface collection; all artifacts were individually point-located, cataloged, and bagged. Flaked stone consisted of 270 artifacts (see Appendix G:Tables G.25 and G.26), and all but 1 (from a test pit) were found on the surface.

Projectile Points and Bifaces

A single small, complete, obsidian side-notched arrow point (ID 6124) (Figure 31a) (see Appendix G:Table G.1) was found at the northwest corner of the artifact scatter. Its tip was slightly damaged, possibly through use. The point was quite thick, and the notches were low and shallow. This suggests that the artifact was associated with Pueblo or Sinagua peoples.

One unfinished biface also was recovered (ID 6302) (see Figure 31b) (see Appendix G:Table G.1). It was made of local chert and had a major "overshot" flake scar on one face. It was in an early stage of manufacture when it was discarded. It was not diagnostic to any specific period.

Tools

A single Other Chert unifacially retouched flake (ID 6311) was the only tool recovered from the site (see Appendix G:Table G.2). It had an even edge but was only a fragment; therefore, little can be inferred from it.

Cores

Eleven cores were found, all but one of which were of local materials. The specimen of nonlocal stone was made of Other Chert. The potential for additional flakes exists, as three of the cores were exhausted, six had some potential, and only two retained good potential. Overall, these cores suggest that the location was intensively, if not extensively, used.

Debitage

Debitage consisted of 122 pieces of debris and 134 flakes. Of the flakes, 4 (3 percent) were biface flakes, all of local material, and the remainder were core flakes. All but one flake had the material type identified and only 2 flakes (1.5 percent) were of nonlocal materials (both obsidian). Among the local materials, the great majority of flakes (n = 100) were chert (76.3 percent); the remainder consisted of 27 (20.6 percent) quartzite and only 4 (3.1 percent) chert sponge artifacts.

Summary

As determined from the sherds, Site 136/663 dated to some time during A.D. 900–1300. The flaked stone indicates that it was a small, temporary procurement camp with an emphasis on core-reduction activities. In addition, the presence of a sandstone metate indicates that seed processing also occurred at the site.

AZ O:1:137/AR-03-04-06-482 (ASM/CNF)

Site 137/482 was a sparse scatter of flaked stone artifacts located at the intersection of SR 89A and Upper Red Rock Loop Road. It had been much disturbed by modern activities, including the construction of a concrete sidewalk bisecting the site. The two roads traversed the site, such that four artificial loci were created: northwest, northeast, southeast, and southwest quadrants. Large portions of the site were located on private land, and no artifacts were collected from these areas. In spite of the disturbances, the incomplete collection, and the probability that large numbers of artifacts had been collected before SRI's fieldwork, some interesting results have been obtained from the analyzed materials. The flaked stone collection consisted of 214 artifacts (see Appendix G:Tables G.27 and G.28), all of which were individually point-located on the site surface.

Projectile Points and Bifaces

Three projectile point fragments (IDs 5918, 5919, and 6118) were found in the southeastern quadrant of the site (Figure 32) (see Appendix G:Table G.1). All were pieces of dart points, indicating an Archaic period use of the area.

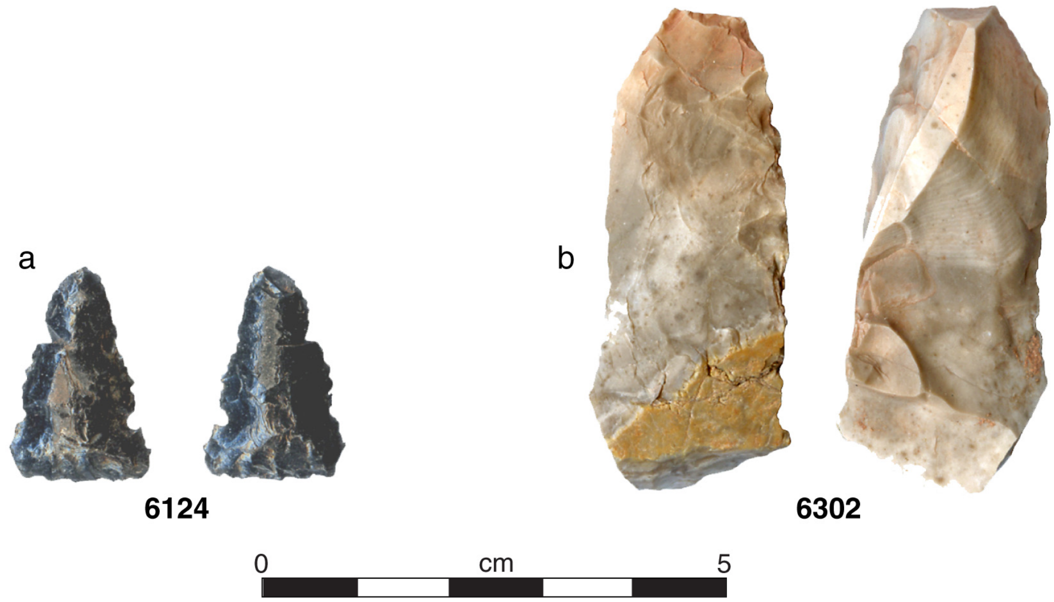

Figure 31. Projectile point (*a*) and biface (*b*) from Site 136/663.

Figure 32. Projectile points (*a–c*) from Site 137/482.

Two were obsidian midsections, and one was a tip of local chert. None retained a base that would allow for a more precise temporal placement. All of the points exhibited pressure flaking, as well as breaks that probably resulted from use as projectile points. The base of a finely flaked obsidian biface was noted at the site during a survey in 1991 (Bassett et al. 1991:44) but was not relocated during the present project. The archaeologists working at the site in 1991 also observed that many flaked and ground stone items previously recorded at the site by the MNA (Dosh 1987) were also missing. This attests to the intensity of the artifact collecting that has taken place during the last decade.

Tools

We recovered three tools (IDs 5990, 6038, and 6101), all of local chert and exhibiting unifacial edge retouch (see Appendix G:Table G.2). One was made on a core; the other two were made from flakes. Two of the tools had denticulate edges, and one had an even edge. All three tools were collected from the northwest quadrant of the site.

Cores

Eight cores were found, 6 in the northwest quadrant and 2 in the middle of the southwest quadrant. All were made from local material. One of the cores was exhausted, 2 had some potential remaining, and 5 retained good potential for further reduction. This indicates that obtaining raw material was not a problem and that site use was not intense or long-term. The collection contained 13.3 flakes (of local chert and quartzite) for each core. Three of the cores were discoidal, an indication of concentrated flaking, but given the fact that 5 cores retained good potential for producing more flakes, cores probably were underrepresented at the site when compared to the number of flakes present. As noted for Site 85/428, perhaps some core tools were made at the site but taken away, used, and discarded elsewhere.

Debitage

In total, 137 flakes and 63 pieces of shatter were collected. Of these, 123 (89.8 percent) were core flakes, and 14 (10.2 percent) were biface flakes. A typically high proportion (85.4 percent) of the flakes was made of local materials, and 14.6 percent were nonlocal stone. Of the latter, 60 percent were obsidian (n = 12), 15 percent were fine-grained basalt (n = 3), and the remaining 25 percent were Other Chert (n = 5). Because of the intensity of modern collecting, we think it likely that the nonlocal materials, especially obsidian, were underrepresented in the collection. Because of their unusual, exotic color and texture, which would contrast starkly with the surface sediments, pieces of obsidian debitage probably were selectively collected from the site by passersby. As noted in Chapter 17, Volume 1, at least 200 obsidian flakes were observed east of Upper Red Rock Loop Road, on private property.

Summary

Although the dart points were all fragments, the pressure flaking suggests that they may date to the Middle Archaic period. All three were tip or midsection fragments, had probable use breaks, and were found in the southeast quadrant. Although this is a small sample, it appears that the southeast quadrant represented a hunting or "kill" site. Point bases usually are found at a hunting camp, where they would have been discarded during weapon refurbishment. Tips and midsections were often lost at a hunting site and/or an area of field processing.

The northwest quadrant contained most of the cores, all of the tools (with the possible exception of the missing obsidian-biface base), and the ground stone (the piece that had been observed earlier and was already missing by 1991). The site appears to have been an Archaic period hunting area with an associated hunting-and-gathering camp. The camp was located on the southeast-oriented basal slope of a hill, and the hunting area occupied a relatively flat area to the southeast. The lack of features, such as roasting pits, could be the result of the high degree of modern disturbance to the site, or it might indicate a short-term use of the area with a focus on meat preparation instead of plant processing. The presence of obsidian and fine-grained basalt in the forms of projectile points and biface flakes indicates that hunters were coming into the area from the north, bringing their weapons with them but relying on local stone for most of their tool needs.

Conclusions

The LOCAP offered a chance to add a new dimension to our understanding of the culture history and prehistoric use of the Verde River valley. In addressing the research questions related to the project's flaked stone artifacts, we were limited by three factors: (1) the project area consisted of only a narrow transect, (2) archaeological collection methods were variable from site to site, and (3) the recent collection of artifacts had significantly altered the archaeological record. Nevertheless, we believe we are in a position to address many aspects of the questions posed for this project. In the following section, we address the following topics: cultural and temporal affiliation, technology and artifact types, and land use and subsistence.

Cultural and Temporal Affiliation

The first and most important question that we wished to address concerned when the area was used and who used it. This question has been reasonably well answered, primarily on the basis of projectile point types and, to a lesser extent, by the evaluation of flaking technology and stone types. There appears to have been a nearly uninterrupted period of use of the project area from the Middle Archaic period through the end of the Formative period. Surprisingly, the flaked stone provided no evidence that the project area was ever used by Yavapai people.

We investigated 13 sites consisting of at least 27 temporal components. Table 31 lists the different components at the sites. Seven sites (Sites 28/903, 31/244, 105/838, 131/37, 135/186, 136/663, and 137/482) appeared to have been single-component sites. They represent Archaic or Formative period occupations. Three of these seven sites (Sites 105/838, 131/37, and 136/663) were used only during the Formative period. Six sites (Sites 53/745, 77/869, 85/428, 104/902, 133/561, and 134/189) had multiple components, each including Archaic and Formative period occupations.

The earliest evidence of use of the project area was for the Middle Archaic period, as sites or site components dating to this time were located on various landforms along all parts of the project corridor. There was a greater use of the project area during the Late Archaic and Early Formative periods than during the Middle Archaic period. Most of the Middle Archaic period projectile points were identified as Pinto/San Jose types, which are usually associated with the Great Basin and Colorado Plateau Archaic, with most made from obsidian or fine-grained basalt that came from the north and northwest. Two large fragments of side-notched points were also identified. This style is commonly associated with the High Plains and Rocky Mountains regions but has also been identified in collections from the Colorado Plateau (see Chapman 1977; Holmer 1980). Mallory points are present along with San Jose points in southwestern Colorado.

Late Archaic period projectile point styles were more variable, with Elko Corner-notched forms dominating. This type is usually associated with the northern Colorado

Table 31. Lower Oak Creek Archaeological Project Site Components, by Period and Culture

Period/Culture	Site Nos.
Middle Archaic	85/428, 31/244, 133/561, 134/189
Middle Archaic?	77/869, 137/482
Late Archaic	77/869, 53/745, 28/903, 31/244, 133/561, 134/189, 135/186
Archaic, unassigned	104/902
Early Formative	105/838, 85/428
Formative (Sinagua)	105/838, 131/37, 53/745
Formative (Hohokam)	53/745
Formative (Pueblo II?)	105/838 (Locus B)
Formative, unassigned	104/902, 77/869, 131/37, 133/561, 134/189, 136/663

Plateau and Great Basin. This is also the case for the Gypsum points, a few of which were present in the collection. This type is found throughout the U.S. West and Southwest. San Pedro points were well represented. This style is usually associated with the desert cultures to the south and southeast of the project area. The presence of both northern and southern styles is interesting. It is not just the forms that are different but also the basic manufacturing technologies. This suggests that the two point styles had different origins and probably were made and used by different ethnic groups.

In the Sonoran Desert, San Pedro points are often found at Late Archaic period sites. In the Four Corners area, they are frequently classified as Basketmaker II and are also associated with early agriculture (LeBlanc 2008; Matson 1991). The project area has provided a good example of this association. Feature 37 at Site 105/838 was a pit structure dating to the Squaw Peak phase, representing the Early Formative period agriculturists of the region. Feature fill contained a San Pedro point with a relative abundance of biface flakes but a dearth of ceramics.

Formative period sites were well represented in the project area; they were similarly distributed along the entire length of the project corridor. That Sinagua groups lived in the project area is easily inferred from the presence of their well-typed arrow points and, of course, from the pottery they left behind. We also found evidence that representatives of two other Formative period cultures may have used the area. Site 53/745 yielded firm evidence of Hohokam use, probably between A.D. 900 and 1100, when the Sinagua also were in the area. At this site, two Hohokam arrow points were recovered from the same area in which some Hohokam sherds were found.

The most unexpected aspect of the flaked stone collection was the complete absence of any obvious evidence for the protohistoric period. None of the recorded projectile points could be attributed to the Yavapai. This does not necessarily mean that the Yavapai did not use the area, only that we were unable to recognize their presence in the flaked stone. Site 53/745 was considered a prime candidate for occupation by Yavapai groups, but our flaked stone analysis provided evidence only for occupation from the Archaic through the Formative periods.

Technology and Artifact Types

Various aspects of stone tool technology are represented at the LOCAP sites, including evidence of local and nonlocal lithic raw materials and stone tool production, use, and maintenance, with eventual discard of exhausted items. Together, these organizational components provide some interesting insights into the Archaic through Formative period use of the area.

A variety of lithic raw materials were selected for the production of stone tools. Most of these materials were readily available from local gravel or bedrock sources, including Kaibab chert, quartzite, coarse-grained basalt, and chert sponge. In contrast, nonlocal obsidian and fine-grained basalt and possibly some nonlocal cherts were also identified at the sites. The lithic assemblage was dominated by local materials (primarily chert, 46 percent), with many fewer nonlocal fine-grained basalt (1 percent) and obsidian (6 percent) artifacts. Fine-grained basalt also constituted 1 percent of the cores, but no obsidian cores were recovered. Again, most of the cores were made of local cherts (60 percent). This contrasts markedly with the retouched tools, which were manufactured mostly of local chert (39 percent) and obsidian (29 percent). Most of the bifaces were made of local chert (70 percent), whereas most of the projectile points were made of obsidian (41 percent), and fewer of local chert (27 percent). The long-term pattern appears to indicate that a relatively greater number of points were made of obsidian during the Middle Archaic and Formative periods and fewer during the Late Archaic period.

Obsidian-source studies reveal that obsidian was obtained from several sources. The Government Mountain source was the most prevalent material type identified; less material came from RS Hill/Sitgreaves, Presley Wash, and Partridge Creek. The first two sources are derived from the San Francisco Mountains area, and the latter two sources are derived from the Mount Floyd volcanic field. A review of the obsidian-source study indicates that the three RS Hill/Sitgreaves artifacts were recovered from the Formative period habitation site (Site 105/838). In contrast, all four of the Mount Floyd artifacts were recovered from Archaic period contexts.

Certainly, the reduction of local materials was a primary activity at all the sites. Indeed, one basalt quarry and several other sites were situated directly on or adjacent to gravel materials. Most of the local chert, quartzite, and coarse-grained-basalt cores were classified with some or good potential, although the quartzite cores seem to have been less intensively reduced. If so, this might account for variations in mean core length. That is, quartzite cores exhibited a mean length of 77.3 mm (sd = 21.1), vs. local chert (58.3 mm, sd = 15.9) and chert sponge (53.5 mm, sd = 13.8). On the other hand, coarse-grained-basalt cores tended to be the largest, with a mean length of 115.4 mm (sd = 44.8); this may reflect differences between bedrock and cobble sources. Otherwise, tested cobbles made of local chert, quartzite, coarse-grained basalt, and chert sponge all attest to the availability of these materials from nearby sources. Nonetheless, the intensity of core reduction did vary among the sites, reflecting specific locales with extended periods of occupation. For example, a typical Formative period habitation site, such as Site 105/838, reflects a low degree of core-reduction intensity that is probably related to the local abundance of resources. In contrast, multicomponent sites appear to exhibit the most-intensive degrees of core reduction, presumably because of the reuse of materials from previous occupations (e.g., Sites 53/745 and 104/902) (see Vierra 1990:66).

The reason for the absence of obsidian cores is unclear, given that the presence of obsidian core flakes indicates that they were also being reduced at the sites. Their absence may be due to several factors, including being fully reduced, removed by the site occupants, or removed by later visitors (possibly recent artifact collectors).

As previously noted, many of the dart and arrow points were made of obsidian. The Archaic period points presumably were highly curated items, having been discarded because of breakage or exhaustion. Indeed, most of the dart points were broken (18 percent). In contrast, the arrow points primarily were whole (43 percent). This pattern presumably reflects the longer use life of dart points. Larger flake (or biface) blanks were used for the dart points, and resharpening could extend the tool use life of these larger artifacts.

The bifaces were often produced at the site locations; they were a mixture of whole bifaces (41 percent), bases (27 percent), tips (18 percent), and other fragments (14 percent). Archaic period bifaces were commonly produced by a soft-hammer-percussion technique, whereas Formative period bifaces were more often manufactured by a hard-hammer-percussion technique. Presumably, some of the Archaic period bifaces eventually would have been used to produce dart points, whereas the Formative period bifaces probably would have been used as knives.

A variety of other tool types were identified in the collections. These included mostly flakes (49 percent), with fewer core (35 percent) and cobble (16 percent) tools. All appeared to have been used as expedient tools that were manufactured on local materials. Simple unifacial percussion or retouch was primarily used to create the working edges. The edges were most often irregular or denticulate in outline (54 percent); fewer edges were evenly shaped (37 percent). These tools primarily exhibited acute working edges that were more suited for chopping or cutting activities. The cobble tools could have been used for chopping; the cores, for chopping or possibly for roughening the surfaces on ground stone implements; and the flakes, for cutting activities. Overall, a variety of processing activities were occurring at the sites.

Land Use and Subsistence

The flaked stone collection from the LOCAP sites suggests that many different subsistence activities were undertaken, from plant processing to hunting and butchering. Land use intensified after the Middle Archaic period, but the area seems to have been used as a resource-procurement area during the Archaic and Formative periods.

Middle Archaic period groups were short-term visitors on fast-moving hunting forays who visited the area for short periods without taking up residence. They probably brought their weapons and specialized tools with them, occasionally producing expedient tools from local stone. The Middle Archaic period use of the area was probably seasonal, and there is not enough evidence to suggest that groups came to the area very frequently. It is likely that the groups were small family units that took advantage of animal and plant resources for only a short time during incursions into the area.

Middle Archaic period sites included two possible base camps where multiple activities took place (Sites 31/244 and 85/428). The remaining sites functioned as limited-activity areas, including a hunting site (Site 137/482), a pair of plant-processing areas (Sites 133/561 and 134/189), and two sites for which the evidence of use during this period was equivocal (Sites 53/745 and 77/869). Although local stone was used for simple tools and flake production, there is little evidence of heavy retooling or manufacture of tool blanks from local stone to be taken elsewhere.

During the Late Archaic period, patterns of land use similar to those of the Middle Archaic period continued, but there were some differences. Late Archaic period sites also were distributed throughout the corridor, but use was much more intensive and frequent. Late Archaic period people initiated a more intensive and possibly permanent use of the area, eventually experimenting with agriculture. There also was a much greater reliance on local stone; little nonlocal material was represented, and tools and weapons were manufactured mostly from local stone.

The greater reliance on local cherts for the production of projectile points and tools, paired with the paucity of nonlocal stones, suggests that Late Archaic period people were more settled into the area and had fewer far-ranging territories. This fits well with the nearby presence of the Dry Creek site, which represents a large base camp dating to this time. On the other hand, four obsidian flakes from Archaic contexts were sourced to the Mount Floyd volcanic field, located about 130 km northwest of the project area. Three of these items were found on sites including Late Archaic period occupations. Nonetheless, obsidian was recovered from both Middle and Late Archaic period contexts. Therefore, it seems likely that the Archaic period groups were traveling between these areas. Obsidian-source studies conducted at Archaic period sites situated on the Kaibab Plateau were able to identify several regional Archaic period procurement ranges. This upland area appears to have been integrated into the seasonal rounds of Archaic period groups moving between the plateau and areas to the north, into Utah, and south, to central/southeastern Arizona, including traveling distances of about 220 km (Shackley 1990:290, 334; Vierra 1994). The 50–60-km distance to the Government Mountain area and the 130-km distance between the LOCAP sites and the Mount Floyd source area easily fall within this procurement range.

Formative period people established larger, permanent residences and practiced more-intensive agriculture. They exploited local stone resources during collecting forays as well as resources close to their settlement, whenever needed. Of all people in the project area, the Sinagua worked with the greatest variety of raw material. Local stone was used for most tool and flake production, but arrow points were made primarily of obsidian originating from the Government Mountain source area, located 50–60 km to the northwest of the project area. Government Mountain obsidian is common on Sinagua sites located near Flagstaff, vs. Mount Floyd obsidian on Cohonina sites located farther to the west (Vierra 1993). The presence of Government Mountain obsidians on the LOCAP Formative period sites indicates close ties with the Sinagua core area.

Formative period site types in and near the project corridor ranged from limited-activity areas, representing stone and plant exploitation, to a village with substantial architecture. The Sinagua farmstead at Site 105/838, expanded from its simple beginnings in the Squaw Peak phase, probably was an outlier of the large pueblo outside the project area that was documented as the Spring Creek site. As expected, these sites yielded evidence of a more intensive use of the area, as a result of foraging and farming activities.

CHAPTER 4

Ground Stone, Manuports, and Minerals

Gabrielle Duff and Stephanie M. Whittlesey

This chapter presents the results of the analysis of 250 ground stone artifacts[1] and 196 manuports recovered at 13 sites investigated during data recovery for the LOCAP. The sites included AZ O:1:131/AR-03-04-06-37 (ASM/CNF) (Site 131/37), AZ O:1:135/AR-03-04-06-186 (ASM/CNF) (Site 135/186), AZ O:1:134/AR-03-04-06-189 (ASM/CNF) (Site 134/189), AZ O:1:31/AR-03-04-06-244 (ASM/CNF) (Site 31/244), AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428), AZ O:1:137/AR-03-04-06-482 (ASM/CNF) (Site 137/482), AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561), AZ O:1:136/AR-03-04-06-663 (ASM/CNF) (Site 136/663), AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), AZ O:1:77/AR-03-04-06-869 (ASM/CNF) (Site 77/869), AZ O:1:104/AR-03-04-06-902 (ASM/CNF) (Site 104/902), and AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903). The sites were located in two clusters in the project area along SR 89A. All sites yielded ground stone artifacts,[2] although the number varied greatly with intensity of use, occupational duration, site size and function, and archaeological sampling. Manuports were found at 12 of the 13 sites.

The research theme of SRI's investigations for the LOCAP was "the identification of past human landscapes" (SRI 1998). As a holistic anthropology of place (Whittlesey 2003), the cultural landscape provides a particularly informed and coherent structure for seeking order and meaning among different land-use strategies (Anschuetz and Scheick 1998). The Verde River embraces tremendous environmental and cultural diversity along its 180-mile length, which stretches from the Colorado Plateau to the Sonoran Desert (Whittlesey and Ciolek-Torrello 1998). This was also certainly true of the LOCAP; at the outset of research, the 13 sites investigated by SRI appeared to have been occupied from the Archaic period to the historical period by groups including the Southern Sinagua and the protohistoric or historical-period Yavapai. Although individually, the small, special-purpose LOCAP sites might appear uninformative, when placed into a regional context using a cultural-landscapes approach, such sites provide a detailed view of land use.

Issues important to the overarching research theme included the age and cultural affiliation or ethnic identity of ancient inhabitants and the subsistence, settlement, and mobility strategies employed by the different groups that occupied the project area. The ground stone collection, including artifacts and manuports, can contribute to answering questions concerning this theme by providing information on raw-material procurement, resource processing, diet, strategies for ground stone manufacturing, technology, and artifact recycling and reuse.

The duration and intensity of occupation can affect the kinds of ground stone materials that are found. Schneider (1993:14) has noted, for example, that "patterns of residential mobility and the distribution of resources tend to leave different types of assemblages at different sites where different resources were being exploited." Adams (1995:75) stated that "tool designs might be different if they were used at long-term habitation sites, as compared to seasonal fieldhouses." The Northeastern Yavapai who occupied the project and study areas for the LOCAP have been characterized as "mobile hunters and gatherers who farmed little, ranging great distances in a biseasonal round" (SRI 1998). Yavapai groups used multiple, short-term settlements where

[1] One bedrock metate from Site 53/745 was not collected and therefore was not analyzed. It is included in the tables where noted and is reported in this chapter, however.

[2] Although manuports technically should be considered "artifacts" of human behavior, they are not modified. They also can be considered "tools" despite lack of modification. Throughout this chapter, we typically refer to "artifacts" when we discuss deliberately modified grinding tools, reserving the term "manuport" for stones that were not modified.

little refuse accumulated, creating a sparse and ephemeral archaeological record (Whittlesey and Benaron 1998). Yavapai assemblages "are characterized by low frequency and diversity of material culture"; the Yavapai's "mobility and casual approach to agriculture necessitated movable artifact assemblages" (Whittlesey 1998a:213). Because the types of tools and the manufacturing technology expected at sites occupied by mobile peoples should differ from those of sedentary groups, we might expect that the ground stone assemblages at sites occupied or used by the Yavapai should differ from those occupied by sedentary farmers, such as the Southern Sinagua.

Other characteristics of Yavapai groups are that they were habitual recyclers and reusers of prehistoric materials, and that they reoccupied prehistoric sites (SRI 1998; Whittlesey 1998a; Whittlesey and Benaron 1998). Yavapai ground stone technology has been described as expedient and partially the result of collecting and reusing materials from prehistoric sites. We can therefore ask the following questions: What attributes indicate whether artifacts have been reused and recycled? Can we demonstrate the reoccupation of prehistoric sites by the Yavapai?

In addition to determining what resources were processed at LOCAP sites, we were specifically concerned with refining the dating of the introduction of agriculture into the area. Schneider (1993:8) stated that "archaeologists must often rely on artifacts, assumed to be the material correlates of plant harvesting and processing behaviors, to make inferences about the prehistoric use of plants and plant products." She added that "the sizes and shapes of archaeological milling implements often are used as criteria for making functional interpretations." Several authors have noted the difficulty in making a direct correlation between types of ground stone tools and the kinds of food products that were processed, however. Adams (1995:89) has maintained that "without supporting residue analysis, pollen analysis, and macrobotanical analysis it is virtually impossible to determine what actually was being processed with mano-metate equipment or with mortar-pestle equipment." Recent research by Adams (1999) has indicated that change in artifact types is not necessarily related to shifts in subsistence strategies. Her experiments indicate, for example, that "metate design differences are related to food-processing strategies and not food procurement." Adams (1995:88) noted that "trough manos and metates are most often associated with corn grinding," but that they "show up in the archaeological record in southern Arizona sometime after A.D. 200 and are thus independent of the introduction of maize agriculture into the U.S. Southwest" (1999:489).

This chapter is organized into four sections. Following this introduction, we present the methods used to analyze the ground stone collection, including important definitions and principles that guided the study. Next, the results section provides the data by site. We revisit the research themes in the interpretations and comparisons section. A short conclusions section ends the chapter.

Methods

All ground stone artifacts were examined in the laboratory in SRI's Redlands, California, office between September and November 1999. In addition, eight mineral samples from Site 105/838 were examined in SRI's Tucson, Arizona, office in 2010. Artifacts were analyzed by means of morphological, typological, and technological attributes. The first author analyzed and recorded the ground stone material and prepared most summary tables. Before addressing research questions, it is necessary to define important terms and to discuss some principles that guided the study. The terms "expedient technology" and "curation" have several definitions. As Nash (1996:81) has noted, "the 'curation' concept has been used to describe and explain a great deal of morphological, technological, and assemblage-level variability with little or no standardization achieved in its usage. In fact it is evident that 'curation' now means vastly different things to different archaeologists." Binford (1973) introduced the concept of "curated technology," as opposed to expedient technology, and since then, the definition has been expanded to include several variations (see Odell [1996] for a discussion). Nash (1996:93) defined expedient tools as those "that are produced when needed and discarded immediately after use." Most definitions of "curated tools" include the following aspects: production of tools for future use, design of tools for multiple uses, maintenance of tools, and transportation of tools and raw materials. Both Nash and Odell have agreed that the terms "curated" and "expedient" are not necessarily mutually exclusive and are affected by variables such as material availability and ethnic boundaries. For the purpose of the analysis of the LOCAP ground stone materials, we made the distinction between expedient *design* and expedient *use*. Ground stone tools that exhibited expedient design are those with little to no evidence of manufacture. Although expediently used tools could be carefully made, typically, they were used minimally for an immediate need and then discarded. Design and use of tools can be affected by raw-material availability, mobility, and lithic-procurement strategies.

To address issues of expediency and reuse during analysis, several attributes of ground stone tools should be examined. To determine if the design is expedient, we must look for evidence of manufacture and production. Wilke and Quintero (1996:2) have noted that "many if not most items of portable milling equipment were produced and shaped entirely by percussion flaking and subsequent dressing by pecking" and "evidence of grinding is almost entirely a property acquired during use." The intensity of use evident on a tool indicates the duration of use and can inform on the question of expediency. The number of utilized surfaces also indicates intensity of use. For example, manos with more than one grinding surface, a ground surface with a triangular profile, or both were used more intensively than manos with a single grinding surface. When a mano's surface thins through use, it can be rotated or turned over. When it is rotated, a triangular profile is created. Rotating a mano helps to keep the user's fingers from coming into contact with the surface of the metate. Eventually, the mano becomes thinner and is discarded or recycled, possibly as a hammerstone or trivet. Evidence of recycling and reuse can be examined by noting if an artifact has a secondary use. Recycling and reuse of artifacts may indicate reoccupation or long-term use of sites.

In all, 250 ground stone artifacts and 196 manuports were analyzed from 13 LOCAP sites (Table 32).[3] The additional metate found at Site 53/745 that was not collected is included in Table 32 and most subsequent tables. All recovered artifacts, with the exception of fragments, were analyzed. Morphological, typological, and technological attributes were recorded to determine technological aspects of tool manufacture, function, use, reuse, and use intensity. Recorded attributes included artifact type; level of use; morphology of ground surfaces; evidence of recycling; evidence of heat modification; the length, width, and thickness of the artifact and its grinding surface(s); and the depth of the grinding surface or surfaces. Whether a mano was used with one or two hands also was recorded. It should be noted that mano subtype (oval, round, or rectangular) refers to the shape of the artifact in plan view. In other taxonomies, manos are classified as basin, trough, and slab manos based on cross-sectional shape (e.g., Adams 1997; Towner et al. 1998). Basin manos are round and were used in a circular motion on a basin metate and fit only one hand. The flat, or slab, mano was used with two hands in a reciprocal motion on flat, or slab, metates (Towner et al. 1998:99). The use of the flat mano appears late in most prehistoric contexts in the U.S. Southwest. Although most trough manos are rectangular, not all rectangular manos are trough manos. When possible, we note the type of nether stone with which a mano was used. Most metates in the LOCAP collections represent the flat or concave type, followed by basin metates. Oval or round manos would be used with these metate types. Technological attributes, including level of use and presence or absence of flaking, aided in examining questions of tool manufacture and intensity of use, which can be useful in determining site function and mobility strategies. Other recorded attributes included material type and the presence of pecking. Manuports were defined as stone objects that did not exhibit evidence of deliberate shaping or use but had been brought through human agency to the site where they were recovered archaeologically.

Some of our assumptions also must be noted. First, most of the LOCAP ground stone artifacts were recovered from surface contexts. This means that the objects have been subject to a variety of natural and cultural formation processes after their initial deposition in the archaeological context. Some of these processes include collecting and recycling by ancient inhabitants, looting and vandalism by modern artifact collectors, erosion, and modern disturbance, such as road building and associated construction, recreational activities, and refuse dumping. This means that the recovered artifacts may not necessarily reflect the original patterns in artifact types, functions, raw materials, or other attributes in which we are interested. Second, because of these processes, an archaeological site is conflated horizontally. Without stratigraphic relationships to guide our interpretations, we cannot confidently assign materials to temporal or cultural components. Lacking guiding principles to eliminate the action of disturbance and formation processes on the archaeological record, we must assume that the recovered materials are representative. Therefore, the interpretations in the discussions that follow must be taken with extreme caution.

Results

AZ O:1:131/AR-03-04-06-37 (ASM/CNF)

Site 131/37 was an extensive artifact scatter with multiple loci located in the southern site cluster. It was interpreted as a Southern Sinagua lithic-procurement and food-processing site associated with a basalt quarry. Ceramic dates indicate that the settlement was used between A.D. 800 and 1200. The site was situated on Tertiary basalt and Sheepshead Group deposits of the Verde Formation (House and Pearthree 1993:7). Much of the site surface was covered with basalt cobbles and boulders that were quarried by the ancient residents. A relatively flat area labeled Locus A was the only part of the site to show soil development. Site 131/37 was investigated with surface collection, shovel tests, test pits, and a backhoe trench.

Six ground stone artifacts and 10 manuports were collected from the surface (Table 33). Manos were the primary artifact type (half of the total), and sandstone was the most common material type, found in 83.3 percent of the artifacts and half of the manuports. Two artifacts (PDs 71 and 72) were sandstone fragments that refitted to form a single rectangular mano. This artifact displayed minimal use. One remaining oval mano had moderate use wear, and one (PD 73) had been resharpened. Both metates exhibited minimal use.

The manuports differed from the artifacts in raw materials. Whereas the only materials found among the artifacts consisted of a predominance of sandstone and some quartzite, the manuports included rhyolite and vesicular

[3] The number of artifacts in tables accompanying this chapter may differ, depending on whether the analyst counted refitting artifact fragments separately or as a single item.

Table 32. Ground Stone from the Lower Oak Creek Archaeological Project, by Site

Site No.	Mano	Metate	Hammerstone	Shaped Stone	Unidentified Ground Stone	Manuport	Total
131/37	3	2	—	—	1	10	16
135/186	3	—	—	—	—	—	3
134/189	2	—	—	—	—	2	4
31/244	4	1	1	—	—	3	9
85/428	13	1	—	—	—	2	16
137/482	—	—	—	—	—	1	1
133/561	9	4	—	—	—	1	14
136/663	—	—	—	—	—	1	1
53/745	60	49[a]	4	—	2	112	227
105/838	46	15	—	5	1	44	111
77/869	3	—	—	—	—	7	10
104/902	6	—	—	—	—	3	9
28/903	7	7	—	—	1	10	25
Total	156	79	5	5	5	196	446

[a] One bedrock metate was not collected.

Table 33. Ground Stone at Site 131/37

Type	Sandstone	Vesicular Basalt	Rhyolite	Quartzite	Total
Mano					
Oval	2	—	—	—	2
Rectangular	1	—	—	—	1[a]
Metate					
Unknown	1	—	—	1	2
Unidentified ground stone	1	—	—	—	1
Subtotal, artifacts	5	—	—	1	6
Manuports					
Cobble	5	1	1	—	7
Unknown	—	1	2	—	3
Subtotal, manuports	5	2	3	—	10
Total	10	2	3	1	16

[a] Two fragments refitted to form one artifact.

basalt in addition to sandstone (see Table 33). All but three manuports of unknown type were cobbles; no tabular manuports were found.

The artifacts supported the inferred function of Site 131/37 and the cultural affiliation of its inhabitants. Shaped and resharpened artifacts with moderate use wear and rectangular manos, some of which may have been used with trough metates, suggest occupation of some duration or intensity, the processing of plant resources, and the likely presence of cultivated plants, including maize. The vesicular basalt manuports may have been stockpiled for future expedient use or for manufacture into shaped grinding equipment. The ground stone supports inferences made on the basis of the flaked stone collection (see Chapter 3)—namely, that the locale was used by mobile populations who engaged in habitation and processing activities while quarrying the basalt outcrop that was the primary reason for visiting the locale.

AZ O:1:135/AR-03-04-06-186 (ASM/CNF)

Site 135/186 was located in the northern site cluster. This lithic scatter was interpreted as an Archaic period (Dry Creek phase), specialized locale used for hunting, plant procurement, and plant processing. The site was situated on an old terrace above Dry Creek; the terraces in this area are covered with Kaibab chert clasts and well-rounded Paleozoic, Precambrian, and Tertiary gravels and cobbles of varied sedimentary, igneous, metamorphic, and volcanic rocks. The site was investigated by means of surface collection, shovel tests, and test pits.

Only three ground stone artifacts, all manos, were collected (Table 34). The collection is one of the smallest among the LOCAP sites and includes no manuports. One mano was recovered during excavation, and the other two were found on the surface. Two manos exhibited minimum use, and one (the oval, sandstone artifact) had moderate use wear. The absence of rectangular manos is consistent with the inferred Archaic age of this settlement. The flaked stone collection also indicated a probable Archaic age and a focus on plant procurement and processing (see Chapter 3).

AZ O:1:134/AR-03-04-06-189 (ASM/CNF)

Site 134/189 was part of the northern site cluster. This was a moderate-density artifact scatter with two possible masonry structures and two other rock features. There were two components. One was interpreted as a Middle and Late Archaic period hunting camp; the other, dating between approximately A.D. 1075 and 1125, was interpreted as consisting of a plant-processing locale and field houses. The site was situated on a gravel-and-sand terrace near Dry Creek; Kaibab chert clasts, sandstone, basalt, and metamorphic cobbles were present. The site was investigated through surface collection, shovel tests, and test pits.

The collection was one of the smallest among the LOCAP sites. Only two ground stone artifacts, both manos, were collected from the surface (Table 35). There also were two manuports. Both manos were oval. The vesicular basalt mano exhibited minimal use wear, and the sandstone mano had been moderately used. The absence of rectangular manos, many of which may have been used with trough metates, could suggest that these artifacts were associated with the Archaic period component rather than the Formative period occupation of the settlement. The scarcity of grinding equipment at this site is unusual given its inferred plant-processing and habitation functions and the abundant raw material available in the locale. The flaked stone collection indicated an emphasis on processing of succulent or fibrous plants, such as agave (see Chapter 3). The Formative period residents may have used the possible masonry structures as field houses related to the procurement and stockpiling of plant resources. Under such short-term conditions, little intensive food processing would be expected.

AZ O:1:31/AR-03-04-06-244 (ASM/CNF)

Site 31/244 was an Archaic period lithic scatter with a possible limited Southern Sinagua component, located in the northern cluster of sites. The site was situated near Dry Creek; available raw materials included Supai Group sandstones and siltstones. Site 31/244 was investigated through surface collection, shovel tests, test pits, and backhoe trenches. Diagnostic artifacts suggested a Middle and Late Archaic period age. The site was interpreted as a hunting and plant-procurement camp where a wide variety of activities took place.

Six ground stone artifacts were collected from the surface (Table 36). An additional three manuports, primarily cobble forms, were found. This was among the smallest of the LOCAP ground stone collections. The manuports were rhyolite and sandstone; the raw materials did not differ between the manuports and the grinding equipment.

Although the collection was small, the manos were of varied forms, including oval, irregular, and unknown shapes. The metate was the flat or concave type. The manos and metate exhibited minimal use. None of the artifacts was culturally or temporally diagnostic, although the absence of trough metates and rectangular manos might be considered to support the inferred Archaic period age of the site. Although the artifact collection was small, it indicates varied activities. The flaked stone collection

Table 34. Ground Stone at Site 135/186

Type	Sandstone	Rhyolite	Total
Mano			
Oval	1	1	2
Unknown	1	—	1
Total	2	1	3

Table 35. Ground Stone at Site 134/189

Type	Sandstone	Vesicular Basalt	Rhyolite	Total
Mano				
Oval	1	1	—	2
Subtotal, artifacts	1	1	—	2
Manuports				
Cobble	—	1	—	1
Unknown	—	—	1	1
Subtotal, manuports	—	1	1	2
Total	1	2	1	4

Table 36. Ground Stone at Site 31/244

Type	Sandstone	Rhyolite	Total
Mano			
Irregular	1	—	1
Oval	1	—	1
Unknown	1	1	2
Metate			
Flat/concave	1	—	1
Hammerstone	—	1	1
Subtotal, artifacts	4	2	6
Manuport			
Cobble	1	1	2
Unknown	—	1	1
Subtotal, manuports	1	2	3
Total	5	4	9

supported this notion, indicating that plant processing, butchering, hide working, and possibly woodworking took place at the locale (see Chapter 3). The expedient character of the flaked stone suggests that flakes were produced as needed, which is more in accord with a Formative period than with an Archaic period occupation. An alternative interpretation is that the Archaic period occupation was limited, and most of the stone material derived from the Southern Sinagua occupation.

AZ O:1:85/AR-03-04-06-428 (ASM/CNF)

Site 85/428 was located in the southern cluster of sites in an area of late Pleistocene and early Holocene alluvial fans and low terraces adjacent to the upper reach of Spring Creek (House and Pearthree 1993:6–7). Site 85/428 had multiple components used recurrently throughout prehistory. Diagnostic artifacts suggested that the site served as a hunting camp and a food-processing locale during the Middle Archaic period and may have seen a sporadic, later Formative period occupation. The site was investigated by means of surface collection, shovel tests, test pits, and backhoe trenches. Four thermal features were identified, one of which (Feature 2) yielded maize remains. The absence of ceramics from this intensively used cooking area suggests that the locale may date to the Squaw Peak phase, or A.D. 1–600, an inference supported by the archaeomagnetic date from Feature 4.

Site 85/428 produced one of the largest artifact collections among the LOCAP sites. Fourteen artifacts and 2 manuports were collected and analyzed (Table 37). These materials derived from surface contexts and from Feature 2, a roasting pit that had been used repeatedly. Both manuports were sandstone cobbles. The mano-to-metate ratio (13 to 1) was skewed in this collection. Oval forms predominated among the manos; 1 rectangular mano had a cross section that suggested that it was used with a flat or concave metate (Figure 33). Recovered from Feature 2, this item also was the only artifact made of vesicular basalt in the Site 85/428 collection and was used moderately. Of the remaining manos, 9 exhibited moderate use wear, and 3 showed minimal use.

Five manos were associated with Feature 2. Two were collected from Level 1 of the feature, and three manos with moderate use wear were found at the bottom; evidence of heat modification on the latter artifacts indicated that they served as cooking stones in the roasting pit in their last episode of use. The metate, which was found on the surface, was of unknown form; it exhibited evidence of moderate use wear.

The ground stone collection supports the inferred Early Formative period age (Squaw Peak phase) of the site. Although most of the manos were forms used with basin metates and may therefore indicate the persistence of Archaic technology and subsistence practices, the presence of one mano that may have been used with a trough metate indicates the processing of maize. Alternatively, this mano may indicate recycling, reuse, and deposition by later populations. The flaked stone collection supports these inferences, representing plant processing, butchering, hide preparation, and tool manufacture, activities associated with habitation (see Chapter 3).

AZ O:1:137/AR-03-04-06-482 (ASM/CNF)

Site 137/482, a low-density flaked stone scatter, was located in the northern site cluster. Supai Group sandstones, in addition to siltstones, provided a range of raw materials. The site was interpreted as a Middle Archaic period hunting camp (see Chapter 3). It was investigated by means of surface collection and shovel tests. Two LOCAP sites shared the distinction of yielding the smallest collection of ground stone in the LOCAP (one piece of ground stone); Site 137/482 was one of them. No ground stone artifacts were found at Site 137/482; only one granitic cobble manuport was found on the surface. The small collection probably was the result of the limited investigations that we carried out and of the relatively high degree of disturbance. The scarcity of ground stone also may be considered to support the inferred age and function of this settlement.

AZ O:1:133/AR-03-04-06-561 (ASM/CNF)

Site 133/561 was an extensive, multilocus lithic and ceramic scatter located in the northern site cluster. The site, at which three loci were designated, was situated in a low, flat area between uplifted landscape features that characterize the topography in this portion of the highway corridor. The geological location was an old terrace above Dry Creek covered with siltstones, sandstones, and conglomerates of the Supai Group. Locus A at Site 133/561 was interpreted as a hunting-and-gathering camp dating to the Middle and Late Archaic periods. Loci B and C represented Formative period resource-procurement locales. The site was investigated by means of surface collection, shovel tests, test pits, and backhoe trenches. Ground stone artifacts were found only in Locus A.

The ground stone collection was one of the largest among the LOCAP sites. Thirteen ground stone artifacts and one manuport were recovered (Table 38). All artifacts were found on the surface, except for one metate, which was found in Shovel-Test Pit 219, Stratum 1. Mano and metate forms were diverse, including oval and round

Table 37. Ground Stone at Site 85/428

Type	Sandstone	Vesicular Basalt	Rhyolite	Total
Mano				
Oval	9	—	—	9
Rectangular	—	1	—	1
Round	3	—	—	3
Metate				
Unknown	—	—	1	1
Subtotal, artifacts	12	1	1	14
Manuports				
Cobble	2	—	—	2
Subtotal, manuports	2	—	—	2
Total	14	1	1	16

manos and basin and flat or concave metates, along with unknown forms (Figure 34). Raw materials were restricted to rhyolite and sandstone; including the manuport, half of the objects were sandstone. Six manos displayed moderate use wear, and three exhibited minimal use. Two metates exhibited evidence of minimal use, and two had moderate use wear.

The presence of a basin metate (see Figure 34b) and the oval and round manos presumed to have been used with these metates, along with the absence of trough metates and rectangular manos, correlates with the inferred Archaic period age of Site 133/561. The presence of grinding equipment indicates that the locale may have been used to process plant foods or for habitation activities; the relative abundance of ground stone also may indicate that the locale was used for a considerable time or was visited repeatedly. The flaked stone collection indicated that the different loci were temporally and functionally, as well as spatially, distinct. Locus A was dated to the Middle and Late Archaic periods on the basis of diagnostic projectile points (see Chapter 3). The heavy chopping and cutting tools found there may have been used to procure and process yucca or agave. The ground stone, which was confined to Locus A, may have been used for the same purpose or for the processing of other plants.

AZ O:1:136/AR-03-04-06-663 (ASM/CNF)

Site 136/663 was located in the northern site cluster. This sparse artifact scatter was interpreted as a limited-activity locale of Formative period age, devoted to hunting and the procurement and processing of wild plants. The site was dated to the later part of the Camp Verde phase (A.D. 900–1150) or perhaps to the early part of the Honanki phase (A.D. 1150–1300). The site was located in an area of Supai sandstones, siltstones, and mudstones; small gravels blanketed the surface. Site 136/663 was investigated by means of surface collection, shovel tests, and test pits. Site 136/663 was the second LOCAP site to yield only a single piece of ground stone (the other being Site 137/482). A single sandstone cobble manuport was recovered. Previous investigations at Site 136/663 reported the presence of a sandstone basin metate (Dosh 1987). Later, ARS visited the site but could not locate the metate (Stone and Hathaway 1997:58–59). Collectors may have removed the artifact. The scarcity of ground stone may be related to the locale's limited use or to the surficial disturbance impacting the site. Regardless, whatever activities took place at this locale did not involve intensive grinding of plant materials. No additional information about activities could be gleaned from the flaked stone collection (see Chapter 3).

AZ O:1:53/AR-03-04-06-745 (ASM/CNF)

Site 53/745 was located in the southern site cluster. This extensive, multilocus site was situated on a hill composed of Tertiary period basalt. Basalt flows and outcrops dominate in the LOCAP area between Spring Creek and the Dry Creek bridge, where they are interspersed with pockets of late Pleistocene and Holocene Sheepshead Group deposits (Weir et al. 1989). Possible occupations or use episodes dating to the Middle Archaic, Late Archaic, Formative, and protohistoric periods were represented at Site 53/745. The site was investigated by means of surface collection, shovel tests, test pits, and backhoe trenches. Volunteer

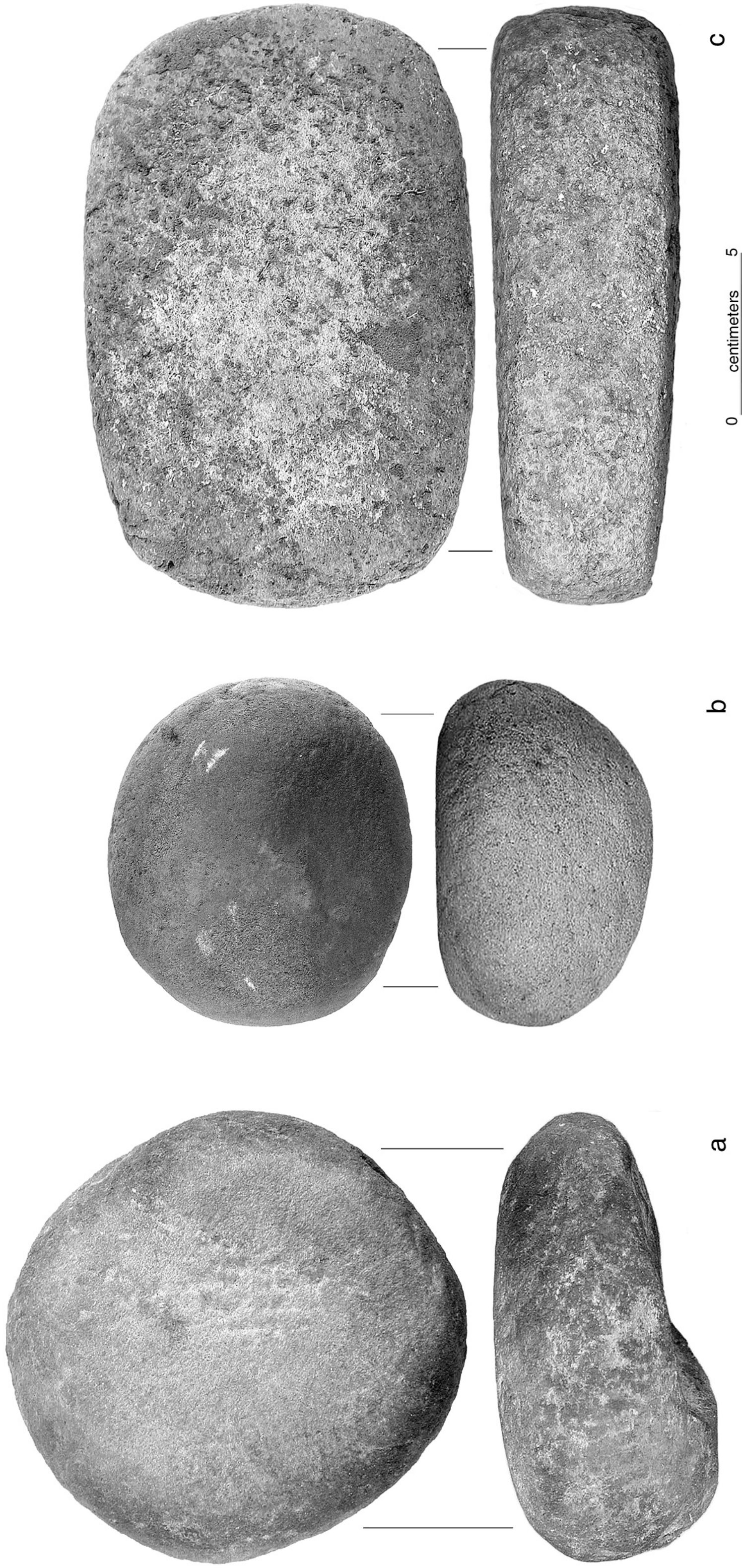

Figure 33. Ground stone from Site 85/428: (*a*) round sandstone mano, fire affected (Catalog No. 8); (*b*) round sandstone mano (Catalog No. 6); (*c*) rectangular mano of vesicular basalt (Catalog No. 1). The cross section of (*c*) indicates that it was used with a flat or concave metate.

Table 38. Ground Stone at Site 133/561

Type	Sandstone	Rhyolite	Total
Mano			
Oval	2	3	5
Round	—	2	2
Unknown	2	—	2
Metate			
Basin	1	—	1
Flat/concave	1	1	2
Unknown	—	1	1
Subtotal, artifacts	6	7	13
Manuport			
Cobble	1	—	1
Subtotal, manuports	1	—	1
Total	7	7	14

investigations led by CNF personnel outside the ADOT ROW focused on the supposed Yavapai occupation.

Diagnostic projectile points suggested either that Middle and Late Archaic peoples used the site or that later populations collected and recycled these tools. A Southern Sinagua occupation was well documented. Masonry structures, possible agricultural features, and a field house were dated by ceramics primarily to the Camp Verde phase (A.D. 900–1150). This site was thought to have represented a protohistoric or early-historical-period Yavapai occupation, on the basis of the presence of Orme Ranch Plain pottery, rock alignments inferred to be the remains of Yavapai dwellings, and many sandstone manuports suggested to be expedient grinding tools.

Site 53/745 produced the largest ground stone collection of all LOCAP sites: 115 artifacts and 112 manuports (see Table 32). One metate found on the site surface was recorded but not collected. Ground stone was not distributed randomly over the site surface but rather was clustered in certain areas. Most was collected from Loci C and E in the site center, with a dense concentration in Locus E downslope from Feature 8, one of the suspected Yavapai wickiup circles.

The manuports were primarily of sandstone (about 91 percent). Most (57 percent) were tabular items, whereas two-thirds of the manuports made of other raw materials were cobble forms. This may indicate the intentional selection of tabular sandstone to serve as expedient nether stones. Raw materials were varied among the artifacts, including vesicular basalt, basalt, andesite, and porphyritic quartzite in addition to the ubiquitous rhyolite and sandstone. Sandstone predominated, however, as among the manuports. Forty-two manos (70 percent) and 36 metates (74 percent) were made of sandstone.

The artifacts were varied and included hammerstones, manos, metates, and unidentified ground stone items (Table 39). Diverse metate types were found, including flat or concave, concave, basin, and trough metates, but most were simple, unshaped slabs (Figure 35). One flat or concave rhyolite metate was very large, measuring 51.0 by 30.5 by 22.0 cm. Despite its size, this metate exhibited minimal use. Feature 11 was a vesicular basalt bedrock metate that was a large boulder or section of bedrock. It was partially buried; the basin-shaped grinding area was tilted and protruded about 20 cm above the ground surface. The exposed portion of the metate measured 58 by 40 cm and had a grinding surface measuring about 15 by 40 cm.

The manos also were diverse, consisting of oval, round, rectangular, and irregular forms in addition to those of unknown type (Figures 36 and 37). There were some associations between raw material and mano type. Although the sample was small, 60 percent of the rectangular manos were made of vesicular basalt, contrasted with only about 11 percent of the oval manos and 18 percent of the manos of unknown form, indicating that this raw material was deliberately selected to make manos that were used with trough or slab metates. Most manos were simple cobbles that displayed only minimal evidence of grinding.

The ground stone collection from Site 53/745 does little to clarify the temporal position and cultural affiliation of the inhabitants, particularly in terms of whether there was a Yavapai presence there. The large number of tabular and cobble sandstone manuports along with the bedrock metates implies the sort of expedient technology that has been suggested for Yavapai people. The clustering of ground stone near the suspected wickiup circles may support the inferred presence of Yavapai residents

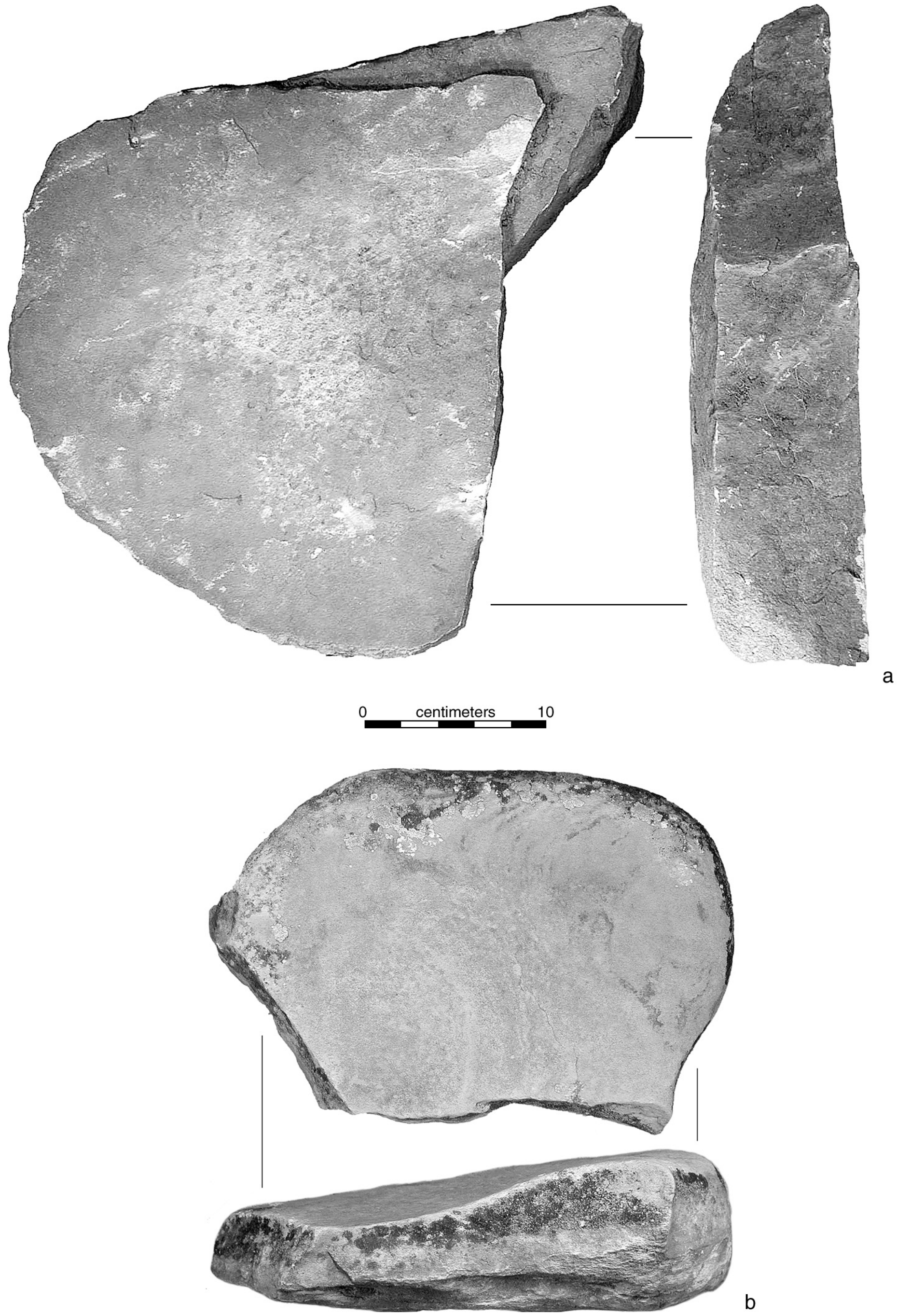

Figure 34. Sandstone metates from Site 133/561: (*a*) flat metate, in two pieces and pecked to shape (Catalog No. 381); (*b*) basin metate (Catalog No. 363).

Table 39. Ground Stone at Site 53/745[a]

Type	Sandstone	Vesicular Basalt	Rhyolite	Basalt	Quartzite	Porphyritic Andesite	Total
Hammerstone	1	—	1	1	1	—	4
Mano							
Irregular	3	1	2	—	—	—	6
Oval	28	4	5	—	—	—	37
Rectangular	2	3	—	—	—	—	5
Round	—	—	—	1	—	—	1
Unknown	9	2	—	—	—	—	11
Metate							
Basin	3	—	—	—	—	—	3
Bedrock	—	1	—	—	—	—	1
Concave	1	2	—	—	—	—	3
Flat/concave	6	4	—	1	—	—	11
Trough	1	—	—	—	—	—	1
Unknown	25	—	2	—	—	3	30
Unidentified	2	—	—	—	—	—	2
Subtotal, artifacts	81	17	10	3	1	3	115
Manuport							
Cobble	33	2	5	—	1	—	41
Tabular	57	—	—	—	—	—	57
Unknown	10	—	3	—	1	—	14
Subtotal, manuports	100	2	8	—	2	—	112
Total	181	19	18	3	3	3	227

[a] Includes a bedrock metate that was not collected.

at Site 53/745. There were no Desert Side–notched or Cottonwood projectile points—styles thought to have been made and used by the Yavapai—in the flaked stone collection (see Chapter 3). The predominance of oval manos and the presence of basin, concave, and flat or concave metates indicate processing of wild-plant foods. These grinding tools may have been used by Archaic, Southern Sinagua, or Yavapai peoples. Rectangular manos and a single trough metate also suggest processing of maize, denoting an agricultural subsistence base. In short, the ground stone at Site 53/745 can be taken as evidence for the use or occupation of the locale by several different groups. This is supported by evidence in the flaked stone collection demonstrating use of the locale by groups moving into the region from the north and south (see Chapter 3). The issues of identifying Yavapai grinding equipment and differentiating it from the tools used by prehistoric peoples are examined in a subsequent section of this report.

AZ O:1:105/AR-03-04-06-838 (ASM/CNF)

Site 105/838, located in the southern site cluster, was situated along Spring Creek in an area of late Pleistocene and early Holocene alluvial fans and low terraces. Gravels and cobbles of basalt and other rock types and shallow soils covered the surface, providing an immediately available source of good-quality raw material. The multilocus site, the most substantial of all LOCAP sites, also was investigated the most intensively, through the excavation of numerous features along with surface collection, shovel tests, test pits, backhoe trenches, and mechanical stripping. The site was interpreted as a habitation site with occupations dating to the Early Formative Squaw Peak phase (A.D. 1–600) and the Camp Verde phase (A.D. 900–1150) and Tuzigoot phase (A.D. 1300–1450) of the Southern

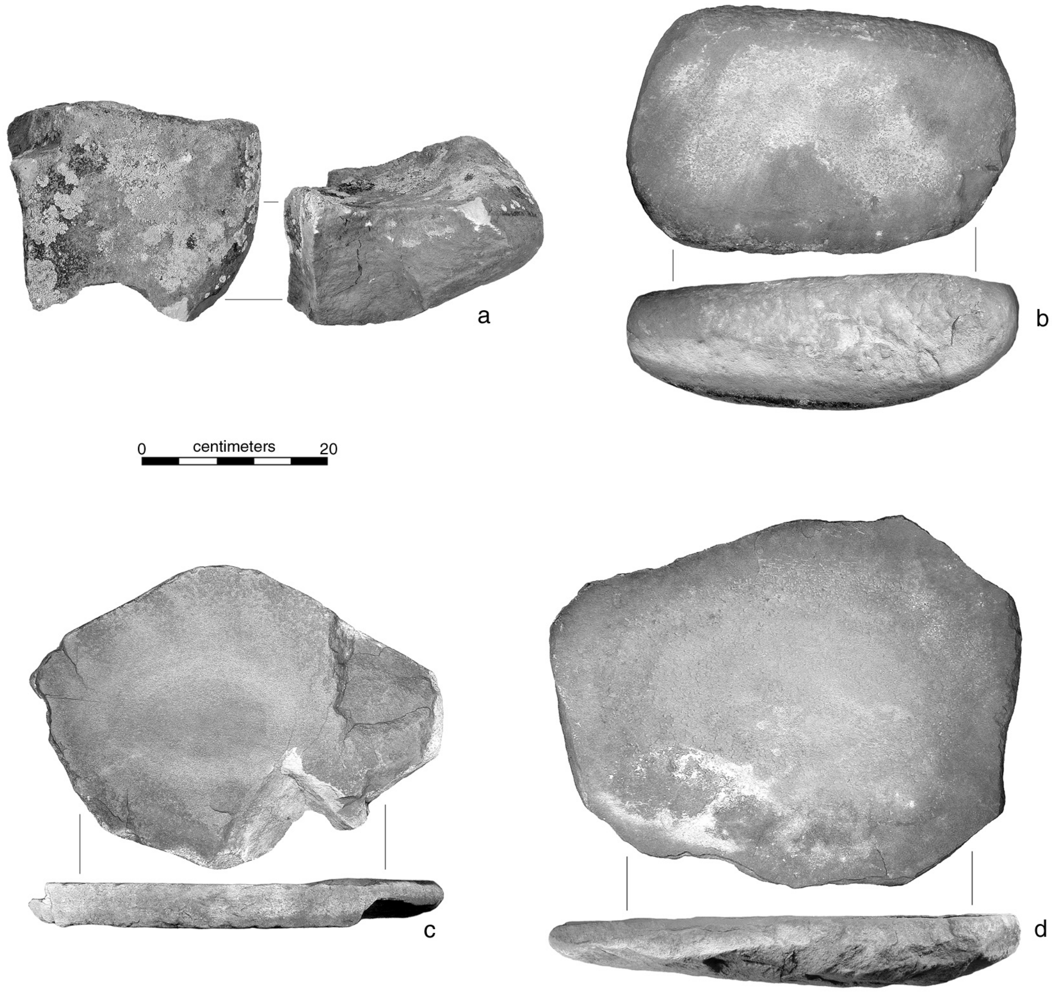

Figure 35. Sandstone metates from Site 53/745: (*a*) concave metate, sides and bottom shaped by flaking and pecking (Catalog No. 229); (*b*) trough metate, rejuvenated (Catalog No. 218); (*c*) basin metate, rejuvenated and ground on both faces with one piece broken off (Catalog No. 222); (*d*) basin metate, flaked and pecked to shape and rejuvenated (Catalog No. 224).

Sinagua sequence. An additional component dating to the Southern Sinagua Honanki phase (A.D. 1150–1300) also may have been present.

Documented features included three pit structures, two definite masonry structures, two possible masonry structures, eight thermal features, a midden, nine rock piles of uncertain function, two rock alignments, four historical-period or modern cobble dumps, and a boulder grinding slick. The features were grouped into several loci: Locus A contained the pit structures and thermal features; Loci B and C contained the masonry features. One of the excavated pit structures, Feature 37, dated to the Squaw Peak phase; the other two dated to the Camp Verde phase.

As expected given the intensity of our investigations, Site 105/838 yielded the second-largest ground stone collection among the LOCAP sites, exceeded only by Site 53/745. Sixty-seven ground stone artifacts and 44 manuports were collected and analyzed (Table 40), including 46 manos, 15 metates, 5 shaped stones, and 1 unidentified ground stone artifact. Thirty-three artifacts were collected from the site surface; most of the remainder were recovered from the three pit structures. Besides the artifacts and manuports, eight mineral samples were collected (Table 41).

Although the raw materials were fairly diverse, most (about 65 percent) were sandstone, as was true for most other LOCAP collections. Proportionately more manuports than artifacts were sandstone, indicating the selection of varied raw materials, including vesicular basalt, for shaped tools. Most of the manuports were found on pit-structure floors; they may have been stockpiled for use as expedient tools or for manufacture into shaped grinding equipment. Most of the manuports were cobble forms; this result contrasts with the result for the other large collection, that from Site 53/745, which included a relatively large number of tabular sandstone manuports. It is unclear whether this reflects the available raw materials or other factors. There also were some correlations

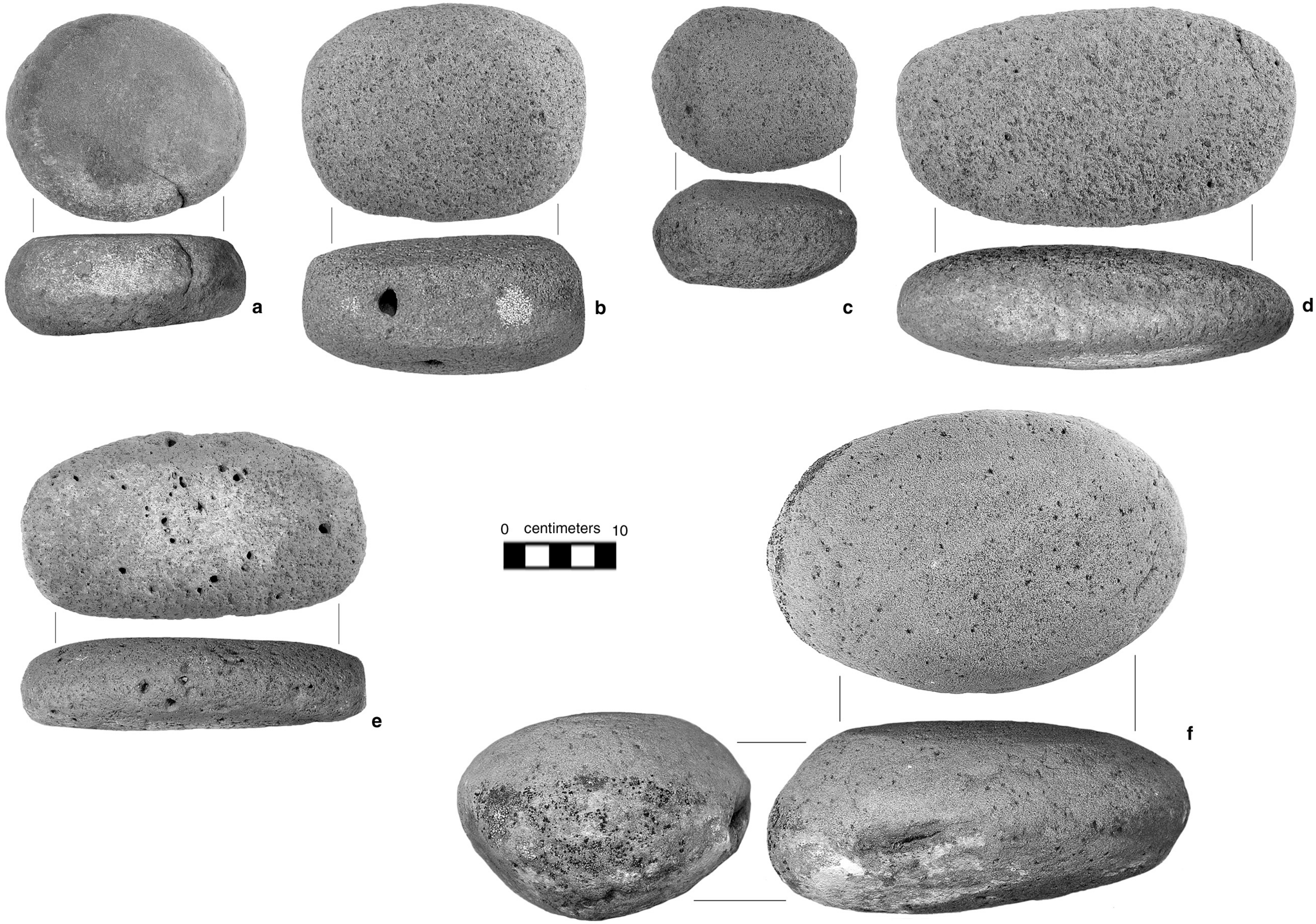

Figure 36. Oval manos from Site 53/745: (*a, f*) sandstone (Catalog Nos. 52 and 15); (*b, c*) rhyolite (Catalog Nos. 24 and 50) (note that cross section of [*c*] suggests use with a flat or concave metate); (*d, e*) vesicular basalt (Catalog Nos. 34 and 32) (note that [*e*] may have been used with a trough metate during its use life).

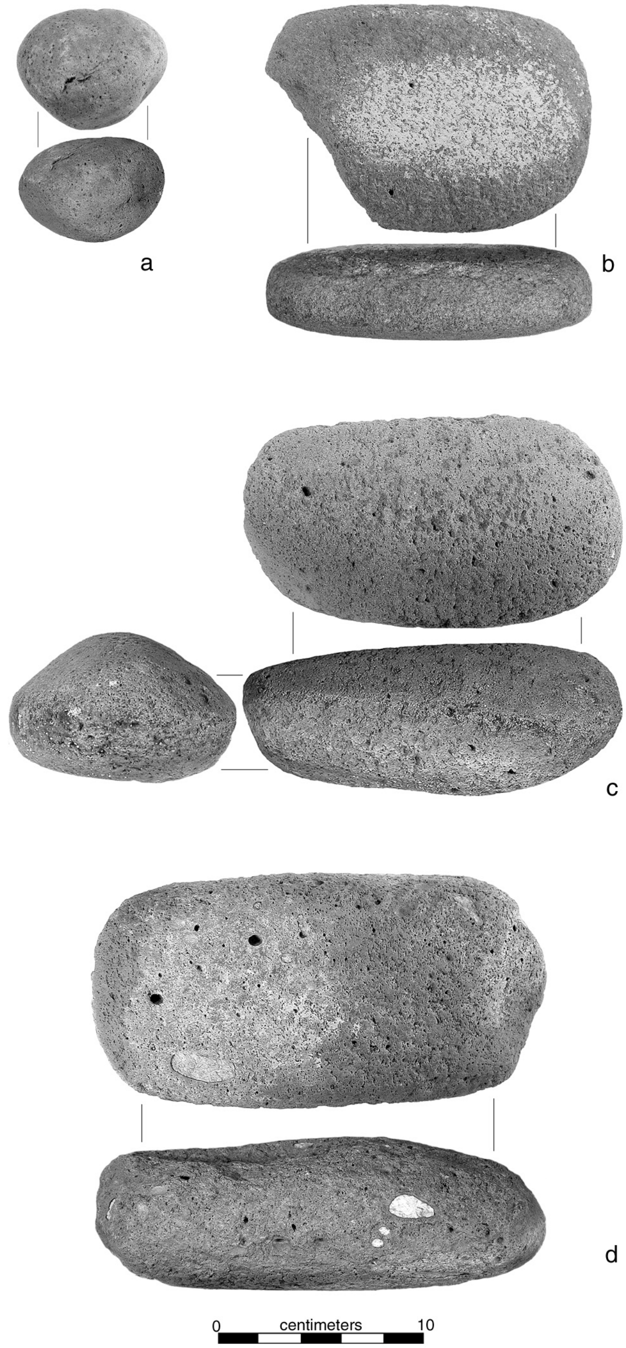

Figure 37. Irregular and rectangular manos from Site 53/745: (*a*) irregular rhyolite mano with patchy ground areas (Catalog No. 193); (*b*) rectangular mano with broken end, probably used with a flat or concave metate (Catalog No. 23); (*c*) rectangular mano with unusual cross sections (Catalog No. 33); (*d*) rectangular mano probably used with a flat or concave metate, possible flake scars on one end (Catalog No. 40) (note large quartz inclusions).

Table 40. Ground Stone at Site 105/838

Type	Sandstone	Vesicular Basalt	Rhyolite	Basalt	Quartzite	Argillite	Total
Mano							
Irregular	2	—	1	—	—	—	3
Oval	9	6	2	—	—	—	17
Rectangular	—	5	—	—	—	—	5
Round	4	1	—	—	—	—	5
Unknown	14	2	—	—	—	—	16
Metate							
Concave	2	—	—	1	—	—	3
Flat/concave	5	3	1	—	—	—	9
Irregular	—	—	1	—	—	—	1
Unknown	1	—	—	1	—	—	2
Shaped stone							
Cylindrical	1	—	—	—	—	2	3
Irregular	1	—	—	—	—	—	1
Rectangular	1	—	—	—	—	—	1
Unidentified	1	—	—	—	—	—	1
Subtotal, artifacts	41	17	5	2	—	2	67
Manuport							
Cobble	26	—	—	—	—	—	26
Tabular	2	—	—	—	—	—	2
Unknown	4	2	6	1	3	—	16
Subtotal, manuports	32	2	6	1	3	—	44
Total	73	19	11	3	3	2	111

Table 41. Mineral Samples at Site 105/838

Feature or Subfeature	Feature or Subfeature Type	PD No.	Unit	Context	Material/Comments
Feature 23	pit structure	198	TP 158	Stratum 1, Level 6	Malachite.
		490	Q4	floor fill	Red ocher/hematite.
Subfeature 4	storage pit	524	Q1	pit fill	Azurite and malachite.
		524	Q1	pit fill	Red ocher/hematite.
		533	Q1	pit fill, Level 2	Azurite and malachite; possibly heavily hydrated turquoise (copper aluminum phosphate) or nonsilicified chrysocolla.
Subfeature 24	storage pit	713	Q2/Q3	pit fill, Level 5	Red ocher/hematite.
Feature 37	pit house	699	Q2	fill, Level 1	Fossiliferous, coarse-grained limestone, burned.
Feature 40	roasting pit	757	Q1	pit fill, Level 4	Red ocher/hematite.

Key: PD = Provenience Designation; Q = Quadrant; TP = Test Pit.

between artifact type and raw material. Proportionately more manos were made of sandstone than were metates, which were made of more varied materials. All rectangular manos were made of vesicular basalt.

Artifact types were varied. The metates included flat or concave, concave, and irregular forms (Figure 38). Whereas some metates were well used, others displayed minimally ground surfaces. Two small "metates" were of mano size but obviously were used as nether stones (Figure 39a and b). These objects resemble those called "pebble mortars" (Adams 1997:26) and "nutting stones" or "anvil stones" (Fratt 2004). These small nether stones probably were used to grind small quantities of plant materials or pigments, depending on use wear. Both artifacts showed secondary use as hammerstones. Another metate had been used as a pestle, exhibiting evidence of battering and pecking on one end (see Figure 39c). After unknown forms, oval manos predominated, as was true for most other LOCAP ground stone collections, but round, rectangular, and irregular forms also were found (Figures 40 and 41). At least one of the rectangular manos of vesicular basalt was used with a trough metate (see Figure 41d). Four manos and one metate showed evidence of heat modification.

The presence of shaped stones—pieces of stone that were ground but had unknown functions—was unusual among the LOCAP collections (see Table 40). The shaped stones included two cylindrical pieces of argillite and three pieces of sandstone (cylindrical, rectangular, and irregular). The cylindrical sandstone piece measured 13.6 by 11.2 by 11.2 mm, and the rectangular sandstone piece measured 20.7 by 5.0 by 4.5 mm (Figure 42a and b). The small size of these shaped stones indicates that they might have served as gaming pieces. The irregular piece of sandstone measured 55.5 by 28.9 by 13.8 mm (see Figure 42c). This pendant-shaped artifact was ground on all margins; the upper and lower surfaces were not ground flat. The function of this artifact is unknown. Although its small size and pendant shape suggest that the object might have been a pendant blank, sandstone was not often used as ornamentation in the ancient U.S. Southwest.

The argillite cylindrical stones (see Figure 42d and e) measured 30.6 by 12.6 by 12.5 mm and 11.7 by 7.1 by 6.3 mm, respectively. Both objects displayed numerous striations. These artifacts might have been bead blanks, toggles, or plugs. One stone was found in the fill of Subfeature 27, an intramural pit on the floor of the pit structure, Feature 23. The argillite derived from the Del Rio Springs source located near modern Prescott, which could have been readily accessed by the Verde region's residents. At many ancient puebloan sites, unusual pieces of stone like the shaped stones from Site 105/838 have been found in contexts that suggest that they served ritual purposes, perhaps as part of medicine bundles or shamans' kits (Whittlesey and Reid 2001).

Recovery contexts provide some clues concerning artifact and structure function. Feature 23, one of the Camp Verde phase pit structures, yielded a number of ground stone artifacts in floor and subfeature contexts. Floor artifacts included two sandstone cobble manuports, one sandstone tabular manuport, an oval sandstone mano, a sandstone flat or concave metate, and a sandstone mano of unknown form. An oval sandstone mano (PD 477) was collected from a thermal feature found on the floor. Subfeature 1 was a semicircular concentration of three large basalt cobbles along with charcoal and oxidized sediment. The feature was interpreted as an informal hearth with trivet. The mano may have served in preparing food that was cooked on this hearth. Other intramural pits apparently served as storage facilities for valued ground stone tools, including rectangular manos. Food-processing activities certainly took place in this structure.

The floor of Feature 37, the Squaw Peak phase pit structure, yielded eight ground stone artifacts of varied types and materials and two sandstone manuports. Two metates were fashioned from rhyolite; one (PD 813) was the flat or concave type, and the other (PD 817) was irregular. PD 753 was a concave metate of fine-grained basalt (see Figure 38b). Sandstone artifacts included a flat or concave metate, one vesicular basalt oval mano, a vesicular basalt rectangular mano (PD 823) (see Figure 41b), and two sandstone manos, one oval and one of unknown type. Both manuports were cobble forms.

Finally, a boulder grinding slick, Feature 14, was located in the center of Locus B. This large, basalt boulder (55 by 45 cm) protruded about 40 cm above the ground surface. The flat top surface of the stone had been used as a grinding surface. This shallow grinding area measured about 35 by 30 cm.

The eight mineral samples came from Features 23, 37, and 40 (see Table 41). Feature 23 contained 6 samples of hematite, malachite, and azurite. These chunks of minerals were found in both the structure fill and the floor fill, as well as in Subfeatures 4 and 24. One sample each was collected from Features 37 and 40. A piece of burned, fossiliferous limestone came from the fill of Feature 37, and Feature 40 yielded some hematite.

The ground stone collection from Site 105/838 reinforces the interpretations of site age and function. The inhabitants apparently practiced a mixed economy centered on farming and wild-plant collection; the presence of rectangular manos made from vesicular basalt indicates a commitment to maize processing. This economy evidently was in place by the Squaw Peak phase. Food processing was an important component of the habitation activities once carried out inside the excavated pit structures, with manos, metates, and manuports of varied forms indicating that grinding of wild seeds and maize took place. The flaked stone collection supports these inferences, indicating a combination of Archaic technology and projectile point styles (a San Pedro style point was found in Feature 37) coupled with the grinding-stone technology associated with a mixed subsistence strategy (see Chapter 3).

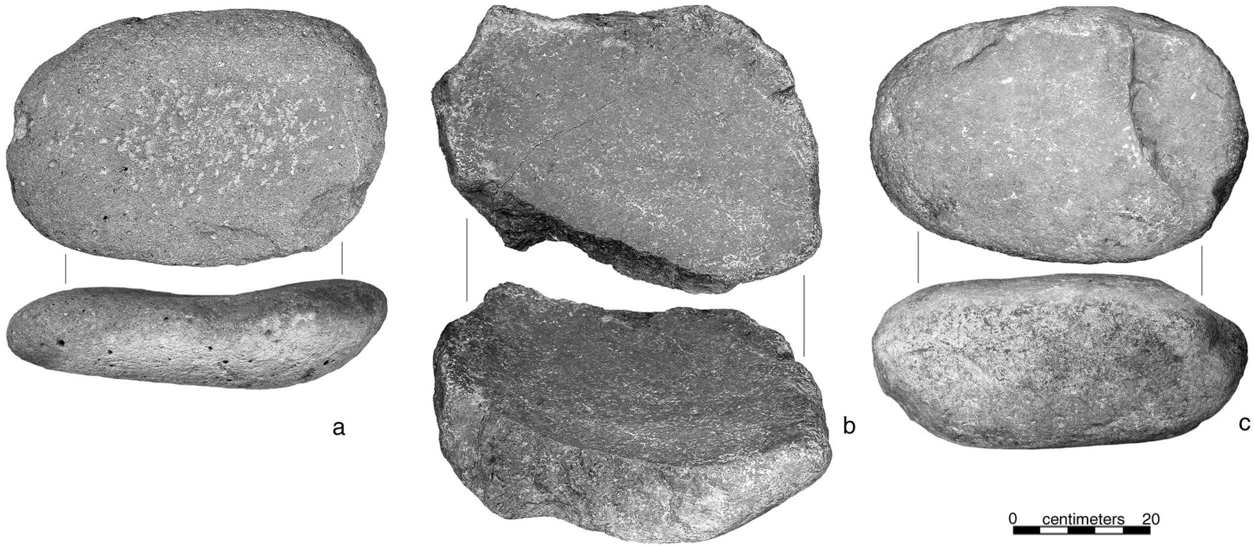

Figure 38. Metates from Site 105/838: (*a*) vesicular basalt concave metate (Catalog No. 238); (*b*) basalt concave metate, rejuvenated (Catalog No. 264) (note crack across the grinding surface); (*c*) sandstone flat or concave metate (Catalog No. 387).

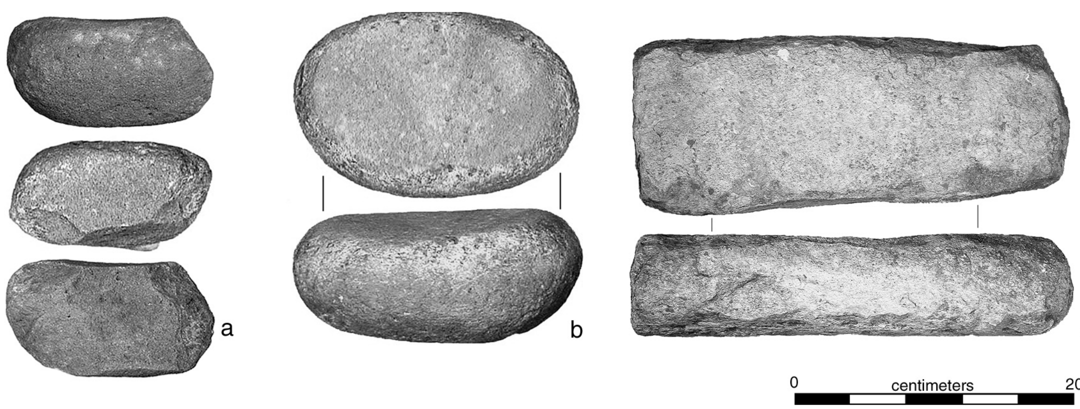

Figure 39. Miscellaneous nether stones from Site 105/838: (*a, b*) small "metates," or pebble mortars, of sandstone, also used as hammerstones (Catalog Nos. 242 and 241); (*c*) sandstone concave metate secondarily used as a pestle preform; it has one ground face and was battered and pecked on one end (Catalog No. 240).

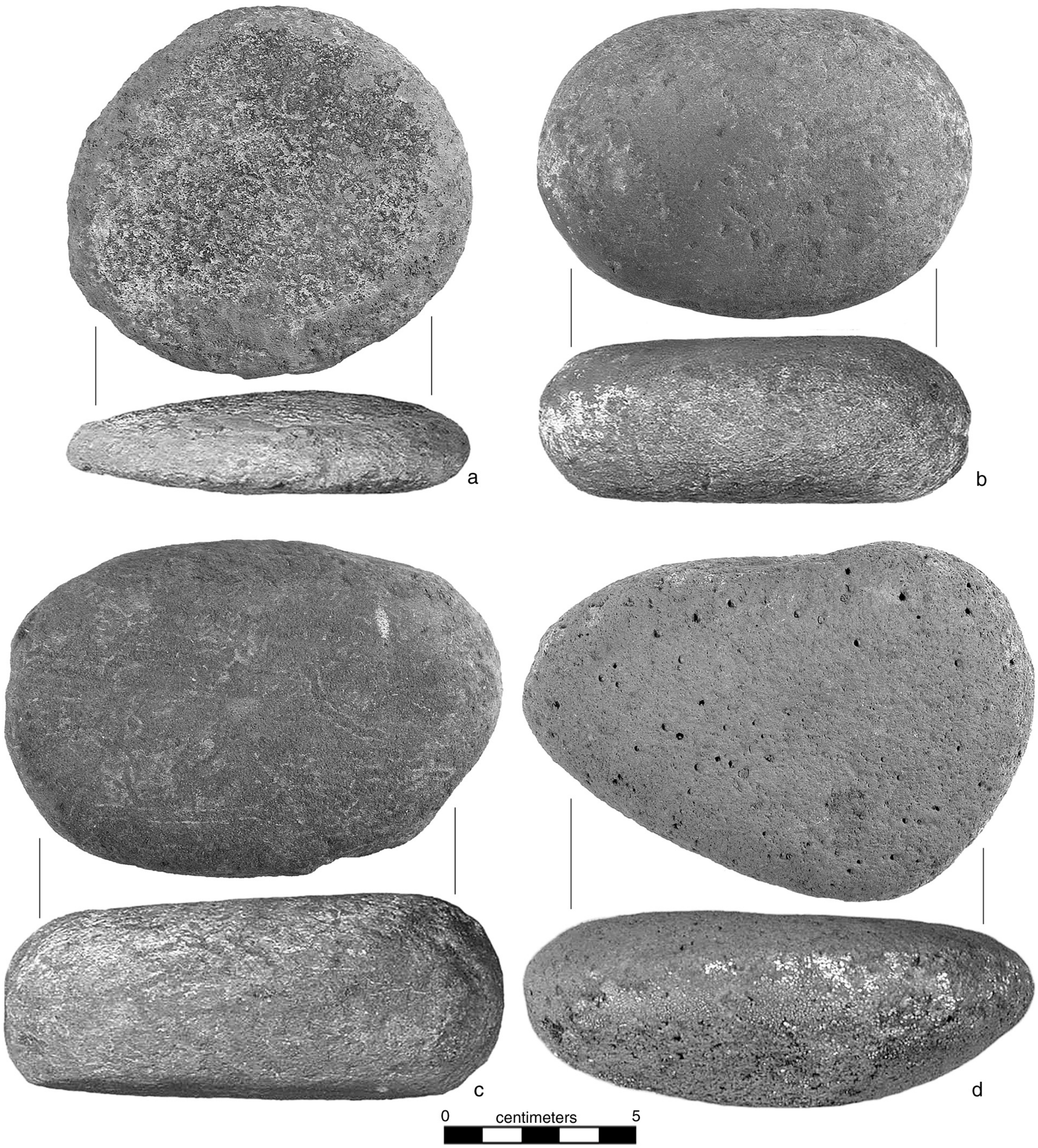

Figure 40. Round and oval manos from Site 105/838: (*a*) vesicular basalt round mano, nearly exhausted (Catalog No. 252); (*b, c*) sandstone oval manos used with flat or concave metates (Catalog Nos. 269 and 268) (note that [*b*] has differential use wear on faces); (*d*) rhyolite oval mano (Catalog No. 283).

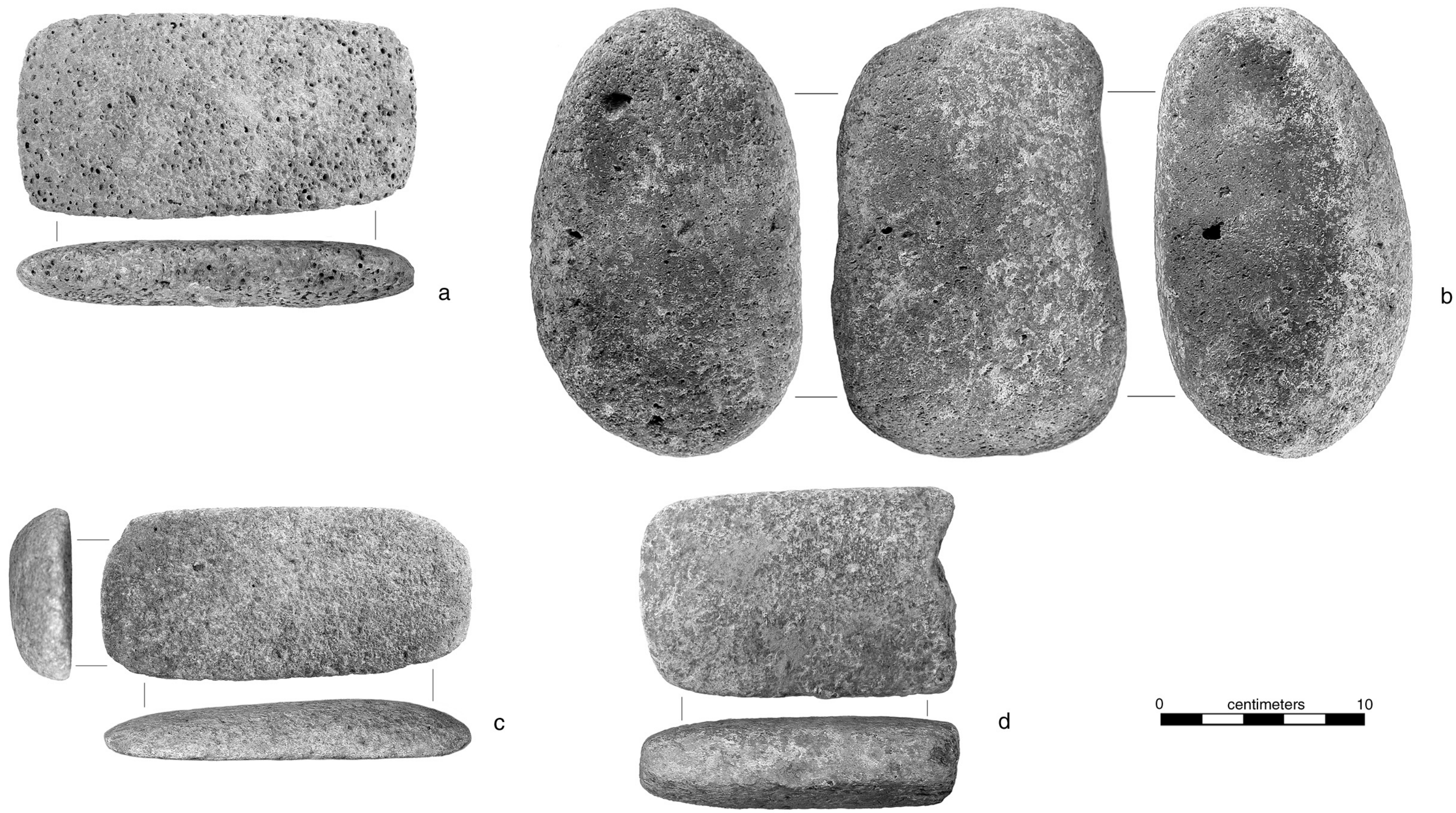

Figure 41. Vesicular basalt rectangular manos from Site 105/838: (*a*) rejuvenated, well-used mano, probably used with a flat or slab metate (Catalog No. 244); (*b*) mano with a convex face, which indicates that the artifact was used with a rocking motion (Catalog No. 385); (*c*) rejuvenated and nearly exhausted mano, probably used with a flat or concave metate (Catalog No. 247); (*d*) mano probably used with a trough metate (Catalog No. 235).

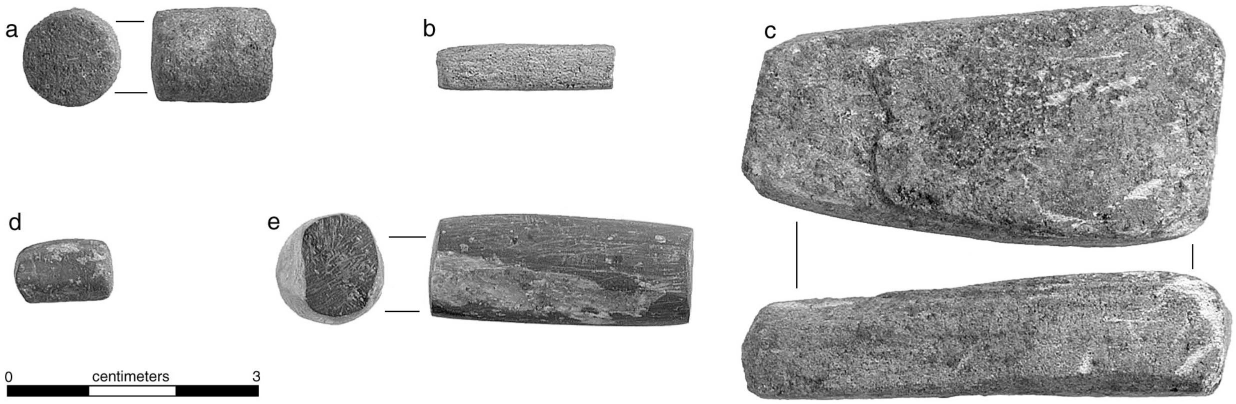

Figure 42. Shaped stones from Site 105/838: (*a*) cylindrical sandstone piece (Catalog No. 393); (*b*) rectangular sandstone piece (Catalog No. 391); (*c*) irregular sandstone piece (Catalog No. 392); (*d, e*) cylindrical argillite pieces (Catalog Nos. 390 and 389).

AZ O:1:77/AR-03-04-06-869 (ASM/CNF)

Site 77/869 was part of the southern cluster of LOCAP sites. Like other sites in the area between Spring Creek and the Dry Creek bridge, the site was located on Tertiary basalt flows and outcrops. It was situated in the middle of a broad *malpais* field surrounded on all sides by vesicular basalt flows. Site 77/869 was investigated by means of surface collection, shovel tests, test pits, and backhoe trenches. This sparse artifact scatter with two possible rock features was interpreted as a resource-procurement and resource-processing camp with possible agricultural features. Although a minor Archaic period component may have been present, most of the site appears to have been used by Southern Sinagua inhabitants. Ceramic dating suggests that the settlement was occupied most intensively between A.D. 1075 and 1180. The rock features might represent soil- and water-control features, although they might also be associated with a historical-period road passing through the site.

Site 77/869 yielded a small collection of ground stone. Only three ground stone artifacts, all sandstone manos, were found, and all derived from the surface (Table 42). Two manos exhibited minimal use, and one (an oval mano) had been used moderately. Seven manuports also were collected; five were sandstone, and two were rhyolite. Given the small sample, it is not known whether the raw-material differences between the artifacts and the manuports are meaningful. Most manuports were cobble forms.

The absence of manos used with trough and slab metates is intriguing, in light of the inferred age and function of the site. Evidently, little food preparation or processing of plant materials was carried out at the locale. The flaked stone collection allowed similarly limited inferences. Projectile point styles indicated occupation during the Late Archaic and, possibly, the Middle Archaic period. No other tools were recovered (see Chapter 3).

AZ O:1:104/AR-03-04-06-902 (ASM/CNF)

Site 104/902 was a multicomponent site located in the southern site cluster. As was true at other LOCAP sites in this highway segment, the terrain was dominated by Pliocene and Miocene deposits of the Verde Formation (Weir et al. 1989) overlain by a thin mantle of unconsolidated alluvial and aeolian deposits (House and Pearthree 1993:8). The site was interpreted as an Archaic period camp, a series of Formative period field houses, and a short-lived historical-period habitation. Diagnostic ceramics indicated occupation by the Southern Sinagua between A.D. 900 and 1100 and again between A.D. 1350 and 1500. A possible earlier Formative period occupation was indicated by a single painted sherd. The site was used as a stone-procurement area and a hunting camp during the Archaic period. The site was investigated by means of surface collection, shovel tests, a test pit, and one backhoe trench.

The site yielded a typically small ground stone collection. Six ground stone artifacts, all manos, were found on the surface (Table 43). Most were found in the area around Feature 1, a probable masonry room that was not excavated. Four manos were sandstone, and two were vesicular basalt. Both of the latter were round, whereas the sandstone manos were irregular in shape or of unknown type. None had been shaped intentionally, and all exhibited minimal use. Three manuports, two of which were cobbles, were collected: one each of sandstone, vesicular basalt, and rhyolite (see Table 43).

The ground stone collection provides little information concerning site function. The lack of rectangular manos

Table 42. Ground Stone at Site 77/869

Type	Sandstone	Rhyolite	Total
Mano			
Oval	2	—	2
Unknown	1	—	1
Subtotal, artifacts	3	—	3
Manuports			
Cobble	4	2	6
Unknown	1	—	1
Subtotal, manuports	5	2	7
Total	8	2	10

Table 43. Ground Stone at Site 104/902

Type	Sandstone	Vesicular Basalt	Rhyolite	Total
Mano				
Irregular	1	—	—	1
Round	—	2	—	2
Unknown	3	—	—	3
Subtotal, artifacts	4	2	—	6
Manuports				
Cobble	1	—	1	2
Unknown	—	1	—	1
Subtotal, manuports	1	1	1	3
Total	5	3	1	9

Note: Refitting fragments counted as 1 artifact.

could be taken as support for the inferred Archaic period age of the site, but the fact that most of the artifacts were collected near a much later masonry feature indicates that they are more likely to represent the Formative period occupation of Site 104/902. The ground stone reflects the expedient processing activities expected at a field-house settlement. The flaked stone collection added little additional information. The tools suggested a wide variety of activities at the locale and a considerable amount of core reduction. The artifacts were not reported by locus, however (see Chapter 3).

AZ O:1:28/AR-03-04-06-903 (ASM/CNF)

Site 28/903 was located in the northern site cluster. It was situated along the west bank of Dry Creek in upland terrain dominated by Schnebly Hill, Hermit Formation, and Supai Group rock types. Supai Group mudstone, siltstone, sandstone, and limestone breccia containing chert clasts were exposed in the site area. Abundant raw materials for flaked stone and ground stone tools were present at the site locale, including sandstone, chert, and other materials available on nearby ridges capped with rim gravels. This extensive lithic scatter contained several loci and represented Archaic and Formative period uses of the locale. Locus A contained the greatest density and widest variety of artifacts. Locus B was located outside the project ROW; Locus C, also located outside the ROW, was a small, high-density flaked stone scatter. Site 28/903 was investigated by means of surface collection, shovel tests, test pits, and backhoe trenches.

The site yielded one of the largest collections of ground stone among the LOCAP sites. Fifteen ground stone artifacts, mostly of sandstone, were found, including seven manos, seven metates, and one piece of unidentified ground stone (Table 44). Two manos and all but one metate were collected from the site surface; the remainder came from

Table 44. Ground Stone at Site 28/903

Artifact	Sandstone	Rhyolite	Quartzite	Total
Mano				
Oval	1	1	—	2
Round	1	—	—	1
Unknown	4	—	—	4
Metate				
Flat/concave	4	1	—	5
Concave	—	1	—	1
Unknown	1	—	—	1
Unidentified	—	1	—	1
Subtotal, artifacts	11	4	—	15
Manuports				
Cobble	—	8	1	9
Tabular	1	—	—	1
Subtotal, manuports	1	8	1	10
Total	12	12	1	25

subsurface test pits. Ten manuports also were found. Eight were collected from the site surface; one (PD 109) was found in Test Pit 93 within Feature 1, and one (PD 130) was found in a backhoe trench. Ground stone was found only in Loci A and B.

The manos included only round, oval, or unknown types; metates represented flat or concave, concave, and unknown types (Figure 43). Six metates were moderately used and one had been rejuvenated. Six manos exhibited moderate use and one had minimal use wear. As was true at some other LOCAP sites, there was slightly more diversity in raw materials among the manuports than among the artifacts. All but one manuport were cobble forms (see Table 44).

Feature 1 in Locus A was interpreted as a thermal feature with an associated occupational surface dating to the Archaic period and devoted to food processing. The fill of Feature 1 contained charcoal and fire-cracked rock; the bottom of the feature was lined with five sandstone slabs. The occupational surface yielded a sandstone flat or concave metate (PD 213) and one of the rhyolite cobble manuports (PD 109).

The lack of rectangular manos and trough metates from the ground stone collection may be taken as support for the inferred Archaic period age of Site 28/903. There is little indication of a subsequent occupation of Formative period age. Food processing evidently took place near Feature 1. The lining of the feature bottom with sandstone slabs suggests that the facility initially served a storage function—not unusual for Late Archaic period occupations—and subsequently was reused as a roasting pit. Regardless, habitation activities are indicated for the Archaic period occupation of this locale.

Archaic period projectile points were recovered from Locus A, and one of probable Archaic period age but unknown style was found on the occupational surface associated with Feature 1. The flaked stone tool collection suggested the processing of tough, fibrous plants and the butchering of game. The materials found in Locus C indicated that tool maintenance was the only activity carried out at that locale (see Chapter 3).

Interpretations and Comparisons

In this section, we address the research questions from the perspective of the LOCAP ground stone collections. We examine issues of raw-material procurement and technology, mobility and sedentism, subsistence practices and grinding efficiency, recycling and reuse, and cultural affiliation and ethnic identity.

Raw-Material Procurement and Technology

The ancient peoples inhabiting the project area had access to a wide variety of landforms and associated geological resources. The first and southernmost section of the highway corridor crosses a large expanse of the Verde Formation

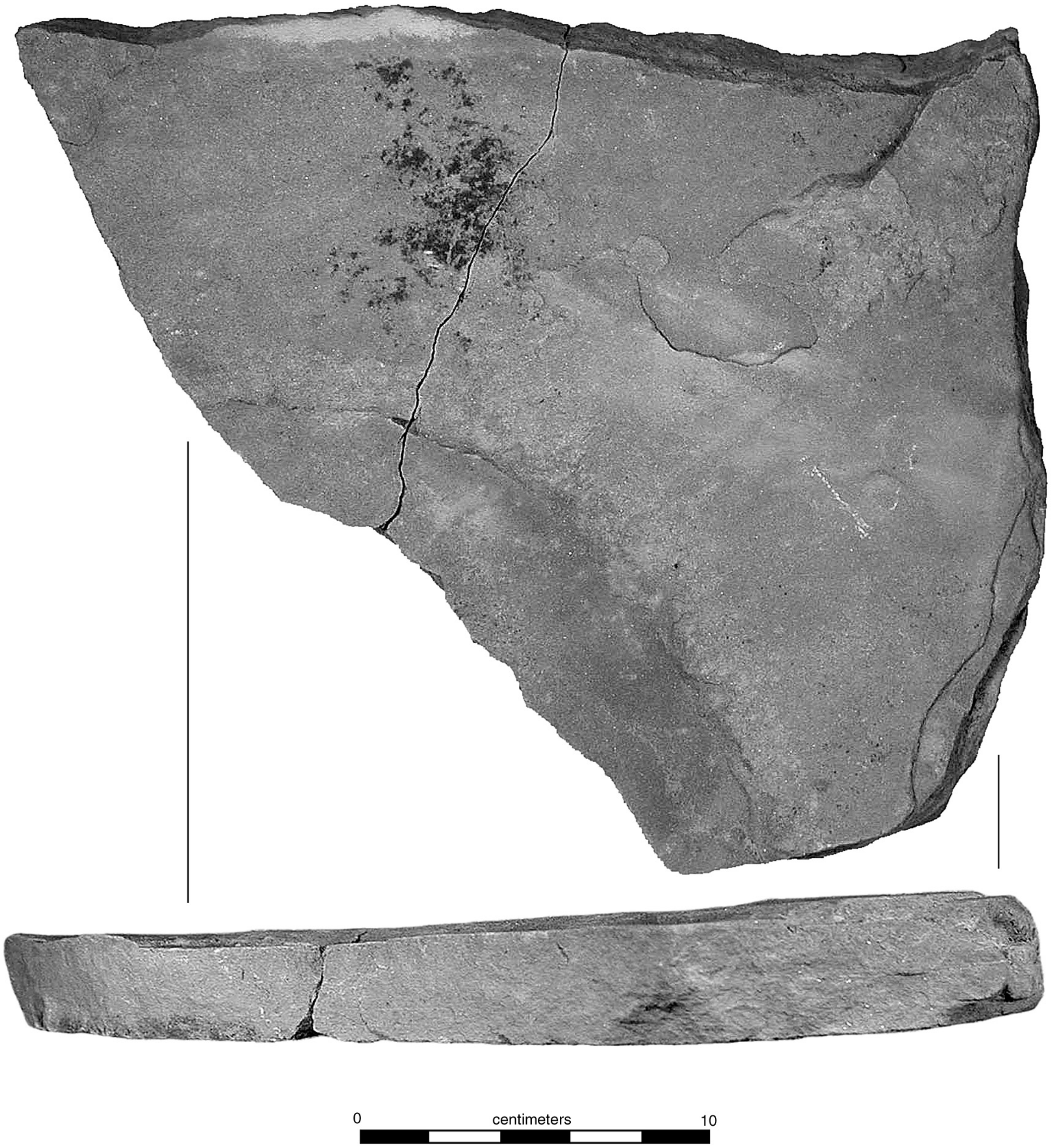

Figure 43. Sandstone concave metate from Site 28/903, pecked to shape (Catalog No. 380).

dating to the Pliocene and Miocene (Weir et al. 1989). A thin mantle of unconsolidated alluvial and aeolian deposits overlies these rocks (House and Pearthree 1993:8). Floodplains and terraces along the Verde River, Dry Creek, Spring Creek, and smaller tributary streams provided suitable cobbles in this part of the project area.

The middle section of the highway corridor is dominated by Tertiary basalt outcrops and flows (Weir et al. 1989). Basalt is the most common volcanic rock in the middle Verde River valley and commonly is coated or cemented with calcium carbonate that is the remnant of limestone that once covered the river basin (see Appendix A, Volume 1). Nonvesicular and vesicular basalt, favored by ancient agriculturists for its efficiency in grinding maize, was easily obtained and abundant in this area. Pockets of Sheepshead Group deposits—sediments derived from the cliffs of the Verde Formation (House and Pearthree 1993:7)—are interspersed among the volcanic areas. Sandstones and limestones of various textures useful for ground stone tools also could be found in the floodplains and low terraces along watercourses in this part of the project area.

The third and northernmost section of the highway corridor is located within the upland terrain of the red rock country, which is dominated by Kaibab Formation, Schnebly Hill, Hermit Formation, and Supai Group rock types. The sandstones and limestones in this area, which erode in tabular as well as cobble forms, were suitable for grinding implements. In addition, many mesa tops and hills in this area are covered with dense rock scatters that geologists call the "rim gravels" (Ranney 1989:25).

These rock scatters are cobbles of Kaibab Formation and Coconino Sandstone and much older pebbles formed during the Lower Paleozoic and Precambrian eras. A variety of raw materials suitable for grinding implements and flaked stone tools are present among these gravels.

The abundant, high-quality, and easily collected raw material in the LOCAP area appears to have influenced the technology and manufacturing processes used by the ancient inhabitants. Sandstone, vesicular basalt, and rhyolite were the most common materials among manuports (Table 45) and tools (Table 46). Rare materials included basalt, porphyritic andesite, quartzite, granite, and argillite (see Tables 45 and 46). Apparently, there was no intentional selection of certain raw-material types for specific tools, with the exception of argillite. This material was used to manufacture the shaped stones found at Site 105/838.

Little to no systematic manufacturing of ground stone tools was conducted by ancient inhabitants. Because of the size and shape of the material available in nearby drainages and outcrops, no alterations were necessary. Sandstone was available in tabular form—primarily used as expedient metates—or cobble form, which was used as manos. Mano shape appears to be largely the result of raw-material characteristics rather than use intensity. Most manos in the collection were oval, the shape of the available sandstone cobbles.

The tabular manuports were similar to many of the metates, most of which were of the flat or concave form. Only four metates, three from Site 53/745 and one from Site 105/838, retained evidence of manufacture in the form of reduction flaking by percussion. One of these was an open-trough metate (bordered on the sides but not on the ends) of sandstone found at Site 53/745. All other metates had been used without any modification, except for pecking.

Similar patterns were observed among the manos. By definition, rectangular manos were shaped intentionally. Twelve rectangular manos were recovered, five of which were found at Site 53/745. In addition, one was found at Site 131/37 and one at Site 85/428; five were located at Site 105/838. As was true for most of the metates, use wear had eliminated evidence of original shaping among the rectangular manos. Moreover, the cobble manuports were similar in shape to many of the manos. The difference in shape and wear between manuports and ground stone tools evidently was negligible.

Despite this expedient use of available raw materials, there were some associations between tool type and raw-material type. In particular, different materials were selected for the tools than for the manuports. About 76 percent of the manuports collected from LOCAP sites were sandstone (see Table 45). Rhyolite was the next most abundant raw material, which constituted approximately 16 percent of manuports. Vesicular basalt accounted for only 3.6 percent of the total, and manuports of nonvesicular basalt, granite, and quartzite were even rarer. By contrast, although sandstone was, again, the most abundant material among the tools (about 68 percent), there was more variety among raw materials. Moreover, vesicular basalt was much more common than among the manuports (the second-most-common material, constituting about 15 percent of the total) (see Table 46).

These patterns in raw materials among tools and manuports suggest that certain materials were selected for their properties. Vesicular basalt may have been preferred for its longer use life, because it needs less-frequent rejuvenating, or because it releases less grit than other materials (Bostwick and Burton 1993:359; Haury 1976:280; Hayden 1987a:14, 1987b:188; Horsfall 1987:341–344). Observing similar correlations between artifact type and raw materials, Towner et al. (1998:109) proposed that vesicular basalt was selected intentionally, because it is much more efficient for food processing than materials such as granite. The vesicles cut the material being ground to a much finer size, thus expediting the grinding process. A disadvantage is that vesicular basalt wears out much more quickly than more durable materials. In the lower Verde River region, granite cobbles were abundant but were selected less frequently for manos than vesicular basalt. Towner et al. (1998:109) suggested that although granite manos are much stronger and more durable than vesicular-basalt manos, they are less efficient. Sandstone is a softer material than basalt and produces a great deal of grit; because the material wears so easily, sandstone tools would wear out readily and would need frequent replacement. The advantage of sandstone is that it is shaped easily. Its abundance in the grinding tools among the LOCAP collection probably could reflect its availability in the project area rather than its intentional selection for its grinding properties.

In addition, observed correlations among raw materials, artifact types, and use wear reinforce the notion that materials were chosen for their properties. Among metates, vesicular basalt artifacts stood out from metates fashioned from other raw materials. Whereas approximately two-thirds of metates made from basalt, rhyolite, and sandstone were used moderately or heavily, and about one-third were used minimally, these proportions were reversed among metates made from vesicular basalt (Table 47). This may indicate that metates of basalt and rhyolite—hard materials with close grain and few inclusions—were more durable and were used longer than metates made from vesicular basalt. The relative scarcity of moderately to heavily used metates of vesicular basalt also might indicate curation of the more valued vesicular-basalt metates. All basin and trough metates in the collection were made of sandstone, although the meaning of this pattern is unclear, because sandstone was the most abundant raw material regardless of artifact type.

Similar differential use wear was observed among the manos according to raw-material type (Table 48). Approximately 40 percent of manos made from vesicular basalt and rhyolite displayed moderate to heavy use wear,

Table 45. Manuports, by Material Type and Site

Site	Sandstone			Vesicular Basalt			Rhyolite			Basalt			Quartzite			Granite			Total
	C	T	U	C	T	U	C	T	U	C	T	U	C	T	U	C	T	U	
131/37	5	—	—	1	—	1	1	—	2	—	—	—	—	—	—	—	—	—	10
134/189	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	2
31/244	1	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	3
85/428	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
137/482	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
133/561	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
136/663	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
53/745	33	57	10	2	—	—	5	—	3	—	—	—	1	—	1	—	—	—	112
105/838	26	2	4	—	—	2	—	—	6	—	—	1	—	—	3	—	—	—	44
77/869	4	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	7
104/902	1	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	3
28/903	—	1	—	—	—	—	8	—	—	—	—	—	1	—	—	—	—	—	10
Total	74	60	15	4	—	3	18	—	13	—	—	1	2	—	4	1	—	—	196

Key: C = cobble; T = tabular; U = unknown.

Table 46. Ground Stone Artifacts, by Raw Material and Site

Artifacts	Sandstone	Vesicular Basalt	Rhyolite	Basalt	Quartzite	Porphyritic Andesite	Argillite	Total
				Site 131/37				
Mano	3	—	—	—	—	—	—	3
Metate	1	—	—	—	1	—	—	2
Unidentified	1	—	—	—	—	—	—	1
				Site 135/186				
Mano	2	—	1	—	—	—	—	3
				Site 134/189				
Mano	1	1	—	—	—	—	—	2
				Site 31/244				
Mano	3	—	1	—	—	—	—	4
Metate	1	—	—	—	—	—	—	1
Hammerstone	—	—	1	—	—	—	—	1
				Site 85/428				
Mano	12	1	—	—	—	—	—	13
Metate	—	—	1	—	—	—	—	1
				Site 133/561				
Mano	4	—	5	—	—	—	—	9
Metate	2	—	2	—	—	—	—	4
				Site 53/745				
Mano	42	10	7	1	—	—	—	60
Metate	36	7[a]	2	1	—	3	—	49
Hammerstone	1	—	1	1	1	—	—	4

Artifacts	Sandstone	Vesicular Basalt	Rhyolite	Basalt	Quartzite	Porphyritic Andesite	Argillite	Total
Unidentified	2	—	—	—	—	—	—	2
				Site 105/838				
Mano	29	14	3	—	—	—	—	46
Metate	8	3	2	2	—	—	—	15
Shaped stone	3	—	—	—	—	—	2	5
Unidentified	1	—	—	—	—	—	—	1
				Site 77/869				
Mano	3	—	—	—	—	—	—	3
				Site 104/902				
Mano	4	2	—	—	—	—	—	6
				Site 28/903				
Mano	6	—	1	—	—	—	—	7
Metate	5	—	2	—	—	—	—	7
Unidentified	—	—	1	—	—	—	—	1
Total	170	38	30	5	2	3	2	250

[a] Includes one bedrock basalt metate that was not collected.

Table 47. Use Wear and Material Type of Metates from the Lower Oak Creek Archaeological Project

Material Type	Minimal	Moderate to Heavy	Rejuvenated	Unknown	Total
Vesicular basalt	6	3	—	—	9
Basalt	—	2	1	—	3
Porphyritic andesite	—	3	—	—	3
Quartzite	1	—	—	—	1
Rhyolite	3	6	—	—	9
Sandstone	18	27	6	2	53
Total	28	41	7	2	78

Note: Excludes one uncollected metate.

Table 48. Use Wear and Material Type of Manos from the Lower Oak Creek Archaeological Project

Material Type	Minimal	Moderate to Heavy	Rejuvenated	Total
Vesicular basalt				
Irregular	1	—	—	1
Oval	5	5	1	11
Rectangular	1	5	3	9
Round	2	—	1	3
Unknown	3	1	—	4
Subtotal	12	11	5	28
Basalt				
Round	—	1	—	1
Rhyolite				

continued on next page

Material Type	Minimal	Moderate to Heavy	Rejuvenated	Total
Irregular	2	1	—	3
Oval	6	6	—	12
Round	2	—	—	2
Unknown	1	—	—	1
Subtotal	11	7	—	18
Sandstone				
Irregular	5	2	—	7
Oval	17	37	2	56
Rectangular	2[a]	1	—	3
Round	3	4	1	8
Unknown	16	19	—	35
Subtotal	43	63	3	109
Total	66	82	8	156

[a] Refitting artifacts counted as one.

whereas sandstone manos were more frequently used moderately or heavily (about 57 percent). This pattern may reflect the fact that sandstone wears easily. Rhyolite manos were much more likely than those made of other materials to show minimal use wear, which may indicate rhyolite's greater resistance to wear and may reflect its hardness. Vesicular-basalt manos were much more frequently rejuvenated than those of other materials (see Table 48). This may suggest a desire to extend the use life of these tools. The numbers are small, but we also see a tendency for rectangular manos of vesicular basalt to have been used more heavily than round or oval manos of the same material. Sandstone rectangular manos displayed the opposite pattern. In addition, whereas oval manos of vesicular basalt tended to be used minimally and moderately in equal frequencies, sandstone oval manos were much more likely to show moderate or heavy use. Again, sandstone's tendency to wear readily and to release grit, as well as its great abundance in the project area, is indicated. Overall, the data suggest that the LOCAP residents preferred vesicular basalt's greater efficiency for short-term food processing and overlooked the greater durability and longer use life of harder materials (see Towner et al. 1998:109).

Despite these patterns, it is clear that there was greater variation in raw materials (and artifact types) at the sites that were investigated most intensively and that therefore yielded more artifacts. The intensively investigated Sites 105/838 and 53/745 accounted for almost 76 percent of the entire ground stone collection. By contrast, Sites 137/482 and 136/663 yielded no ground stone artifacts. Site 137/482 could not be fully investigated, because much of the site was located on private land and had been disturbed heavily by modern construction. Although all artifacts from the surface of Site 136/663 were collected, this site also had been impacted by erosion, roads, and modern activities.

The flaked stone collection indicated somewhat different patterns in raw-material procurement and use. Although local materials dominated, there was a notable use of obsidian from several sources near modern Flagstaff, Arizona; of a fine-grained basalt, probably also from the Flagstaff or Ash Fork area; and of nonlocal chert, some of which resembled "Perkinsville jasper" found near modern Clarkdale, Arizona (Slaughter and Rickard 1994) (see Chapter 3). Just as vesicular basalt was selected for maize-grinding tools, the ancient residents of the LOCAP area chose obsidian and fine-grained basalt for certain tools, particularly projectile points. Although the presence of nonlocal materials deriving some 50–60 km from the project sites might be interpreted as evidence of trade, it is more likely to suggest a mobile population shifting periodically from north to south. Direct procurement of Government Mountain obsidian certainly could be indicated.

In addition, there were differences through time in the use of nonlocal materials. Obsidian and other exotic stones were more frequent in the collections dating to the Middle Archaic period; in the Late Archaic period, there was a greater reliance on local raw materials (see Chapter 3). This pattern suggests increasing sedentism and less far-ranging territories, which also is reflected in the ground stone collection. The Formative period population worked with the greatest variety of raw material, although continuing to rely on obsidian for projectile points.

Mobility and Sedentism

Questions about expedient technology inform our understanding of mobility and sedentism among the LOCAP populations. As discussed previously, scholars have linked an expedient ground stone technology with a considerable degree of mobility. People who move frequently from one settlement or resource-procurement area to another are likely to collect available materials as needed for immediate use and subsequent discard, creating so-called expedient tools (Nash 1996:93); there is little investment in manufacturing, tool maintenance, or transportation of raw materials. By contrast, more-sedentary peoples do invest in such behaviors, producing tools for future use, designing tools for multiple uses, and expending effort in maintaining tools and transporting tools and raw materials.

This appears to be true for the LOCAP ground stone collection. Given the abundance of good-quality raw material in the local area that was conveniently shaped for use without modification, it is not surprising that we found little evidence of deliberate shaping. It is possible that sandstone cobbles and tabular manuports were collected and stockpiled at settlements in the project area for future use. Although most artifacts recovered from LOCAP sites are of expedient *design,* not all were *used* expediently. More than half of the artifacts had been used moderately and were not discarded immediately after a single use; fewer artifacts (approximately 40 percent) exhibited minimal use. The intensity of use also varied. Slightly more than half of the manos had only one grinding surface, with a small number showing triangular profiles; slightly fewer than half had two grinding surfaces, and a small number of these had a triangular profile on one face. One mano had three ground surfaces. Two metates from Site 105/838 also displayed two opposing grinding surfaces. In addition, a small percentage of the manos and metates showed evidence of resharpening, which would indicate prolonged and intensive use.

Two grinding surfaces may indicate one or more of the following: prolonged grinding achieved by turning the tool over instead of stopping work to resharpen the tool; the use of single manos with different metates, such that different faces were compatible with particular nether stones; or an attempt to prolong use life (J. Adams 1994:89; Valado 1999:381). The technique of rocking a mano to create a beveled use surface not only prolongs the tool's use life but also may indicate the desire to avoid scraping the grinder's fingers or to keep the substance that is being ground in place (Adams 1993:336; Bartlett 1933:16, 28; Valado 1999:381). Together, this information indicates that slightly fewer than half of the LOCAP manos were intensively used.

The frequency of minimally used artifacts in the LOCAP collections may imply curation behavior by a locally mobile population or one that was moving permanently across long distances. Valado (1999:381) has observed that a large number of unused or lightly used tools could indicate abandonment, among other possibilities. It would be much easier to collect and shape new tools than to invest the labor necessary to move the old, unused tools. The availability of suitable raw materials might also affect curation behavior, however.

The issue of mano-to-metate ratios may contribute to an understanding of mobility, sedentism, and expedient technology. Throughout the U.S. Southwest, manos commonly outnumber metates, regardless of site age, and this phenomenon has not been explained adequately. In addition, the proportions of different kinds of manos often are dissimilar to the kinds of metates represented at a site. For example, there may be many flat or concave metates and few of the corresponding manos. An overabundance of manos also characterized the LOCAP ground stone collections. Collections from all sites contained manos, with the exception of those yielding no tools. The number of manos far exceeded the number of metates at most sites, and the ratios fell into three groups. Metates were not found at six sites (Sites 137/482, 136/663, 135/186, 134/189, 77/869, and 104/902). The ratio of manos to metates was approximately 1 to 1 at three sites (Sites 131/37, 53/745, and 28/903). Mano-to-metate ratios were high, although variable, at Sites 31/244, 133/561, and 105/838, ranging from about 2 to 1 to 4 to 1. Site 85/428 had an exceptional ratio of 13 manos to 1 metate.

Several explanations have been proposed for disproportionate mano-to-metate ratios. It has been suggested (e.g., J. Adams 2003:204) that metates were more valuable than manos and therefore were either curated when the site was abandoned or were collected and reused by people who subsequently occupied the area. The labor investment required to shape metates compared to manos may indicate their comparative value. Metates made of more-durable material, such as vesicular basalt, and those that were well shaped, such as trough metates, might be more subject to collection and reuse by later occupants. One would assume that manos, rather than metates, would constitute the portable portion of the tool kit because of the size and weight of metates, however. For example, Valado (1999:374) has observed that movement across long distances may result in leaving lightly used and, in particular, heavier tools behind (see also Schiffer 1987; Schlanger 1991; Schlanger and Wilshusen 1993).

The presence of numerous manos with few metates may signal the use of multiple hand tools with single nether stones. Manos of variable coarseness or size may have been chosen by different grinders or may have been used according to the different resources to be processed. J. Adams (2003:202) has suggested that centralized grinding areas may have been used by grinders employing their personal manos with a communal metate. Such work areas have yet to be found in Archaic and Hohokam sites, however, although multiple mealing bins and specialized food-processing rooms have been found in Mogollon and Anasazi sites. Such work areas do not appear to characterize the LOCAP sites. The bedrock metate at Site 53/745 and the boulder grinding slick at Site 105/838 certainly could have been used communally by many different grinders, but work areas are difficult to recognize at sites where only surface collection was carried out. There may have been work areas at Site 85/428, where several manos were collected from the surface of a roasting pit, and others were found in the fill of one stripping unit. Another may have been present at Site 104/902 in the area near Feature 2, a possible masonry room.

Caching of hand stones and nether stones, particularly in sealed pits in the floors of dwellings and in outdoor areas, has been suggested to be the signature of short-term occupation and high mobility. DeBoer (1988) has argued that subterranean storage indicates periodic or seasonal abandonment. Among the Nunamiut, artifact caches are insurance gear, or items left behind in anticipation of future needs (Binford 1979). Similarly, Henderson (1993:386) interpreted the numerous tool caches found at the Late Archaic period Coffee Camp site in southern Arizona as stored equipment left behind when the settlement was left temporarily as the inhabitants moved to another locale. Underground caches, particularly when sealed, provided safe storage that protected valuable tools and equipment from raiding when camps were left unoccupied and unprotected. Few such caches were found at the LOCAP sites, although intramural pits at Site 105/838 might be considered cache pits. The dearth of storage pits at the LOCAP Archaic period sites probably is more a function of the small sample and their special function than an indication of population mobility and the duration of the occupation.

It is possible that nether stones were made of perishable materials. Ethnographic accounts describe the use of wooden nether stones that "under ordinary circumstances, probably would not be preserved in the archaeological record" (Schneider 1993). Finally, some metates may have been taken from sites by modern looters.

Having explored these options, we can say only that there appears to be a correlation between occupational duration and sample size and the presence or absence of metates at the LOCAP sites. Components of Archaic period and Formative period age that appear to have been used more intensively or for habitation yielded more metates (and more ground stone in general) than sites that were used only briefly and for nonhabitation purposes. It is safe to conclude that considerable collecting and reuse of ground stone tools took place, and that residents curated ground stone tools when settlements were abandoned temporarily or permanently.

The flaked stone collection provided support for these inferences. It is presumed that during the Middle and Late Archaic periods, the population was highly mobile with widely ranging territories. Increased sedentism was apparent in the Formative period, but continued reliance on obsidian and other nonlocal stone indicates a population that was moving back and forth to obtain necessary resources (see Chapter 3).

Subsistence Practices and Grinding Efficiency

Some of our more important research questions concerned subsistence—the range of food resources that the inhabitants of LOCAP sites used, the role of agriculture in the subsistence base, and the time at which agriculture may have been adopted in the region. The ground stone collection contributes some information regarding these topics. Traditionally, archaeologists have recognized a correlation between the morphology of grinding equipment and the kinds of materials that were processed. Trough metates are associated with processing maize, whereas basin metates are thought to indicate grinding activities involving smaller seeds from wild plants. Hence, the appearance of trough metates at sites is thought to signal maize cultivation, and the presence of basin metates indicates the persistence of a seed-collecting economy (e.g., Haury 1950:317, 545; 1976:282). Rarely is this correlation so clear-cut, however. Having said that, we note that three different metate types were present among the collections from the seven project sites where these tools were found. Flat or concave metates were most numerous (n = 28), followed by basin metates (n = 4); only 1 recovered metate was a trough form. At face value, this suggests that little processing of maize took place. At least some of the 12 rectangular manos were used in conjunction with trough metates, however.

Adams (1999) has suggested that flat or concave manos and metates were designed to be more efficient tools for processing oily or soaked seeds than basin manos and metates, and that this design continued to be useful for processing soaked corn kernels after the introduction of maize. Trough metates were designed for dry grinding, as the raised borders would serve to contain the resulting meal (J. Adams 2003:204). Trough metates and the accompanying large, heavy manos also can be seen as more-efficient grinding tools, as they have a larger surface area and require a reciprocal motion (J. Adams 2003:205). Adams (1999:486) concluded from her grinding experiments that "the confining trough and larger contact area between the mano and metate made it the most efficient for grinding dried kernels and seeds." She also has suggested (J. Adams 2003:205) that single grinders could produce more meal using trough metates than other metate shapes.

Trough metates postdated the introduction of agriculture in the U.S. Southwest by centuries. As suggested earlier (Whittlesey 1998b:166, 2004b:21), trough metates mark maize *dependence,* not maize cultivation and consumption. A complex was introduced during the Red Ware horizon of the Early Formative period (Deaver and Ciolek-Torrello 1995) that included sophisticated ceramic containers; new, floury varieties of maize; and new cooking techniques along with improved grinding technology. This technological complex enabled U.S. Southwest populations to derive as much nutritional value from corn as possible, allowing a greater degree of dependence than had been possible during the Late Archaic period. Whereas maize ears had previously been roasted on the cob, as indicated by the numerous extramural thermal facilities and the lack of intramural hearths at Late Archaic settlements, new cooking techniques introduced during the Early Formative period centered on cornmeal and the foods that could be prepared from it, such as stews and tortilla-like breads. Whole-corn kernels may have been parched—a cooking technique using intramural hearths and shallow ceramic bowls—and then cooked in *posole*-like stews. In addition, trough metates require more labor to manufacture than other types (J. Adams 1994:79; Valado 1999:379). Trough metates therefore signify not only a commitment to agriculture and a diet based on foods made from cornmeal but a concomitant investment in technology.

It therefore does not seem coincidental that trough metates and rectangular manos were found at LOCAP sites dating to the Formative period. The single trough metate in the LOCAP ground stone collection was found at Site 53/745, however. This multicomponent site has Archaic period and possible historical-period Yavapai components in addition to Formative period occupations. Conversely, trough metates and associated manos were absent at sites thought to have Archaic components (Sites 31/244, 133/561, and 28/903, in addition to Site 135/186, from which no metates were recovered). Flat or concave and basin metates and associated manos were found in these collections. These patterns support the inferred age of these sites and the presumed small-seed-collecting economy of the inhabitants. We must consider, however, the fact that metates and manos other than the trough variety can be used to process maize when it is not a major component of the diet (J. Adams 1998, 2001), and the form of grinding equipment probably reflects maize-processing and cooking techniques as much as, or perhaps more than, specialization for grinding tasks. When maize is roasted fresh on the cob or whole kernels are parched and stewed, no grinding is necessary (Whittlesey 2004b:21–22).

Regarding the time at which agriculture was introduced into the region, we find that evidence for maize appears first at sites dating to the Early Formative period, which is represented by the Squaw Peak phase. At least one rectangular mano was associated with the Squaw Peak phase (A.D. 1–600) structure at Site 105/838. At Site 85/428, an inferred Squaw Peak phase occupation was represented by Archaic-style flaked stone artifacts, maize cultivation, and rectangular manos. Roasting pits at this site contained maize remains, suggesting that corn was roasted in these facilities (or that cobs were used as fuel). These adjacent sites may represent a single occupation episode. Farming populations were settling the middle Verde River valley and adjacent areas in locations with well-watered, arable soil. The LOCAP Squaw Peak phase settlements may represent a population on the verge of making the transition to maize dependence. Accordingly, their grinding tools were fashioned to process maize efficiently.

Efficiency and intensity are important in discussing subsistence production. An increase in grinding efficiency means that the same amount of substance can be ground in less time than it previously required, or more substance can be ground in the same amount of time. Increased intensity means that each grinder spends more time at the grinding task (Valado 1999:373). Changes in efficiency and intensity can reflect social or technological processes—the size of the group being fed, the available raw materials, the foodstuffs being processed, and so on. Changes in efficiency and intensity will be reflected at the artifact level, allowing archaeologists to monitor changes in subsistence production. With increases in social or technological processes, we might expect to see a greater investment in making grinding tools, the appearance of wear-management strategies and resharpening, and the modification of tools to make them more comfortable to use (J. Adams 1994:83, 284; Bartlett 1933:13; Valado 1999:374).

None of these technological processes appears with any frequency in the LOCAP ground stone collection. Rejuvenated tools were rare, few manos exhibited triangular profiles or multiple grinding surfaces, and use wear rarely reached an intensity that required rotating or turning the tool. Together, this suggests not only that most LOCAP residents were relatively mobile but also that the population was small, and that there was little need to increase grinding efficiency or intensity. With this said, we observe that rectangular manos used with flat or trough metates often were fashioned from vesicular basalt—a material noted for its grinding efficiency. When maize was processed at LOCAP settlements, some thought was evidently given to grinding efficiency.

Last, we note that food products other than plants may have been processed using the mano-metate tool kit. Recent studies from Californian sites (Sutton 1993; Yohe et al. 1991) using immunological techniques and ethnographic accounts suggest that the carcasses of small mammals, as well as plant products, may have been ground on metates. We note that the faunal remains from LOCAP sites exhibited a great amount of crushing and grinding (see Chapter 8), perhaps to extract fats and marrow, and animal products may have been processed for this purpose by means of manos and metates.

In summary, the ground stone tools suggest a subsistence base grounded in wild-plant-food collecting and hunting supplemented with agriculture at the settlements of Formative period age and at some of the Archaic period settlements. Many tools were used expediently at sites that were devoted to procurement and processing tasks; tools that were used more intensively were employed at camps that were occupied longer or more intensively.

Recycling and Reuse

Collecting, recycling, and reuse behaviors can inform on our questions regarding occupational history and, in particular, the issue of Yavapai occupation. As mentioned previously, the Northeastern Yavapai (as well as the Northern Tonto Apache, whose traditional territory overlapped into the LOCAP study area) were inveterate recyclers and reusers of artifacts, including materials collected from prehistoric sites and modern Euroamerican material culture (Whittlesey 1998a; Whittlesey and Benaron 1998). This was particularly true for the Lower Verde Archaeological Project (LVAP) ground stone tools. The Northeastern Yavapai used metates that were found at prehistoric sites and only rarely made them; the Southeastern Yavapai located and used prehistoric bedrock mortars (Whittlesey and Benaron 1998:160). The Western Apache manufactured grinding equipment or retrieved manos and metates from prehistoric sites; prehistoric bedrock mortars also were used (Whittlesey and Benaron 1998:177). When the University of Arizona Field School was operating at Grasshopper Pueblo, older Cibecue Apache women requested metates from the pile of cataloged stone artifacts stored behind the laboratory.

Reused artifacts, particularly those that were reshaped, therefore may indicate recycling by people who were not the original makers and users of grinding equipment. Valado (1999:374) noted that sequential secondary use (use that modifies a tool such that it is no longer functional for its original task) and the presence of artifacts that have been redesigned for no apparent functional reason may indicate the influx of a new population or the resumption of occupation at a previously abandoned settlement. In this light, it is particularly intriguing that Western Apache women who used recycled metates collected from prehistoric sites sometimes shaped them into a more satisfactory form (Whittlesey and Benaron 1998:177).

Several LOCAP artifacts had been reused. A flat or concave, sandstone metate from Site 105/838 with a single grinding surface (PD 209) had been shaped into a pestle preform. Another concave, sandstone metate (PD 168) had been reused as a hammerstone. At Site 53/745, one mano had been used as a hammerstone, and one hammerstone had been used as a mano. At Site 131/37, a quartzite metate (PD 9) also had been reused as a hammerstone. Site 85/428 yielded three manos that had been recycled as cooking stones in Feature 2, a roasting pit. We think that these cases may reflect the expedient ground stone technology found at the LOCAP sites, with single artifacts serving in a variety of processing activities. There is little evidence for systematic collecting and recycling of ground stone tools by Yavapai people. The bedrock grinding slicks found at Sites 53/745 and 105/838 certainly could have been used by the Yavapai, as suggested by ethnographic information, but there is no direct evidence.

Cultural Affiliation and Ethnic Identity

To examine issues of ethnic identity and cultural affiliation, we must refer to ethnographic accounts and previous archaeological investigations to determine the characteristics of Archaic, Southern Sinagua, and Yavapai ground stone assemblages.

Archaic Ground Stone

The Squaw Peak phase of the middle Verde region is equivalent to the Late Archaic period of central and southern Arizona and the Basketmaker II period on the Colorado Plateau. Breternitz's (1960a:19, 21) description, derived from excavations at the Calkins Ranch site (NA2385) and the Montezuma Well site (NA4616C), indicated an informal, expedient grinding technology. Ground stone included one-sided and two-sided, round to oval hand stones (one-handed manos); grinding slabs; and polishing stones. No formal metates or large, rectangular manos were found. This assemblage is similar to those from Late Archaic sites in other areas, although apparently it was more casual and expedient. For example, Cienega phase sites in the Tucson Basin yielded flat or concave and basin metates (J. Adams 1998).

Southern Sinagua Ground Stone

Information about ground stone assemblages from the earlier, pit-house-dwelling settlements in the middle Verde region derives primarily from Breternitz's (1960a) work. These sites yielded grinding equipment that also showed investment in manufacture and intensive use and therefore reflected the practice of maize agriculture. Breternitz (1960a:21–22) defined the Hackberry phase on the basis of data from NA3607 and early deposits at the Verde Ball Court site (NA3528). Although no trait list was provided for this phase, round to oval hand stones were found, leading Breternitz to suggest that basin metates eventually would be listed as typical material items of the phase.

The following Cloverleaf phase (Breternitz 1960a:22–23) was defined on the basis of considerably more evidence than earlier phases, which included excavations at the Calkins Ranch site (NA2385) and the Verde Ball Court site (NA3528). Among the most common tools were trough metates and one- or two-sided, rectangular manos, which replaced the earlier basin metates and round to oval hand stones. Hammerstones and pestle/pounders also were common. The small Verde View site (AZ O:5:12 [ASM]) (McGuire 1977), which had a Cloverleaf phase component, produced a diverse ground stone collection. Metates included a complete slab form of rhyolite and fragments of rhyolitic tuff and vesicular basalt. Manos represented oval, loaf-shaped, and rectangular varieties. The latter two forms were well shaped by pecking, and all had been used in trough metates. Raw materials were sandstone (most common), vesicular basalt, and rhyolite. McGuire (1977:38) noted evidence for breakage during manufacture and resharpening.

The Lazy Bear No. 1 site (NA11076) was assigned an A.D. 875–925 date (James and Black ca. 1974). More ground stone than flaked stone was recovered from this site; the collection included two incipient trough metates, one open-ended trough metate, and a basin metate. Other ground stone included the poll of a three-quarter-grooved maul, a hammerstone, and pestle/pounders.

Ground stone of the Camp Verde phase indicated further investment in manufacturing and tool maintenance. Breternitz (1960a:23) based his description of the phase on investigations at the Calkins Ranch site (NA2385), the Verde Ball Court site (NA3528), the Montezuma Well site complex (NA4616A and NA4616C), two sites near Tuzigoot Pueblo, and the Winneman Ranch site (NA3945A). Ground stone items included round to oval and rectangular manos that were used with trough metates and grinding slabs, hammerstones, and multifunctional basalt hoes. The Verde Terrace site (AZ O:5:6 [ASM]) was a pit-house hamlet dating to the Camp Verde phase that was excavated intensively and yielded a substantial artifact collection (McGuire 1977). All metates of recognizable form had the trough shape; all but three were of vesicular basalt. There was some evidence that metates had been broken during manufacture, and four intentionally broken metates were found in a cremation area (McGuire 1977:83). No whole metates were found. Manos included loaf-shaped and rectangular forms; all larger examples exhibited facets indicating their use with trough metates. The most common material was vesicular basalt, followed by granite and sandstone.

Diversity decreased, and trough metates became the grinding tool of choice, during the later occupations in the middle Verde region, reflecting further investment in maize agriculture. Ground stone tools recovered from Tuzigoot Pueblo reflected the concomitant increase in efficiency and intensity expected at Late Formative settlements that were maize dependent. Caywood and Spicer (1935:76–77) indicated that all metates were of the trough form and were made of "scoriaceous basalt" and fine-grained sandstone. Basalt metates were most frequent; all basalt metates were of the double-open-ended type. Only one-third of the trough metates made of sandstone were open-ended, and all were open only on one end. In addition, the sandstone metates "were rarely worked as deeply as the latter" (Caywood and Spicer 1935:77). This statement is unclear, but it appears to indicate that the basalt metates were used more heavily than the sandstone metates. Caywood and Spicer (1935:77) also observed that there was no consistent association of raw materials in room contexts; sandstone manos were used with basalt metates, and the reverse. The Sinagua of Tuzigoot Pueblo did not use mealing bins; metates were inset into the floor, sometimes deeply, at a convenient grinding angle. Some metates, found in some of the later rooms at the site, had been converted into shallow mortars. Mortars were otherwise rare at Tuzigoot Pueblo.

Manos were primarily of the rectangular form used with trough metates, with a single grinding surface and a plano-convex shape in cross section. Most were pecked to shape, and some had pecked depressions to enable the grinder to hold the tool comfortably (Caywood and Spicer 1935:77). The mano-to-metate ratio was skewed at about 5 to 1. The authors reported finding as many as 31 manos of various forms on the floor of a single room; the average was 12–15 manos per room (Caywood and Spicer 1935:78).

Similar grinding equipment was found at Montezuma Castle in the middle Verde River valley. Trough metates were far more common than basin metates; most were made of vesicular basalt. Manos also were of the trough type and made of basalt. A few sandstone manos appeared to have been used with flat metates (Jackson and Van Valkenburgh 1954:28).

Yavapai and Western Apache Ground Stone

Because the LOCAP study area overlapped the traditional territories of the Northeastern Yavapai and Northern Tonto Apache peoples, and in light of the extraordinary cultural similarities between these linguistic groups, we include Western Apache ground stone assemblages in our discussion. Ethnographic accounts indicate that both groups used expedient tools or collected equipment from prehistoric sites and recycled them; seldom was much energy invested in making grinding equipment from scratch.

According to Gifford (1936:280), the Northeastern Yavapai used bedrock mortars in low-elevation areas where mesquite was abundant. The accompanying stone pestle was "ready-made"; the meaning of this label is unclear, but it probably indicates that a naturally available stone of appropriate shape was used. Metates were of two types: a flat or slightly concave form and a trough form. Gifford (1936:280) wrote that they were "usually found, rarely made." Manos were used with both hands in a reciprocal motion, indicating their rectangular shape; occasionally, manos were used to pound on metates. Grinding equipment of the Western Yavapai was more expedient still; they collected stones of appropriate shape (flat stones for metates, cobbles for manos and pestles) or collected old metates and manos from prehistoric sites.

The Western Apache manufactured their grinding equipment or collected it from ancient sites. Ferg (1987:59) indicated that slab metates were preferred, although Goodwin's informants described trough and legged forms (Whittlesey and Benaron 1998:177). Mortars were made, or prehistoric mortars were found and reused (Ferg 1987:59). Bedrock mortars, pestles, manos, and metates used by the Tonto Apache were similar to those used by the Northeastern Yavapai (Whittlesey and Benaron 1998:Table 5.4).

Yavapai ground stone shares some characteristics with Archaic period grinding equipment. The treatment plan for the LOCAP (SRI 1998:11) noted that at sites along the Clarkdale Pipeline, ground stone tools resembled Archaic styles, regardless of whether sites were assigned to the

Archaic period, to the Formative period, or to the Yavapai. Archaic sites generally produce simple, utilitarian forms and lack open-ended trough metates and rectangular manos. Metates typically have large, deep, oval basins, and the manos are large, with convex grinding surfaces.

Discussion

We have no unambiguous answers to the question: Who occupied the LOCAP sites? The Southern Sinagua and Yavapai ground stone assemblages certainly appear to be different. The former invested considerable effort in shaping and resharpening tools and in wear management, suggesting that they used the equipment intensively. The Yavapai had a casual and expedient approach to grinding equipment, collecting suitably shaped stones and using them without shaping, or they collected old tools from prehistoric sites and reused them. The ground stone tools found at Archaic period LOCAP sites are consistent with those described by Breternitz (1960a)—round to oval manos with single grinding surfaces and flat or concave metates. Basin metates also were present. No trough metates or rectangular manos were found at the Archaic sites. The Squaw Peak phase components at Sites 85/428 and 105/838 did yield a few rectangular manos, suggesting that maize dependence was beginning to take hold in the region at this time.

The later, Formative period LOCAP sites yielded ground stone collections that also were consistent with the assemblages described by Breternitz (1960a). Although flat or concave metates persisted, trough metates appeared, and the rectangular manos associated with this metate type increased in frequency. The sample is small, but it appears to reflect the processes of increasing commitment to maize agriculture and a concomitant increase in grinding intensity through time, which Breternitz also described. Most of the rectangular manos were made from vesicular basalt, reflecting the emphasis on this raw material among settlements of Late Formative period age in the middle Verde region. At least one metate in the LOCAP collection had a curved base, requiring it to be partially buried to be stabilized.

Although the flat or concave metates and the manuports found at many LOCAP sites may indicate a Yavapai presence, this is a matter of conjecture. Because the Yavapai and the Western Apache collected much of their grinding equipment from prehistoric sites, we cannot differentiate Southern Sinagua or even Archaic period grinding equipment from that used by the Yavapai unless the tools were modified in such a way as to suggest recycling. The form of the tool alone is insufficient for differentiating among groups. For example, the Southern Tonto Apache used slab, basin, trough, unshaped, and so-called Apache-type metates, as well as one-handed round and square and two-handed manos, collected from prehistoric sites. As discussed previously, the bedrock grinding slicks at LOCAP sites could have been used by the Yavapai, but there is no direct evidence.

Perhaps the most likely evidence for Yavapai occupation comes in the form of tabular sandstone manuports at Site 53/745. Such objects were found at only two other LOCAP sites (Sites 105/838 and 28/903) and in low frequencies. Ninety-five percent of all tabular sandstone manuports were collected from Site 53/745. This certainly is consistent with the ethnographic observation that the Yavapai collected and used suitable tabular stones as nether stones (Gifford 1936:280), although this practice was described for the Western Yavapai rather than the Northeastern Yavapai who might have inhabited the LOCAP area.

The flaked stone collection similarly indicated no unequivocal evidence of a Yavapai presence. No projectile points traditionally associated with the Yavapai, such as the Desert Side–notched and Cottonwood styles, were recovered. Bradley et al. (see Chapter 3) did not recognize any possible Yavapai signatures in the other flaked stone tools or debitage, although they recognize that we know little about protohistoric technology and tool types.

Summary and Conclusions

The LOCAP ground stone collections have provided some information that can answer our questions about subsistence practices, mobility and sedentism, and cultural affiliation. In general, the ground stone tools were consistent with those expected among relatively mobile populations who practiced a mixed foraging-farming-hunting subsistence strategy and who moved regularly between numerous short-term, special-purpose settlements used for farming, resource collecting, and habitation. The technology was expedient, focusing on available raw materials that could be used without spending much time in shaping tools. Tool use was not expedient, however; there was considerable investment in extending the use life of grinding equipment.

The ground stone tools were consistent with those expected at Archaic period settlements and settlements of Formative period age, with increasing commitment to agriculture through time reflected in the appearance of trough metates and rectangular manos and the use of efficient raw materials, such as vesicular basalt, to manufacture these tools. As early as the Squaw Peak phase, these tools indicate the beginnings of an agriculturally based economy that would persist and become more intensive through the remainder of prehistory.

No indisputable associations can be made between the ground stone collections and the cultural affiliation or ethnic identity of the peoples who used them. The expediently designed tools that have been associated with Yavapai ground stone assemblages were present at Site 53/745, where a Yavapai occupation has been postulated, but they generally characterize *all* LOCAP collections and also were recovered from Archaic period sites and sites of Formative period age. The unusual concentration of tabular sandstone manuports at Site 53/745 is the most convincing evidence in the LOCAP ground stone assemblages for a Yavapai occupation, although it is unclear to what extent this patterning might reflect the available raw materials, archaeological sampling, or other processes.

The analysis of ground stone artifacts and manuports from the LOCAP sites has raised a number of questions concerning the correlation between grinding equipment and subsistence practices and artifact collecting, recycling, and reuse. Our results indicate the need for archaeologists to study these processes carefully in future research and to avoid simplistic interpretations. Our study has contributed greatly to understanding the nature of technology, subsistence, and mobility in a little-studied region of central Arizona.

CHAPTER 5

Shell Artifacts

Arthur W. Vokes

The excavations by SRI during the LOCAP along SR 89A resulted in the recovery of 57 pieces of shell from three sites: AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), and AZ O:1:104/AR-03-04-06-902 (ASM/CNF) (Site 104/902). It is estimated that this sample represents a collection of 41 individual artifacts (Table 49). Material from subsequent excavations by a CNF volunteer project is not included in this analysis. The bulk of this collection consisted of unworked fragments of freshwater shellfish that would have been available from Oak Creek Canyon and some of its tributaries, such as Spring Creek. Only 14 pieces of shell were marine in origin; more than 65 percent of this subset represented formal artifacts that were obtained and used by the prehistoric inhabitants of the investigated settlements. This chapter provides a descriptive summary of the different artifact forms and a comparison of the LOCAP collection with collections from other sites in the surrounding region.

Methods

The collection was subjected to a detailed analysis that involved the creation of a descriptive record—often including a scale drawing—along with a set of linear measurements obtained through the use of a digital vernier caliper. Notes on the condition, shape, decorative motifs, and technological features were recorded. For the purposes of analysis, fragments that could be refitted were considered single items, and the number of pieces was recorded in the analysis notes. In instances where fragments—particularly those of *Anodonta* (floaters)—could not be refitted, but the evidence indicated a high probability that they were from the same artifact, the pieces were also recorded as a single item, and a count of the fragments was included on the specimen's detail sheet. Specimens were generally considered complete if a full set of linear measurements could be obtained.

The taxonomy employed during this analysis is largely based on that developed by Haury (1965b, 1976) for the shell collection from the Hohokam site of Snaketown. The nomenclature and biological determinations of the marine material were made in accordance with Keen's (1971) *Sea Shells of Tropical West America*. Another source employed for identification purposes was Abbott's (1974) *American Seashells.*

Two additional pieces of shell from Site 105/838 (PDs 552 and 611, both from floor pits in Feature 23) were found in the artifact collection after analysis. These were integrated into the following text and tables.

Genera and Species

Two sources of marine shell were available to the prehistoric inhabitants of the region. These are the Pacific coastal waters off the modern state of California, and the Gulf of California, which is also referred to as the Sea of Cortez. Archaeologists working in the U.S. Southwest benefit from a natural division of oceanic environments that is present off the western coast of the Baja California peninsula. Two different currents—the warm Panamic from the south and the colder Californian from the north—converge and turn seaward in the area of Magdalena Bay. Consequently, many species of mollusk are found in only one of the two zones or have a limited distribution and frequency in one zone relative to the other. Although both biotic communities are known to have contributed to the shell material available to the prehistoric inhabitants of the southern U.S.

Table 49. Shell Data Summarized, by Provenience and Site Number

Feature/Context	Provenience Designation (PD)	Subfeature	Level	Artifact	Genus	Condition	Count	Minimum No. of Individuals
				53/745				
Site surface	PD 6050		0	bracelet fragment	*Glycymeris*	unburned	1	1
				105/838				
Site surface	PD 59		0	unworked fragment	*Pecten*	unburned	1	1
Trench 177	PD 242			unworked fragment	*Anodonta*	unburned	5	1
Stripping Unit 142	PD 152			unworked fragment	*Anodonta*	unburned	1	1
Feature 23 (pit house)								
Test Pit 158	PD 164		2	unworked fragment	*Anodonta*	unburned	10	1
	PD 169		3	unworked fragment	*Anodonta*	unburned	1	1
	PD 198		6	unworked fragment	*Anodonta*	unburned	1	1
	PD 230		7	unworked fragment	*Anodonta*	unburned	1	1
Test Pit 319	PD 344		5	bracelet fragment	*Glycymeris*	unburned	1	1
Fill	PD 409		1	unworked fragment	*Anodonta*	unburned	2	2
	PD 479		1	bracelet fragment	*Glycymeris*	unburned	1	1
	PD 353		2	unworked fragment	*Anodonta*	unburned	1	1
	PD 490		2	unworked fragment	*Anodonta*	unburned	1	1
Roof/wall fall	PD 489		1	unworked fragment	*Anodonta*	unburned	1	1
	PD 382		3	bracelet fragment	*Glycymeris*	charred	1	1
Floor fill	PD 426		2	unworked fragment	*Anodonta*	unburned	1	1
	PD 490		2	bracelet fragment	*Glycymeris*	burned	1	1
Floor pit	PD 534	4	3	unworked fragment	*Anodonta*	unburned	1	1
	PD 552	4	5	unworked fragment	*Anodonta*	unburned	1	1
	PD 611	19	3	unworked fragment	*Anodonta*	unburned	1	1
	PD 710	24	4	unworked fragment	*Anodonta*	unburned	1	1
	PD 719	24	7	whole-shell bead	*Olivella*	unburned	1	1
	PD 719	24	7	disk bead	unidentified	unburned	1	1

Feature/Context	Provenience Designation (PD)	Subfeature	Level	Artifact	Genus	Condition	Count	Minimum No. of Individuals
	PD 744	27	3	unworked fragment	*Anodonta*	unburned	1	1
	PD 675	27	4	bilobed bead	unidentified	unburned	1	1
	PD 678	27	5	whole-shell bead	*Olivella*	unburned	1	1
	PD 678	27	5	unworked fragment	*Anodonta*	unburned	4	2
	PD 682	27	6	unworked fragment	*Anodonta*	unburned	2	1
	PD 716	35	6	plain bracelet	*Glycymeris*	unburned	1	1
	PD 749	37		plain bracelet	*Glycymeris*	unburned	1	1
Feature 29 (pit house)								
Test Pit 322	PD 354		3	unworked fragment	*Anodonta*	unburned	1	1
Test Pit 390	PD 391		1	unworked fragment	*Anodonta*	unburned	1	1
	PD 402		3	unworked fragment	*Anodonta*	unburned	1	1
Test Pit 484	PD 486		2	unworked fragment	*Anodonta*	unburned	1	1
Fill	PD 516		2	unworked fragment	*Anodonta*	unburned	1	1
Roof/wall fall	PD 420			plain ring	*Glycymeris*	unburned	1	1
	PD 501		1	unworked fragment	*Anodonta*	unburned	1	1
Floor pit	PD 714	23	2	unworked fragment	*Anodonta*	unburned	1	1
				104/902				
Site surface	PD 12		0	unworked fragment	*Laevicardium*	unburned	1	1

Southwest, the principal source appears to have been the Gulf of California.

The shell species recovered during the LOCAP are summarized in Table 50. Three marine pelecypod genera were identified within the current sample, along with one gastropod genus. All of these would have been available from the Gulf region. Although some of the genera have species that are also endemic to the colder waters off the west coast, these can be eliminated from consideration on the basis of morphology, size, and distribution. In all cases in which the specific species could be identified, the species are forms endemic to the Gulf area. Only *Laevicardium elatum* (giant eggcockle) extends into the colder waters along the California coast and could have been obtained through exchange from the populations of southern California (Abbott 1974:486). However, the species does not appear to be as common in these colder waters as it is in the warmer Panamic province, and it does not appear that this shell was extensively exploited by the prehistoric populations of southern California (Gifford 1947). Therefore, it seems likely that the valve represented by the one recovered fragment of *Laevicardium* originated in the Gulf of California.

The genus *Olivella* (olives) is well represented in both biotic communities. However, the species are well segregated from each other. Silsbee (1958) has reported that one method of distinguishing the species found off the California coast from those of the Gulf is in the shape and extent of the callus. This offers a relatively simple method for identifying the general geographic source of the shell, even if the species can not be determined. Both valves in the LOCAP sample appeared to be shells from the Gulf of California.

Artifact Collection

The collection, summarized in Table 51, was largely split between artifact forms manufactured from marine shell and unmodified fragments of a locally available freshwater bivalve. Three different types of artifact forms were present, including several varieties of beads, a number of bracelets, and a plain ring-pendant.

Beads

After bracelets, beads were the most common artifact form, and four shell beads were recovered from the excavations. Two were simple forms of whole-shell beads, and the other two were different forms of cut beads. All specimens were recovered from the trash fill in two of the floor pits in Feature 23 at Site 105/838 and may represent a single composite artifact.

The whole-shell beads were created by simply grinding away the apex of the spire of the *Olivella* valve and removing enough of the internal structure to permit the passage of the cord through the length of the shell.

The only disk bead recovered during the excavations was made of a white marine shell. The bead was roughly round in plan view, with a slightly wedge-shaped profile. The other cut-shell bead form was essentially a bilobed-style bead, although it lacked the side constrictions that typically define the lobes that characterize the artifact form. Thus, the specimen was roughly rectangular with rounded ends and a uniconical perforation centered at one end. The bead was more than 10.3 mm in length, which would be similar in size to the larger bilobed beads in the Snaketown collection. Haury (1976:310) noted that these larger bilobed beads were restricted to the later period of that site's occupation, which was essentially contemporaneous with the Camp Verde phase, to which this specimen is attributed.

Bracelets

Seven bracelets—six from Site 105/838 and one from the surface at Site 53/745—were recovered; bracelets were the most common finished shell-artifact form in the collection. This is not an unusual pattern for shell collections in Arizona. In some Hohokam collections, as many as 70 percent of the finished artifacts have been bracelets (Vokes 1988). In the LOCAP sample, they were more than 58 percent of the finished artifact forms.

All of the project specimens were plain bands that varied in width from 3.24 to 7.85 mm, with an average value of 4.59 mm. The specimen from Site 53/745 was one of the narrowest bands in the sample and the smallest in terms of the band's thickness. The profile of slightly more than half of the bands (57 percent) retained the natural slope of the original shell. In two of the remaining bands, the exterior face of the bands had been ground back to form a surface that was nearly vertical to the natural plane of the margin. The final example was a mixture of these treatments, as the lower portion was ground to a nearly vertical face, and the upper half retained the natural slope. The reasons for steepening the face are unclear, although it would have produced a more visible, flat face against the arm.

Rings

A single example of a ring-pendant made of a medium-sized *Glycymeris* (bittersweets) valve was recovered from Feature 29 at Site 105/838. The fragment, which included portions of the ventral and side margins, was quite broad, with a width of 5.14 mm. The band's exterior surface retained the natural slope of the shell, although the marginal edge was ground away.

Table 50. Genera and Species Identified in the LOCAP Shell Collection

Genus/Species	Minimum No. of Individuals	No. of Identified Specimens	Marine Biotic Province
Marine			
Pelecypods			
Glycymeris gigantea	1	1	Gulf of California
Glycymeris sp.	7	7	Gulf of California
Laevicardium elatum	1	1	Gulf of California to Southern California
Pecten vogdesi	1	1	Gulf of California
Gastropods			
Olivella sp.	2	2	Gulf of California
Unidentified marine	2	2	
Freshwater			
Pelecypods			
Anodonta californiensis	27	43	

Key: LOCAP = Lower Oak Creek Archaeological Project.

Table 51. Artifact Forms, by Genera, in the LOCAP Shell Collection

Genus	Artifact Form						Total
	Beads			Plain Bracelet	Plain Ring	Unworked Fragments	
	Whole Shell	Disk	Rectangular				
Marine							
Glycymeris	—	—	—	7	1	—	8
Laevicardium	—	—	—	—	—	1	1
Pecten	—	—	—	—	—	1	1
Olivella	2	—	—	—	—	—	2
Unidentified	—	1	1	—	—	—	2
Freshwater pelecypods							
Anodonta	—	—	—	—	—	27	27
Total	2	1	1	7	1	29	41

Key: LOCAP = Lower Oak Creek Archaeological Project.

Unworked Fragments

Two fragments of marine shell and all of the freshwater *Anodonta* appeared to be unmodified sections of the shell. The former specimens were the only instances of *Pecten* (scallops) and *Laevicardium* in the project sample. The *Pecten* fragment, which was recovered from the surface of Site 105/838, incorporated portions of the side and dorsal margin as well as a section of the adjoining back. These are areas of the valve that were often unmodified when the valve was fashioned into a whole-shell pendant; thus, it was possible that this was a fragment of this type of artifact. This cannot be confirmed, however. The *Laevicardium* fragment was a very large segment of the posterior and side panels of the shell—roughly corresponding to 20 percent of the original valve. The fragment, which measured nearly 92 by 33.3 mm, probably represented a piece of raw material rather than a finished artifact. The segment was the only piece of shell collected from Site 104/902. Unfortunately, only a small portion of this site was located within the ROW and could be excavated; all artifacts were collected from the entire site surface, however. It is possible that more material is buried in the remainder of the site, which included one probable masonry structure.

There was a total of 43 pieces of *Anodonta* in the collection. I estimate that these pieces probably represent no fewer than 27 valves of this very fragile freshwater bivalve. In the Salt River basin, Hohokam settlements often produced massive numbers of these unmodified shell fragments, which have led this author and others to conclude that *Anodonta* was employed as a dietary element (Haury 1976:308; Howard 1987:77; Vokes 1988:373). The absence of worked specimens in the LOCAP material suggests that *Anodonta* may also have served as a food supplement for the local population. All of the fragments were recovered from Site 105/838. The presence of a spring-fed stream in the immediate area of the settlement may have provided a convenient resource for this shellfish. If this stream could not have sustained a viable population of *Anodonta*, Oak Creek—located a short distance to the south and east—would certainly have sustained a healthy population.

As a food source, *Anodonta* would certainly have served as a dietary supplement rather than as a primary source of animal protein and caloric intake. Data on the nutritional value of freshwater mussels supplied by Parmalee and Klippel (1974:432) indicate that shellfish are a relatively poor source of food energy and that they "contain far fewer calories per given unit than provided by most other meat animals." It should be noted that the shellfish examined in the Parmalee and Klippel (1974) analysis were members of a different subfamily of Unionidae (pearly mussels). The two species *Proptera alata* (pink heelsplitter) and *Actinonaias carinata* (a freshwater mussel) are much larger mollusks than *Anodonta californiensis* (California floater) and would therefore have provided relatively more meat per animal. Thus, the specific nutritional findings may not exactly reflect those for *Anodonta*, although the food energy values are probably relatively similar.

Discussion

The LOCAP collection contained a total of 57 pieces of shell estimated to represent approximately 41 individual (i.e., original, unbroken) artifacts or ecofacts, of which 27, or 66 percent, were unworked fragments of freshwater shell, specifically *Anodonta* (see Table 49). The marine shell represented genera and species that are endemic to the Gulf of California. The sample was largely dominated by one genus, *Glycymeris,* which accounted for two-thirds of the identified marine material. This distribution reflects the emphasis in the collection on one artifact form, the shell bracelet. These account for more than 58 percent of the finished artifacts, which is comparable to percentages in most Hohokam collections that date to the late pre-Classic period. Furthermore, the ring-pendant is a related form that was also made from this genus. The other forms present, such as whole-shell beads made of *Olivella*, were also common in Hohokam collections. Thus, it seems probable that all of the marine-shell artifacts were obtained through trade with Hohokam populations living along the Salt, Gila, and Verde Rivers.

Although this collection contains material from three different sites, all but two specimens were recovered from Site 105/838. Although this concentration of shell is in part a reflection of the intensity of project effort at this settlement, it also reflects the nature of the site's occupation in contrast to that of other sites investigated. The three sites identified as habitation loci are the three settlements that produced shell; Locus A of Site 105/838 was the most intensively investigated. The sites that did not produce shell material were smaller localities that do not appear to have been habitation settlements but, rather, food-processing sites. Alternatively, they may have had other specialized functions.

The specimen from Site 53/745 was derived from the surface. It is unknown if any additional shell was recovered during the CNF-guided volunteer excavations at this site. The specimen from Site 104/902 was also recovered from the surface. Although limited excavation, including excavation of one structure, was conducted there, the excavation effort was not on the same scale as that mounted at Site 105/838.

The effort at Site 105/838 was focused on Locus A, which was fully excavated. Virtually all of the shell material was recovered from the fill from two of the three pit structures present in this locus. It is not surprising that these two structures (Features 23 and 29) dated to the Camp Verde phase (A.D. 900–1150); the third structure (Feature 37) dated to the Squaw Peak phase (A.D. 1–650), when people had not yet established a shell-trade network. This material does not appear to be related to the occupation of these structures but was trash deposited into the structural depressions after the houses were abandoned. The presence of trash deposits within the features indicates that the site was occupied over a substantially long period, although not necessarily year-round or for a single occupation. That Site 105/838 produced such a relatively high frequency of freshwater shellfish can probably be explained by its proximity to Spring Creek. This geographic feature is described as having several year-round springs that would have created a lush wetland and provided access to abundant water (see Chapter 6, Volume 1). Such an environment could have sustained a small population of *Anodonta*. In its later stages of development, this animal burrows into the muddy substrata of streams and ponds. The proximity of Oak Creek would also have supplied an alternative source for this resource.

This general pattern continues to be evident when the sample of settlements is expanded to include other sites in the middle Verde region. Table 52 summarizes the collections reported from several other excavations within the area. All of these sites are characterized as having been habitation sites. Although there are other sites that seem to relate to agricultural or other specialized activities, none reports the presence of shell—including freshwater material. Of the habitation sites, the larger settlements produced more-complex collections. The shell from the

Table 52. Comparisons among LOCAP Shell Collections and Those from Other Sites in the Verde River Valley Region

Site and Number	Phase	Artifact Form												Total
		Beads		Pendant			Bracelet	Ring	Other	Manufacturing Evidence and Whole Shell	Worked Fragments	Unworked		
		Whole	Cut	Whole	Cut	Other						Marine	*Anodonta*	
53/745	Camp Verde phase/ Tuzigoot phase	—	—	—	—	—	1	—	—	—	—	—	—	1
105/838	Camp Verde phase	2	2	—	—	—	6	1	—	—	—	1	27	39
104/902	unknown	—	—	—	—	—	—	—	—	—	—	1	—	1
Verde Terrace (N:4:23 [ASM])[a]	Cloverleaf phase/ Tuzigoot phase	—	—	—	—	—	2	—	1	2 (*Anodonta*)	—	—	161	166
Verde Terrace (O:5:6 [ASM])[b]	Camp Verde phase	—	1	—	5	1	3	—	—	1 (*Anodonta*)	—	—	65+	76+
Verde View (O:5:12 [ASM])[b]	Cloverleaf phase	—	—	—	—	—	2	—	1	1	—	4	—	8
O:5:155 (ASM)[c]	Camp Verde phase	—	—	—	—	—	1	—	—	—	—	—	6	7
Calkins Ranch (NA2385)[d], Verde Ball Court (NA3528)[d], Montezuma Well (NA4616)[d]	Cloverleaf phase/ Camp Verde phase	2	1	3	2	—	34	1	—	—	3	3	17 (?)	66

Note: ASM sites are preceded by AZ.
Key: LOCAP = Lower Oak Creek Archaeological Projec.t
[a] Greenwald (1989).
[b] McGuire (1977).
[c] Potter (1999).
[d] Breternitz (1960a); Stebbins et al. (1981).

larger settlements, such as the Verde Terrace site (AZ O:5:6 [ASM]) (McGuire 1977) and the settlements investigated by Breternitz (1960a), contained various forms of pendants as well as beads and bracelets, along with some limited evidence for local manufacturing. Smaller settlements, such as the Verde View site (AZ O:5:12 [ASM]) (McGuire 1977) and another site, also called Verde Terrace site (AZ N:4:23 [ASM]) (Greenwald 1989), had relatively small shell collections that were dominated by bracelets and unworked *Anodonta*. This pattern of larger settlements having larger, more diverse collections is to be expected, because these communities are likely to have been occupied over a longer period and would have been more attractive to traders, given the relatively larger potential market. The presence of the lone *Laevicardium* fragment at Site 104/902 is intriguing, in that this piece was large and may represent a piece of raw material related to local manufacturing, which may in turn suggest the presence of a larger community. The reported presence of a relatively large habitation site outside, yet close to, the project area could have been the immediate source for obtaining the marine material by the local population.

CHAPTER 6

Macrobotanical Analyses

Karen R. Adams and Rein Vanderpot

This chapter presents the results of the analysis of the archaeobotanical remains from four sites investigated as part of the LOCAP. The sites (AZ O:1:105/AR-03-04-06-838 [ASM/CNF] [Site 105/838], AZ O:1:85/AR-03-04-06-428 [ASM/CNF] [Site 85/428], AZ O:1:28/AR-03-04-06-903 [ASM/CNF] [Site 28/903], and AZ O:1:133/AR-03-04-06-561 [ASM/CNF] [Site 133/561]) were located along a 10-km-long stretch of SR 89A at elevations ranging from 1,100 to 1,250 m (3,600 to 4,100 feet) AMSL. The lower elevations of the project area were set in semidesert grasslands, and the upper portions were in Great Basin conifer woodland (Brown 1982). A mix of both plant communities, however, was present at all four sites. Nearby drainages—Spring Creek, Dry Creek, Oak Creek, and Coffee Creek—host a variety of riparian biological elements and would have provided domestic drinking water to people in the prehistoric period. All four sites contained one or more subsurface archaeological features. Site 105/838 was a Formative period farmstead occupied between ca. A.D. 600 and 1450. Site 85/428 included two temporal and functional components: one was a poorly defined Middle Archaic period hunting camp, and the other was an Early Formative period plant-processing camp represented by a series of roasting features. A maize cupule from one of these features provided an AMS date of A.D. 410–600. The main component of Site 28/903 was a Late Archaic period base camp, including a subsurface thermal feature. Site 133/561 was a multilocus site containing components dating to the Late Archaic, Formative, and protohistoric/historical periods. Charcoal collected from a roasting pit exposed on the surface of Locus C (the youngest component) provided the only analyzed plant materials from the site.

The research questions guiding the macrobotanical analysis were simple and straightforward. We wanted to know what kinds of native and domesticated plants were being exploited; what this meant in terms of site use, seasonality, agricultural dependence, and overall land use; how these patterns may have changed through time; and how our findings compare to what we know about the greater region.

This chapter is organized into four basic sections. After this introduction, the analysis methods are summarized. Next, the analysis results are presented, including a breakdown of the recovered plant taxa, site-specific discussions, and a summary of the plant record in terms of diversity and rank order of resources. Following this, the macrobotanical data are compared to the pollen data. In the chapter's concluding section, the research questions are reassessed.

Methods

Flotation Samples

Of the total of 73 flotation samples analyzed, 61 were collected from Site 105/838, 9 from Site 85/428, and 3 from Site 28/903. None was collected from Site 133/561, which only yielded wood-charcoal samples. The samples, ranging in original sediment volume from 2 to 24.7 liters, were individually processed via water separation to light-fraction volumes ranging from 10 to 410 ml. The light fractions were further subdivided into a series of particle sizes to facilitate microscopic examination, and all materials larger than 0.5 mm were examined. The complete archaeobotanical flotation database, including provenience information, volumetric data, and parts recovered, is presented in Appendix H:Table H.1. Descriptive details of a number of grass-grain (Poaceae [Gramineae]) types are provided in Appendix H:Table H.2.

For each flotation sample, charred reproductive parts and as many as 20 wood-charcoal fragments that were large enough to retain anatomical features were pulled for identification. A collection of modern specimens representing many of the tree and shrub species in the region provided comparative materials for the LOCAP wood-charcoal analysis. A similar collection of reproductive parts, a comparison to specimens in the University of Arizona Herbarium (ARIZ), and the use of seed identification manuals (Martin and Barkley 1961) allowed for the identification of seeds and other reproductive parts. The criteria for the identification of all charred plant parts are published elsewhere (K. Adams 1994a, 1998, 2003).

Macrofossil Samples

An additional 37 wood-charcoal samples from the four sites were analyzed. Most of these were collected as potential radiocarbon samples; some represented architectural materials. All 37 macrofossil samples are detailed in Appendix H:Table H.3.

Results

A wide variety of reproductive parts and wood-charcoal types were recovered from the LOCAP samples (Table 53). Seeds and other reproductive parts were recovered in 86 percent of the examined flotation samples; a small number of samples (n = 10), including all three samples from Site 28/903, contained no reproductive parts. Many taxonomic identifications are followed by the word "type" in this report, indicating that the ancient specimen closely resembled the taxon named but may also compare well to other taxa. This conservative approach reflects the similarity in appearance of parts of plants that are burned and degraded, as well as the incomplete nature of modern comparative collections. In the following sections, we discuss the results of the analysis of the flotation samples from Sites 85/428 and 105/838 and the charcoal samples from these sites, as well as from Sites 28/903 and 133/561.

Highlights of the Archaeobotanical Record

Prehistoric groups living at the project sites had access to at least four domesticated plants: maize, cotton (*Gossypium* sp.), little barley (*Hordeum pusillum*), and kidney bean (*Phaseolus vulgaris*). They also gathered the seeds of a number of annuals, including cheno-ams (*Chenopodium/Amaranthus*), whitestem stickleaf (*Mentzelia albicaulis*), bugseed (*Corispermum*), plantain (*Plantago*), spiderling (*Boerhavia*), winged pigweed (*Cycloloma atriplicifolium*), spurge (*Chamaesyce*), and purslane (*Portulaca*). A variety of grasses were regularly sought, as were cacti (hedgehog cactus [*Echinocereus*] and prickly pear [*Opuntia*]), globemallow (*Sphaeralcea*), bulrush (*Scirpus*), banana yucca (*Yucca baccata*), and other perennial resources. At least 15 tree and shrub species provided fuel, construction timbers, or both. The archaeological and ethnographic evidence establishing these plants as important human resources has been presented elsewhere (K. Adams 1987, 1988, 1994a, 1994b, 1998, 2003; Adams and Welch 1994a, 1994b, 1998; Bohrer 1962, 1987, 1991; Gasser and Kwiatkowski 1991a, 1991b) and will not be repeated here.

Domesticates

Maize was the most frequently recovered domesticate. At Site 85/428, it was preserved in a deep roasting pit (Feature 2) as cupule and kernel fragments. Twenty-seven flotation samples from the three pit structures (Features 23, 29, and 37) and several other features at Site 105/838 contained cupule or cob fragments, which suggests that leftover cobs were used frequently as a fuel or tinder source. In these same contexts, maize-kernel evidence was preserved in 10 samples. The overall recovery rates for maize remains at these two sites were 44 percent (Site 85/428) and 47 percent (Site 105/838), suggesting a strong reliance on this cultigen (Table 54).

The other domesticates had a more limited distribution. Grains of an indigenous domesticate, little barley, were recovered from two of the pit structures (Features 29 and 37) and a rock-lined hearth (Feature 21) at Site 105/838. They were found in approximately 13 percent of all samples examined. Likewise, cottonseed fragments were present in two of the pit structures (Features 23 and 29) and Feature 21 at Site 105/838, or in 10 percent of the samples analyzed. Finally, a single seed fragment of kidney bean preserved in Feature 29 at Site 105/838.

Wild Plants: Reproductive Parts

Reproductive parts of wild plants have been divided into two groups: (1) those of annual, often weedy plants, and (2) those of perennial or probably 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, and population size and reproductive success are often dependent on the amount and timing of precipitation. The second group includes perennial plants that are part of established vegetation, representing more-stable and less disturbed portions of the landscape. Ancient remains from the LOCAP sites that could not be identified to the genus or species level (e.g., grass grains) have been conservatively placed in the perennial category.

Table 53. Plant Remains Identified in LOCAP Flotation and Charred Wood Beam Samples

Taxon	Common Name	Parts Recovered
Domesticates		
Gossypium	cotton	seed
Hordeum pusillum	little barley	caryopsis (grain)
Phaseolus vulgaris	kidney bean	seed fragment
Zea mays	maize, corn	cob, embryo, kernel, cupule
Wild plants, reproductive parts		
Achnatherum hymenoides type	Indian ricegrass	caryopsis
Arctostaphylos type	manzanita	seed
Asteraceae (Compositae) type	sunflower family	achene
Astragalus type	milkvetch	seed
Boerhavia type	spiderling	seed
Chamaesyce glyptosperma type	ridgeseed spurge	seed
Chenopodiaceae-*Amaranthus*	cheno-am	seed
Corispermum type	bugseed	seed
Cycloloma atriplicifolium type	winged pigweed	seed
Echinocereus type	hedgehog cactus	seed
Mentzelia albicaulis type	whitestem stickleaf	seed
Opuntia type	prickly pear	seed
Plantago type	plantain	seed
Poaceae (Gramineae) type	grass	caryopsis (8 types)
Portulaca type	purslane	seed
Prosopis type	mesquite	seed
Scirpus type	bulrush	achene
Sphaeralcea type	globemallow	seed
Yucca baccata type	banana yucca	seed
Wild plants, vegetative parts		
Atriplex type	saltbush	charcoal
Canotia type	canotia	charcoal
Ephedra type	Mormon tea	charcoal
Fraxinus type	ash	charcoal
Juniperus type	juniper	charcoal, twig fragment
Larrea type	creosote bush	charcoal
Monocotyledon type	monocot	tissue
Opuntia type	cactus (prickly pear or cholla)	charcoal
Pinus type	pine	charcoal
Phragmites australis type	common reed	stem fragment
Platanus type	sycamore	charcoal
Populus/*Salix* type	cottonwood/willow	charcoal
Prosopis type	mesquite	charcoal
Quercus type	oak	charcoal
Rumex type	dock	root (uncharred)

Note: All remains were charred, except those of *Rumex*, which were considered modern in origin.

Table 54. Distribution of Charred Specimens of Domesticates, Annual Plants, and Perennial Resources in Flotation Samples from Sites 85/428 and 105/838

Taxon	85/428 (n = 9) (%)	105/838		
		Locus A (n = 56) (%)	Locus B (n = 5) (%)	Total (n = 61) (%)
Domesticates				
Zea mays kernel, cob, cupule	44	49	40	47
Hordeum pusillum–type caryopsis	—	14	—	13
Gossypium-type seed	—	11	—	10
Phaseolus vulgaris–type seed fragment	—	2	—	2
Annual, often weedy plants				
Cheno-am	44	71	40	66
Mentzelia albicaulis–type seed	11	34	40	34
Corispermum-type seed	11	14	—	13
Plantago-type seed	—	7	20	6
Boerhavia-type seed	11	2	—	2
Cycloloma atriplicifolium–type seed	—	2	—	2
Euphorbia glyptosperma–type seed	—	2	—	2
Portulaca-type seed	—	2	—	2
Perennial or probably perennial plants				
Poaceae (Gramineae)– (8 types) type caryopsis	11	20	20	20
Echinocereus-type seed	—	9	—	8
Sphaeralcea-type seed	—	9	—	8
Asteraceae (Compositae)–type achene	11	5	—	5
Scirpus-type achene	—	5	—	5
Opuntia- (prickly pear) type seed	—	4	—	3
Oryzopsis hymenoides-type caryopsis	—	4	—	3
Yucca baccata–type seed	—	2	20	3
Arctostaphylos-type seed	—	2	—	2
Astragalus-type seed	—	2	—	2
Prosopis-type seed	—	—	20	2

Note: Specimens arranged in approximate order of ubiquity. Three samples from Site 28/903 contained no reproductive parts. Parenthetical numbers in header (e.g., n = 9) are the number of samples per site.

Annual, Often Weedy Plants

The record of charred seeds or fruit of annual native plants from the LOCAP sites reveals a fairly broad distribution of cheno-am seeds in 44–66 percent of the samples analyzed from Sites 85/428 and 105/838 (see Table 54). Stickleaf and bugseed seeds also were commonly recovered from both sites. Rarely preserved resources included seeds of plantain, spiderling, winged pigweed, spurge, and purslane. Site 105/838 preserved a total of eight separate types of annual seeds, probably the residue of food preparation; Site 85/428 preserved four types. This difference may result from the greater number of samples examined from Site 105/838. The LOCAP record of annual plants suggests a reliance on wild resources, and—particularly for Site 105/838—a moderate level of environmental disturbance.

Perennial Plants

The record of reproductive parts of perennial or probably perennial plants is notable at Site 105/838, where at least 11 separate resources were preserved (see Table 54). Perhaps the most intriguing discovery is that of a diversity of unidentified grass grains, currently representing a minimum of eight separate types based on metric and nonmetric traits (Table 55; see Appendix H:Table H.2). These grains were found in 20 percent of the flotation samples from Site 105/838. Including the evidence for little barley and Indian ricegrass (*Achnatherum hymenoides*) indicates that

Table 55. General Traits of Eight Separate Grass (Poaceae [Gramineae])– Grain Types Recognized in the Site 105/838 Samples

Provenience	Type	Grain Shape	Ratio L:W	Compression	Embryo %	Facet Profile
PD 213, F 21	Type 1	long/slender	4.74	dorsal/ventral	17.5	equal along length
PD 213, F 21	Type 7	long/slender	4.00	rounded	12.5	widest above embryo
PD 507, F 39	Type 8	short/sturdy	1.88	rounded	20.0	widest above embryo
PD 540	Type 3	short/sturdy	1.50	lateral	17.3	widest above embryo
PD 720, F 29/33	Type 4	long/slender	3.33	dorsal/ventral	20.0	equal along length
PD 761, F 37/2	Type 5	short/sturdy	1.66	lateral	28.6	widest above embryo
PD 766, F 29/24	Type 2	long/slender	2.20	dorsal/ventral	<21.6	equal along length?
PD 840, SF 1	Type 6	long/slender	2.50	rounded	12.0	equal along length

Note: Grain shape "short and sturdy" applies to grains with a length-to-width ratio of ≤2.0, whereas "long and slender" grains have a length-to-width ratio of >2.0. Compression can be dorsal/ventral, where both these surfaces are expansive and the grain rests comfortably on either one; lateral, where the dorsal and ventral surfaces form two rather narrow ridges, and the wide flattened lateral surfaces are expansive and form the facets upon which the grain rests; or rounded, when by nature or by burning, the grain has plumped up into a fairly rounded profile. The "embryo %" expresses the relative proportional length of the embryo in relation to the entire grain, a relationship helpful in placing grains into very general grass categories (Reeder 1957). The facet profile is determined by laying the grain on a stable facet and noting whether the dimension is widest at the base, widest just above the embryo, or equally wide for most of its length. Full descriptive details are provided in Appendix H:Table H.2.

Key: F = Feature; L = length; SF = Subfeature; W = width.

the occupants of Site 105/838 gathered the grains of at least 10 different grasses. Two of these grasses (little barley and Indian ricegrass) are known to ripen in the cool season, which is late spring or early summer. The seasons of availability for the others are unknown but could easily span the entire growing season from late spring through late fall. In addition to grass grains, the site occupants occasionally harvested fruit of other resources including cacti (hedgehog and prickly pear), globemallow, bulrush, yucca, manzanita (*Arctostaphylos*), legumes (milkvetch [*Astragalus*] and mesquite [*Prosopis*]), and fruits of the sunflower family (Asteraceae [Compositae]) (see Table 54).

Wild Plants: Vegetative Parts

Wood charcoal provides information on fuelwood use and construction needs. The data indicate that the occupants of Sites 85/428 and 105/838 used a variety of woody taxa (Table 56). Eight wood types, including saltbush (*Atriplex*), juniper, canotia (*Canotia*), mesquite, oak (*Quercus*), ash (*Fraxinus*), cactus (*Opuntia* type), and pine (*Pinus*) were sought by occupants of Site 85/428, as evidenced by the multiple uses of a large roasting pit (Feature 2). The macrofossil record of wood from Site 105/838 revealed a number of the same types identified in flotation samples, as well as creosote bush (*Larrea*). At this site, people routinely brought in reed (*Phragmites*) stems, and wood of juniper, cottonwood/willow (*Populus*/*Salix*), mesquite, saltbush, and ash. On occasion, they sought canotia, sycamore (*Platanus*), Mormon tea (*Ephedra*), and possibly others. The two sites reveal differences in taxa brought in, although these differences may reflect the fact that a single feature is represented at Site 85/428, whereas multiple structures and other features were sampled at Site 105/838.

Charcoal samples from several postholes excavated in the Site 105/838 pit structures were identified as canotia, ash, juniper, cottonwood/willow, and mesquite. Although these specimens could reasonably represent construction wood, some could also represent debris that entered the postholes after use. It is likely that some of the reed grass collected from Site 105/838 served as construction material used in house or ramada roofing or for wall construction. Charred termite fecal pellets identified in two of the pit structures at the site suggest that termites occupied wood brought into the structures as fuelwood or roofing materials.

Finally, charcoal from Feature 1 at Site 133/561 was identified as pine and juniper, and the samples from Site 28/903 also were identified as pine. Radiocarbon analysis of the Site 133/561 charcoal returned a date of A.D. 1510–1600 or later. The modern distribution of trees and shrubs along SR 89A suggests that access to most of these resources was fairly easy. Most of the vegetation grew within walking distance of ancient dwellings, and some may have drifted downstream and may have been opportunistically gathered as driftwood.

Site-Specific Results

AZ O:1:85/AR-03-04-06-428

Although Site 85/428 also included a Middle Archaic hunting camp, the main component was an Early Formative period plant-roasting area. Six flotation samples from a multiple-episode roasting pit (Feature 2) preserved a

Table 56. Distribution of Wood Charcoal and Other Vegetative Parts in Flotation Samples from Sites 85/428 and 105/838

Taxon	85/428 (n = 9 samples) (%)	105/838 (n = 61 samples) (%)
Phragmites australis–type stem fragment		41
Juniperus-type charcoal, twig fragment	55	30 (M)
Populus/*Salix*-type charcoal		16 (M)
Prosopis-type charcoal	22	15 (M)
Atriplex-type charcoal	67	13 (M)
Fraxinus-type charcoal	11	11
Canotia-type charcoal	44	3
Monocotyledon-type tissue		3
Platanus-type charcoal		3 (M)
Ephedra-type charcoal		3
Unknown-type charcoal		2
Quercus-type charcoal	22	
Opuntia-type charcoal	11	
Pinus-type charcoal	11	(M)

Note: All samples from Site 85/428 were from a single roasting pit (Feature 2). A parenthetical "M" (M) indicates specimens recovered also as macrofossils during excavation. Table is arranged in order of ubiquity for Site 105/838.

variety of reproductive parts, including maize, cheno-ams, stickleaf, bugseed, spiderling, grass grains, and fruits of the sunflower family (see Table 54). All are potential food sources representing some of the subsistence resources at this location. A diversity of wood-charcoal types, including juniper, mesquite, saltbush, ash, canotia, oak, cactus, and pine, were carried into this roasting pit as fuel (see Table 56). Two samples from a separate roasting pit (Feature 4) and a single sample from a fire-cracked-rock cluster (Feature 1) preserved no reproductive parts.

AZ O:1:105/AR-03-04-06-838

Site 105/838 was a multilocus and multicomponent habitation site immediately south of Spring Creek. Locus A contained an Early Formative period (A.D. 1–600) pit structure (Feature 37) with an intrusive roasting pit (Feature 41) probably dating to the same time period. The other two pit structures (Features 23 and 29) and a series of extramural features in this locus dated to the Camp Verde phase (A.D. 900–1150). Fifty-six flotation samples were recovered from seven Locus A features (the three pit structures as well as several associated thermal features [Features 21, 26, and 31]) and the midden (Feature 27) (Table 57). Comparing and contrasting the patterns of plant foods recovered in Locus A contexts reveal some patterns. Domesticates were preserved in the three pit structures and in some extramural features. With the exception of a single roasting pit (Feature 31), cheno-am seeds were ubiquitous. Other widely distributed wild plants include stickleaf, grasses, and bugseed. These resources were apparently available to and gathered by all households at Locus A. Eleven additional wild plants were sought by one or two households.

In terms of feature types, eight thermal features preserved from 0 (Feature 31) to 11 (Feature 21) reproductive parts, suggesting some differences in activities related to food processing among these features. Thermal features can, however, accumulate food-processing debris after they cease to function as cooking/heating features. Five postholes contained a moderate number of reproductive parts, suggesting that they became filled with trash at some point. A variety of storage and other unspecified pits in the structures contained many of the same plant parts recovered in thermal features and postholes. In the midden (Feature 27), few reproductive parts were preserved, suggesting that preservation was poor because of long-term exposure to the elements.

At Locus B of Site 105/838, a Tuzigoot phase component was represented by a masonry-lined pit room (Feature 13). Five flotation samples from this locus were analyzed. The samples came from Feature 13 and a rock feature (Feature 3), which may have been a storage pit. The rock feature preserved no identifiable plant remains. The cobble-lined pit room contained cheno-am, stickleaf, and maize remains. Two thermal features excavated in the floor (Subfeatures 1 and 2) also preserved grass grains,

Table 57. Presence of Plant Parts in Features and Subfeatures at Locus A of Site 105/838

Taxon and Part	Feature No.															Total
	F 23				F 29				F 37			F 21	F 26	F 31	F 27	
	General (n = 6)	TF (2) (n = 2)	PH (2) (n = 2)	Pit (8) (n = 14)	General (n = 5)	TF (3) (n = 3)	PH (1) (n = 1)	Pit[a] (5) (n = 7)	General (n = 6)	PH (2) (n = 2)	Pit[b] (2) (n = 2)	TF (1) (n = 3)	TF (1) (n = 1)	RP (1) (n = 1)	Mid (1) (n = 1)	
Domesticates																
Zea mays cob, kernel parts	X	X		X	X	X		X	X	X		X				9
Gossypium-type seed	X			X				X				X				4
Hordeum pusillum–type caryopsis					X			X	X			X				4
Phaseolus vulgaris–type seed								X								1
Wild plants, reproductive parts																
Achnatherum-type caryopsis												X	X			2
Asteraceae (Compositae)–type achene								X	X	X						3
Arctostaphylos–type seed												X				1
Astragalus–type seed									X							1
Boerhavia–type seed					X											1
Chamaesyce glyptosperma–type seed									X							1
Cheno-am seed	X	X	X	X	X	X	X	X	X	X	X	X	X		X	14
Corispermum-type seed				X	X			X	X			X				5
Cycloloma atriplicifolium–type seed	X															1
Echinocereus-type seed				X				X	X		X					4
Mentzelia albicaulis–type seed	X			X	X	X	X	X	X		X				X	9
Opuntia- (prickly pear) type seed								X				X				2
Plantago-type seed									X			X				2
Poaceae (Gramineae)–type caryopsis				X	X	X		X	X			X				6
Portulaca-type seed									X							1
Scirpus-type achene									X			X				2
Sphaeralcea-type seed			X	X	X	X										4
Wild plants, vegetative parts																
Atriplex-type charcoal								X				X		X		3
Canotia-type charcoal								X		X						2
Ephedra-type charcoal								X								1
Fraxinus-type charcoal	X							X		X						3
Juniperus-type charcoal, twig	X							X		X			X	X		5
Monocotyledon-type tissue								X								1
Phragmites-type stem fragment	X	X	X					X				X				5
Platanus-type charcoal	X															1
Populus/Salix-type charcoal	X	X	X					X								4
Prosopis-type charcoal								X		X						2

Note: The parenthetical number that follows the subfeature type in the header—for example, TF (2)—is the number of subfeature types; "n" equals the number of flotation samples.

Key: F = Feature; Mid = midden; PH = posthole; RP = roasting pit; TF = thermal feature.

[a] One of the seven pits (Subfeature 1) in Feature 29 was subsequently reassigned as Feature 39, an intrusive thermal pit.

[b] One of the two pits (Subfeature 2) in Feature 37, was subsequently reassigned as part of Feature 41, an intrusive roasting pit.

banana yucca seeds, plantain seeds, and the only mesquite seed evidence recovered from the project area. This sparse record, resulting perhaps in part to the low number of flotation samples examined from this locus, represents a subset of specimens recovered from Locus A. Charcoal types that preserved include saltbush, juniper, mesquite, sycamore, and some monocotyledon tissue, again a subset of the diverse types that preserved in Locus A.

Resource Diversity

Resource diversity was relatively high at Locus A of Site 105/838, where at least 22 different reproductive parts, including agricultural products and wild resources, were preserved (see Table 54). A less varied collection of plant parts was recovered from Site 85/428 (n = 7) and Locus B of Site 105/838 (n = 7). These differences may be a result of sample size or may reflect actual differences in plant use at these various locations. Basically, the core group of plant parts preserved in Locus A of Site 105/838 is the same as those preserved at Site 85/428 and Locus B of Site 105/838.

Rank Order of Resources

The relative rank order of reproductive parts, based on ubiquity, suggests that maize was consistently used at Sites 85/428 and 105/838 (see Table 54). Wild-plant resources frequently brought into both locations included cheno-ams, stickleaf, grasses, and bugseed. No pronounced differences were noted among the various temporal contexts, which included the Early, Middle, and Late Formative periods. The fact that the relative rank order remained fairly stable suggests that plant use in the LOCAP area remained consistent through time.

Complementarity of Pollen and Seed Records

The pollen record of the LOCAP sites complements the macobotanical record well (see Chapter 7). The use of maize and grasses is clearly reflected in the pollen record, as is the presence of agricultural weeds such as spiderling, globemallow, and Arizona poppy (*Kallstroemia grandiflora*). A single cucurbit (*Cucurbita*) pollen grain was recovered, and it may have derived either from domesticated squash or possibly from wild *Cucurbita* plants, although neither was recovered in the flotation record. The near absence of cholla- ("*Cylindropuntia*"-) type pollen agrees with the flotation record. The relatively low signal of juniper pollen suggests that juniper trees did not grow in abundance in the area immediately surrounding the sites, and people may have picked up some juniper as driftwood for use. The presence of cattail (*Typha*) pollen suggests that this useful resource was available in a nearby riparian area, where cottonwood/willow, reed, sycamore, and ash would also have been found. Neither the pollen record nor the flotation record preserved any agave evidence. Agave pollen is not expected as part of the pollen record, as people often harvest agave plants before they flower. However, agave use can be signaled by the presence of charred agave tissue, including individual fibrovascular bundles, in flotation samples, and these were absent from the project sites.

Conclusions

In the following sections, we will briefly address the research questions identified in the introduction of this chapter. These questions pertained to the kinds of native and wild plant being exploited, agricultural dependence, seasonality, mobility, landscape modification, and how the LOCAP data compare to those from the greater region.

Plant Taxa

The first question—What kinds of native and domesticated plants were being exploited?—has already been answered at length above. The archaeobotanical record recovered from Sites 85/428 and 105/838 indicates that people living along Spring Creek were agriculturists who also used a diversity of wild plants common to weedy and stable habitats. In their fields, they grew maize, kidney beans, cotton, and little barley. They took advantage of stands of annual plants of disturbed habitats such as cheno-ams, stickleaf, and bugseed, as well as a number of others. They relied on at least 10 different grasses that probably spanned the growing season from late spring through late fall.

Agricultural Dependence

The Early Formative period and Camp Verde phase occupants of Locus A at Site 105/838 relied on agricultural products and annual plants that probably grew as weeds in their fields. Plants such as cheno-ams, spiderling, globemallow, spurge, and purslane are known garden weeds (Adams and Welch 1998; Gish 1991:244). Others, such as plantain, stickleaf, and bugseed, also thrive in disturbed habitats. Bohrer (1991) has suggested that some of the taxa recovered here (cheno-ams, stickleaf, and plantain) may have been encouraged at one time or cultivated by Hohokam groups. Although most species of globemallow are perennial in Arizona (Kearney and Peebles

1960:540–547), one perennial species has been observed thriving along two modern agricultural field edges (Adams and Welch 1998).

There were fewer domesticates in the Early Formative period contexts represented by Features 37 and 41 in Locus A of Site 105/838 and Feature 2 at Site 85/428, when compared to the later, Camp Verde phase contexts in the rest of Locus A at Site 105/838. Whereas the Camp Verde phase samples contained maize, little barley, kidney bean, and cotton, the Early Formative period features contained little barley (at Site 105/838) and maize (at both sites) as the only domesticates. The earlier contexts also contained fewer field weeds; only six were identified (as opposed to eight in the later samples). A preference for cheno-ams, stickleaf, grasses, and bugseed is clearly indicated. Samples from Tuzigoot phase Feature 13 in Locus B of Site 105/838 contained maize as the sole domesticate and five of the eight field weeds. These patterns could be a result of the sample size or could possibly indicate a less intensive use of these earlier and later locations. It could also reflect a greater reliance on agriculture in the early Camp Verde phase and less in the earlier and later periods. That field areas were smaller or used less intensively during the Early Formative period is also suggested by the pollen counts for cheno-am, which are consistently lower in the early contexts compared to the late ones (see Chapter 7).

Seasonality of Resource Availability

The season of availability is fairly well known for many of the resources recovered from the project sites. This information is contained within general floras (Kearney and Peebles 1960) and in specific phenological records gathered in the Tonto Basin (Adams and Welch 1994a) and the lower Verde region (Adams and Welch 1998) to the east. As determined from these sources, plants such as little barley, plantain, ricegrass, and milkvetch produce some of the first-ripening fruits and seeds and can be classified as “cool-season” resources. “Warm-season” resources are available in the period from midsummer through fall and include cheno-ams, purslane, bugseed, stickleaf, and probably many of the currently unidentified grass types. The LOCAP plant record generally reveals plant harvesting in both the cool and warm seasons. Archaeobotanical records are often mute regarding winter occupation, and this record is no exception (Adams and Bohrer 1998).

Mobility vs. Sedentism

The archaeobotanical record suggests that the occupants of the Camp Verde phase farmstead at Locus A of Site 105/838 were sedentary agriculturists. This required them to occupy the farmstead for the duration of the agricultural growing season at the very least, and perhaps beyond. Probably, tasks related to field operation had to be performed in the spring as well.

There is some evidence—lower cheno-am pollen counts and fewer domesticates and garden weeds—that the groups occupying the Early Formative period components of Sites 85/428 and 105/838 practiced agriculture less intensively.

Human Landscape Modification

The archaeobotanical record also reveals a fair amount of information about the past environment of the LOCAP area. Most of the plant taxa listed in Table 53 have been identified in the area at present (Kearney and Peebles 1960), leading to the inference that there is some level of similarity between plants of the ancient and modern landscapes. Not included in this perspective are the relative proportions of the different resources and how humans may have altered the landscape to suit their needs.

Historical-period observations suggest that weedy annuals are often encouraged along with cultivated crops (Bohrer 1960; Whiting 1939). Researchers expect an increase in weedy annuals with agriculture, because fields provide a perfect habitat for disturbed-ground species (Ford 1984). As determined from the ancient plant record of agricultural resources and annual plants of disturbed habitats, the occupants of Site 105/838 (Locus A) seem to have caused some level of intentional landscape disturbance. This could have included taking advantage of overbank flooding of Spring Creek and its tributaries for floodplain management of crops and indigenous wild plants. Stable habitats supporting perennial plants such as cacti, yucca, trees, and shrubs were also present in the area.

The LOCAP Plant Record in a Broader Regional Context

Middle Verde Region

Several archaeobotanical studies are available for the middle Verde region. Excavated Squaw Peak phase sites are scarce, and before the present project, the most important macobotanical data for this time came from a pit structure at AR-03-04-06-294 (CNF) (Logan and Horton 1996:41–45). A charred maize kernel from a hearth in this structure, although not submitted for radiocarbon analysis, marked the earliest evidence to date for maize agriculture in this part of the Verde River region. Data are more abundant for the subsequent Hackberry and Cloverleaf phases (not documented for the LOCAP) and, in particular, for the Camp Verde phase. Brandt (1989) examined plant remains from a small Hohokam-style, Hackberry/Cloverleaf phase pit structure at the Verde Terrace site (AZ N:4:23 [ASM]) near Tuzigoot National Monument. She concluded that the inhabitants were using cultigens (maize), weedy plants (cheno-ams and others), and perennials (dropseed [*Sporobolus*], reed, and prickly pear) from the area, generally agreeing with the results of the analysis of the Locus A features at LOCAP Site 105/838. Two other specialized-activity areas with *hornos*, one of them possibly related to Yavapai activities in the area, contained cheno-am seeds that Brandt interpreted as lining material for a roasting event.

The best comparative data for Feature 13 at Locus B of Site 105/838 come from a series of three masonry field houses dating to the Tuzigoot phase (Bohrer 1998; Gasser 1981; Van Ness 1990). Flotation samples from the three structures contained maize remains, in addition to small numbers of seeds of amaranth (*Amaranthus*), cheno-ams, and Poaceae. The collection from the Site 105/838 structure led the other collections in terms of species ubiquity and variability, suggesting that a much wider variety of plant-exploitation activities took place there. Field houses are not always productive of macrobotanical remains. Bohrer (1998) examined a few flotation samples from two small cobble-masonry habitation structures dating to the Honanki phase or Tuzigoot phase at the Grosetta Ranch Road site (AZ N:8:40 [ASM]) in the same general area. Although she identified burned evidence of milkvetch, pepperweed (*Lepidium*), and brome (*Bromus*), she believed that these might represent introduced species that thrived in disturbed ground that was burned regularly during the historical period. Some distance away, near Montezuma Castle, an area covered with waffle gardens, linear borders, checkdams, and canals represented the Southern Sinagua Beaver Creek field system in the period A.D. 1200–1350 (Fish and Fish 1984). Preliminary pollen analysis revealed the presence of maize and cotton as crops.

The Northeastern Periphery

Plant use in the northeastern periphery of the Hohokam cultural area has been synthesized elsewhere (K. Adams 2003). Only the notable similarities or differences between this broader record, which includes information from the Tonto Basin, lower Verde River valley, and Sycamore Creek, and a number of general syntheses of the Hohokam plant record (Bohrer 1991; Gasser and Kwiatkowski 1991a, 1991b) will be highlighted here. In terms of similarities, the LOCAP area was similar to some smaller northeastern periphery sites with a subset of the range of Mesoamerican domesticates, whereas larger sites usually contained the full complement. Smaller sites often emphasized wild plants, including cholla- and saguaro (*Carnegiea gigantea*)–type cacti. Although emphasis on cacti is lacking in the LOCAP plant record, people definitely used a variety of wild plants characteristic of disturbed and stable habitats. The indication that mesquite fruits were used minimally is consistent with subsistence patterns for this region.

The LOCAP sites displayed some interesting differences in the record of plant parts recovered. Most areas in the northeastern periphery have shown evidence of cultivated or managed agave plants, which were lacking in the LOCAP samples. Also, smaller sites along smaller drainages and in mountainous terrain often have low levels of maize recovery, yet along SR 89A, maize was present in 44–47 percent of the flotation samples from two sites. The cheno-am, little barley, and cotton evidence suggests that all were important components of the economy. Two weedy annuals, stickleaf and bugseed, were particularly well represented in the LOCAP record. Also, the presence of 10 different grass types, including domesticated little barley and ricegrass, suggests that grassland resources were used intensively and probably included different types that ripen throughout the growing season. Overall, the LOCAP macrobotanical data exhibit a wider range of economically important plant species than noted for most sites of similar type and size in the surrounding region. The meaning of these patterns for interpreting local subsistence practices will be explored further in Volume 3.

CHAPTER 7

Pollen Analysis

Suzanne K. Fish

The results of this pollen analysis provide insights into past environmental conditions and subsistence practices for two sites—Sites AZ O:1:85/AR-03-04-06-428 (Site 85/428) and AZ O:1:105/AR-03-04-06-838 (Site 105/838)—investigated as part of the LOCAP along SR 89A in the middle Verde River region of central Arizona. A single sample from a third Archaic period occupation at AZ O:1:28/AR-03-04-06-903 (Site 28/903) failed to yield adequately preserved pollen. Four samples from Site 85/428, a food-processing locale used during a relatively early interval of the agricultural era, were collected from two roasting pits and a stratigraphic trench. Twenty-one samples pertained to residential loci at Site 105/838, a farmstead with pit structures, masonry structures, and other features representing multiple occupations.

According to classifications in Brown (1982), environmental zones in the project area range from semidesert grasslands to Great Basin conifer woodland. Sites 85/428 and 105/838 were situated adjacent to each other in the hills and tablelands of a desert grassland zone that includes juniper and agave, with lower-elevation grassland facies and higher-elevation facies that contain scattered piñon and scrub oak present within a 15-km radius.

Analytical Methods

Approximately 60 cc of sediment were processed per sample. *Lycopodium* spore tracers were added to monitor extraction results. Following deflocculation in dilute hydrochloric acid, a mechanical swirl step as described by Mehringer (1967:136–137) separated the heavier sediment fraction. Samples were not subjected to fine screening to insure maximum recovery of aggregated pollen grains. Heavy-liquid flotation in zinc bromide of 2.0 density further reduced extraneous matrix material. Rinses with hydrofluoric acid, water, and absolute alcohol completed the extraction process. The extract was mounted in a glycerol medium and stained for examination under a microscope.

A standard sum of 200 noncultigen pollen grains was tabulated for each sample. This sum has been shown to adequately register representative distributions of common pollen types in samples from southwestern vegetation communities (Martin 1963:30–31). Percentages for types other than cultigens were calculated on the basis of the 200-grain standard sum. Cultigen pollen was tabulated in addition to the 200-grain sum to avoid numerical constraint on the percentages of types more directly related to the vegetation and environment of the site vicinities. Therefore, the value given for cultigens is not a percentage but represents the number of grains encountered in the course of completing the standard sum. Maize and cucurbit, including squash and pumpkin, are designated as cultigen categories, although the morphologically indistinguishable pollen of some wild cucurbits also may be included in the latter category.

After tabulation was completed, an equivalent amount of additional material was scanned at lower magnification to detect rare pollen types and, in particular, any with economic significance. Identifications made only in scanning are indicated in the tables. Types that were present in aggregates of six or more pollen grains were also noted. Because clusters are less efficiently transported by wind than single grains, aggregates also indicate the likelihood of a relatively immediate plant source for the pollen. Aggregates also may reflect that pollen was introduced directly from the immature floral parts of a source plant, because pollen is usually dispersed at maturity as a single grain rather than in clusters. The presence of aggregates thus provides evidence that may be considered in interpreting the economic value of pollen taxa.

Appendix I:Table I.1 presents values for the principal pollen types in site samples. Appendix I:Table I.2 lists additional infrequent types that are subsumed under the "other" category in Table I.1. Appendix I:Table I.3 lists the presence of identified pollen types that indicate probable economic activity or resource use by site inhabitants. Table 58 is a concordance of the scientific and common names of the pollen taxa listed in Tables I.1, I.2, and I.3.

Environmental Patterns

Nonarboreal pollen types were predominant in all analyzed LOCAP samples except for Site 28/903 (see Appendix I:Table I.1), indicating that the vegetation was open and that trees constituted a minor element (Hevly 1968; Hevly et al. 1965). Small frequencies of pine and oak pollen represent regional airborne components that were introduced into the assemblages of local types. Although the invasion or spread of juniper during recent times is a noted phenomenon in the Verde River valley and elsewhere, the frequency of juniper pollen in a modern sample from Site 105/838 tabulates within the same range as the archaeological samples. Minor amounts of mesquite pollen indicate that these trees or shrubs were present at Sites 85/428 and 105/838. Because mesquite pods and catkins are widely consumed and the wood is a typically prized fuel, even this low pollen presence may have resulted from the introduction of resources.

Mesquite would have been available in riparian vegetation along major drainages and, to a lesser extent, their tributaries near the sites. Minor pollen frequencies indicate the presence of additional riparian-edge trees, such as willow, ash, sycamore, alder (*Alnus*), and walnut (*Juglans*). Some of these pollen types may have been introduced through airborne transmission from trees that grew in the upland portions of nearby drainages and their watersheds. The use of these plant resources cannot be confirmed as the source of riparian-tree pollen for these instances (e.g., walnut pollen) in site samples, but the pollen documents potential resource availability.

At Site 105/838, pollen types representing additional species of riparian or damp habitats are cattail and sedge (Cyperaceae). Seeds of bulrush were recovered by flotation, along with those of common reed, another riparian plant. The distribution of these plants may have been expanded by the construction of canals or reservoirs in and around the major drainages in the study area.

The presence of desert grassland vegetation during site occupations is indicated by the recovery of morphologically similar grass pollen (Poaceae [Gramineae]) that encompasses all species and by pollen of creosote bush, Mormon tea, and canotia. Bursage (*Ambrosia*) or closely related species ("low-spine Compositae" [Asteraceae]) and various other shrubby and herbaceous members of the sunflower family ("high-spine Compositae") that are found in riparian zones and grasslands are also consistently represented in the LOCAP archaeological samples.

The cheno-am category, including the morphologically indistinguishable pollens of many chenopods and amaranths, is prominent to predominant in project-area samples (see Table 58). Cheno-am frequencies reflect the combined contributions of riparian, desert grassland, and weedy species. For example, saltbush is a shrubby chenopod typically found in riparian-edge settings and may be locally concentrated in grasslands. Chenopods and amaranths are among the most common annuals found in naturally disturbed floodplain soils. In modern samples from some southern Arizona drainages, cheno-am pollen is the most frequent type (Hevly et al. 1965). Chenopods and amaranths also are ubiquitous in the weedy vegetation that proliferates in culturally disturbed and organically enriched habitats. For this reason, high values for this type are typical of southwestern archaeological sites in a variety of topographic situations (e.g., Fish 1985). In other words, an elevated range of cheno-am frequencies is an expected correlate of more-intensive and more-extensive occupations.

Pollen representing a set of three weedy plants was present in LOCAP samples in high frequencies when compared to those for samples from natural vegetation (e.g. Hevly et al. 1965). Spiderling, globemallow, and Arizona poppy are weeds present in modern fields (Parker 1958), and their pollen has been recovered in elevated percentages from the sediments of prehistoric fields in southern Arizona (Fish 1984, 1985). They appear to have been important elements of past weedy floras characteristically associated with agriculture (Fish 1994). These pollen types are not well suited for prolific airborne dispersal. The pollen of weeds growing in contact with crops probably adhered to the surface of cultigens, thus adding to site frequencies when harvests were transported and stored. Although spiderling, globemallow, and Arizona poppy registered abundantly in pollen records from prehistoric fields, these weedy plants also could have been constituents of weedy vegetation in residential areas of ancient settlements.

Identification of Plant Resources

Appendix I:Table I.3 summarizes the pollen types identified at Sites 85/428 and 105/838 that are interpreted as having an economic origin or significance. The pollen representing domesticates is the most straightforward evidence, as no natural source is possible. Maize pollen is unequivocal. The pollen of wild gourds furnishing edible seeds and flesh cannot be distinguished in all cases from that of some domesticated cucurbits (squash and pumpkin). However, rare cucurbit pollen

Table 58. Common Names of Pollen Taxa

Scientific Name[a]	Common Name
Nonarboreal	
Artemisia	sagebrush
Boerhavia	spiderling
Canotia	canotia
Cereus type	saguaro, hedgehog, or related cacti
Cheno-am	chenopod, amaranth
"Compositae" [Asteraceae]	
Low-spine	bursage or related species
High-spine	sunflower family
"*Cylindropuntia*" [*Opuntia*]	cholla
Cyperaceae	sedge
Ephedra	Mormon tea
Eriogonum	wild buckwheat
Erodium	stork's bill
Euphorbia	spurge
Gilia	gilia
"Gramineae" [Poaceae]	grass family
Kallstroemia	Arizona poppy
"Labiatae" [Lamiaceae]	mint family
Larrea	creosote bush
Fabaceae	pea or bean family
"Liguliflorae" [Cichorioideae]	dandelion type, sunflower family
Liliaceae	lily family
"*Platyopuntia*" [*Opuntia*]	prickly pear
Rhamnaceae	buckthorn family
Rosaceae	rose family
Solanaceae	potato family
Sphaeralcea	globemallow
Typha	cattail
"Umbelliferae" [Apiaceae]	parsley family
Arboreal	
Abies	fir
Acacia	acacia
Alnus	alder
Fraxinus	ash
Juglans	walnut
Juniperus	juniper
Pinus	pine
Platanus	sycamore
Prosopis	mesquite
Quercus	oak
Salix	willow
Domesticates	

continued on next page

Scientific Name[a]	Common Name
Cucurbita	squash, pumpkin
Zea	maize

[a] A scientific name in quotation marks is a synonym commonly used in the palynological literature. It is followed, in brackets, by the currently accepted name for that taxon.

typically is designated to be of economic origin and is categorized as coming from a cultigen.

A series of other highly probable resource types have been assigned economic significance on the basis of their infrequent appearance in samples from natural vegetation and their importance in the subsistence of indigenous southwestern peoples. Pollens of cacti are distinguished as prickly pear ("*Platyopuntia*") and cholla ("*Cylindropuntia*"). Together, these cacti provide edible fruits, pods, and vegetative parts (e.g., Curtin 1984; Felger and Moser 1985; Gallagher 1977; Russell 1975). Mesquite provides fuelwood and edible pods and catkins. Sedge species furnish edible seeds and roots, and stems used in many crafts (e.g., Bean and Saubel 1972:80–81; Curtin 1984:99). Sedge seeds recovered in flotation probably represent a resource associated with site pollen. Cattail is a source of craft and construction materials, as well as edible roots and shoots (e.g., Curtin 1984:64–65; Russell 1975:133, 154). The copiously produced pollen is used as raw material for yellow body paint and pit baked as a prized food.

The criterion used to assign economic significance to instances of pollen types that are common in samples and that are predictable taxa of site environs is the presence of large aggregates. The solidity of this interpretation increases if the aggregates are accompanied by anomalous frequencies. The economic use of grasses is inferred on the basis of aggregates, although the particular utilized species cannot be distinguished through pollen morphology. Edible grass seeds are documented by flotation results, and there are craft and architectural uses for the stems and leaves. An unspecified member of the broad sunflower family category was present in large aggregates. Potato family (Solanaceae) species were probable site weeds, along with wild buckwheat (*Eriogonum*). The potato family includes edible resources such as ground cherry (*Physalis*) fruits and the roots of wild potato (*Solanum jamesii*) (Gallagher 1977:124). Wild buckwheat seeds and shoots are consumed, and plant parts are used medicinally (e.g., Bean and Saubel 1972:72).

Cheno-am pollen aggregates are so commonly encountered in site samples that it is not possible to discern whether they were introduced by cultural means or whether they were dispersed by weeds responding to occupational disturbance in the immediate sampling locale. Undoubtedly, the occupants of the LOCAP sites consumed the edible seeds and greens, as did almost every indigenous group of the U.S. Southwest. Because it probably represents a source in agricultural or disturbance weeds, an instance of spiderling aggregates was not included in Appendix I:Table I.3, even though the Seri consume the herbage as cooked greens (Felger and Moser 1985:349).

AZ O:1:28/AR-03-04-06-903

No information is available for Site 28/903, an Archaic period campsite on the west bank of Dry Creek. A single sample from Test Pit 72 was examined. Pollen preservation was inadequate for reliable tabulation.

AZ O:1:85/AR-03-04-06-428

One of two samples from Trench 128 at this food-processing location near Spring Creek was Holocene in age and was collected in conjunction with a deeper sample of presumed Pleistocene sediments. Pollen was not preserved in the older sample. The distribution of principal pollen types in the Holocene sample was generally similar to that in samples from two roasting pits (Features 2 and 4) at the site, revealing no meaningful differences in environmental conditions among the three proveniences (see Table 58). The roasting pits dated early in the agricultural sequence. One contained charred maize (see Chapter 6, this volume).

Features 2 and 4 yielded frequencies of cheno-am pollen that overlapped only with the lower range from Site 105/838, a residential settlement. This is consistent with the expectation that weed pollen would be represented at relatively lower levels under conditions of limited soil and vegetation disturbance at a nonresidential locale. The cheno-am percentages from Feature 4, somewhat higher than those from Feature 2, may reflect the use of weedy chenopods or amaranths to construct a moist, green pit lining or covering to protect the cooked resources from charring through direct contact with coals (e.g., Greenhouse et al. 1981).

Flotation of Feature 2 contents produced maize kernels and cupules, the latter probably reflecting that cobs were used for fuel (see Chapter 6, this volume). Maize pollen was not observed, however. It is therefore probable that the maize brought to the site did not include the outer leafy parts and husks that contain abundant pollen. It may have been brought as dried cobs that were husked elsewhere, with the residual parts added to the fuel supply after consumption. The very low level of the three agricultural-weed pollen types—spiderling, globemallow, and Arizona poppy—at Site 85/428 further suggests that the maize was transported from locales at a distance rather than having been obtained from fields in the immediate vicinity. Alternatively, it might mean that field areas were not very large.

Instances of pollen that fit the criteria for resource use do not correspond to the potential resources identified in the Feature 2 flotation sample, although the presence of chenopod or amaranth and grass pollen parallels the recovery of seeds. Relatively elevated frequencies of wild buckwheat pollen and aggregates suggest that the source plants were introduced by the people who used the roasting pit. The absence of charred wild buckwheat seeds coupled with ethnographic accounts of their infrequent consumption supports the interpretation that these weedy, herbaceous plants were used as pit liners or coverings for resources that were roasted. Pollen contents did not identify the resources that were processed in Feature 4.

AZ O:1:105/AR-03-04-06-838

Three occupational loci at Site 105/838 were situated on the top and slopes of a low hill along Spring Creek. A single sample from Feature 15, a masonry room in Locus B, failed to produce adequately preserved pollen. The results of the analysis provide information on a farmstead in Locus A with three pit structures (Features 23, 29, and 37) and associated extramural features (Features 21 and 31). Residents occupied this locus from the Early Formative period (A.D. 1–650) through the early Camp Verde phase (approximately A.D. 900–1000).

Natural and Modified Environmental Conditions

The distributions of the principal pollen types in a sample from the modern surface of Site 105/838 generally resemble those from the two extramural features and one of the pit structures, Feature 37 (see Appendix I:Table I.1). This set of archaeological samples diverged significantly from modern distributions in that the combination of the three agricultural weeds in Feature 37—spiderling, globemallow, and Arizona poppy—was more prominently represented, signaling the probability that there were fields nearby and that the pollen was introduced on the outer surfaces of harvested crops. The agricultural weeds were also more frequently encountered in Features 23 and 29 than in the modern sample, but these two pit structures also contained substantially higher cheno-am frequencies. Because pollen configurations indicative of zonal vegetation did not differ markedly between the modern and prehistoric samples, the elevated cheno-am frequencies appear to be related to the modifications to the environment imposed by site inhabitants.

The high cheno-am frequencies in Features 23 and 29 probably correspond to an interval in the occupation of Locus A that was more extended, more intensive, or both. Elevated values were not concentrated in floor deposits, as might be expected with intensive use of these plants, but also were present in the fill and roof fall of Feature 23, suggesting that increased weedy growth within site environs could have been a source of the high frequencies. By contrast, cheno-am levels in Feature 37 indicate a lower level of disturbance weeds, because residential occupation was new or less extensive. Consistently higher combined frequencies for the three agricultural weeds in Feature 37 suggests that the occupation of the feature was comparatively abbreviated or ephemeral and confirms that it took place before that of the other two structures and was more directly related to farming activities or crop storage. This is in line with fact that Feature 37 was occupied during the Early Formative period, when fields probably were not yet very extensive, and Features 23 and 29 were occupied during the Camp Verde phase, when agriculture was much more extensive.

Maize pollen in most samples and numerous instances of aggregates in all three pit structures at Site 105/838 indicate ready access to a freshly harvested staple. In combination with the representation of agricultural weeds, this pattern suggests that the inhabitants' cultivated fields that were relatively nearby. The presence of cattail pollen in each structure indicates that there were permanently damp habitats for these plants and, inferentially, that a reliable, year-round source of water (i.e., Spring Creek) was present for domestic and agricultural purposes. It is quite possible that residents developed such sources to improve sustainability and to deliver water to fields, thereby extending specialized mesic habitats. The repeated appearance of willow pollen in site samples—although present in low frequencies—supplies further evidence for long-term water supplies.

Resource Evidence

Cultigens identified by pollen at Site 105/838 are maize and cucurbits (squash or pumpkin). The ubiquity of maize among samples implies that it occupied a central role in the inhabitants' diet. The pollen of beans (Fabaceae) and cotton, recovered as charred remains, is typically rare; these plants do not depend on wind for pollination and disperse very limited amounts. Consequently, the lack of tabulated pollen does not necessarily indicate that these were uncommon crops.

Seeds and greens of chenopods and amaranths undoubtedly were important resources for farmstead residents. The repeated recovery of aggregates echoes the presence of widespread and abundant charred seeds in flotation, documenting the ready availability of these species (see Appendix I:Table I.1). Pollen frequencies were sufficiently high and aggregates were so regularly observed, however, that the contributions of residential weeds cannot be distinguished from those of introduced resources.

Feature 37 is distinctive in the diversity of resources that registered in three floor samples (see Appendix I:Table I.3). In addition to maize, this household used prickly pear, mesquite, grass, cattail, a species in the potato family, sedge, and a species in the sunflower family. Flotation recovery of *Scirpus*-type sedge seeds and little barley further indicates that sedge and grass resources were present.

The floor and floor features of the pit structure, Feature 23, registered maize, cucurbit, grass, cattail, and potato family resources. Cholla buds, usually gathered in the early spring, probably are the source of the pollen. The fill of the structure produced cattail tabulations and scanning observations of maize and cholla. In deposits postdating the primary residence of the structure, this set of resources could reflect an admixture of occupational refuse or postoccupational debris introduced by rodents.

A variety of resources were identified in the floor features of Feature 23. The hearth contained maize and cattail pollen. Subfeature 1, the location of a cooking trivet, yielded maize, cattail, and potato family pollen. Subfeatures 24 and 25, two storage pits, again produced small amounts of maize and cattail pollen. The repeated appearance of maize reinforces the primary resource role of this cultigen. Although cattail may be consumed as roots, shoots, or pollen, widespread pollen recovery in Site 105/838 structures alternatively may indicate that the stems were used in roof-thatch or wall construction.

The pollen recovered from the third pit structure, Feature 29, parallels the types and quantities of resources found in the other structures. The floor and a storage pit yielded maize; additional grass and potato family records were recovered from the floor and cattail and sedge from the pit. As in Feature 37, charred little barley corresponds with the grass pollen aggregates.

Features 21, 31, and 40 were extramural facilities sampled in Locus A. Feature 40, a roasting pit, did not yield preserved pollen. Feature 31, a second roasting pit, yielded no indication of associated resources; flotation similarly produced only woody charcoal. Resources cooked in Feature 21, a hearth, again left no pollen record, which contrasts with the recovery of charred maize, cottonseeds, little barley seeds, and wild resources. Divergent results in this case may be explained by the destruction of resource pollen in exposed extramural contexts or by the fact that charred remains represent secondary refuse with little adhering pollen. Features 21 and 31 share a low range of cheno-am frequencies with Feature 37. These two thermal features may have been used during the same interval of Locus A occupation, the Early Formative period.

Conclusions of Pollen Analysis

Pollen results from Sites 85/428 and 105/838 span centuries of agricultural occupation in the LOCAP area, but results do not reveal detectable changes in the zonal configuration of natural vegetation. Contrasts within and between the sites are more compatible with differing magnitudes of vegetation response to cultural modification in and around site locales. Cheno-am levels suggest heightened residential disturbance during the occupation of Features 23 and 29 at Site 105/838 and lesser disturbance levels during the occupation of Site 85/428 and that of Feature 37 at Site 105/838. Feature 37 registered heightened inputs of agricultural weeds, possibly in conjunction with the differential location of fields or an occupational orientation that more directly reflects farming activities and/or crop storage. This structure also yielded the most diverse resource record.

Resource patterns can be assessed only for Site 105/838. Wild resources registered by pollen could have been gathered within the immediate confines of the project area. Prickly pear and cholla would have been widespread elements of desert grasslands and open woodlands but appear as minor resources in the pollen record. Mesquite would have been most abundant and productive in riparian settings, along with sedge. The ubiquity of cattail in the pit structures suggests easy access to these plants, which thrive in permanently damp habitats. This also suggests that cattails were used regularly, perhaps as structural material. The levels of pollen from agricultural weeds that flourish alongside crops when they receive supplemental water also suggest proximity to drainages.

Pollen results attest to the role of maize as a staple and the probable cultivation of squash or pumpkin. The co-occurrence of grass-pollen aggregates and charred little barley suggests repeated use of this probable domesticate. Many wild buckwheat species favor agricultural environs, as is true of the species of the potato family that were utilized as food. Fields and the margins of ditches or other water-control features would have furnished vital secondary resources for the inhabitants of Site 105/838 in addition to primary crops.

In view of evidence suggesting perennial sources in the vicinity, domestic water does not appear to have placed significant seasonal limits on the occupation of Site 105/838, and the ready availability of water similarly may have attracted inhabitants for shorter-term use of nearby Site 85/428. Resources identified by the pollen exhibit an appreciable duration from spring through fall. Cholla buds are typically gathered in the spring, and the other resources become available as the summer progresses. Crop harvests probably extended at least into the early fall, and the gathering of mesquite beans may have been similarly prolonged. Year-round occupation cannot be conclusively confirmed, but it is clear that the farmers occupying Site 105/838 subsisted on a diverse diet centered on maize during extended stays.

CHAPTER 8

Prehistoric Faunal Exploitation in the Lower Oak Creek Archaeological Project Area

Robert M. Wegener

Excavations undertaken by SRI during the LOCAP along SR 89A yielded a medium-sized faunal collection. In all, 553 specimens were collected from 4 of the 13 sites investigated during Phase 1 testing and Phase 2 data recovery. Most of these specimens were highly fragmented pieces of bone; most that could be identified to species were from leporids. Faunal remains were recovered from the following sites: AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428), AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), and AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903). Three pit structures at Site 105/838—one dating to the Squaw Peak phase and two to the Camp Verde phase—contained most of the recovered bone. Forty-two of 59 samples cataloged as faunal bone were recovered from these three features.

The analysis of this faunal collection was designed generally to address our second research domain, land-use patterns. The specific goals were to identify taxa used for food and tools, to infer the habitats from which these fauna were obtained, and to suggest the tools and techniques probably used to procure and process the animal resources. The analysis was also designed to facilitate an intersite comparison among the LOCAP sites and among sites within the middle Verde River region for which faunal collections have been reported. Insofar as some of the features excavated by SRI were inferred to date to the latter portion of the Squaw Peak phase (A.D. 1–650), this analysis may shed some light on subsistence practices (our third research domain) during the Early Formative period. The LOCAP faunal collection was too small to address most of the larger substantive issues associated with the first research domain defined in the SRI treatment plan (SRI 1998)—the archaeology of forager-farmers—but methodological issues are considered below in the concluding remarks. Finally, none of the LOCAP animal bone was recovered from contexts inferred to be associated with either Yavapai or Apache occupation (this would address our final research domain, Native American history). However, faunal remains associated with Southern Sinagua cultural contexts may be relevant to precontact economic endeavors associated with specific Hopi clans who once lived in the middle Verde River region (see Volume 3).

Methods

Collection Methods

All faunal materials recovered during the LOCAP were analyzed. Excavators collected nonhuman animal remains in a number of ways. Some were recovered by screening pit-structure fill and floor fill at Site 105/838 with 1/4-inch- (5.62-mm-) mesh hardware cloth; others were collected from 1-by-1-m control units within these structures with 1/8-inch- (3.25-mm-) mesh hardware cloth for the screening process. Grab-sampling in intramural pits produced the greatest number of field-sorted remains. In terms of the recovery methods employed during this study, the gathering of flotation samples from intramural pits and various strata within the pit structures at Site 105/838 proved the most effective faunal-collection technique. Quarter-inch screening and flotation samples resulted in the collection of vertebrate remains at Sites 85/428 and 28/903. The five specimens encountered at Site 53/745 were collected from the surface.

Analytic Methods

Specimen Identification

Each identifiable faunal specimen was classified according to animal taxon, skeletal element, and age at death.

Identifications were made from published literature (e.g., Brown and Gustafson 1990; Gilbert 1973; Gilbert et al. 1985; Gustafson n.d.; Olsen 1964, 1968, 1979a, 1979b; Zweifel 1994) and the comparative vertebrate collection of the ASM, located at the University of Arizona in Tucson. A list of 437 vertebrate species recorded for the CNF (U.S. Department of Agriculture Forest Service 1987) was also consulted as a guide to species that probably would be encountered. The ASM comparative collection proved particularly useful because of its emphasis on U.S. Southwest fauna and because it has representatives of most types found in the LOCAP study area.

All identifications were made to the most specific taxonomic classification possible (e.g., genus or species). To facilitate this process, a species list similar to that constructed by Shelley and Cairns (1998) during the LVAP study was compiled. Data from the CNF and standard zoological treatments (e.g., Cockrum 1960; Hall and Kelson 1959; Lowe 1964) provided the information required to construct a compendium of terrestrial fauna native to the CNF (see Appendix J:Table J.1). This reference tool includes the scientific and common names of taxa potentially present in the faunal collection, as well as the habitat preference(s) for each species. Table 59 is a concordance of scientific and common names used in this chapter.

The initial step in the identification process was to determine the vertebrate class and skeletal element represented by individual specimens. Identification beyond the level of genus often proved difficult because a high frequency of severely fragmented postcranial specimens lacked diagnostic landmarks, such as muscle attachments or articular surfaces and teeth. Specimens that were too fragmentary or weathered to be confidently assigned to a specific genus or species were often designated using the genus and/or species name immediately preceded by "cf." ("compare"). Finally, a handful of specimens were coded as "indeterminate." Indeterminate specimens consisted of minute fragments of cancellous bone tissue or slivers of cortical bone.

The animal's approximate age at the time of death was also recorded. This information is often used to determine the season in which a given species typically was captured and killed. Epiphyseal fusion, along with tooth eruption and occlusal-surface wear, are the most commonly used criteria. In this analysis, three age categories were used—juvenile, adult, and indeterminate—to describe the age of the animal at the time of death. Unfortunately, the high frequency of specimens classified as indeterminate made it nearly impossible to construct viable age profiles per taxon.

Quantification

The number of identified specimens (NISP) was the primary analytical unit used in this analysis. Here, following Grayson (1984:186), a specimen was defined as "a bone or tooth, or fragment thereof," and every individual specimen was included in the calculation of the NISP. One of five NISP categories characterized each bone or bone fragment. Each specimen was counted as a single value (n = 1) in only one NISP category. NISP-end referred to bone fragments possessing articular ends. Bone shafts and shaft fragments lacking articular ends were classified as NISP-shaft. NISP-flat denoted flat-bone fragments (e.g., scapulae, cranial bones, or pelvic bones). Whole bones received a coding of NISP-intact. Teeth and tooth fragments were identified as NISP–teeth/enamel. Summing these categories for a specific taxon and unit of analysis (e.g., feature or site) produced a 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 a specimen (e.g., burning).

Animal-Size Classes

When one is working with highly fragmented faunal collections, assigning each specimen to a size class often is all that is possible or practical. Criteria used to place a specimen in a size class include thickness of the cortical bone and relative size. Given the predominance of small and fragmentary specimens in the LOCAP faunal collection, each specimen was assigned to one of six categories following a method for classifying highly fragmented bones devised by Thomas (1969:393). When severe splintering made assignment to a size class impossible, the item was coded as indeterminate. The classification is as follows:

Class I: animals weighing less than 100 g (e.g., meadow vole [*Microtus* sp.] and western pocket gopher [*Thomomys* sp.])
Class II: animals weighing between 100 and 700 g (e.g., squirrel [Sciuridae] and chipmunk [*Tamias* sp.])
Class III: animals weighing between 700 g and 5 kg (e.g., cottontail [*Sylvilagus* sp.] and marmot [*Marmota* sp.])
Class IV: animals weighing between 5 and 25 kg (e.g., coyote [*Canis latrans*] and bobcat [*Lynx rufus*])
Class V: animals weighing more than 25 kg (e.g., pronghorn [*Antilocapra americana*], deer, and bighorn sheep [*Ovis canadensis*])
Class VI: indeterminate

Thermal Alterations

Three nominal categories were used to characterize the thermal alterations exhibited by each specimen: 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) placed sheep and goat mandibles and astragali in a kiln for 4 hours and documented several color stages. Bone that is heated between 300°C and 500°C mostly blackens but can appear yellowish red and red to purple. Intensely heated

Table 59. Scientific and Common Names of Identified Animal Taxa

Scientific Name	Common Name
Bivalvia	
Unionidae	
Anodonta californiensis	California floater
Osteichthyes	
Cyprinidae	minnow
Reptilia	
Squamata	
Serpentes	
Colubridae	
Pituophis catenifer	gopher snake
Viperidae	
Crotalus sp.	rattlesnake
Testudines	
Kinosternidae	
Kinosternon sp.	mud turtle
Testudinidae	tortoise
Amphibia	
Bufonidae	
Anaxyrus cognatus	Great Plains toad
Ranidae	
Rana sp.	frog
Aves	
Accipitridae	
Buteo swainsoni	Swainson’s hawk
Buteo jamaicensis	red-tailed hawk
Anatidae	
Anas platyrhynchos	mallard
Branta canadensis	Canada goose
Mergus serrator	red-breasted merganser
Ciconiidae	
Mycteria americana	wood stork
Corvidae	
Corvus corax	raven
Falconidae	
Falco peregrinus	peregrine falcon
Odontophoridae	
Callipepla gambelii	Gambel’s quail
Passeriformes	perching bird
Phasianidae	
Meleagris gallopavo	wild turkey
Picidae	woodpecker

continued on next page

Scientific Name	Common Name
Podicipedidae	
Aechmophorus occidentalis	western grebe
Psittacidae	
Ara macao	scarlet macaw
Rallidae	
Fulica americana	American coot
Mammalia	
Artiodactyla	
Antilocapridae	
Antilocapra americana	pronghorn
Cervidae	
Cervus canadensis	elk
Odocoileus sp.	deer
Odocoileus hemionus	mule deer
Odocoileus virginianus	white-tailed deer
Ovis canadensis	bighorn sheep
Carnivora	
Canidae	
Canis latrans	coyote
Canis sp.	dog, fox
Felidae	
Lynx rufus	bobcat
Puma concolor	mountain lion
Mustelidae	
Taxidea taxus	badger
Procyonidae	
Procyon lotor	raccoon
Ursidae	
Ursus sp.	bear
Lagomorpha	
Leporidae	
Lepus sp.	jackrabbit
Lepus californicus	black-tailed jackrabbit
Sylvilagus sp.	cottontail
Sylvilagus audubonii	desert cottontail
Perissodactyla	
Equidae	
Equus caballus	horse
Rodentia	
Castoridae	
Castor canadensis	beaver
Erethizontidae	
Erethizon dorsatum	porcupine

Scientific Name	Common Name
Geomyidae	
Thomomys sp.	western pocket gopher
Thomomys bottae	Botta's pocket gopher
Heteromyidae	
Dipodomys sp.	kangaroo rat
Muridae	
Microtus sp.	vole
Neotoma sp.	pack rat, woodrat
Neotoma albigula	white-throated woodrat
Ondatra zibethicus	muskrat
Peromyscus sp.	white-footed mouse
Sciuridae	
Cynomys sp.	prairie dog
Spermophilus sp.	ground squirrel

bone (>600°C) becomes purplish blue and blue. When completely incinerated, or calcined, bone becomes bluish white or gray. In this study, blackened specimens were classified as "charred," and specimens with gray, blue-gray, white, and, occasionally, buff-colored surfaces indicating almost complete incineration were classified as "calcined."

Individual Specimen Size

Seven ordinal categories were used to characterize the maximum dimension of each specimen, as measured with a template. These categories were as follows: <5 mm, 5–15 mm, 15–25 mm, 25–35 mm, 35–50 mm, 50–100 mm, and >100 mm. Recording specimen size allows for an assessment of the degree of fragmentation among taxa, features, periods, and sites. Such information can provide useful insights concerning processing and cooking practices when compared to the archaeological context and thermal alterations.

Weathering Stage

One of six weathering stages was used to describe each specimen, where Stage 0 represents bone that is relatively fresh and greasy, and Stage 5 indicates highly weathered bone that is fragile and splintered. These stages are detailed in Appendix J:Table J.2. 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 . . . [that] is a part of the normal process of nutrient recycling in and on soils." This definition was used in this analysis. Three biological factors largely determine the rate of bone weathering: bone density, size of the bone (e.g., surface area), and fluctuations in temperature and moisture. Patterns in weathering data are often used to discern refuse-disposal practices and the history of site formation.

Appendix J:Table J.2 provides weathering-stage criteria for large mammals (Behrensmeyer 1978) and small mammals (Andrews 1990). Behrensmeyer developed six weathering stages to describe remains of large African mammals in modern surface contexts, whereas Andrews used a four-stage series to describe small-mammal bones recovered from owl pellets. It is important to note that the classifications used by Behrensmeyer and Andrews were originally applied to nonarchaeological materials, and the relationship between these classification systems and the depositional histories of archaeofaunas remains uncertain. However, the LOCAP faunal specimens can and do meet the criteria for assignment of these stages.

No soft tissue, integument, or grease was present on or in any of the specimens; thus, no specimen received a coding of Stage 0. Stage 1 was the most commonly observed weathering stage, followed by Stage 2 and, rarely, Stage 3. We did not encounter specimens weathered beyond Stage 3.

Results

The 553 faunal specimens recovered during this project represent 4 vertebrate classes and 17 lower taxa (Table 60). Common and scientific names for terrestrial fauna can be found in Table 59 and Appendix J:Table J.1. This archaeological faunal collection represents a mere fraction of the 473 vertebrate taxa that currently inhabit the middle Verde River region and the CNF. Most of the taxa identified during the LOCAP are ubiquitous throughout the northern

Table 60. Number and Percentage of Identified Specimens for Each Taxon and Site

Taxon	Site No.								NISP Total	
	85/428		53/745		105/838		28/903			
	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Fishes										
Cyprinidae sized	1	11.1	—	—	1	0.2	1	2.8	3	0.5
Reptiles										
Crotalus sp.	—	—	—	—	3	0.6	1	2.8	4	0.7
Birds										
Aves (eggshell)	—	—	—	—	4	0.8	—	—	4	0.7
Mammals										
Indeterminate	—	—	—	—	14	2.8	—	—	14	2.5
Leporid sized	1	11.1	1	20.0	222	44.1	18	50.0	242	43.8
Leporid	1	11.1	—	—	49	9.7	2	5.6	52	9.4
Lepus cf. *californicus*	—	—	—	—	110	21.9	4	11.1	114	20.6
Sylvilagus sp.	1	11.1	—	—	56	11.1	1	2.8	58	10.5
cf. *Sylvilagus* sp.	—	—	—	—	1	0.2	—	—	1	0.2
Spermophilus sized	—	—	—	—	22	4.4	—	—	22	4.0
Spermophilus sp.	—	—	—	—	1	0.2	—	—	1	0.2
Thomomys cf. *bottae*	—	—	—	—	1	0.2	1	2.8	2	0.4
Neotoma cf. *albigula*	—	—	—	—	1	0.2	—	—	1	0.2
Muridae sized	2	22.2	—	—	9	1.8	—	—	11	2.0
Microtus sp.	—	—	—	—	1	0.2	—	—	1	0.2
Medium-sized artiodactyl	1	11.1	4	80.0	7	1.4	7	19.4	19	3.4
cf. *Odocoileus* sp.	—	—	—	—	1	0.2	—	—	1	0.2
Odocoileus sp.	2	22.2	—	—	—	—	1	2.8	3	0.5
Total[a]	9	99.9	5	100.0	503	100.0	36	100.1	553	100.0

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

Southwest, and their identification does not require detailed discussion. The exception is the nonmammalian taxa, which are discussed.

The first section describes the project fauna and is organized by vertebrate class. The discussion is meant to be a general treatment based on unique specimens and basic trends. Detailed site-specific summaries and analyses can be found in the following section.

Identified Taxa

Fishes

Remains of the Osteichthyes (bony fishes) in the LOCAP faunal collection consisted of three small (<3 mm) precaudal centrums (see Table 60). One of these, from a Camp Verde phase (A.D. 900–1125/1150) pit structure (Feature 23) at Site 105/838, was calcined. Sites 85/428 and 28/903 each contained a single unaltered specimen. All three specimens, probably representing minnows (Cyprinidae) <10 cm in length, were recovered from discrete features and exhibited few signs of exposure to prolonged weathering.

Currently, the segments of Oak and Spring Creeks situated closest to the LOCAP sites are capable of supporting small minnow populations only on a short-term and seasonal basis. It is possible, however, that Cyprinidae species may inundate these drainages during spring freshets and become trapped during drier conditions, thus becoming an easily collected food resource.

Reptiles

Rattlesnake (*Crotalus* sp.) vertebrae and fangs were the only reptilian remains in the collection (see Table 60). These specimens included two calcined fangs from within a hearth (Subfeature 1) in Feature 29 at Site 105/838 (northern pit structure) and one unaltered precloacal vertebra from within an intramural pit located in Feature 23 (southern pit structure), also at Site 105/838. Another charred precloacal vertebra was recovered from a small Archaic period open-air hearth discovered at Site 28/903. All four specimens were screen captured during the laboratory processing of field-collected flotation samples. The symmetry of the hemal and neural arches on the vertebrae and the relative size, shape, and presence of the fangs were used as the distinguishing attributes for these specimens.

The fact that all four rattlesnake specimens were recovered from discrete cultural features, coupled with the high frequency of burning, suggests that the prehistoric occupants of Sites 105/838 and 28/903 probably used these venomous burrow hunters. How these rattlesnakes were used remains unclear. Snakes have been used as food and medicine by many cultural groups, and their use in ceremonies and rituals among the Hopi is well documented.

Birds

Site 105/838 was the only site that contained avian remains—four small (<5 mm), quadrangular eggshell fragments (see Table 60). An intramural pit (Subfeature 4) in Feature 23 contained three eggshell fragments, two calcined and one unaltered. The remaining eggshell fragment rested in an intramural posthole (Subfeature 7) discovered in Feature 37 (western pit structure). This suggests that this subfeature might have functioned as an intramural pit rather than a posthole. Conversely, it is possible that the fragment migrated into the posthole during housecleaning or after the abandonment and collapse of the structure.

To the best of my knowledge, this is the first time that avian eggshell has been recovered from and reported for an archeological site in the middle Verde River region. Identification of these specimens was verified under 70× magnification using a lighted ocular microscope. No haversian system typical of bone was observed, but amniotic pores—tiny, ovate pores that are a distinguishing feature of eggshell—were seen. The pores permit the necessary exchange of gases between the amniotic membrane and the atmosphere, thus preventing the asphyxiation of the developing fetus. The fragments were moderately weathered and slightly exfoliated, prohibiting an accurate identification of their origin. However, the thickness of the fragments suggests that they came from grouse- to quail-sized birds.

Mammals

Mammals dominated the project collection, constituting 542 (98 percent) of the 553 specimens in Table 60. Fourteen mammalian taxa were identified. Rodents were the most diverse taxa, in terms of richness, encountered in the collection. Leporid (rabbit and hare) and leporid-sized bones and bone fragments were the most numerous mammal remains, and artiodactyl remains were relatively rare. Indeterminate mammal remains (n = 14) constituted only 2.5 percent of the project NISP-total. Most of these were small pieces (5–15 mm) of cancellous bone or splintered long-bone fragments.

Leporids

Leporid-sized specimens were the most commonly encountered taxa, particularly at Sites 28/903 and 105/838. Black-tailed jackrabbit (*Lepus* cf. *californicus*) was the most numerous species in the collection (NISP = 114). The remains of these hares were nearly twice as abundant as remains of cottontails (rabbits, *Sylvilagus* sp.) in the LOCAP faunal collection (NISP = 58). Many nondiagnostic specimens (NISP = 52), such as phalanges or metapodial fragments, could be identified only to the level of leporid. These were particularly common at Site 105/838, however, and the degree of fragmentation encountered at this site probably accounted for this pattern (see the site-specific summaries that follow). A small left anterior scapula fragment that included the acromion process was the only specimen tentatively identified as deriving from an adult desert cottontail (*Sylvilagus* cf. *audubonii*).

Significant differences between the proportions of jackrabbit and cottontail bones present became evident when the lagomorph index was calculated. Szuter and Bayham's (1989) simplified version of the lagomorph index (S/L) was used in this analysis. This simplified measure divides the NISP-total for cottontails (S) by the NISP-total for all lagomorphs (Lagomorpha: rabbits, hares, and pikas) (L). The lagomorph index tracks the ratio of cottontail to leporid remains in a faunal collection. Low ratio values indicate that relatively few cottontail remains were present in a given sample when compared to jackrabbit remains.

Interpretations for variability in the lagomorph index often rely on two criteria: (1) the habitat preferences of these animals and the physiographic setting of the sites containing their remains (Bayham and Hatch 1985:421–422, 423) or (2) the environmental impacts of settlement and agriculture (Szuter 1991). The site's occupational history constitutes another significant factor. Sites with a record of continuous, long-term occupation often yield lower lagomorph-index values (Szuter 1985, 1986a, 1986b; Szuter and Brown 1986). Further, Szuter (1984:157, 160; 1991:199) identified patterned variability when comparing site types and noted that the differences between small farmsteads and larger villages were the most dramatic. Lagomorph indexes from farmstead faunas (with a mean of 0.34 and standard deviation of 0.23) were generally higher and more variable than those from village sites, which had a lower mean of index and a standard deviation of 0.17. During the Camp Verde phase (A.D. 900–1125/1150), Site 105/838 probably functioned as a small farmstead, but its relatively low lagomorph index (0.13) suggests that jackrabbits were more abundant than cottontails. This may indicate that the environment was culturally modified and that field hunting was practiced. The Southern Sinagua undoubtedly altered their environment by preparing fields and constructing houses. These ground-disturbing activities retarded plant succession, thereby promoting the growth of native weedy annuals. These plants provide little cover, producing the habitat conditions preferred by jackrabbits.

Rodents

Specimens of ground squirrel (*Spermophilus*) size were the most numerous rodent remains recovered. A single dorsoventrally split cheek tooth, unaltered by fire and retrieved from an intramural pit at Site 105/838, was the only specimen confidently identified as deriving from a ground squirrel. Ground squirrel cheek teeth are brachydontic (low crowned), and the well-developed talonid basin and anterior and posterior valleys that generally pass completely across the tooth readily distinguish them from those of other rodents. The fact that all of these were found within the two Camp Verde phase pit structures discovered at Site 105/838 directed the analysis toward the following question: Do these specimens simply reflect the natural activities of these fossorial (burrowing) creatures, or were the animals used as a food source?

A pocket gopher cheek tooth from Site 28/903 and a left mandible from Site 105/838 were the only other specimens from a fossorial rodent. Pocket gophers are highly specialized for fossorial life and should be considered an intrusive element in most archaeological deposits although there is evidence that they were used for food in the U.S. Southwest (Rea 1998; Shaffer 1992; Szuter 1991). At least 41 subspecies have been reported for Arizona (Cockrum 1960), and they are regionally ubiquitous. Pocket gopher teeth are hypsodontic (high crowned), and the occlusal surface displays a simple central basin surrounded by anterior and posterior enamel plates when moderately worn.

Woodrats (*Neotoma* sp.) have been described in ethnographic literature as a favored food of aboriginal peoples of the U.S. Southwest (Castetter and Bell 1942; Castetter and Underhill 1935; Whitman 1940) and desert regions of California and the Great Basin (Steward 1970). Adult white-throated woodrats (*Neotoma albigula*) range between 28 and 40 cm in length and generally choose the base of a prickly pear or cholla (*Opuntia* sp.) cactus to build their nests. Woodrat teeth are more rounded and less compact than those of closely related genera, and the bicolumnar lower third molar is particularly distinctive. The only collected evidence of this taxon in the LOCAP collection is a single charred and dorsoventrally split third mandibular molar collected from Site 105/838. The economic importance of woodrats at this small farmstead remains in question.

Specimens of Muridae (mouse, rat, and vole) size constituted a small portion (2.0 percent) of the project NISP-total (see Table 60). Their placement in animal-size Class I, their relative size, and the cortical-bone thickness were the diagnostic attributes used to assign these nondiagnostic specimens (n = 11) to this category.

Voles inhabit a variety of environmental areas, from high mountain streams and lakesides to lower-elevation, dry, grassy areas removed from water. Voles do not burrow but make runway systems beneath the cover of leaf litter or snow. Presently, there are four species of vole in Arizona: the Mexican vole (*Microtus mexicanus*), the montane vole (*Microtus montanus*), the long-tailed vole (*Microtus longicaudus*), and the sagebrush vole (*Lemmiscus curtatus*). The long-tailed vole is found in a variety of environments at elevations ranging from sea level to more than 4,000 m (13,123 feet) AMSL. Habitats include dry, grassy areas;

riparian corridors; montane meadows; coniferous forests; and arctic tundra. The sagebrush vole prefers arid habitats with loose, sandy soils that support scattered stands of sagebrush (*Artemisia* sp.). The prismatic shape of vole teeth readily distinguishes them from those of other rodents. In the LOCAP collection, voles were represented by one calcined vole tooth found in Feature 23 at Site 105/838.

Artiodactyls

This category contained 19 quadrangular diaphysis fragments, ranging between 2 and 8 cm in length, from medium-sized artiodactyls. Artiodactyl remains constituted only 3.4 percent of the LOCAP NISP-total (see Table 60) and 4.1 percent of the LOCAP faunal collection. The only confident genus-level identifications were made for specimens from Sites 85/428 (NISP = 2) and 28/903 (NISP = 1), which were classified as fragmentary deer bones and antler.

Most specimens assigned to the medium-sized-artiodactyl category exhibited curvate fracture margins suggestive of green-bone breakage (Johnson 1985), and 6 of the 19 specimens were charred and/or calcined. Specimens identified to element included a split radial carpal and fragmentary metapodial splinter awl from farmstead Site 105/838. A tibia-shaft fragment was discovered stratigraphically underlying the Late Archaic component at Site 28/903. Cortical-bone thickness and relative size were the attributes used to assign specimens to this category (i.e., animal-size Class V).

Specimens confidently identified as deer remains were very rare (NISP = 3) and constituted fewer than 1 percent of the NISP total. None of the postcranial specimens could be typed to a specific species. Mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) are present in the LOCAP area today, and it is possible that the deer remains from the project sites represented both species. Deer prefer ecotones of woodland and open fields. White-tailed deer are common inhabitants of the chaparral and woodland slopes from 1,524 to 2,134 m (5,000 to 7,000 feet) AMSL. They concentrate in grasslands in midsummer; they are not dependent on standing water and can endure up to 3 days without drinking (Wallmo 1972:30). Mule deer inhabit ecotones wherever sufficient foliage, fruits, shrub buds, and mast are found (U.S. Department of Agriculture Forest Service 1987:189), but they require daily drinking water.

Site-Specific Summaries

This section describes the faunal specimens recovered from the individual sites during the course of the LOCAP project and offers an interpretation. Sites are presented from south to north, and most of the discussion is focused on the multiple-occupation farmstead, Site 105/838, where 96 percent (NISP = 503) of the project faunal material was recovered.

AZ O:1:105/AR-03-04-06-838 (ASM/CNF)

Nearly all (500 of 503) of the specimens recovered from this multicomponent farmstead were from discrete subsurface features, especially intramural pits, excavated during SRI's Phase 2 data recovery efforts (Table 61). Three specimens were collected during Phase 1 testing and included two unaltered leporid-sized shaft fragments that were grab-sampled from Trench 177 and a screen-captured leporid-sized shaft fragment from Test Pit 158, Stratum II, Level 6. The three specimens were unaltered by fire. The three pit structures discovered at this site—Features 23, 29, and 37—contained most of the recovered bone. Site 105/838 features are discussed individually below.

Feature 23

This Camp Verde phase pit structure, the largest and southernmost of the three excavated pit structures, contained the greatest diversity of taxa from any single context at Site 105/838 (Table 62; see Table 61). Leporid-sized bone fragments, the most numerous type of specimen observed in the field, accounted for 41.6 percent (NISP = 74) of the 178 specimens recovered from Feature 23. However, numerous additional remains of mammals, fishes, reptiles, and birds were encountered in the 16 analyzed flotation samples—totaling 103.6 liters—collected from this feature.

A single calcined fish vertebra was removed from a flotation sample collected from the pit fill; one rattlesnake vertebra and three eggshell fragments, two of which were calcined, were recovered from samples taken from this intramural pit (Subfeature 4) (see Tables 61 and 62). The thickness of the eggshell specimens suggests that they were from quail-sized birds. Eight ground squirrel–sized bones were associated with these remains; however, these specimens represented most of a single individual and none was burned or calcined; thus, they probably were intrusive to the pit. The only other ground squirrel–sized specimen, an intact and unaltered femur, was recovered from another intramural pit, Subfeature 24. The only other evidence of burrowing rodents recovered from this feature consisted of the left mandible of a pocket gopher and an isolated ground squirrel cheek tooth from another intramural pit (Subfeature 37).

The cross-mended fragments (n = 3) of a charred metapodial awl found in the floor fill near the southwest corner of this pit structure represented the only bone tool and tentatively identified deer bone from the site (Figure 44). Other medium-sized-artiodactyl remains included six field-collected bone fragments. Three were from the house fill,

Table 61. Number and Percentage of Identified Specimens from Each Feature at Site 105/838

Taxon	Feature No.												NISP Total	
	23		26		29		30		31		37			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Fishes														
Cyprinidae sized	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Reptiles														
Crotalus sp.	1	0.6	—	—	2	0.7	—	—	—	—	—	—	3	0.6
Birds														
Aves (eggshell)	3	1.7	—	—	—	—	—	—	—	—	1	5.3	4	0.8
Mammals														
Indeterminate	10	5.6	—	—	4	1.4	—	—	—	—	—	—	14	2.8
Leporid sized	74	41.6	2	40.0	129	44.0	3	100.0	1	50.0	10	52.6	222	44.1
Leporid	12	6.7	2	40.0	35	11.9	—	—	—	—	—	—	49	9.8
Lepus cf. *californicus*	33	18.5	—	—	75	25.6	—	—	1	50.0	2	10.5	110	21.9
Sylvilagus sp.	22	12.4	—	—	28	9.6	—	—	—	—	6	31.6	56	11.2
cf. *Sylvilagus* sp.	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Spermophilus sized	9	5.1	1	20.0	12	4.1	—	—	—	—	—	—	22	4.4
Spermophilus sp.	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Thomomys cf. *bottae*	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Neotoma cf. *albigula*	—	—	—	—	1	0.3	—	—	—	—	—	—	1	0.2
Muridae sized	2	1.1	—	—	6	2.0	—	—	—	—	—	—	9	1.8
Microtus sp.	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Medium-sized artiodactyl	6	3.4	—	—	1	0.3	—	—	—	—	—	—	7	1.4
cf. *Odocoileus* sp.	1	0.6	—	—	—	—	—	—	—	—	—	—	1	0.2
Total[a]	178	100.3	5	100.0	293	99.9	3	100.0	2	100.0	19	100.0	503	100.2

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

Table 62. Number and Percentage of Identified Specimens, by Stratum, from the Southern Pit House (Feature 23) at Site 105/838

Taxon	Southern Pit House										NISP Total	
	House Fill		Floor Fill		Hearth Fill		Pit Fill		Posthole Fill			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Fishes												
Cyprinidae sized	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Reptiles												
Crotalus sp.	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Birds												
Aves (eggshell)	—	—	—	—	—	—	3	2.5	—	—	3	1.7
Mammals												
Indeterminate	—	—	1	5.6	1	3.8	8	6.6	—	—	10	5.6
Leporid sized	3	42.9	6	33.3	22	84.6	40	32.8	3	75.0	74	41.6
Leporid	—	—	1	5.6	1	3.8	10	8.2	—	—	12	6.8
Lepus cf. *californicus*	1	14.3	9	50.0	—	—	21	17.2	1	25.0	33	18.5
Sylvilagus sp.	—	—	—	—	2	7.7	20	16.4	—	—	22	12.4
Sylvilagus cf. *audubonii*	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Spermophilus sized	—	—	—	—	—	—	9	7.4	—	—	9	5.1
Spermophilus sp.	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Thomomys cf. *bottae*	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Muridae sized	—	—	1	5.6	—	—	1	0.8	—	—	2	1.1
Microtus sp.	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Medium-sized artiodactyl	3	42.9	—	—	—	—	3	2.5	—	—	6	3.4
cf. *Odocoileus* sp.	—	—	—	—	—	—	1	0.8	—	—	1	0.6
Total[a]	7	100.1	18	100.1	26	99.9	122	100.0	4	100.0	178	100.4

Key: NISP = number of identified specimens.

[a] Because of rounding of numbers, not all percentage totals equal 100.0.

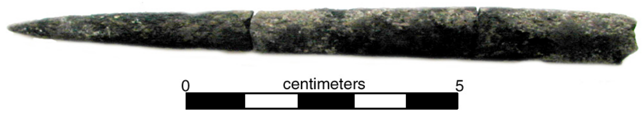

Figure 44. Splinter awl from Site 105/838 representing a fragmentary metapodial from a medium-sized-artiodactyl.

including one charred metapodial fragment that measured 13 cm in length (the largest specimen recovered from this site) and two small, unaltered shaft fragments. The three remaining deer-sized specimens were encountered during the excavation of the intramural pits. One of these, a radial carpal fragment, was collected from Subfeature 24. Subfeatures 4 and 37 each yielded a single, small, quadrangular shaft fragment.

Regardless of taxon, most of the specimens (122, or 68.5 percent) from the southern pit structure (Feature 23) were recovered from intramural pit fill (see Table 62). Only 3 of these, the 2 eggshell fragments from Subfeature 4 and 1 vole tooth from Subfeature 37, were charred or calcined (Table 63). Almost two-thirds of the calcined specimens were found in the floor fill, which suggests that these specimens burned with the structure. Two hearths, Subfeatures 1 and 5, contained 11 charred leporid-sized bone fragments. The remaining charred leporid-sized bone fragments were recovered from the house fill and floor fill, which also yielded 6 charred jackrabbit specimens. Few specimens (NISP = 7), whether charred, calcined, or intact, were recovered from the house fill, and even fewer (NISP = 4) from the postholes.

Feature 26

The 11.8-liter flotation sample removed from the second level of this small, open-air hearth discovered in Test Pit 222 yielded one ground squirrel–sized and four leporid bone fragments (see Table 61). With the exception of two leporid-sized shaft fragments, all specimens were charred and represented distal appendages, including two leporid third phalanges and one first phalanx from a ground squirrel–sized animal. This pattern of burning possibly represents the spit roasting of these animals as discussed by Szuter (1991:167) and described in ethnographic accounts (Spier 1928). The foot bones of ground squirrel–sized mammals were typically covered with very little flesh. It is likely that these body parts would burn readily and fall into a cooking fire or roasting pit if the animals were prepared by spitting (i.e., cooking an animal whole by placing it over an open fire). However, this interpretation is tentative because of the paucity of the remains recovered from this feature.

Feature 29

The northern pit structure, Feature 29, which also dates to the Camp Verde phase, contained the greatest number of vertebrate remains (NISP = 293) from any single feature at this site (Table 64; see Table 61). Leporid-sized specimens (NISP = 129) dominated the fauna from this pit structure, followed by jackrabbits, specimens identifiable as leporid only, and cottontails. As was true for Feature 23, ground squirrel–sized remains were more numerous than those that represented Muridae-sized animals. Despite the fact that the 17 analyzed flotation samples totaling 87.5 liters were examined, only mammal remains were recovered.

As was true for the southern pit structure, most (82.3 percent) of the recovered specimens from the northern pit structure were from flotation samples taken from intramural pits (see Table 64). But unlike the specimens recovered from the southern pit structure, a high percentage of the specimens from intramural pits within the northern house were charred or calcined, and all specimens recovered from the intramural hearths were fire altered (Table 65). Rabbit bones were the most numerous mammal remains recovered from all strata, but they were particularly concentrated in the intramural pits. This suggests that these intramural pits functioned partially as trash receptacles, and the hearth specimens probably were the discarded portions of prehistoric meals.

Ground squirrel–sized specimens were recovered from two intramural pits (Subfeatures 24 and 26) and an intramural hearth (Subfeature 1). Subfeature 24 contained a charred distal tibia and first phalanx, one calcined flat bone (e.g., scapula or innominate) fragment, and four unaltered specimens, including two metatarsals, one horizontal ramus, and a second phalanx. Subfeature 26 contained a single unaltered glenoid fragment. The hearth, Subfeature 1, contained two calcined and one charred ground squirrel-sized shaft fragment, and an additional shaft fragment was encountered in Subfeature 23.

Feature 30

Three specimens were recovered from the 2.4-liter flotation sample analyzed from this intrusive ash pit, which was located in the fill of Feature 29 (see Table 61). These included two leporid-sized shaft fragments and one lumbar-vertebra fragment. All specimens lacked evidence of burning and possibly were deposited during the cleaning of some other, nearby feature.

Feature 31

A 4.3-liter flotation sample removed from the southern half of this cobble-lined thermal feature produced two burned specimens (see Table 61). The first was a charred third phalanx from a jackrabbit, and the second was a calcined shaft fragment from a leporid-sized animal.

Feature 37

The western pit structure (Feature 37), which dated to the Squaw Peak phase, contained the smallest number of

Table 63. Number and Percentage of Charred and/or Calcined Specimens, by Stratum, from the Southern Pit House (Feature 23) at Site 105/838

Taxon	Southern Pit House										NISP Total	
	House Fill		Floor Fill		Hearth Fill		Pit Fill		Posthole Fill			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Fishes												
Cyprinidae sized	—	—	1	7.1	—	—	—	—	—	—	1	3.0
Birds												
Aves (eggshell)	—	—	—	—	—	—	2	66.7	—	—	2	6.1
Mammals												
Leporid sized	3	75.0	5	35.7	11	100.0	—	—	—	—	19	57.6
Leporid	—	—	1	7.1	—	—	—	—	—	—	1	3.0
Lepus cf. *californicus*	—	—	6	42.9	—	—	—	—	1	100.0	7	21.2
Muridae sized	—	—	1	7.1	—	—	—	—	—	—	1	3.0
Microtus sp.	—	—	—	—	—	—	1	33.3	—	—	1	3.0
Medium-sized artiodactyl	1	25.0	—	—	—	—	—	—	—	—	1	3.0
Total[a]	4	100.0	14	99.9	11	100.0	3	100.0	1	100.0	33	99.9

Key: NISP = number of identified specimens.

[a] Because of rounding of numbers, not all percentage totals equal 100.0.

Table 64. Number and Percentage of Identified Specimens, by Stratum, from the Northern Pit House (Feature 29) at Site 105/838

Taxon	Northern Pit House												NISP Total	
	House Fill		Floor Fill		Floor		Hearth Fill		Pit Fill		Posthole Fill			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Reptiles														
Crotalus sp.	—	—	—	—	—	—	2	11.1	—	—	—	—	2	0.7
Mammals														
Indeterminate	—	—	—	—	—	—	—	—	4	1.7	—	—	4	1.4
Leporid sized	—	—	9	50.0	—	—	8	44.4	105	43.4	7	70.0	129	44.0
Leporid	2	50.0	—	—	—	—	1	5.6	31	12.8	1	10.0	35	11.9
Lepus cf. *californicus*	1	25.0	5	27.8	1	100.0	3	16.7	65	26.9	—	—	75	25.6
Sylvilagus sp.	—	—	3	16.7	—	—	—	—	25	10.3	—	—	28	9.6
Spermophilus sized	—	—	—	—	—	—	3	16.7	9	3.7	—	—	12	4.1
Neotoma cf. *albigula*	—	—	1	5.6	—	—	—	—	—	—	—	—	1	0.3
Muridae sized	—	—	—	—	—	—	1	5.6	3	1.2	2	20.0	6	2.0
Medium-sized artiodactyl	1	25.0	—	—	—	—	—	—	—	—	—	—	1	0.3
Total[a]	4	100.0	18	100.1	1	100.0	18	100.1	242	100.0	10	100.0	293	99.9

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

Table 65. Number and Percentage of Charred and/or Calcined Specimens, by Stratum, from the Northern Pit House (Feature 29) at Site 105/838

Taxon	Northern Pit House												NISP Total	
	House Fill		Floor Fill		Floor		Hearth Fill		Pit Fill		Posthole Fill			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Reptiles														
Crotalus sp.	—	—	—	—	—	—	2	11.1	—	—	—	—	2	1.7
Mammals														
Indeterminate	—	—	—	—	—	—	—	—	—	—	1	16.7	1	0.8
Leporid sized	—	—	3	50.0	—	—	8	44.4	20	23.0	4	66.7	35	28.9
Leporid	2	66.7	—	—	—	—	1	5.6	19	21.8	—	—	22	18.2
Lepus cf. *californicus*	1	33.3	1	16.7	1	100.0	3	16.7	33	37.9	—	—	39	32.2
Sylvilagus sp.	—	—	1	16.7	—	—	—	—	11	12.6	—	—	12	9.9
Spermophilus sized	—	—	—	—	—	—	3	16.7	3	3.4	—	—	6	5.0
Neotoma cf. *albigula*	—	—	1	16.7	—	—	—	—	—	—	—	—	1	0.8
Muridae sized	—	—	—	—	—	—	1	5.6	1	1.1	1	16.7	3	2.5
Total[a]	3	100.0	6	100.1	1	100.0	18	100.1	87	99.8	6	100.1	121	100.0

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

faunal remains (Table 66). As was true for the other structures (Features 23 and 29), rabbit bone fragments dominated the recovered remains. Most (14 of the 19 recovered specimens) were situated in the floor fill, and only 1 was thermally unaltered. Although only 6 specimens could be identified to genus, cottontail bones were three times as abundant as jackrabbit bones. A flotation sample collected from an intramural posthole (Subfeature 7) contained a small, thermally unaltered eggshell fragment.

AZ O:1:85/AR-03-04-06-428 (ASM/CNF)

Excavation at Site 85/428 resulted in the collection of nine faunal specimens representing seven taxa, six mammalian and one piscean (see Table 60). A large roasting pit (Feature 2) contained six of these specimens, including the unaltered fish bone. The west half of a small, discrete rock cluster (Feature 4) housed a single unaltered Muridae-sized left humerus. An intact, unaltered third phalanx from an adult deer rested on the surface, and an artiodactyl scapula came from Stripping Unit 134. Feature 2 is treated separately below, because this large thermal feature contained most of the fauna recovered from this site.

Feature 2

This Squaw Peak phase roasting pit contained a single, unaltered proximal right tibia from a Muridae-sized animal. Perhaps the most interesting specimen recovered from this feature was a small precaudal fish centrum. The centrum body was all that preserved, and it was unaltered; it probably represents a small cyprinid (minnow) <10 cm in length. The means by which this fish bone came to be deposited in the roasting pit is unknown. It may have been deposited by humans as food refuse. Alternatively, it may have been deposited in the feature as part of an animal scat or as part of the intestinal contents of an animal butchered at the site. A left proximal deer tibia also was recovered. It, too, was unaltered by fire; lacked evidence of carnivore scavenging, such as tooth punctures or gnawing damage; and exhibited a classic spiral fracture suggestive of green-bone breakage (Binford 1981; Haynes 1983; Johnson 1985). It was broken within centimeters of the proximal articular surface, suggesting the possibility that the tibia and femur were disarticulated through breakage. Alternatively, the fracture may simply reflect the removal of the fat-rich marrow locked within the medullary cavity of the tibia. Leporid remains associated with this deer tibia included an unaltered right proximal cottontail radius, a calcined third phalanx from a leporid, and a small, tabloid leporid-sized shaft fragment.

These remains suggest that deer, leporids, and perhaps fish were pursued and processed by the occupants of Site 85/428. Although the small number of recovered specimens and identified taxa does not allow us to more precisely assess the dietary contribution that different animals represented in the ancient inhabitants' diet, it is likely that deer provided the primary source of animal products. Shelley (1993) estimated that a single deer provides a quantity of edible meat comparable to that from 100 cottontails, depending on the size of the individual animals. Consequently, it would require many rabbits to provide the amount of meat present in a single deer tibia.

AZ O:1:53/AR-03-04-06-745 (ASM/CNF)

Only five surface-collected bone fragments were recovered from this extensive, multilocus ceramic and lithic scatter (see Table 60). All specimens were calcined, and four were quadrangular long-bone fragments from medium-sized artiodactyls. None exhibited signs of prolonged weathering in the form of desiccation cracks, splintering, or exfoliation, and all easily met the requirements of Behrensmeyer's Weathering Stage 1 (see Appendix J:Table J.2). This suggests that the calcined specimens probably were of recent origin. Despite this inference, the effects of calcination on bone weathering remain a poorly understood taphonomic phenomenon, and it is possible that the bones were older than they appeared to be.

The organic fraction of bone is incinerated at the temperatures required to calcine bone (>600°C–700°C), but the essentially inert and inorganic hydroxyapatite fraction persists and is often fused (Shipman et al. 1984). Therefore, it is possible that the decay of calcined bone requires longer periods of exposure to chemical and physical weathering agents. Continued research in this area is necessary to enhance our understanding of how burning affects bone weathering, which would increase our ability to assess site-formation and taphonomic processes when using bone-weathering data.

AZ O:1:28/AR-03-04-06-903 (ASM/CNF)

Phase 2 field excavation of a possible Archaic period component, coupled with nested laboratory screening, resulted in the collection of 36 specimens that represented nine taxa: seven mammalian, one piscean, and one reptilian (Table 67; see Table 60). The only possible evidence of artiodactyl procurement was encountered in profile in Trench 126.

Flotation samples proved particularly useful in capturing vertebrate remains at this site, yielding 26 of the specimens—all of which were located in a small, buried, open-air hearth (Feature 1). The remaining 10 specimens

Table 66. Number and Percentage of Identified Specimens, by Stratum, from the Western Pit House (Feature 37) at Site 105/838

Taxon	Western Pit House								NISP Total	
	House Fill		Floor Fill		Pit Fill		Posthole Fill			
	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Birds										
Aves (eggshell)	—	—	—	—	—	—	1	100.0	1	5.3
Mammals										
Leporid sized	1	33.3	8	57.1	1	100.0	—	—	10	52.6
Lepus cf. *californicus*	1	33.3	1	7.1	—	—	—	—	2	10.5
Sylvilagus sp.	1	33.3	5	35.7	—	—	—	—	6	31.6
Total[a]	3	99.9	14	99.9	1	100.0	1	100.0	19	100.0

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

Table 67. Number and Percentage of Identified Specimens at Site 28/903

Taxon	Surface		Excavation Units		Trench 126		Feature 1		NISP Total	
	NISP	%	NISP	%	NISP	%	NISP	%	n	%
Fish										
Cyprinidae sized	—	—	—	—	—	—	1	6.3	1	2.8
Reptiles										
Crotalus sp.	—	—	—	—	—	—	1	6.3	1	2.8
Mammals										
Leporid sized	—	—	9	56.3	—	—	9	56.3	18	50.0
Leporid	—	—	1	6.3	—	—	1	6.3	2	5.6
Lepus sp.	—	—	2	12.5	—	—	2	12.5	4	11.1
Sylvilagus sp.	—	—	—	—	—	—	1	6.3	1	2.8
Thomomys cf. *bottae*	—	—	—	—	—	—	1	6.3	1	2.8
Medium-sized artiodactyl	—	—	4	25.0	3	100.0	—	—	7	19.4
Odocoileus sp.	1	100.0	—	—	—	—	—	—	1	2.8
Total[a]	1	100.0	16	100.1	3	100.0	16	100.3	36	100.1

Key: NISP = number of identified specimens.
[a] Because of rounding of numbers, not all percentage totals equal 100.0.

were either grab-sampled or screen captured during fieldwork. These specimens included the remains of black-tailed jackrabbits and deer-sized animals. These remains were found in the upper portion of a moderately formed cambic soil (Stratum IIIa) and were associated with numerous flaked and ground stone artifacts in the excavation units placed around the Feature 1 hearth. A right ilium and an acetabulum fragment represented a jackrabbit. The skeletal remains of deer-sized animals were present in the form of 5 small long-bone fragments (<25 mm): 4 unaltered and 1 calcined.

Trench 126

Three deer-sized long-bone fragments were found in the cambic horizon (Stratum IIIa) exposed in Trench 126, which was placed perpendicular to Dry Creek and immediately north of the Phase II block excavation (see Table 67). The specimens were severely weathered (Weathering Stage 3) and proved difficult to remove from the northern trench wall without undue breakage. This suggests that they probably weathered on the surface for several years before being incorporated into the overbank sediments and subsequent soil that enveloped them. These specimens consisted of a possible proximal shaft fragment of a tibia, one medioposterior metatarsal fragment, and another small, indeterminate diaphysis fragment. Artifacts were not directly associated with these specimens, and it is entirely possible that the bone fragments represented a deer-sized animal that gravitated to water before its death. However, these specimens were located in the same stratigraphic context as and less than 3 m from the occupational debris associated with Feature 1. This context suggested a cultural origin for these remains.

Feature 1

No bones or bone fragments were observed in or associated with this feature during excavation. However, the 6.6 liters of fill removed for flotation analysis from this small (40-cm-diameter), nondiscrete, open-air hearth yielded 16 faunal specimens (see Table 67) that were the remains of a small cyprinid, a rattlesnake, and several small-to-medium-sized mammals. No artiodactyl remains were encountered.

Fishes were represented by a single fish centrum, and the small diameter of the specimen indicated that it derived from a small minnow <10 cm in length. A precloacal vertebra identified as rattlesnake was found in the same sample. Both specimens lacked macroscopic evidence of burning. Mammal remains (14 specimens), particularly leporid-sized shaft fragments, dominated the feature; a jackrabbit innominate and distal tibia were also present. Many of the leporid-sized shaft fragments were charred or calcined, suggesting that they probably were discarded in the fire after people cooked and consumed the meat. Cottontails and pocket gophers were represented by a single unaltered specimen of each: a right glenoid and a molariform tooth, respectively. The pocket gopher tooth appeared modern and is considered intrusive. An unaltered and longitudinally fractured first phalanx could be identified only as leporid.

These remains indicate that at times, Feature 1 was used to process and cook small mammals, particularly rabbits, and perhaps even fish from nearby Dry Creek. The burned, leporid-sized shaft fragments suggest that rabbit bones were broken for the fat-rich marrow they contained and that the resultant fragments were tossed into the fire. However, there is no evidence, based on burning or breakage, that people used rattlesnakes for food. Rattlesnakes are adept burrow hunters, and the rattlesnake vertebra, like the pocket gopher tooth, probably is intrusive.

Intersite Comparisons

Although the middle Verde River region has witnessed more than 100 years of archaeological reconnaissance (e.g., Mindeleff 1896), surprisingly few faunal collections have been recovered and analyzed. For instance, before SRI's work at Site 105/838, one of the larger reported faunal collections from the region was recovered at the Verde Terrace site (AZ 0:5:6 [ASM]) (McGuire 1977:Table 12). However, the Verde Terrace site yielded only 121 bones and/or bone fragments identifiable to taxon. Similarly, only a handful of remains (NISP = 23) were reported from AZ N:4:23 (ASM), AZ N:4:27 (ASM), and AZ N:4:28 (ASM) excavated during the Verde Valley Ranch Project (Greenwald 1989) near Tuzigoot Ruins (Pierce 1989:Appendix D).

Table 68 shows a comparison of the number and percentage of identified specimens from the Verde Terrace site with those recovered by SRI at Site 105/838. The primary occupation of both sites dates to the Camp Verde phase (A.D. 900–1125/1150). Rabbit remains dominated both collections, but the lagomorph-index value for the Verde Terrace site (0.53) is four times greater than the 0.13 value for LOCAP Site 105/838. This suggests that cottontails were more abundant near the Verde Terrace site, but this difference may be a consequence of environmental setting rather than differences in site function, length of occupation, or commitment to agriculture. The Verde Terrace site is situated within 1.5 km (1 mile) of the Verde River and Beaver Creek. Similarly, AZ N:4:23 (ASM), which is situated within 1 km (0.6 mile) of the Verde River, contained nearly equal numbers (albeit few) of cottontail (NISP = 2) and jackrabbit (NISP = 3) bones. The very small sample, however, makes this site a poor candidate for comparison. Perennial riparian corridors provide cover and food and are an ideal cottontail habitat, in contrast to the ephemeral segment of Spring Creek situated near LOCAP Site 105/838. Thus, environmental setting alone probably explains the dramatic differences in the lagomorph-index values of these sites.

Nonmammalian taxa were rare, but archaeological fish remains from the middle Verde River region have been

Table 68. Number and Percentage of Identified Taxa from Site 105/838 and the Verde Terrace Site[a]

Taxon	Site 105/838		Verde Terrace Site		NISP Total	
	NISP	%	NISP	%	n	%
Fishes						
Teleost	—	—	5	4.1	5	0.8
Cyprinidae sized	1	0.2	—	—	1	0.2
Amphibians						
Anaxyrus cognatus	—	—	6	5.0	6	1.0
Rana sp.	—	—	4	3.3	4	0.6
Reptiles						
Kinosternon sp.	—	—	1	0.8	1	0.2
Crotalus sp.	3	0.6	—	—	3	0.5
Birds						
Aves (eggshell)	4	0.8	—	—	4	0.6
Passeriformes	—	—	1	0.8	1	0.2
Mammals						
Indeterminate	14	2.8	—	—	14	2.2
Leporid sized	222	44.1	—	—	222	35.6
Leporid	49	9.7	—	—	49	7.9
Lepus cf. *californicus*	110	21.9	37	30.6	147	23.6
Sylvilagus sp.	56	11.1	42	34.7	98	15.7
Sylvilagus cf. *audubonii*	1	0.2	—	—	1	0.2
Spermophilus sized	22	4.4	—	—	22	3.5
Spermophilus sp.	1	0.2	—	—	1	0.2
Thomomys cf. *bottae*	1	0.2	9	7.4	10	1.6
Dipodomys sp.	—	—	2	1.7	2	0.3
Neotoma cf. *albigula*	1	0.2	1	0.8	2	0.3
Muridae sized	9	1.8	—	—	9	1.4
Microtus sp.	1	0.2	—	—	1	0.2
Puma concolor	—	—	1	0.8	1	0.2
Medium-sized artiodactyl	7	1.4	9	7.4	16	2.6
cf. *Odocoileus* sp.	1	0.2	—	—	1	0.2
Odocoileus cf. *hemionus*	—	—	1	0.8	1	0.2
Antilocapra americana	—	—	1	0.8	1	0.2
Ovis canadensis	—	—	1	0.8	1	0.2
Total[b]	503	100.0	121	99.8	624	100.8

Key: NISP = number of identified specimens.
[a] Data on the Verde Terrace site adapted from McGuire (1977:Table 12).
[b] Because of rounding of numbers, not all percentage totals equal 100.0.

previously reported by McGuire (1977:Table 12) at the Verde Terrace site and by Minckley and Alger (1968) at Perkins Pueblo (AZ N:4:2 [ASM]). The Verde Terrace site yielded only 5 "teliost" (i.e., teleost, or bony fish) specimens, whereas Minckley and Alger (1968:92–96) analyzed 194 specimens from Perkins Pueblo and identified five species, including desert (Gila mountain) sucker (*Catostomus clarki*), Sonora sucker (*Catostomus insignis*), razorback sucker (*Xyrauchen texanus*), roundtail chub (*Gila robusta robusta*), and Colorado squawfish (*Ptychocheilus lucius*). None of the Perkins Pueblo specimens exhibited evidence of charring, and only three of the identified species—desert sucker, Sonora sucker, and roundtail chub—still swim the Verde River.

The former presence of razorback sucker and Colorado squawfish suggests marked changes in the Verde's annual flow regime in the upper Verde River valley near Perkins Pueblo. Both species prefer large, strongly flowing streams quite unlike today's shallow and sluggish middle Verde River (Miller 1961; Lowe 1964). According to Minckley and Alger (1968:96), "canyons above and below the Perkins Pueblo site may have afforded suitable habitat, however, when water levels were higher." We cannot discount the effects of human activities, such as deforestation and the eradication of beavers (*Castor*), on the Verde River's flow during the historical period (Whittlesey 1998a). Minckley and Alger's results suggest that effective annual precipitation and stream discharge were greater during the occupation of Perkins Pueblo than at present. Similarly, the segments of Oak and Spring Creeks situated near LOCAP Sites 105/838, 85/428, and 28/903 currently could sustain small minnows only on a short-term or seasonal basis at best. As mentioned previously, cyprinid species may migrate into these drainages during spring freshets and become trapped during drier conditions, thus becoming an easily collected resource.

Artiodactyl remains form a modest component of the reported middle Verde River region faunas. Together, deer and deer-sized bone fragments constituted only 4.1 percent of the LOCAP fauna (see Table 60). Single deer, pronghorn, and bighorn sheep specimens were recovered at the Verde Terrace site, although nine additional deer-sized bone fragments also were recovered (see Table 68). The general paucity of recovered artiodactyl remains suggests that these animals made less of a dietary contribution than did rabbits.

Discussion

By far, leporids were the most commonly encountered mammal remains at all three sites. This pattern is typical of faunal collections throughout the deserts of Arizona (Szuter 1991) and the Great Basin (Wegener 1998). The preponderance of leporid remains at LOCAP sites encourages us to consider how the prehistoric occupants of the middle Verde River region exploited this important source of meat, fat, and furs. Furthermore, the highly fragmented nature of the LOCAP faunal collection suggests that a review of the ethnographic and taphonomic literature may shed light on the behaviors and agents responsible for the bone breakage. Fortunately, there is little question concerning the cultural origin of most of the faunal collection. Most remains rested in the three pit structures encountered at Site 105/838. In addition, several taphonomic studies (e.g., Brain 1981; Bunn 1982) have suggested that high percentages of minimally identifiable specimens—such as those dominating the LOCAP collection—are a characteristic by-product of human food processing. Similarly, Gifford-Gonzalez's (1989:Figure 6) research indicates that humans produce more indeterminate bone fragments than do African wild dogs (*Lycaon pictus*) and North American wolves (*Canis lupus*).

Cross-Cultural Data on Rabbit Procurement and Processing

Cross-cultural comparisons of the procurement and processing of small-to-medium-sized mammals present one possible means of interpreting the project collection. Ethnographically, the horticulturists of the Southwest employed diverse techniques when hunting rabbits. The Havasupai (Spier 1928:113), the Maricopa (Spier 1933:67), the Zuni (Cushing 1920:591–592), and the Tewa (Parsons 1929:133) skewered cottontails with sticks. Tohono O'odham and Tarahumara hunters dispatched jackrabbits with bows and arrows (Castetter and Underhill 1935:42; Lumholtz 1912:11). The Maricopa used traps (Spier 1933:37). The Tohono O'odham (Densmore 1929:180), the Tarahumara (Bennet and Zingg 1976:115; Pennington 1963:90), and the Seri (McGee 1898:197) also ran the animals down. All these groups held communal rabbit hunts, as did the Navajo, the Hopi, the Pima, the Yavapai, the Walapai, and the Mohave (Spier 1928:121). Ceremony was often associated with communal hunts. The Tewa (Parsons 1929:135) held a *katsina* dance before a hunt, and the Zuni hunted after the corn harvest as a means of giving thanks (Stevenson 1904:442).

When compared to those describing procurement, ethnographic accounts of the processing of small-to-medium-sized mammals are few. Ethnographers reported that the Maricopa (Spier 1933:66) and the Tohono O'odham (Joseph et al. 1949:29) dried and stored rabbit meat. Whether this entailed the entire carcass is not described. Perhaps the most detailed descriptions of rabbit processing are from the Great Basin. Numic groups living in the Great Basin relied extensively on rabbit meat and fur. If the rabbits were to be eaten immediately, the usual practice was to cook them whole by pit roasting. 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 crushing most of the porcupine (*Hystrix*) and springhare (*Pedetes*) bones added to meals in their Kalahari camps. Both accounts describe behaviors that result in highly fragmented and minimally identifiable faunal collections similar to those encountered by SRI excavators at the LOCAP sites.

Mobility and Communal Hunting

Most of the year, highly mobile Archaic and protohistoric nuclear families probably hunted individual small mammals. The seasonal abundance of critical and productive resources—for example, intervals when patches of agave and piñon nuts were ready to be harvested—allowed several nuclear families to work together. As recorded in ethnographic accounts, during these intervals the combined efforts of a sufficient number of people made communal net hunting effective and possible. This scenario is well documented for the Northern Paiute (Couture et al. 1986:Figure 2; Fowler 1986:82–83; Whiting 1950:19) and the Western Shoshone (Steward 1970:122, 176). These Numic groups routinely held communal rabbit drives near their fall camps, where abundant seasonal plant resources allowed several families to stay in one place in November, when pelts were in their prime. Drive captains—important leaders who did not inherit this status but earned it through demonstrated skill—directed the placement of large nets (>100 m in length) to form semicircular or V-shaped enclosures in the brush-filled valley bottoms. Men, women, and children then systematically drove large numbers of jackrabbits and an occasional cottontail into the net(s).

The commitment to place and the reduced mobility patterns of the larger, later Formative populations of the U.S. Southwest, such as the Southern Sinagua, undoubtedly made communal net hunting easier to carry out. Scheduling and manpower probably were less problematic. Subsequently, the annual number of net hunts probably increased. This hypothesized increase in the frequency of net hunting probably has an archaeological signature.

Ontogeny, Ethology, and Hunting Techniques

Jackrabbits rely on speed (up to about 40 km per hour) and distance to avoid predators, whereas cottontails depend on cover and rarely flee farther than 30 m when flushed. These differences are related to habitat preferences, which are rooted in the ontogeny and evolutionary history of these animals. Female jackrabbits give birth to precocial offspring in open, fur-lined hollows. The young are hopping about in a few days—a behavioral adaptation that appears to have developed in open environments. Consequently, juvenile jackrabbits are better able to avoid predators in open terrain when compared to the altricial offspring of their cottontail relatives. However, this rapid development and reliance on speed makes them more susceptible to net hunting when compared to cottontails. Cottontails prefer rocky hill and canyon country, where they rest in rocky crevices and thick brush during the day. Cottontail newborns are very small and somewhat helpless, and they require cover for protection and several weeks' growth before leaving the form, or nest. These attributes make cottontails an easier prey to capture for individual hunters. Hence, it is likely that individual prehistoric hunters successfully hunted more juvenile cottontails than jackrabbits throughout the year. The cottontail's tendency to hide instead of running is also advantageous to individual hunters.

If we are correct in assuming that Late Archaic and Formative period groups engaged in communal net hunts more frequently than their less numerous and more mobile Early and Middle Archaic predecessors, then jackrabbit remains should dominate the leporid component of faunal collections postdating the Middle Archaic period. Hunting-and-gathering groups of the protohistoric period may present a possible exception. For instance, Yavapai families dwelling in the middle Verde River region probably faced scheduling and manpower constraints similar to those experienced by Middle Archaic period populations. Unfortunately, we did not gather data to test this hypothesis, but faunal data could help to evaluate this idea.

Furthermore, if net hunting was a major hunting technique of Formative period populations and all entangled rabbits were killed, this technique would effectively produce a random sample of animals of various ages. Black-tailed jackrabbits breed from January through July, producing one to four litters consisting of one to eight young. Growth is rapid, and young are about as heavy as their parents in only 10 weeks (Zeveloff 1988:98–99). Thus, the presence of few specimens that represented juvenile animals in large collections of jackrabbit remains may identify late-fall or winter procurement. Conversely, large collections containing a fairly even number of juvenile and adult specimens could represent late-spring and summer procurement.

Butchering Patterns

It has long been suggested that bone-grease rendering produces faunal collections dominated by many tiny bone fragments (Leechman 1951; Noe-Nygaard 1977). Vehik (1977:172–173) proposed that bone-grease rendering leaves the following evidence: (1) the presence of many small bone fragments, (2) low percentages of bones with high grease content, and (3) the presence of fire-cracked rock, hammerstones, anvil stones, and firepits. These seminal studies focused on large-mammal processing; however, similar patterns probably were produced when people prepared rabbits, or rabbit-sized animals, for cooking or storage. If so, then grease-rich bones may have been broken beyond recognition, which in turn probably would result in few identifiable grease-rich bones.

Observed and expected frequencies were calculated for three postcranial regions—axial, thoracic limb, and pelvic limb—in order to test the hypothesis that grease-rich bones were significantly underrepresented in the Site 105/838 faunal collection (Table 69). Only leporid, leporid-sized, jackrabbit, and cottontail bones from Site 105/838 (NISP = 438) were used in the following calculations (see Tables 60 and 61). Cervical (n = 7), thoracic (n = 12), and lumbar (n = 7) vertebrae were placed in the axial category. Bones assigned to the thoracic limb included the scapula, humerus, radius, and ulna. The femur, tibia, and innominates were placed in the pelvic-limb category. Metapodials were excluded because they contain minimal grease or marrow and are covered with little soft tissue. Observed percentages are based on the number of rabbit, or rabbit-sized, specimens recovered from Site 105/838 that could be identified as a particular bone (e.g., humerus or tibia) (n = 89). Expected percentages were calculated by dividing the number of particular bones identified per skeletal region by the number of bones present in each skeletal region. For example, the scapula, humerus, radius, and ulna were assigned to the thoracic-limb region for analysis. Each of these bones is paired—for example, a left and a right radius. Therefore, the expected number of thoracic-limb bones in this analysis totals 8, or 20 percent, of the 40 bones considered. Similarly, the expected number of pelvic bones totals 6, or 15 percent, of the 41 bones considered. One-way goodness-of-fit tests (Hays 1973:717–723) identified significant differences between the observed and expected frequencies of skeletal elements at Site 105/838 ($x^2 = 143.7$; $df = 2$; $p < .001$). This suggests that it is highly unlikely that the differences between the expected and observed percentages are the result of sampling. Differential preservation, and perhaps butchering and cooking methods, probably account for these significant discrepancies.

Grease- and fat-rich vertebrae are conspicuously underrepresented at Site 105/838, but the meat- and marrow-laden long bones of the thoracic and pelvic limbs are overrepresented (see Table 69). This pattern may indicate that people processed the axial skeleton by crushing it, thus producing many minimally identifiable fragments. Reducing the vertebra this way exposes the grease-rich cancellous tissue and decreases the time necessary to render it. Conversely, this survivorship pattern also corresponds with the structural density of the individual bones and probably signals density-mediated attrition (Lyman 1994; Lyman et al. 1992). Skeletal parts with low structural density—cancellous vertebrae, for instance—are more easily destroyed than the dense cortical bone that characterizes long-bone diaphyses. Nonetheless, this correspondence between structural density and the observed and expected frequencies does not negate the fact that the Site 105/838 faunal collection suggests that intensive processing of rabbits and rabbit-sized animals took place there.

Excluding teeth, long-bone articular ends are perhaps the most identifiable portions of the postcranial skeleton, whereas minimal fragmentation may render vertebrae unidentifiable. Examining the number and percentage of specimens in each of the five NISP categories and six size grades (see the analytic methods section above) clearly argues for the intensive processing of rabbits and rabbit-sized animals at that site. Of the 438 rabbit and rabbit-sized bones recovered from Site 105/838, only 48 (10.9 percent) were intact, but small, quadrangular (i.e., <15 mm) diaphysis fragments constituted 54.4 percent (NISP = 243) of the sample. Articular ends and flat-bone fragments (e.g., scapulae and pelvic and cranial bones) form 14.3 and 17.6 percent of the collection, respectively. Teeth and tooth fragments constitute a minor 3.3 percent of the collection. This preponderance of small shaft fragments, coupled with the paucity of vertebrae and intact specimens, suggests that the entire postcranial skeleton was intensely processed. If so, rabbits probably provided an important—if not primary—source of meat, fat, and furs for the Formative period occupants of Site 105/838.

Animal Resources and Changing Subsistence Patterns through Time in the LOCAP Study Region

Faunal bone, teeth, and eggshell recovered from 4 of the 13 sites investigated during the LOCAP provide new data for understanding prehistoric subsistence in the middle Verde River region. Particularly useful are the faunal data that derived from features that could be assigned calendrical dates or temporal phases on the basis of radiocarbon assay, archaeomagnetic analysis, ceramic-production dates, and diagnostic projectile point styles. Among these are 16 specimens associated with a Late Archaic period thermal feature (Site 28/903 [Feature 1]), 19 specimens associated with an Early Formative period Squaw Peak phase pit structure (Site 105/838 [Feature 37]), 6 specimens from a Squaw Peak phase roasting pit (Site 85/428 [Feature 2]), and 504 specimens from two Middle Formative Camp Verde phase pit structures (Site 105/838 [Features 23 and 29]). To gain a broader perspective on faunal-resource use through time, however, we assembled faunal data from

Table 69. Observed and Expected Frequencies and Chi-Square Values, for Leporid-Sized Bones from Site 105/838

Skeletal Segment	Observed		Expected		Chi-Square
	NISP	%	NISP	%	
Axial	8	9.0	26	65.0	48.2
Thoracic limb	40	44.9	8	20.0	31.0
Pelvic limb	41	46.1	6	15.0	64.5
Total	89	100.0	40	100.0	143.7

Key: NISP = number of identified specimens.

similarly dated contexts in the middle Verde River region and present these data in Table 70.

Eighteen components (two Archaic period components and three Squaw Peak, one Hackberry/ Cloverleaf, two Cloverleaf, one Late Cloverleaf/Early Camp Verde, four Camp Verde, four Honanki, and one Tuzigoot phase components) deriving from 17 archaeological sites were used in this comparative study (Caywood and Spicer 1935; Deats et al. 2004; Goodman et al. 2000; Hallock 1984; Hartman 1976; James and Black ca. 1974; Kriegh 1977; Logan et al. 1992; McGuire 1977; Pierce 1989; Shutler and Adams ca. 1949). More than 2,006 individual specimens representing 56 different taxa are listed in Table 70. Mammals contributed the greatest number of taxa (n = 29), followed by birds (n = 17), reptiles (n = 5), amphibians (n = 2), fishes (n = 2), and mollusks (n = 1). The NISP was greatest for mammals (n = 1,645), followed by mollusks (n = 113), fishes (n = 39), reptiles (n = 22), birds (n = 18), and amphibians (n = 7). Unidentified animal bone (n = 163), typically in the form of small, nondiagnostic fragments, accounted for the remainder.

Of the mammals, specimens representing the order Lagomorpha (n = 696) were the most frequently encountered in the archaeological record, followed by artiodactyls (n = 250), rodents (n = 80), and carnivores (n = 13). Additionally, the presence, but not the quantity, of perissodactyl (herbivorous, hoofed mammals, such as horses) remains was noted at Tuzigoot Pueblo. Mammals identifiable only to a size class (small, small-medium, medium, and large) (n = 606) constituted more than one-third of the collection.

The focus on jackrabbits, cottontails, and deer as important subsistence resources was firmly established during the Archaic period. As shown in Table 71, by the Camp Verde phase (A.D. 900–1125/1150), virtually all other mammalian, piscean, and reptilian taxa documented in Table 70 appear to have been considered economic resources for the Formative period populations of the middle Verde River region. The faunal remains from the two Camp Verde phase pit structures (Features 23 and 29) at LOCAP Site 105/838 are typical of the range of subsistence resources recovered from the small residential sites during the Middle Formative period. Not until the Tuzigoot phase, however, do we have clear evidence for the capture of a wide variety of avian taxa and the recovery of carnivores—species that may have been valued more for their feathers, pelts, bones, and symbolic associations than for their meat and other tissues.

Despite the ubiquity of jackrabbit, cottontail, and deer remains in most of these faunal collections, the changing ratios of taxa through time does suggest that changes in prey species, prey abundance, or the physical habitat that supported these animals influenced human subsistence behavior. Table 72 presents the lagomorph, artiodactyl, and large-game indexes for sites in Table 70 that have frequency data rather than presence/absence data. Because the total number of specimens is relatively small, especially for the older site components, we have grouped sites by temporal period. The five sites dating to the Late Archaic period (ca. 2000 B.C.–A.D. 1) and Squaw Peak phase (A.D. 1–650) were grouped, as were the three sites assigned to the Hackberry phase (A.D. 650–700/800) and Cloverleaf phase (A.D. 700/800–900). Three of five Camp Verde phase (A.D. 900–1125/1150) sites were used in this study, as were three of the four Honanki phase (A.D. 1125/1150–1300) sites. The single Tuzigoot phase (A.D. 1300–1400/1425) site was not used, because the data were reported only as presence/absence.

The lagomorph index indicates that there was a decline in the recovery of cottontails compared to jackrabbits by the Hackberry/Cloverleaf interval that continued into the Camp Verde phase. The surprisingly high lagomorph index for the Honanki phase suggests that more cottontails were taken than jackrabbits during this late interval (discounting the possibility that immature or small jackrabbits may have been misclassified as cottontails). This probably is a sampling problem. The two sites that contributed most of the bone to the Honanki sample (Cross Creek Ranch Pueblo and the Talon site) are located along Oak Creek near Red Rock State Park, adjacent to areas heavily vegetated with riparian plant communities and piñon-juniper woodlands. That the lagomorph index in Table 72 is *not* low suggests that cottontails thrived near this ecotonal habitat, where vegetation was lush and provided food and

Table 70. Faunal Remains from Archaeological Sites in the Middle Verde River Valley Inferred to be Subsistence Resources

Taxon	Archaic		Squaw Peak			Hackberry-Cloverleaf	Cloverleaf		Late Cloverleaf–Early Camp Verde	Camp Verde				Early Honanki	Honanki			Tuzigoot	Total
	Campsite		Resource Processing		Habitation	Habitation	Habitation		Habitation	Habitation				Habitation	Habitation			Habitation	
	NA50051[a] (Dry Creek)	28/903[b] (F 1)	AR-03-04-06-722[c]	85/428[b] (F 2)	105/838[b] (F 37)	AZ N:4:23[d] (Verde Terrace) (F 3, F 4)	AZ N:4:18[e] (Kish)	AZ O:5:12[f] (Verde View)	NA11076[g] (Lazy Bear)	AZ O:5:6[f] (Verde Terrace)	AZ O:1:29[h] (Woods)	NA20981[i] (Allredge)	105/838[b] (F 23, F 29)	NA5111[a] (Panorama Ruin)	NA4490[a] (Kittredge Ruin)	AR-03-04-06-703[c] (Cross Creek Ranch)	AZ O:1:141[j] (Talon Site) (Areas 23–26, F 1, F 2, F 8)	AZ N:4:1[k] (Tuzigoot Pueblo)	
Mollusks																			
Anodonta californiensis	—	—	—	—	—	—	—	4	—	65	present	—	35	—	present	—	9	present	113
Fishes																			
Cyprinidae sized	—	1	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	3
Osteichthyes	—	—	—	—	—	—	7	—	—	5	—	—	—	—	—	24	—	—	36
Reptiles																			
Serpentes	—	—	—	—	—	—	—	—	—	—	present	—	—	—	—	—	—	—	present
Crotalus sp.	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2
cf. *Pituophis catenifer*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	7
Testudinidae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	—	11
Kinosternon sp.	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	2
Amphibians																			
Anaxyrus cognatus	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	6
Rana sp.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Birds																			
Aves	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	3	present	5
Aves (eggshell)	—	—	—	—	1	—	—	—	—	—	—	—	3	—	—	—	—	—	4
Aechmophorus occidentalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Ara macao	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Buteo jamaicensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Buteo swainsoni	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Callipepla gambelii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	6
Corvus corax	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	present	1
Falco peregrinus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Fulica americana	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Meleagris gallopavo	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Mycteria americana	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Anatidae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Anas platyrhynchos	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Branta canadensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Mergus serrator	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Picidae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Mammals																			
Artiodactyls																			

continued on next page

Taxon	Archaic		Squaw Peak			Hackberry-Cloverleaf	Cloverleaf		Late Cloverleaf–Early Camp Verde	Camp Verde				Early Honanki	Honanki			Tuzigoot	Total
	Campsite		Resource Processing		Habitation	Habitation	Habitation		Habitation	Habitation				Habitation	Habitation			Habitation	
	NA50051[a] (Dry Creek)	28/903[b] (F 1)	AR-03-04-06-722[c]	85/428[b] (F 2)	105/838[b] (F 37)	AZ N:4:23[d] (Verde Terrace) (F 3, F 4)	AZ N:4:18[e] (Kish)	AZ O:5:12[f] (Verde View)	NA11076[g] (Lazy Bear)	AZ O:5:6[f] (Verde Terrace)	AZ O:1:29[h] (Woods)	NA20981[i] (Allredge)	105/838[b] (F 23, F 29)	NA5111[a] (Panorama Ruin)	NA4490[a] (Kittredge Ruin)	AR-03-04-06-703[c] (Cross Creek Ranch)	AZ O:1:141[j] (Talon Site) (Areas 23–26, F 1, F 2, F 8)	AZ N:4:1[k] (Tuzigoot Pueblo)	
Antilocapra americana	1	—	—	—	—	—	—	—	present	1	—	—	—	13	4+	—	—	present	19
Cervus canadensis	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Medium-sized artiodactyl	13	—	—	—	—	1	61	2	present	9	—	2	7	—	—	8	—	—	103
Odocoileus sp.	3	—	6	—	—	—	50	—	present	1	present	—	—	1	3+	19	37	present	120
cf. *Odocoileus* sp.	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2
Ovis canadensis	—	—	—	—	—	—	—	—	—	1	present	—	—	2	1+	—	—	—	4
Carnivores																			
Canis sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	present	7
Canis latrans	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	—	—	—	present
Lynx rufus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	present	5
Procyon lotor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Puma concolor	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Taxidea taxus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Ursus sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Lagomorphs																			
Leporidae	—	1	—	1	—	—	100	—	—	—	—	—	47	—	—	—	—	—	149
Lepus cf. *californicus*	2	2	—	—	2	2	68	4	present	37	—	—	108	1	2+	34	5	present	267
Sylvilagus sp.	—	1	—	1	6	2	61	—	present	42	present	—	50	—	present	75	41	present	279
cf. *Sylvilagus* sp.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Perissodactyls																			
Equus caballus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	—	—	—	present
Rodents																			
Castor canadensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	present
Dipodomys sp.	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2
Erethizon dorsatum	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Microtus sp.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Neotoma cf. *albigula*	—	—	—	—	—	—	4	—	—	1	present	—	1	—	—	8	—	—	14
Ondatra zibethicus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	present	1
Peromyscus sp.	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	3
Thomomys cf. *bottae*	—	1	—	—	—	1	11	—	—	9	present	—	1	—	—	27	—	—	50
Sciuridae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	4
Cynomys sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	present	—	3	—	3
Spermophilus sp.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Unidentified mammal																			

Taxon	Archaic		Squaw Peak			Hackberry-Cloverleaf	Cloverleaf		Late Cloverleaf–Early Camp Verde	Camp Verde				Early Honanki	Honanki			Tuzigoot	Total
	Campsite		Resource Processing		Habitation	Habitation	Habitation		Habitation	Habitation				Habitation	Habitation			Habitation	
	NA50051[a] (Dry Creek)	28/903[b] (F 1)	AR-03-04-06-722[c]	85/428[b] (F 2)	105/838[b] (F 37)	AZ N:4:23[d] (Verde Terrace) (F 3, F 4)	AZ N:4:18[e] (Kish)	AZ O:5:12[f] (Verde View)	NA11076[g] (Lazy Bear)	AZ O:5:6[f] (Verde Terrace)	AZ O:1:29[h] (Woods)	NA20981[i] (Allredge)	105/838[b] (F 23, F 29)	NA5111[a] (Panorama Ruin)	NA4490[a] (Kittredge Ruin)	AR-03-04-06-703[c] (Cross Creek Ranch)	AZ O:1:141[j] (Talon Site) (Areas 23–26, F 1, F 2, F 8)	AZ N:4:1[k] (Tuzigoot Pueblo)	
Small mammal (rodent sized)	—	—	—	1	—	2	—	—	present	—	—	—	29	—	—	29	16	—	77
Small to medium-sized mammal (rabbit sized)	—	9	—	1	10	—	—	—	—	—	—	—	203	—	—	123	19	—	365
Medium-sized mammal (coyote-sized)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	—	—	14
Large mammal (deer sized)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	112	22	—	134
Indeterminate mammal	—	—	—	—	—	—	—	2	—	—	—	—	14	—	—	—	—	—	16
Unidentified bone fragments	—	—	—	—	—	—	82	—	—	41	—	18	—	—	—	16	6	—	163
NISP Total	20	16	6	6	19	9	448	13		224		20	504	18	10	532	161		2,006

Note: Site numbers preceded by AZ are Arizona State Museum (ASM) sites; those preceded by AR are Coconino National Forest (CNF) sites; those preceded by NA are Museum of Northern Arizona (MNA) sites.

Key: F = feature; NISP = number of identified specimens.
[a] Sheilagh Thompson Brooks and Milton Wetherill identifications in Shutler and Adams (ca. 1949).
[b] Wegener (this volume).
[c] Goodman et al. (2000).
[d] Pierce (1989).
[e] Kriegh (1977).
[f] Sandra Arndt identifications in McGuire (1977).
[g] George Ruffner identifications in James and Black (ca. 1974).
[h] Hallock (1984).
[i] Logan et al. (1992).
[j] Deats et al. (2004).
[k] Gerrit Miller, Jr., Alexander Wetmore, Ward Russell, and Alden Miller identifications in Caywood and Spicer (1935) and Hartman (1976).

Table 71. Earliest Evidence of Fauna from Archaeological Sites in the Verde River Region, by Site Age

Animal, by Site Age	Site	Reference
Archaic (6500 B.C.–A.D. 1)		
Minnow-sized fish	LOCAP Site 28/903	this volume
Pocket gopher	LOCAP Site 28/903	this volume
Porcupine	Dry Creek (NA50051)	Shutler and Adams ca. 1949
Pronghorn	Dry Creek (NA50051)	Shutler and Adams ca. 1949
Rattlesnake	LOCAP Site 28/903	this volume
Squaw Peak phase (A.D. 1–650/700)		
Bird eggshell	LOCAP Site 105/838	this volume
Hackberry (A.D. 650 –700/800) and Cloverleaf phase (A.D. 700–800/900)		
Mud turtles	Verde Terrace site (AZ N:4:23 [ASM])	Pierce 1989
Cloverleaf phase (A.D. 700–800/900)		
Bird bone	Kish (AZ N:4:18 [ASM])	Kriegh 1977
Elk	Verde View (AZ O:5:12 [ASM])	McGuire 1977
Freshwater clam	Verde View (AZ O:5:12 [ASM])	McGuire 1977
White-footed mouse	Kish (AZ N:4:18 [ASM])	Kriegh 1977
Woodrats	Kish (AZ N:4:18 [ASM])	Kriegh 1977
Camp Verde phase (A.D. 900–1125/1150)		
Frog	Verde Terrace (AZ O:5:6 [ASM])	McGuire 1977
Ground squirrel	LOCAP Site 105/838	this volume
Kangaroo rat	Verde Terrace (AZ O:5:6 [ASM])	McGuire 1977
Mountain lion	Verde Terrace (AZ O:5:6 [ASM])	McGuire 1977
Bighorn sheep	Verde Terrace (AZ O:5:6 [ASM])	McGuire 1977
Toad	Verde Terrace (AZ O:5:6 [ASM])	McGuire 1977
Honanki phase (A.D. 1125/1150–1300)		
Canid	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Coyote	Kittredge Ruin (NA4490)	Shutler and Adams ca. 1949
Bobcat	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Horse	Kittredge Ruin (NA4490)	Shutler and Adams ca. 1949
Muskrat	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Prairie dog	Kittredge Ruin (NA4490)	Shutler and Adams ca. 1949
Quail	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Turkey	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Woodpecker	Cross Creek Ranch Pueblo (AR-03-04-06-703)	Goodman et al. 2000
Honanki (A.D. 1125/1150–1300) and Tuzigoot (A.D. 1300–1400/1425) phase		
Badger	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976
Bear	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976
Beaver	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976
Birds, multiple taxa	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976
Raccoon	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976
Scarlet macaw	Tuzigoot (AZ N:4:1 [ASM])	Caywood and Spicer 1935; Hartman 1976

Table 72. Faunal Indexes for the Sample of Regional Sites

Period or Phase (No. of Sites)	Lagomorph Index[a] S/(S + L)	Artiodactyl Index[a] A/(A + L)	Artiodactyl Index[b] $A_g/(A_g + L)$	Large-Game Index[c] $(A + A_{ms})/(L + L_s)$	Large-Game Index[d] A/(L + R)
Archaic and Squaw Peak (n = 5)	0.50	0.63	0.37	0.67	1.52
Hackberry and Cloverleaf (n = 3)	0.46	0.33	0.18	0.49	0.45
Camp Verde (n = 3)	0.39	0.08	0.02	0.05	0.08
Honanki (n = 3)	0.74	0.34	0.32	0.72	0.40

Key: A = NISP-artiodactyl; A_g = NISP–artiodactyl and artiodactyl-sized fragments; A_{ms} = NISP–all artiodactyl-sized fragments; L = NISP–all leporids; L_s = NISP–leporid-sized; R = NISP-rodents; S = NISP–all cottontails.
[a] Szuter (1991); Szuter and Bayham (1989).
[b] Jon Driver (personal communication 2004).
[c] This study.
[d] Szuter and Bayham (1989:83).

shelter for many small animals. Nevertheless, the diminishing number of cottontails relative to jackrabbits in the earlier periods does suggest that changes in the abundance of these two genera took place over time. It is likely that human-induced changes to the habitat surrounding habitation sites—clearing of land for fields and cutting of trees and brush for timber and fuel—resulted in the changing frequencies of these leporid taxa.

Both versions of the artiodactyl index and the large-game index show exactly the same pattern as the lagomorph index. They diminish through time. Again, the two Honanki sites along Oak Creek influence the values for the final phase in Table 72, for the same reasons given above. The artiodactyl and large-game indexes also illustrate another trend when they are compared to the lagomorph index—namely, the prevalence of small game relative to large game in the residues recovered in archaeological sites increases through time. The relative dominance of leporids and other small game may reflect the depletion of locally available deer and pronghorn near habitation sites and their immediate resource catchments rather than the total depletion of these artiodactyl populations from the middle Verde River region. Future detailed recording of artiodactyl skeletal elements would help clarify this situation and lend support to the argument that hunting parties established long-distance hunting camps and returned to the home base with choice cuts. The fact that the Honanki phase artiodactyl and large-game indexes are higher than their Camp Verde phase counterparts supports the idea that game species were not totally depleted. Nevertheless, the Honanki phase artiodactyl and large-game indexes generally are lower than those for the Late Archaic period–Squaw Peak phase interval, which implies that changes in the numbers and distribution of large-animal populations had indeed taken place by the Late Formative period.

In sum, we suggest that the faunal collection from the LOCAP sites is a reasonably representative sample of faunal collections recovered from sites in the middle Verde River region and that useful information on resource abundance, subsistence patterns, and human-environment interactions is contained in our collection. When these data are integrated with the results of pollen and macrobotanical analyses, important insights into the socioeconomic patterns of prehistoric populations will be possible.

Concluding Remarks

The reporting and analysis of faunal remains from archaeological sites in the middle Verde River region have evolved since the first professional investigations in the early twentieth century. No longer are excavators merely describing the various finished tools manufactured from animal bone, tissue, and fur. Today, animal remains are collected as in situ objects point-provenienced on house floors and occupational surfaces, as medium-sized specimens recovered in excavation screens with sieved openings ranging from 1/4 to 1/16 inch, and occasionally, as with the LOCAP sites, as small fragments recovered from sediment samples collected for pollen and flotation analysis. Contemporary faunal analysts typically identify animal bone, teeth, and other durable parts to the lowest taxonomic category and record other potentially informative data, such as the completeness of the specimen, specimen size, presence or absence of burning, and evidence of butchering. Less commonly, faunal analysts working in the U.S. Southwest record degree of weathering and processing intensity. It can be argued, on the basis of behavior described in ethnographic reports, that faunal data can potentially address issues of ethnicity or social identity if a careful analysis of prey selection, carcass processing, and ritual use of faunal items can be applied to a faunal collection of sufficient size and diversity. At a minimum, differences among Archaic, Formative, and precontact and historical-period Yavapai and Apache populations should be discernible. Further, the need to synthesize data collected from a wide array of site types and periods is essential, as it is necessary to contrast and compare data to detect trends across space and through time.

In conclusion, it is fair to say that the inclusion of the smallest faunal remains recovered by archaeologists during the LOCAP resulted in the collection of useful information. Fish bones, snake vertebrae, rodent teeth, and eggshell augment the usual recovery of cottontail, jackrabbit, and deer bones identified in archaeological sites of the middle Verde River region. Had more subsurface features been found with the ADOT ROW, we might have been able to reach more-definitive conclusions about the subsistence practices of the ancient populations. Nonetheless, the recovery of 553 faunal specimens and their analysis resulted in one of the largest reported faunal collections in the middle Verde River region to date—a well-documented collection that can be used by future analysts for some time to come.

CHAPTER 9

Geomorphology of the Lower Oak Creek Archaeological Project Area, with Reference to Verde River and Sinagua Agricultural Dynamics

Gary A. Huckleberry and Philip A. Pearthree

The middle Verde River region contains a wealth of natural and cultural prehistory, much of which has only recently been studied in any systematic detail. In terms of archaeology, this is a region of prehistoric cultural mixing, a valley influenced by the migrations and interaction of people from the desert lowlands to the south and west and the forested uplands to the north and east. Although visited by Paleoindian and Archaic groups, not until the Formative period—about 2,000 years ago—did the middle Verde region become a place of permanent settlements. Many of those permanent settlements are still visible today, and some have been set aside as protected national monuments, such as Tuzigoot and Montezuma Castle. These most visible constructions were created by the Sinagua people, who lived in the region during the time spanning approximately A.D. 650–1425. The Sinagua homeland extended to the forested slopes of the San Francisco Peaks. The Spanish name "Sinagua," or "without water," was assigned to them by archaeologist Harold S. Colton (1939, 1960). However, in the middle Verde region, Sinagua is a misnomer, because the people had reliable water; the area is supported by several perennial streams, including the Verde River and Oak Creek. Occupying this comparatively well-watered region was the branch of the Sinagua known as the Southern Sinagua (Pilles 1981a).

The Southern Sinagua represent a prehistoric cultural zenith in the middle Verde region, but like many of the other great prehistoric cultural traditions of the Southwest—Hohokam, Anasazi, Mogollon, and Salado—the Sinagua abandoned their homeland after several centuries of agrarian success. Several possible social and environmental mechanisms have been invoked for this abandonment, but unfortunately, there have been few opportunities to test some of the hypotheses for the depopulation of the middle Verde region in the late thirteenth and early fourteenth centuries using large-scale environmental archaeological investigations.

The LOCAP provided an opportunity to collect cultural and environmental data relevant to the issue of prehistoric population and settlement changes in the middle Verde region. As part of our efforts to understand past environmental conditions in the project area, we performed geomorphological studies within the ROW of SR 89A and in adjacent areas. In addition to analyzing specific site-formation processes, geomorphological analysis can be useful in recognizing past surficial processes that may have either facilitated or prevented certain subsistence activities. For example, there is increasing interest in the role of flooding and channel changes in the rise and fall of prehistoric irrigation societies in Arizona (Gregory 1991; Huckleberry 1999; Waters 1988, 1998). Undoubtedly, agricultural groups in the middle Verde region had to endure the vicissitudes of climate change that affected the dependability of the resource base. Floods, droughts, and any substantial change in the flow regime of the Verde River and its tributaries are likely to have created problems for intensive agriculturists.

This report presents the results of geomorphological field investigations performed July 13–17, 1998, as part of the testing phase of the LOCAP. Geomorphological descriptions are provided for the archaeological sites located within the project area. During our visit, several sites contained open trenches, allowing us to characterize subsurface deposits. Representative soil profiles were described according to the U.S. Department of Agriculture Soil Survey Manual (Soil Survey Division Staff 1993). Our investigations, however, extended beyond the ROW in order to address broader subsistence issues. Specifically, we also investigated the late-Holocene stratigraphy of the Verde River within the town of Cottonwood with the intent of better understanding local flood history. We present alluvial chronological information for this reach of the Verde River by analyzing geomorphological evidence preserved in natural stream-cut exposures and a 60-m stratigraphic trench. We combine this information with other recent paleoflood studies of the Verde River that have been performed under the auspices of the Arizona Geological Survey, the Desert Research Institute, the Nevada Bureau of Mines and Technology, and the University of Arizona.

Geomorphology of the Northern Middle Verde River

The middle Verde River valley is a broad lowland situated in the deeply dissected and mountainous Transition Zone of Arizona (Figure 45). It is bounded by the Black Hills to the west and south and the escarpment of the Colorado Plateau or Mogollon Rim to the north and east. Structurally, the middle Verde River valley is a half-graben with the steeply dipping Verde Fault running along the southwest side of the valley; in the Cottonwood area, the fault runs along the base of the Black Hills (Anderson and Creasy 1967; House and Pearthree 1993). The northeast side of the middle Verde River valley is bounded by several smaller normal faults that step down toward the valley (Lindberg 1983; Ranney 1988). The middle Verde River valley is the by-product of approximately 10 million years of tectonics, basin filling, and subsequent erosion. During the Miocene, the area contained a large, internally drained basin that filled with a combination of stream and lake sediments. White, tan, and red sandstones, siltstones, and limestones (Verde formation) make up much of the middle Verde River valley floor and contain an assemblage of late-Tertiary fossils (Nations et al. 1981). Other geological formations in the project area include Tertiary basalts and the Pennsylvanian-Permian Supai formation, an assemblage of red-stained sandstones and siltstones (Weir et al. 1989). The Supai formation exposed in the Mogollon Rim is the source of Sedona's red rocks and unique landscape. Within the project area, the rocks of the Supai formation outcrop between Dry Creek and Sedona.

During the late Pliocene, approximately 2–3 million years ago, the Verde River cut through bedrock to the south and connected with the Gila River hydrologic basin, thus initiating a period of episodic denudation that continues today. Ridges, benches, and mesa tops found in the northern middle Verde River valley were created as the Verde River and its tributaries down-cut into the basin fill. The sculpting of the topography was a combination of regional uplift of the Transition Zone (Menges and Pearthree 1989) and the numerous glacial to interglacial climatic changes of the Quaternary. House and Pearthree (1993) mapped the surficial geology of the northern middle Verde River valley and recognized seven different Pliocene and Quaternary stream-terrace and alluvial-fan surfaces. They interpreted these deposits to represent periods of aggradation superimposed on the long-term down-cutting trend. The oldest surfaces are late Pliocene–early Pleistocene in age, heavily dissected by streams, and situated several hundred meters above the modern Verde River. At lower elevations are middle-Pleistocene to Holocene landforms that are significantly different in age (as determined from different degrees of soil formation) but similar in elevation. This suggests a period of reduced regional down-cutting and increased base-level stability. The youngest landforms are Holocene in age and restricted to low-lying stream terraces and adjacent fans associated with the modern drainages. These Holocene landforms are limited in area but most relevant to discussions of human-environmental interactions, especially with regard to indigenous irrigation agriculture.

One of the driving forces behind landscape evolution is climate change, and, indeed, the topography of the study area has been shaped by numerous climatic oscillations during the last 2 million years. Changes in moisture and temperature associated with shifts between glacial and interglacial climate affected the rate of bedrock weathering and removal of sediment. However, at any given time, the climate of the middle Verde River valley is highly variable in space because of the topography. For example, the LOCAP area ranges in elevation from 1,000 m (3,280 feet) AMSL at Cottonwood to 1,370 m (4,500 feet) AMSL at Sedona. The elevational lapse rate for the middle Verde River valley is 5.5°C, 258 mm per km (Davis and Shafer 1992), and, accordingly, there is a climatic gradient of reduced temperature and increased precipitation from Cottonwood to Sedona. However, precipitation differences are greater than those for temperature. Mean annual precipitation ranges from 30 cm (11.8 inches) at Cottonwood to 46 cm (18.3 inches) at Sedona, whereas mean annual temperatures are only approximately 1°C (~2°F) cooler in Sedona (see the Western Regional Climate Center's Web site, http://www.wrcc.dri.edu/). This discrepancy arises from orographic effects: most of the winter storms come from the west, placing Cottonwood in the rain shadow of the Black Hills. By contrast, Sedona is located on the southwest slope of the Mogollon Rim at a point where air is lifted and adiabatically cooled. Consequently, the wettest month in Cottonwood is August (5.6 cm, or 2.2 inches, of precipitation) during the height of the summer monsoon. By contrast, Sedona receives as much precipitation (5.3 cm, or 2.4 inches) in January as in August. Therefore, there is greater effective moisture in Sedona, and the area supports a piñon-juniper woodland, whereas the uplands around Cottonwood are characterized by upper Sonoran desert shrubs. These differences in precipitation and plant communities combined with contrasting bedrock lithologies result in contrasting runoff and sediment-yield conditions between the two areas. In terms of dry-farming potential, greater winter precipitation near Sedona provides improved antecedent soil moisture conditions for spring planting, provided that hillslopes contain adequate soil cover.

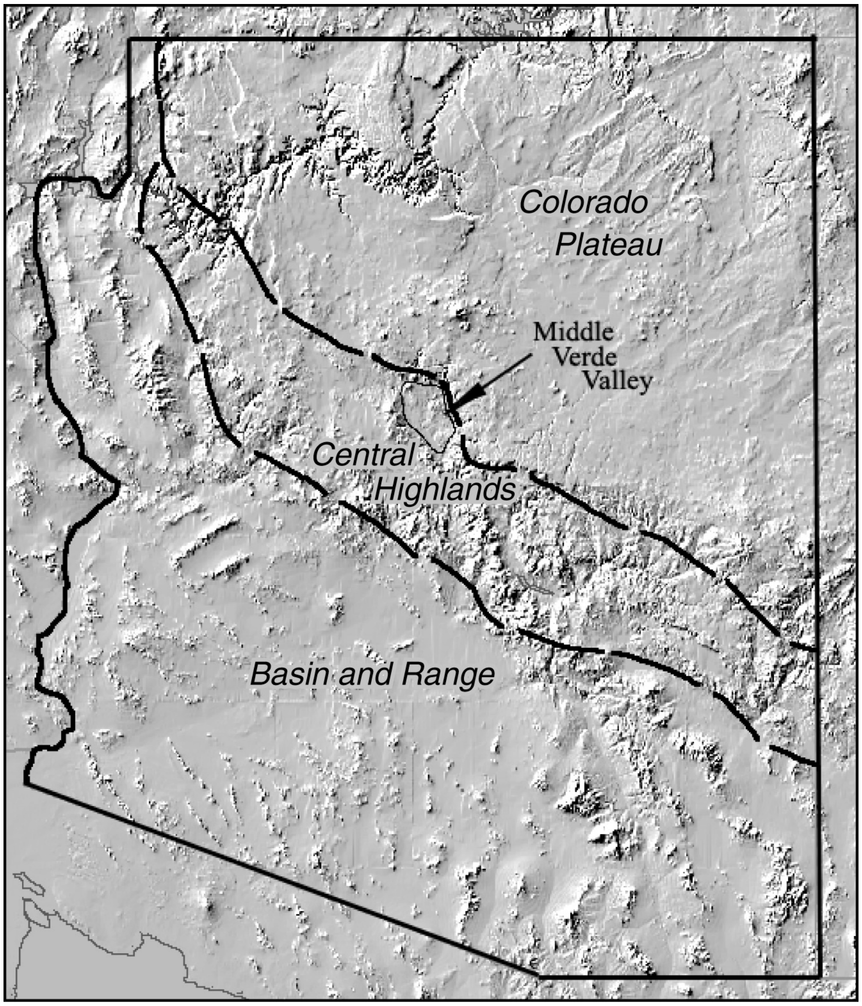

Figure 45. Middle Verde River valley and Arizona physiography (adapted from map by Ray Sterner, ©1997, Johns Hopkins University, Applied Physics Laboratory).

Archaeological Sites within the Project Area

The LOCAP area extends from Cottonwood northeast toward Sedona across a variety of landforms and three bedrock types. Most of the landform surfaces crossed by SR 89A are erosional; that is, they are etched into bedrock or basin fill with only a veneer of surficial deposits. This is particularly true for the northeastern part of the study area, where surfaces are dominated by Supai sandstone (Weir et al. 1989) creating an area predominantly characterized by slickrock and thin, discontinuous soils. Mappable deposits of alluvium and colluvium are restricted to areas along the base of hillslopes or along the edges of larger drainages. The potential for buried archaeological remains is consequently very low in these slickrock areas, as is the capacity for agriculture, given such shallow soils. Nonetheless, this area was utilized prehistorically by foraging and agricultural peoples. Several of the ridge tops contain a veneer of cryptocrystalline gravels—the famed "rim gravels" (McKee 1951)—that were transported from the southwest before the middle Verde River valley existed. These gravels yielded materials suitable for making stone tools, and dry farming was practiced in localized areas of deeper soils.

Although most of the landforms crossed by SR 89A are erosional, there are more-recent depositional landforms located in the lower-elevation, southwestern part of the project area. The surficial deposits in this area are documented on maps for the Page Springs and Cornville 7.5-minute USGS quadrangles (House and Pearthree 1993). From Cottonwood, SR 89A crosses the Verde River floodplain near the community of Bridgeport, where the modern channel is flanked by two Holocene terraces inset into older Verde formation deposits. Piedmont streams and associated alluvial fans of similar age are graded to these terraces. Climbing out of the Verde River floodplain, the highway crosses basin-fill deposits of the Verde formation interspersed with late-Quaternary piedmont alluvium derived from adjacent hillslopes (the Sheepshead Unit of House and Pearthree [1993]). At Spring Creek, the highway crosses late-Pleistocene alluvial terraces but then climbs over hills of Tertiary basalt and shallow soils. Exceptions are present between basalt ridges, where small basins contain accumulations of piedmont alluvium (e.g., at the junction of SR 89A and the turnoff to Page Springs). The highway continues northeast over small patches of piedmont alluvium, Tertiary basalt, and Verde formation before reaching Supai sandstone near Dry Creek. Between Dry Creek and Sedona, Supai sandstone outcrops at or near the surface, and there are very few areas of piedmont alluvium large enough to be mapped. Two exceptions are archaeological site AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561), a large area of alluvial-fan deposits, where arroyos expose up to 2 m of the alluvium in places, and along Dry Creek, where a discontinuously preserved alluvial terrace flanks the modern channel.

Of the 13 archaeological sites we investigated (Table 73), most are located in areas mapped as bedrock and basin fill. Such areas contain only thin (generally <50 cm) soils and regoliths that are probably Holocene in age, given the general geomorphic instability of these slopes. Sites that do contain thicker alluvial deposits include AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838), AZ O:1:85/AR-03-04-06-428 (ASM/CNF) (Site 85/428), AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903), and Site 133/561. Three of these sites (Sites 105/838, 85/428, and 28/903) were tested with backhoe trenches. The fourth site (Site 133/561) did not contain any backhoe trenches during our field inspection, because most of the deeper areas of alluvium were located outside the project ROW.

Site 105/838 is located on an old Pleistocene terrace of Spring Creek (CT1 of House and Pearthree [1993]) that is overlain by younger (Holocene) fan deposits (Figure 46). Three lithostratigraphic units are distinguished at the site. The oldest deposit (Unit 3) makes up the Pleistocene terrace and contains rounded cobbles and a well-developed, red (5YR) argillic soil (Table 74). This is overlain by Unit 2, a weakly stratified, sandy alluvium derived from hillslopes to the north that contains a Stage I calcic horizon, implying a middle-Holocene age. The surface deposit (Unit 1) represents more-recent hillslope alluvium that has been only minimally affected by soil formation. Artifacts contained within Unit 1 suggest an age of less than 2,000 years. In places, Unit 3 is present at the surface; elsewhere it is overlain by Unit 1 or 2, or both. Soil profile SR89A-2 describes all three lithostratigraphic units at one place (see Table 74).

A Holocene terrace (CT2 of House and Pearthree [1993]) of Spring Creek is inset into the Pleistocene terrace at Site 105/838. Site 85/428 is situated upstream on this younger terrace. The terrace surface appears level, producing the impression that it formed during one depositional event, but backhoe trenching exposed a buried cut-and-fill sequence (see Figure 46) indicating that the terrace is the by-product of two episodes of aggradation and degradation. The timing of these events is uncertain, although the older alluvium contains a Stage I calcic horizon (Table 75), which would indicate a mid-Holocene age. The younger alluvium contains only incipient calcification, which suggests a late-Holocene age, and Sinagua artifacts on the surface suggest that it is no younger than 600 years old.

Site 28/903 is situated on a low stream terrace of Dry Creek wedged against a hillslope composed of Supai sandstone (see Figure 46). Less than 3,000 m^2 in total area and 2 m in depth, this terrace contains two discrete alluvial deposits as evidenced by a buried soil horizon (Table 76). The lower alluvium contains a moderately developed argillic horizon, which indicates a late-Pleistocene age. The upper alluvium contains a weakly developed cambic horizon, suggesting a late-Holocene age. The terrace surface slopes toward the modern channel of Spring Creek and is currently being eroded by slope wash. This terrace may correlate to other discontinuously preserved terraces observed upstream along Dry Creek near AZ O:1:135/AR-03-04-06-186 (ASM/CNF) (Site 135/186) and AZ O:1:134/AR-03-04-06-189 (ASM/CNF) (Site 134/189).

With the exception of Site 133/561, archaeological sites located in the northeastern, upland part of the project area did not contain significant deposits of alluvium and colluvium (see Table 73). However, there were areas outside the project ROW, adjacent to AZ O:1:131/AR-03-04-06-37 (ASM/CNF) (Site 131/37) and AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), that did contain deep soils. These areas were located in broad swales and appeared to contain more than 2 m of alluvium derived from adjacent basaltic ridges. The soils formed within these swales are vertic, as evidenced by dark brown colors, silty clay textures, and numerous large desiccation cracks (Birkeland 1984:148; Buol et al. 2003:349–360). Consequently, although these areas may contain buried cultural deposits, their integrity is questionable, given the "self-mixing" of these soils.

Verde River Flood Dynamics and Prehistoric Agriculture

Although the geomorphic and stratigraphic record presented at archaeological sites located within and adjacent to the SR 89A ROW provides some insight into landscape history, these localities are not necessarily ideal for understanding larger-scale ecological processes that influenced prehistoric adaptation in the middle Verde River valley. As a result, our investigations

Table 73. Overview of Geomorphic Context and Potential for Buried Cultural Deposits

Site No.	Geomorphic Context[a]	Potential for Subsurface Cultural Deposits	Notes
104/902	Verde formation (Tsy); hillslope with thin colluvium	poor	Moderate slope wash; soils range from Calciorthids to Torriorthents.
105/838	degraded Pleistocene terrace (CT1) buried in places by Holocene fan alluvium	good in places	Quite variable soil formation ranging from Torrifluvents to Calciorthids.
85/428	Holocene terrace of Spring Creek (CT2)	very good	Late-Holocene terrace inset into late-Pleistocene/early-Holocene terrace.
77/869	basalt ridge (Tb)	poor	Moderate slope wash.
131/37	basalt ridge (Tb); deep vertic soils to the northeast	poor to moderate	Moderate slope wash.
53/745	basalt ridge (Tb); shallow lithosols	poor	Moderate slope wash.
28/903	Holocene terrace and colluvium above Dry Creek	moderate but spatially limited	Low alluvial terrace inset into hillslope; moderate slope wash.
31/244	Supai sandstone (PPs) and thin colluvium	poor	Well-developed argillic soil (Haplustalf) at surface.
133/561	fan alluvium derived from Supai sandstone (PPs) hillslope	very good	Fan alluvium incised ~2 m; exposes Ustochrept soils.
134/189	Supai sandstone (PPs) and thin colluvium	poor	Steep slopes above Dry Creek.
135/186	Supai sandstone (PPs) and thin colluvium	poor	Steep slopes above Dry Creek.
136/663	Supai sandstone (PPs) and thin colluvium	poor	Steep slopes.
137/482	Supai sandstone (PPs); thin lithosols	poor	Bedrock exposed at surface.

[a]Surficial geologic map units from House and Pearthree (1993); bedrock map units from Reynolds (1988).

extended to the geomorphic history of the Verde River, an important lifeline for prehistoric populations in the valley as they adopted and intensified agriculture. Domesticated crops probably entered the region more than 3,000 years ago (Huckell 1995; Wills 1988), and by 1,400 years ago, agricultural communities began to form along the middle Verde River and its tributaries. The middle Verde River valley is well suited for irrigation agriculture, given its relatively low elevation, extended growing seasons, and perennial water. Early agricultural systems were probably characterized by floodwater farming along the main perennial watercourses and tied to seasonal increases in discharge, possibly supplemented by *ak chin* floodwater farming (Hack 1942) along ephemeral tributaries. Eventually, food production intensified with the development of canal irrigation. Exactly when canal irrigation began in the middle Verde River valley is unknown. Conservative estimates place it at around A.D. 800 (Fish and Fish 1977; Pilles 1981a). It is possible that canal irrigation began several centuries earlier in the middle Verde River valley, given interaction with the Phoenix Basin, where canals date back to at least A.D. 100 (Henderson 1989). By A.D. 1100, the Southern Sinagua were practicing diverse foraging and food-production strategies in upland and lowland settings (Pilles 1996), but much of the population was aggregated in puebloan communities located along the Verde River and its perennial tributaries, where canal irrigation was critical to subsistence.

Given the importance of prehistoric irrigation agriculture in the middle Verde River valley, the geomorphic history of the hydrologic system—particularly in relation to high-frequency climate changes of the late Holocene—is deeply connected to the successes and failures of ancient agricultural communities. Specifically, flow regimes that varied between extremes of drought and flood placed limits on the success of their agricultural systems. Droughts reduced surface runoff and limited food production, whereas floods damaged canal headworks and, if large enough, altered the floodplain to the point that canal-system alignments had to be entirely relocated. Such environmental dynamics have been correlated to prehistoric cultural change elsewhere in Arizona, including areas along the Salt (Ackerly et al. 1987; Nials et al. 1989; Waters 1998), Gila (Huckleberry 1995), and Santa Cruz (Waters 1988) Rivers.

Our understanding of high-frequency climate change in the middle Verde region is still preliminary, although new insights are being gained through the analysis of tree rings and alluvial stratigraphy. After a period of maximum aridity approximately 4,000–6,000 years ago (Davis and Shafer 1992), the regional climate has experienced no major, millennial-scale (low-frequency) climatic changes. By 4,000 years ago, most modern plant communities were established (Van Devender 1987); some of the most significant changes in plant geography have resulted from prehistoric and historical-period human activities (Davis

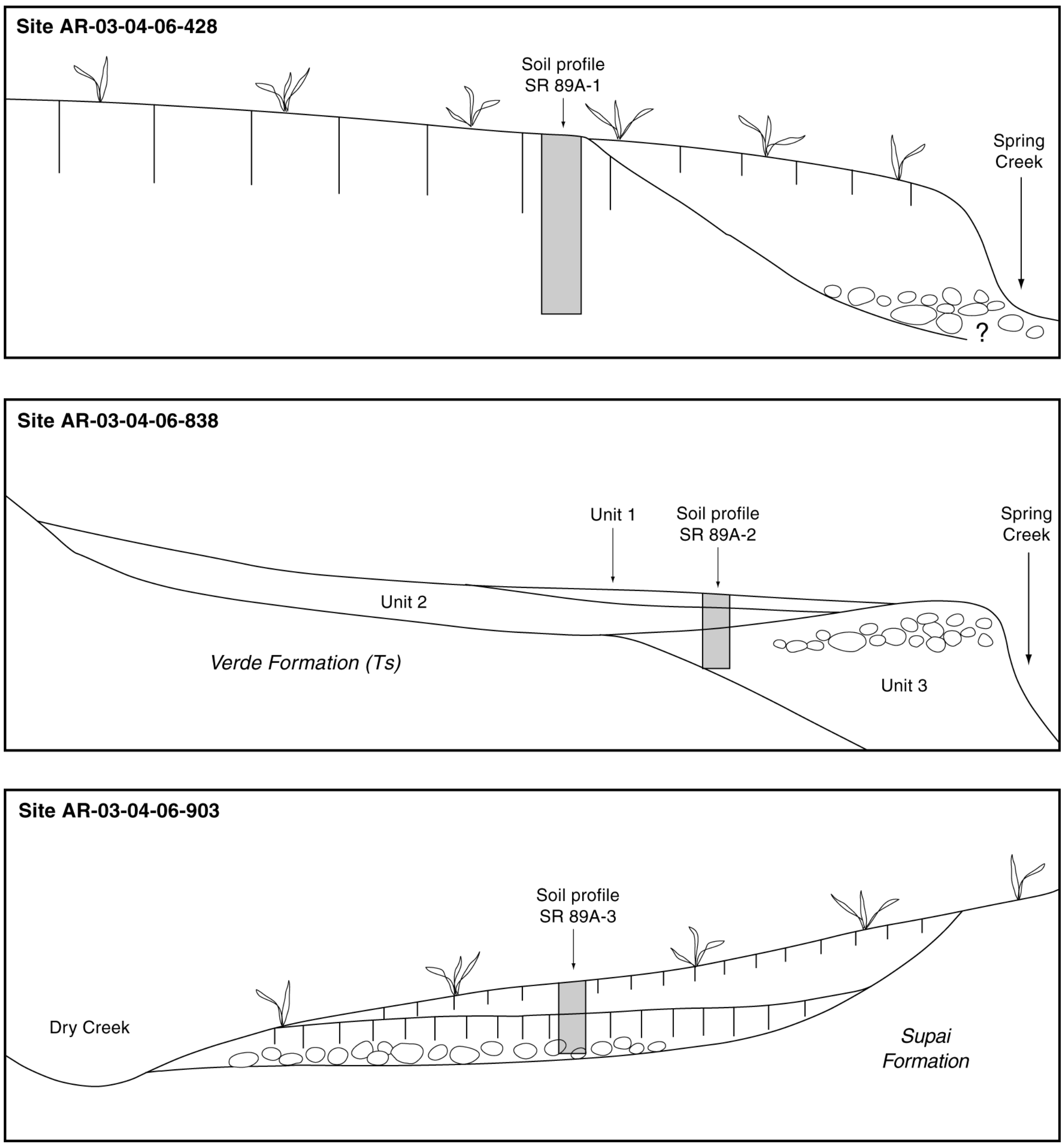

Figure 46. Schematic cross sections of landforms at Sites 85/428, 105/838, and 28/903.

Table 74. Soil Profile Description for LOCAP Site 105/838

Soil profile: SR89A-2
Classification: Ustochrept or Calciorthid
Location: Site 105/838; SE 1/4, NW 1/4, SE 1/4, Section 16, Township 16 North, Range 4 East, Yavapai County, Arizona
Vegetation: mesquite (*Prosopis*), acacia (*Acacia*), yucca (*Yucca*), and assorted grasses
Parent material: alluvium derived from sandstones and siltstones of Verde formation
Topography: degraded Pleistocene terrace of Spring Creek overlain by Holocene fan alluvium
Elevation: 1,100 m above mean sea level (AMSL)
Slope: 1 percent (south aspect)
Described by: Gary Huckleberry
Date recorded: July 16, 1998
Remarks: Profile taken in middle of Backhoe Trench 206. Carbonates are partly inherited from the parent material. There are three lithostratigraphic units. Unit 1 (Ak and Ck) contains ~30 cm of stratified, sandy alluvium with Sinagua artifacts. Unit 2 (2Bkb horizons) is a weakly stratified, sandy deposit with gravel lenses. Unit 3 (3Btkb) is a highly oxidized quartz sand with moderate soil development and is part of the original Pleistocene terrace.

Unit	Descriptions
Ak	0–2 cm. Yellowish brown (10YR 5/4), fine, loamy sand; weak, medium, granular structure; soft (dry), slightly sticky and slightly plastic (wet); violently effervescent; clear, smooth boundary.
Ck	2–31 cm. Light brown (10YR 6/4), fine, loamy sand; massive; slightly hard (dry), slightly sticky and slightly plastic (wet); violently effervescent; abrupt, smooth boundary.
2Bk1b	31–52 cm. Light brown (7.5YR 6/4) with common, fine, prominent filaments of white (7.5YR 8/) carbonate (Stage I); loam; moderate, coarse to very coarse, prismatic and angular blocky structure; hard (dry), slightly sticky and plastic (wet); violently effervescent; clear, smooth boundary.
2Bk2b	52–87 cm. Brown (7.5YR 5/4) with few fine, prominent irregular seams of white (7.5YR 8/) carbonate (Stage I); fine, sandy loam; weak, medium, subangular blocky structure; slightly hard (dry), slightly sticky and plastic (wet); violently effervescent; clear, smooth boundary.
2Bk3b	87–120 cm. Brown (7.5YR 5/4) with few fine, prominent filaments of white (7.5YR 8/) carbonate (Stage I); fine, sandy loam; moderate, coarse, angular blocky structure; hard (dry), slightly sticky and plastic (wet); violently effervescent; abrupt, smooth boundary.
3Btkb	120–140+ cm. Yellowish red (5YR 4/6) with common, very fine, prominent filaments of white (7.5 YR 8/) carbonate (Stage I); sandy clay loam; weak, coarse, angular blocky structure; hard (dry), sticky, and very plastic (wet); strongly effervescent; clay skins occur as many fine bridges between grains.

Key: LOCAP = Lower Oak Creek Archaeological Project.

et al. 1985). Whereas the last 4,000 years in the middle Verde region have witnessed no major climate changes, tree rings and alluvial stratigraphy provide evidence of decadal- to centennial-scale changes in temperature and moisture (Ely 1997; Salzer 2000; Van West and Altschul 1998). These climatic changes do not radically change the overall configuration of the landscape, but they can have tremendous impact on geomorphically sensitive components, particularly rivers. For example, rivers in semiarid settings are highly dynamic, because of the wide variation in their seasonal discharges (Graf 1988). Such rivers tend to have compound channel configurations characterized by a low-flow channel contained within a much wider flood channel. It is probable that, like other semiarid and arid stream systems in Arizona (e.g., Burkham 1972; Hereford 1993; Huckleberry 1994; Kolbe 1991; Parker 1993), the Verde River responded to high-frequency climate changes and consequent modifications to flood frequency and magnitude by adjusting its channel geometry.

Historical Flooding and Channel Changes on the Verde River

Historically, the Verde River has experienced channel changes in response to changes in flood frequency and magnitude. Combined archival and gauged records of flooding indicate that the area experienced several large floods between 1891 and 1945 (Pearthree 1996:Figure 4a

Table 75. Soil Profile Description for LOCAP Site 85/428

Soil profile: SR89A-1
Classification: Ustochrept or Calciorthid
Location: Site 85/428; NW 1/4, NW 1/4, NE 1/4, SE 1/4, Section 16, Township 16 North, Range 4 East, Yavapai County, Arizona
Vegetation: mesquite (*Prosopis*), acacia (*Acacia*), yucca (*Yucca*), and assorted grasses
Parent material: alluvium derived from sandstones and siltstones of Verde formation
Topography: Holocene stream terrace of Spring Creek
Elevation: 1,100 m above mean sea level (AMSL)
Slope: 1 percent (southwest aspect)
Described by: Gary Huckleberry
Date recorded: July 16, 1998
Remarks: 7 m from south end of backhoe trench; Sinagua and Late Archaic artifacts at surface

Unit	Descriptions
A	0–2 cm. Brown (7.5YR 5/4), fine, loamy sand; moderate, medium, platy to angular blocky structure; slightly hard to hard (dry), not sticky and not plastic (wet); slightly effervescent; clear, smooth boundary.
Bw1	2–38 cm. Strong brown (7.5YR 5/6), fine, loamy sand; weak, coarse, angular blocky structure; slightly hard to hard (dry); not sticky and not plastic (wet); noneffervescent; clear, smooth boundary.
Bk2	38–75 cm. Strong brown (7.5YR 5/6) with common fine, prominent filaments of white (7.5YR N8/) carbonate (Stage I+); fine, loamy sand; moderate, coarse, prismatic, and angular blocky structure; slightly hard (dry), not sticky and not plastic (wet); violently effervescent; gradual, smooth boundary.
Bk3	75–99 cm. Strong brown (7.5YR 5/6) with few fine, prominent filaments of white (7.5YR N8/) carbonate (Stage I); fine, loamy sand; weak, coarse, angular blocky structure; slightly hard (dry), not sticky and not plastic (wet); violently effervescent; gradual, smooth boundary.
Bk4	99–129 cm. Strong brown (7.5YR 5/6) with few fine, prominent filaments of white (7.5YR N8/) carbonate (Stage I); fine, loamy sand; weak, coarse, angular blocky structure; soft (dry), not sticky and not plastic (wet); violently effervescent; gradual, smooth boundary.
Bk5	129–165+ cm. Strong brown (7.5YR 5/6) with few medium-sized, prominent seams of white (7.5YR N8/) carbonate (Stage I); fine, loamy sand; weak, coarse, angular blocky structure; slightly hard (dry), not sticky and not plastic (wet); violently effervescent on carbonate seams, noneffervescent in adjacent matrix.

Key: LOCAP = Lower Oak Creek Archaeological Project.

and b). However, the period between 1946 and 1965 was one of overall reduced flood frequency and magnitude. Since 1966, a greater number of relatively large discharge events have occurred, including the exceptionally large flow event of 1993 (House et al. 1995). Unlike the lower Salt and Gila Rivers, which flow over large alluvial basins, the middle Verde River has a narrow floodplain confined by bedrock or partially consolidated basin fill. Consequently, this would typically lessen the amount of channel widening or the number of shifts in the main flow channel. Nonetheless, the channel did respond to these changes in flood regime. In the middle Verde River valley, flood channels generally became narrower between 1950 and 1972 (Pearthree 1996). After 1972, channels began to widen, particularly in response to the floods of 1978 and 1980. Also during the twentieth century, the position of the low-flow channel shifted between the banks of the flood channel in response to deposition of channel deposits during the larger flow events that tended to divert flow.

All in all, the overall compound form of the middle Verde River, with its gravelly, low-flow channel inset into a wider flood channel, has not changed dramatically since 1891. However, 1891 may have been a pivotal point in time for the middle Verde River. The 1891 flood was

Table 76. Soil Profile Description for LOCAP Site 28/903

Soil profile: SR89A-3
Classification: Ustochrept or Haplustalf
Location: Site 28/903; NW 1/4, NE 1/4, SW 1/4, Section 19, Township 17 North, Range 4 East, Yavapai County, Arizona
Vegetation: cottonwood (*Populus*) and desert willow (*Chilopsis*) along Dry Creek; juniper (*Juniperus*) and piñon (*Pinus*) on the upper slopes
Parent material: alluvium derived Supai formation (red sandstone/siltstone)
Topography: low alluvial terrace of Dry Creek
Elevation: 1,213 m above mean sea level (AMSL)
Slope: 2–3 percent (east aspect)
Described by: Gary Huckleberry and Amy Holmes
Date recorded: July 16, 1998
Remarks: Profile taken in middle of backhoe trench located on low terrace above Dry Creek immediately north of SR 89A bridge. Two alluvial units contained within terrace. Lower unit is late Pleistocene in age. Upper unit is middle to late Holocene in age and is currently being eroded by slope wash.

Unit	Descriptions
A	0–6 cm. Reddish brown (5YR 4/4), fine, loamy sand; moderate, medium, platy structure; soft (dry), not sticky and not plastic (wet); noneffervescent; clear, smooth boundary.
Bw	6–60 cm. Reddish brown (5YR 5/4), fine, loamy sand; weak, coarse, angular blocky structure; slightly hard (dry), not sticky and not plastic (wet); noneffervescent; abrupt, smooth boundary.
2Bt1b	60–95 cm. Reddish brown (5YR 5/4), sandy clay loam; moderate, medium to coarse, angular blocky structure; very hard (dry), slightly sticky and plastic (wet), noneffervescent; clay skins occur as many prominent coatings on ped faces and coatings and bridges on and between sand grains; clear, wavy boundary.
2Btk2b	95–120+ cm. Reddish brown (5YR 5/4) gravels with sandy clay loam matrix; single grain; loose (hard); strongly effervescent; carbonates are disseminated; clay skins occur as common distinct coatings on sands and gravels.

Key: LOCAP = Lower Oak Creek Archaeological Project

similar in size to the 1993 floods on the Verde River and was clearly one of the largest floods in the past several centuries (House et al. 1995, 2002). Moreover, it coincided temporally with a period of heavy deforestation of the hillslopes above the middle Verde River, particularly in the Clarkdale area (Byrkit 1978; Davis et al. 1985). Timber was removed to support the mines, and cattle populations were at their maximum across Arizona. A combination of reduced ground cover and a very large flood may have shaped the middle Verde River floodplain into a complex form that still exists today. Historical survey records indicate that the 1891 flood removed several hundred acres of "fine bottomland" and replaced it with channel gravel (Pearthree 1996:6). The exact channel geometry before 1891 is uncertain, although the first cadastral surveys in the 1870s indicate a perennial low-flow channel approximately 15–30 m wide and 0.5 m deep with a sandy bottom. Hence, current channel geometry may not be a true reflection of the character of the middle Verde River during the prehistoric Formative period. Nonetheless, it is probable that large prehistoric floods caused, at a minimum, a widening of the flood channel and could have introduced other alterations, such as down-cutting, changes from single-channel to braided-channel forms, and reduced sinuosity.

Prehistoric Agriculture and Paleoclimatic Variations

In addition to depending on the dynamism of the floodplain, the resilience of irrigation systems in response to floods and channel changes depends in part on the nature of the systems themselves. What little is known of middle Verde River prehistoric canal systems (Dart 1989:11) suggests that they were small and limited to low Holocene terraces within the modern geologic floodplain (Fish and Fish 1977). These canals were much smaller in flow capacity and length than their counterparts in the Phoenix Basin. Hence, only moderate amounts of pooled labor would have been necessary to replace damaged headworks or, if need be, shift and replace canal alignments. However, as population densities and reliance on canal irrigation increased, the communities were nonetheless vulnerable to food shortages because of flooding, regardless of the scale of the hydraulic system. Indeed, prehistoric canal systems in the Tonto Basin constructed by the Salado are similar in scale to those of the Southern Sinagua in the middle Verde River valley. Increased streamflow variance for the Salt River and Tonto Creek (derived from tree-ring data) during the Roosevelt Phase (A.D. 1250–1350) is believed to have damaged canal systems and contributed to local community abandonment and reorganization (Waters 1998). Although conditions for irrigation improved during the final Gila phase (A.D. 1350–1450), a series of large floods and droughts during the late 1300s seriously stressed the Salado and may have been an impetus for their departure from the Tonto Basin. Likewise, population and reliance on canal irrigation increased in the middle Verde River valley between A.D. 900 and 1400, and the Southern Sinagua were vulnerable to hydroclimatological and fluvial geomorphic change, especially during the Honanki and Tuzigoot phases (A.D. 1125/1150–1400/1425). Hence, it is important to consider how flood regimes have changed over the last 2,000 years on the Verde River.

We are just now starting to understand the prehistoric flood history of the middle Verde River. In the 1980s, archaeologists began to focus on the impact of Salt River flooding on the Hohokam. As part of investigations of the prehistoric village of Las Colinas, Graybill (1989) used tree rings to reconstruct annual discharge for the Salt and Verde Rivers for the period A.D. 740–1370. These reconstructions were later expanded for the Verde River to encompass the period A.D. 572–1985 (Van West and Altschul 1998). Figure 47 presents that reconstruction, in which annual discharges (calibrated by stream gauges on the lower Verde River) are converted into *z*-scores to provide an indication of the relative magnitudes of annual discharge in the time series. In their study of agricultural carrying capacity along the lower Verde River, Van West and Altschul (1998:374) noted that the two most stressful environmental conditions were generated in A.D. 899–904 and A.D. 1382–1389 by the occurrence of one or two extreme floods followed by extreme droughts. The one-two, flood-drought punch during the late thirteenth century is believed by many to have been a catalyst for the decline of the Hohokam (Gregory 1991; Masse 1991; Nials et al. 1989).

Correlations between the dendrohydrological reconstruction and the local cultural chronology provide possible evidence supporting a link between flooding and demographic changes in the middle Verde River valley. Specifically, the period of prolonged low annual streamflow variance for the Verde River coincides with the expansion of canal systems and the concentration of population into pueblo communities along the river during the Camp Verde, Honanki, and Tuzigoot phases. Moreover, the increase in annual streamflow variance beginning in A.D. 1382 (see Figure 47) occurred when many of the larger pueblos in the middle Verde River valley were being abandoned. For example, the latest dendrochronological date on wooden beams used in the construction of Tuzigoot is A.D. 1386 (Hartman 1976). By A.D. 1425, the middle Verde region was depopulated by Sinagua populations.

The depopulation of the middle Verde region in the late thirteenth and early fourteenth century coincides with large rearrangements of communities across the U.S. Southwest (Fish et al. 1994), and one cannot presume that floods alone were adequate cause for regional abandonment. This was a time of climatic deterioration in central Arizona, however. Tree-ring studies performed at temperature-sensitive, high-elevation sites in the San Francisco Peaks area indicate that the period spanning A.D. 1380–1450 was dry and warm (Salzer 2000). A period of overall reduced moisture punctuated by occasional large, destructive floods would have stressed upland (dry and runoff farming) and lowland (canal and *ak chin*) agricultural systems. This raises questions about the extent of the climate's role in the rise and eventual collapse of the Southern Sinagua. Was the A.D. 900–1381 interval a period of floodplain stability conducive to Southern Sinagua irrigation agriculture, thus facilitating village formation and increasing population? Likewise, was the period of increased streamflow variance beginning in A.D. 1382 a time of increased large-flood frequency and drought, concomitant channel changes, and canal-system damage, all of which could have contributed to the collapse of the Southern Sinagua culture?

Unfortunately, correlation does not equal causation, and arguments linking distant paleoenvironmental data (in this case, tree rings) to local cultural behavior (settlement shifts) should be tested with site-specific, empirical data. This is where geomorphological study can contribute to our understanding of the cultural ecology of the middle Verde region. Tree rings reconstruct annual discharge on the Verde River, not instantaneous discharge, and individual floods are not directly recorded in the dendrohydrological reconstruction. However, a flood deposit represents a discrete flooding event. Hence, alluvial stratigraphic studies that identify and date flood deposits can shed light on the behavior of the Verde River—namely, fluctuations in flow in response to flood events, drought, and other climatic factors—during times of important cultural change in the past.

Paleoflood Studies of the Verde River

During the past 15 years, there have been systematic efforts by Quaternary geologists and geomorphologists to study the paleoflood history of Arizona streams and rivers. Most gauged records extend back only to the early twentieth century, and it is clear that such short records of flow history are inadequate to fully characterize the flooding potential of these hydrological systems. By using slack-water deposits as paleostage indicators (Kochel and Baker 1988),

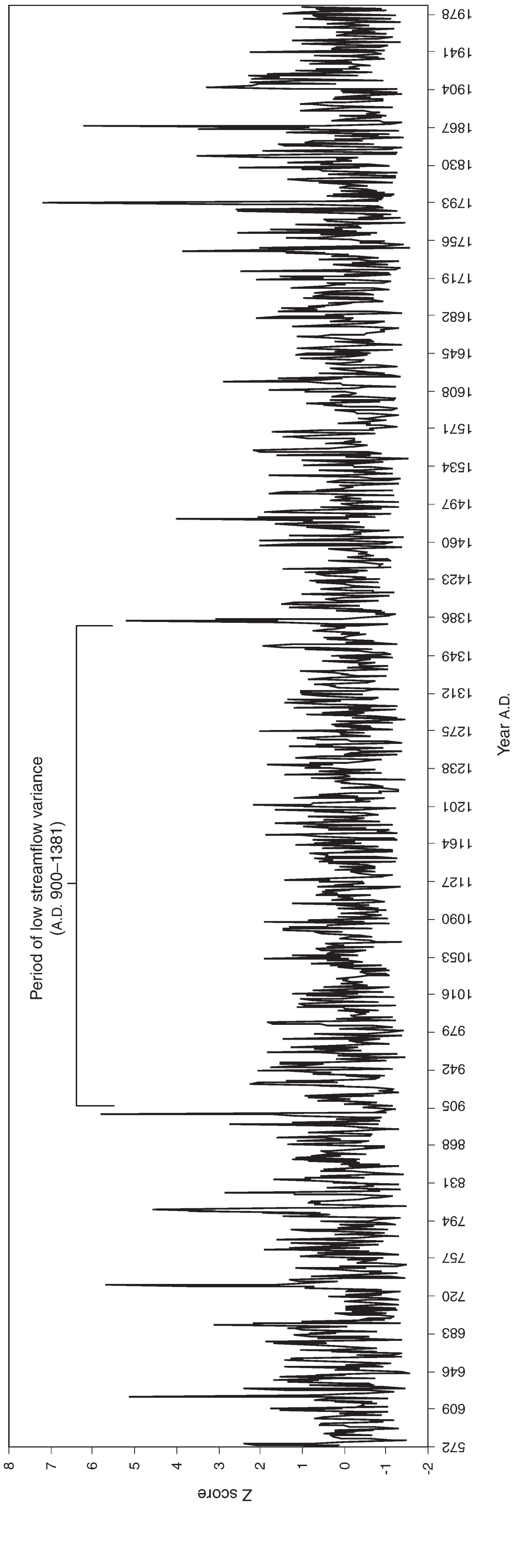

Figure 47. Verde River flow reconstructions for period A.D. 572–1985 (adapted from Van West and Altschul 1997). Annual discharge values are normalized to z-values.

considerable paleoflood information has been generated for the Gila River hydrological basin, including the Verde River (Ely 1997; Ely and Baker 1985; House et al. 1995, 2002). Of relevance to our study of prehistoric agricultural systems is the fact that the frequency of large floods does not appear to be distributed randomly through time. In Arizona, a compilation of 150 ^{14}C dates from 250 slack-water deposits from the Little Colorado and Gila River Basins indicates that high-magnitude flooding was more frequent 3,600–5,000 years ago and 2,200 years ago to the present, with an intervening period of reduced large-flood frequency (Ely 1997). Moreover, within the last 2,200 years, there were prominent peaks in high-magnitude flooding at 900–1,100 years ago (A.D. 900–1100) and after 500 years ago (A.D. 1400); the period 600–800 years ago (A.D. 1200–1400) appears to have been a period of reduced large-flood frequency.

Ely (1997) has correlated these clusters of dated slack-water deposits, and presumably increased flooding, to centennial-scale global climatic variations that influence the predominant position of the polar jet stream. Because historically, the largest floods on the high-order streams of the Little Colorado and Gila River Basins occur in winter, these periods of increased large-flood frequency coincide with prolonged conditions of meridional circulation, such as occur during the warm phase of the El Niño–Southern Oscillation. If the frequency of large-magnitude floods did change, as suggested by Ely's reconstruction, then the regional, slack-water-based paleoflood record would suggest that indigenous agriculturists developed their irrigation systems under conditions of occasional large floods (and, presumably, channel dynamics). However, the period A.D. 1200–1400 was a period of floodplain stability conducive to the operation and maintenance of canal systems, and the frequency of large floods increased after A.D. 1400, around the time when people were leaving the middle Verde region.

The use of a broad area encompassed by Ely's (1997) study facilitates the analysis of nonstationarity in large-flood frequency because of the large ^{14}C sample size. However, it also groups together different stream systems that have contrasting flood-climate relationships. For example, rivers in southern Arizona are more greatly influenced by late summer–early fall eastern Pacific tropical storms than those with catchment areas that border the Mogollon Rim (Hirschboeck 1985). Hence, individual rivers within the larger synthesis may differ in their alluvial histories. Fortunately, considerable effort has been made in dating slack-water deposits in the Verde River Basin. A recent compilation of 49 ^{14}C dates from Verde River slack-water sites (House et al. 2002) is presented in Figure 48. Grouped into calibrated 200-year intervals, most of the ^{14}C ages date to the last 2,000 years. The most significant pattern to stand out is the dramatic increase in dated slack-water deposits from the interval between A.D. 1000–1200 and A.D. 1200–1400. Although the actual number of floods represented by each deposit within any one time interval can be exaggerated because the same flood event could be dated at multiple sites, we can assume that that type of error applies equally for all time intervals. Hence, the Verde River paleoflood slack-water record differs from Ely's (1997) regional synthesis. There is no evidence of a period of reduced large-flood frequency during A.D. 1200–1400; in fact, this period corresponds to a period of high large-flood frequency on the Verde River. A similar pattern is observed from lowland alluvial sites in the Phoenix Basin, where a compilation of 32 ^{14}C dates from overbank flood deposits on the lower Verde, lower Salt, and middle Gila Rivers indicates a peak, albeit smaller, in large floods for the A.D. 1200–1400 period (Huckleberry 1999). Hence, the slack-water-based paleoflood record for the Verde River seems to suggest that floods and channel dynamics began to emerge as a problem for the Sinagua beginning around A.D. 1200, approximately 200 years before they abandoned the valley.

Use of slack-water stratigraphy to reconstruct flood history is not without potential pitfalls. A common criticism is that many of the slack-water sites are in upper reaches of the hydrologic basin, where floods generated by localized storms can result in a preserved slack-water deposit but not represent a large, instantaneous discharge downstream because of attenuation of the flood-wave and reservoir effects. Also, there is inherent uncertainty in the interpretation of the slack-water stratigraphy. Although organic caps, desiccation cracks, and incipient soils are good markers for separating discrete flood events, other, more-equivocal evidence, such as textural changes and silt caps, are often used to distinguish temporally discrete floods when they may only represent flow variations within individual floods (House et al. 2002). The result is to overcount the number of floods represented at a given site. The latter criticism is not to be taken lightly and is good reason to employ all tools and insights necessary to carefully document the alluvial stratigraphy at slack-water sites. The former criticism is also valid but can be addressed by including more information about alluvial chronology obtained from the alluvial reaches of rivers. Such locations are not well suited for most paleoflood studies because boundary conditions are poorly defined, thus preventing the calculation of instantaneous discharge. However, alluvial reaches do have the benefit of providing a picture of flooding in areas where prehistoric peoples were more likely to place their farms and canal systems.

To date, there is very little chronological information for stratigraphy from the alluvial reaches of the Verde River. Johnson et al. (1998) presented an alluvial chronology for the lower Verde River near Bartlett Reservoir based on eight ^{14}C dates. Overbank flood deposits date back approximately 2,000 years, and the investigators inferred a period of floodplain stability ca. A.D. 400–900, as evidenced by reduced rates of overbank deposition and soil formation. However, these sites are located more than

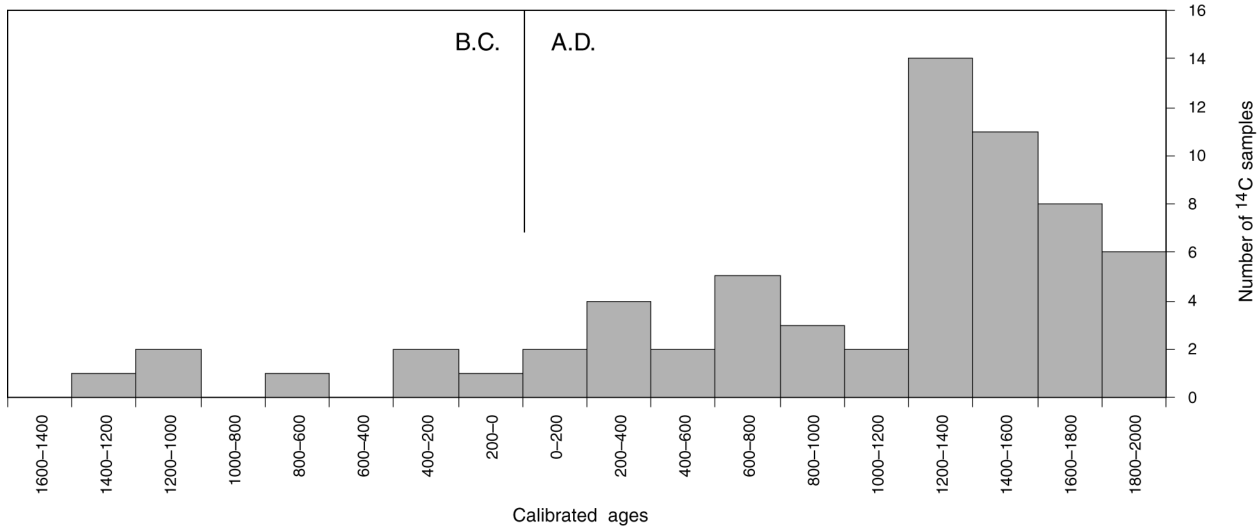

Figure 48. Distribution of ^{14}C ages from Verde River slack-water sites in 200-year intervals (adapted from House et al. 2002).

50 km downstream from the southern end of the middle Verde River valley, and it is uncertain how well those deposits correlate upstream. To date, there has been no systematic effort to construct an alluvial chronology for the middle Verde River.

As part of our investigation, we performed a reconnaissance of late-Holocene terraces along the middle Verde River (mapped as YT1 and YT2 by House [1994] and House and Pearthree [1993]). Most of these terraces are on private land and are difficult to access. However, the floods of 1993 cut into some of these terraces, creating new stratigraphic exposures that can be seen from the modern channel. In the town of Cottonwood, there are several exposures on the east bank of the Verde River at Dead Horse Ranch State Park. One exposure, located immediately downstream from Tuzigoot National Monument, is more than 3.5 m in height and contains a stack of massive, planar, and cross-bedded sandy and silty overbank flood deposits with buried soils (Figure 49). We refer to this locality as Cut-off Cliff. A beer bottle indicates that the upper 70 cm is recent; the remaining sequence has yet to be ^{14}C dated. Another >3.5-m exposure located a few hundred meters downstream from the bridge to Dead Horse Ranch State Park contains a fire hearth at a depth of 1.6 m within a sequence of overbank Verde River alluvium interfingered with gravelly, sandy alluvium from a tributary fan (Figure 50). We refer to this locality as Dead Horse Cliffs. Charcoal from the fire hearth yielded an uncalibrated ^{14}C age of 1,430 ± 80 years B.P. (VRDHC-1; A-10062; wood charcoal; conventional age determination) (House et al. 2002). Another 2.4-m-high stream cut was recorded another 300 m downstream. This locality, referred to as Dead Horse Lagoon, contains overbank Verde River deposits similar to those at the Cut-off Cliff locality. To date, we have no chronological control for this stratigraphy.

During the course of our fieldwork, we identified an undeveloped piece of land owned by the City of Cottonwood (Riverfront Park) on a low terrace across from Dead Horse Ranch State Park on the south side of the Verde River. Carla Van West of SRI gained permission from city officials to place a stratigraphic trench across the terrace as part of our study. According to city officials, this parcel of land was inundated during the 1993 flood, and large pieces of flotsam could still be seen on the periphery of the lot. We excavated a 60-m trench aligned north–south, approximately perpendicular to the Verde River (Figure 51). The trench exposed a sequence of channel and overbank flood deposits and buried soils within the upper 2.5 m of the terrace. Two radiocarbon dates on detrital alluvial charcoal yielded an age of 620 ± 40 years B.P. at a depth of 1.4 m and 1,450 ± 50 years B.P. at a depth of 2.4 m (Figure 52). As determined from these two ^{14}C dates and interpretations of stratigraphy, this terrace experienced at least six major inundations over the last 1,500 years, potentially of a magnitude similar to that of the 1993 flood. No prehistoric agricultural features were identified, but the flood deposit dating to 620 ± 40 years B.P. (VRRFP-KH1; Beta-133670; uncalibrated AMS radiocarbon age) correlates in time to the A.D. 1200–1400 period of maximum flooding inferred from the slack-water sites (see Figure 48). Given the proximity to Tuzigoot and Bridgeport Ruins, the Southern Sinagua probably were farming this terrace and experienced this flood. The degree to which it impacted their agricultural systems is not known.

In summary, the alluvial stratigraphic record of the middle Verde River is poorly known. However, dendrohydrological and slack-water stratigraphic data for the Verde River suggest that floods became more numerous beginning in the A.D. 1200s, a time during which people began to consolidate into larger communities. It is possible that

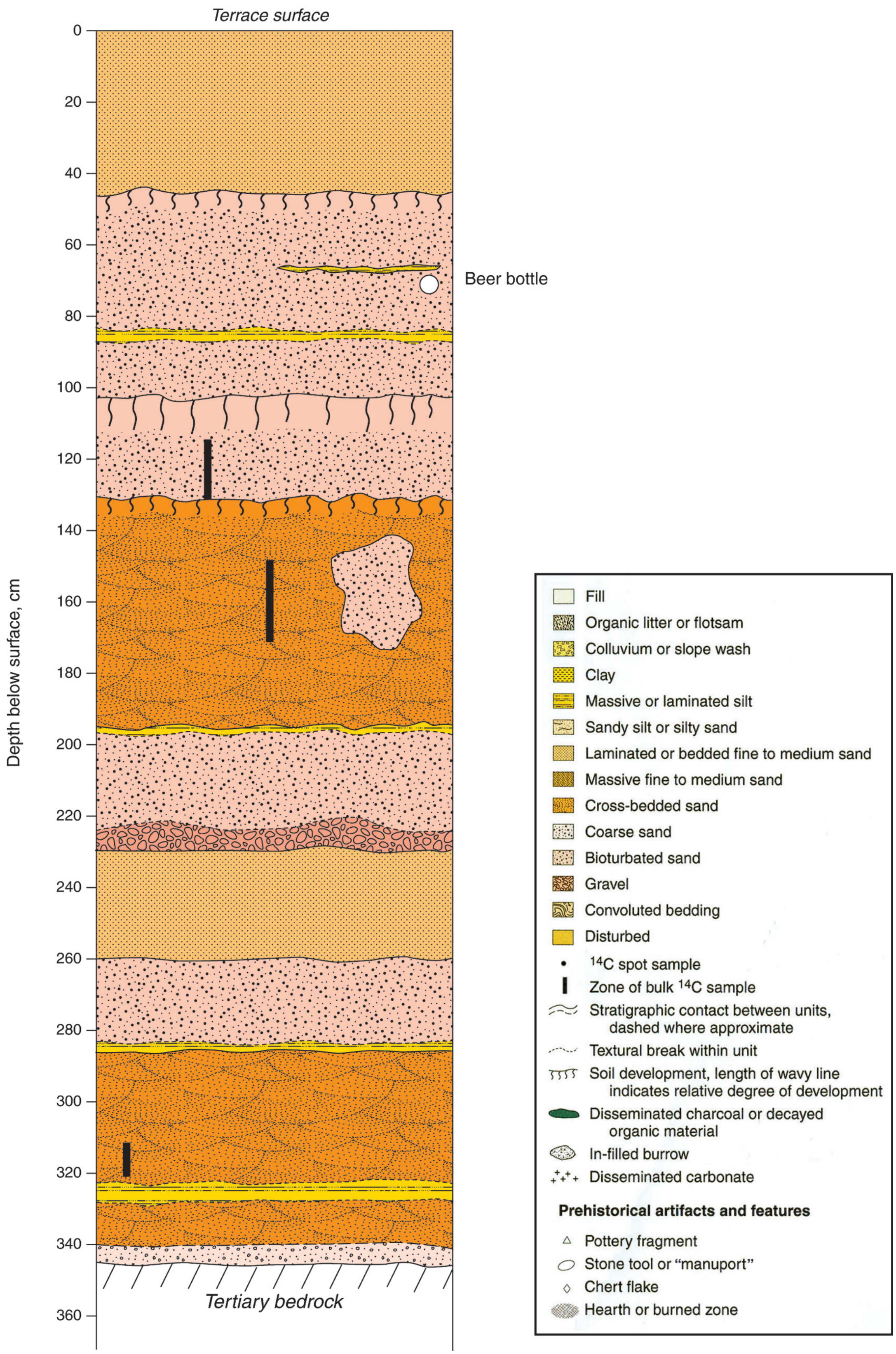

Figure 49. Stratigraphic section at Cut-off Cliff, Dead Horse Ranch State Park. Vertical black lines show zones where bulk samples were extracted for future ^{14}C dating. (Sections described by Kyle House and Phil Pearthree.)

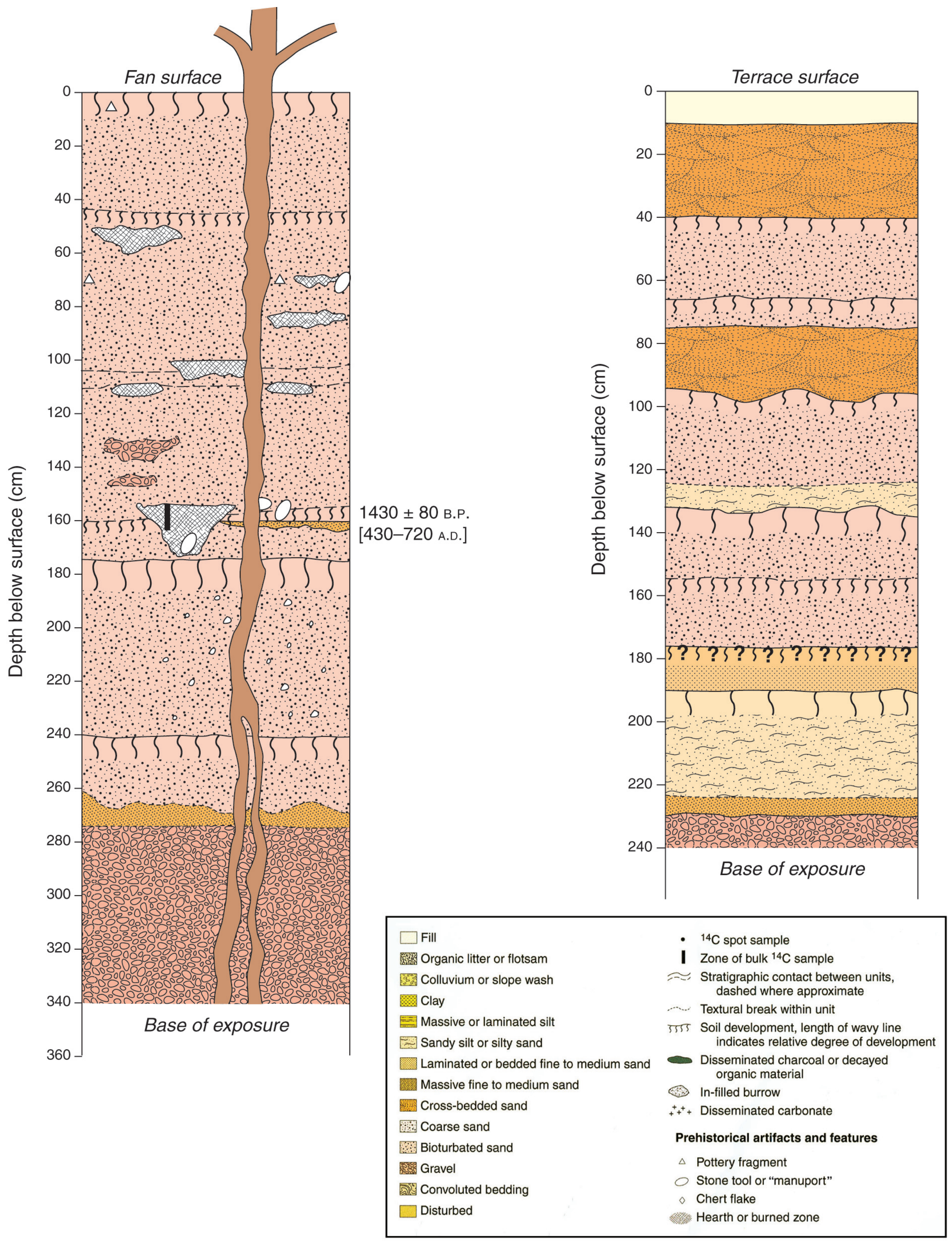

Figure 50. Stratigraphic sections described in exposures along the Verde River in Dead Horse Ranch State Park. The column on the left is the Dead Horse Cliffs site, located several hundred meters downstream from the bridge crossing to the park. There are several burned zones and at least one firepit in this section. The column on the right is the Dead Horse Lagoon site, located about 300 m downstream. (Sections described by Kyle House and Phil Pearthree.)

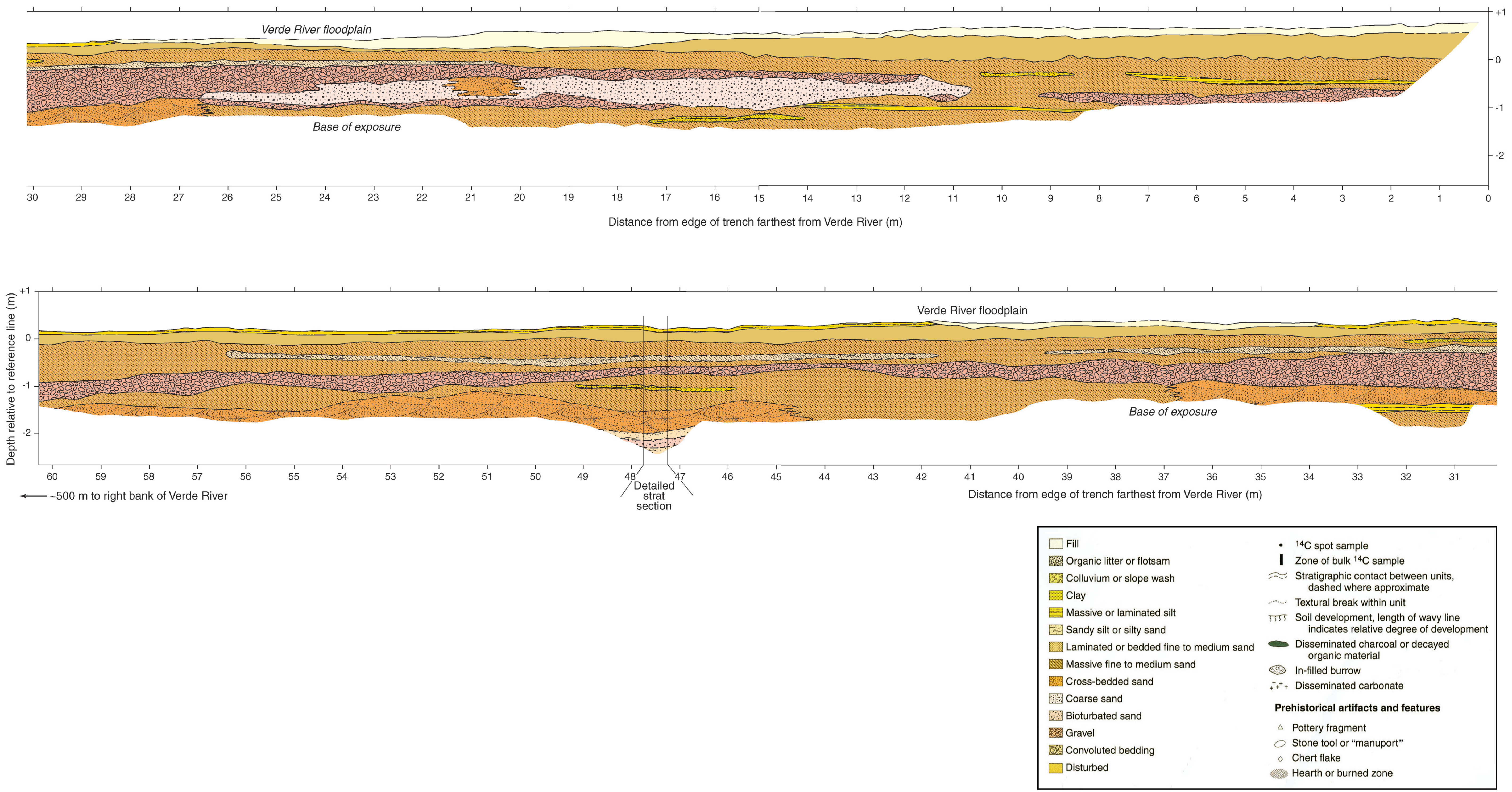

Figure 51. Verde River floodplain stratigraphy exposed in a backhoe trench at Riverfront Park, Cottonwood, Arizona. (Section described as follows: 0–25 m, Phil Pearthree and Jeanne Klawon; 25–62 m, Gary Huckleberry and Carla Van West; 47.25–47.75 m, Kyle House.)

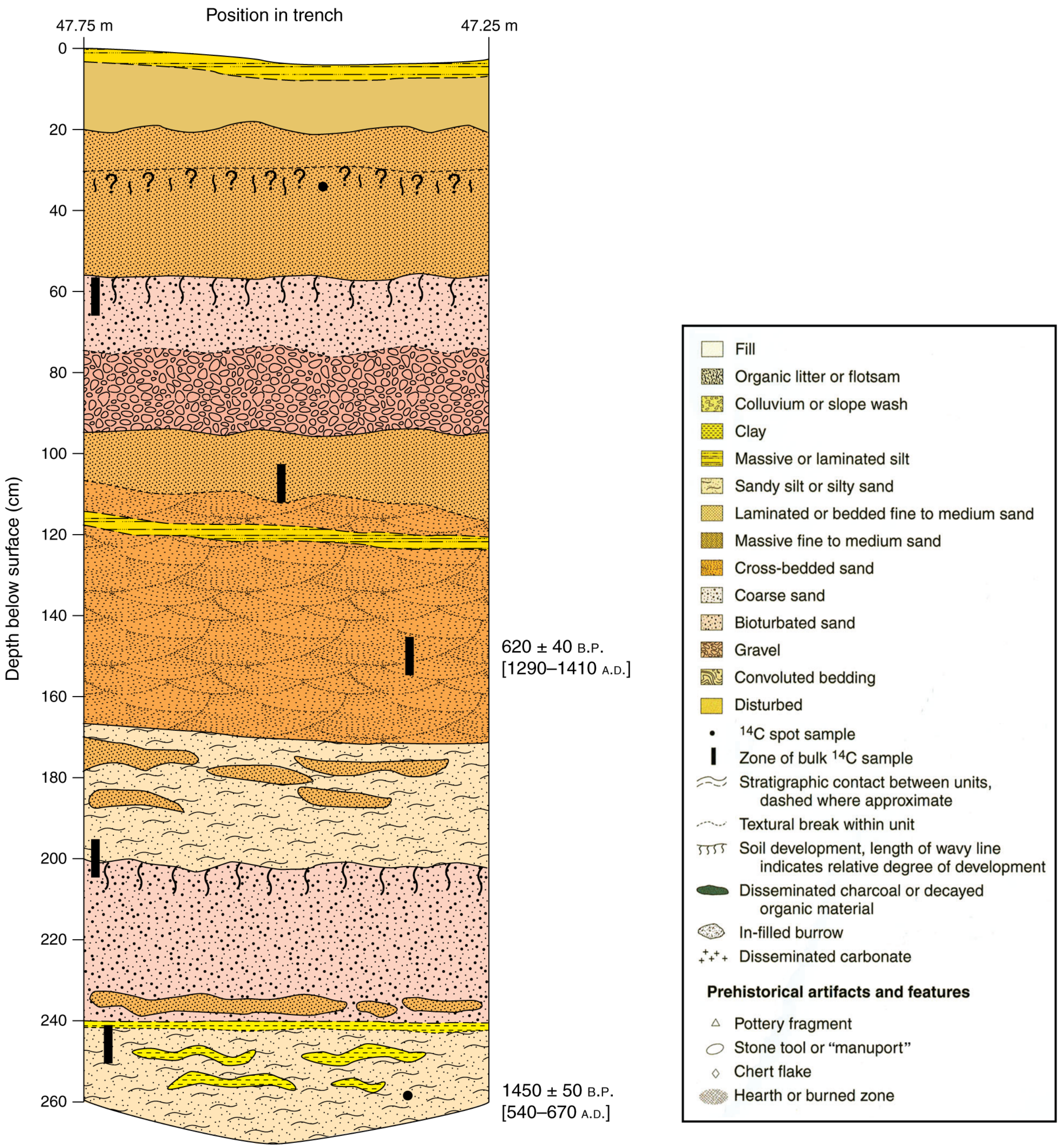

Figure 52. Detailed stratigraphic section from the backhoe trench in Riverfront Park, Cottonwood, Arizona. (Section described by Kyle House.)

this demographic shift, coupled with an increasing use of upland dry and runoff agriculture (Pilles 1981a, 1996), was a response to increased environmental uncertainty. The aggregation of people facilitates the pooling of labor to compensate for the increasing work expenditures necessary to maintain the agricultural system, and increased diversification of agricultural strategies is a good risk-minimization strategy. Dendrohydrological data suggest that the amount of runoff in the Verde River became much more unpredictable after A.D. 1381, a time when population was at its peak in the middle Verde River valley. As suggested for the lower Verde region (Van West and Altschul 1998), the combination of large floods followed by drought may have overtaxed the Southern Sinagua at a time when they were pushing the limits of the carrying capacity of their agricultural system. This idea should be considered a hypothesis ripe for testing through future geomorphologic and stratigraphic analysis of the middle Verde River. Future work should be directed toward a stratigraphic reconnaissance of the Verde River channel with the objective of finding more-recent stream-cut exposures. Also, future excavations in the Verde River floodplain performed in compliance with state and federal antiquity laws should include an assessment of alluvial stratigraphy and chronology. This would help researchers to fill the gap resulting from the paucity of stratigraphic sites from the middle Verde River. Together, the dendrohydrological and geological data from upland and lowland sites can be integrated to better understand how the Verde River changed through time in response to high-frequency, low-magnitude, late-Holocene climate change.

Conclusion

The LOCAP area along SR 89A from Cottonwood to Sedona provides an environmental transect of the northern middle Verde region. Our geomorphic evaluation of the project area concludes that most of the sites located within and adjacent to the ROW are surface or near-surface sites situated on bedrock or basin fill. Exceptions include sites located immediately along Dry and Spring Creeks and a few isolated localities where surficial deposits and associated soils are fairly deep. The area probably was used by prehistoric agriculturists—given climate and soil fertility—but there is a trade-off with respect to agricultural potential: the northeastern uplands have greater effective moisture (more antecedent soil moisture from winter precipitation and cooler temperatures) but offer a smaller area containing arable soils (dominated by Supai sandstone slickrock).

Our investigation included a consideration of the hydrological history of the middle Verde River valley. The paleoflood history of the Verde River is partially revealed by the dendrohydrological and stratigraphic record. A consideration of the dendrohydrological record and the geomorphic behavior of rivers in semiarid settings suggests that the period A.D. 900–1381 was marked by low streamflow variance and overall floodplain stability. This coincides with a time of agricultural expansion and population increase in the middle Verde region when canal systems were constructed and supplemented by upland dryland and runoff farming. This was not a period of cultural stasis, however, as interaction with the Hohokam to the south during the first part of this period was later replaced by increased interaction with Puebloan peoples to the north, particularly after A.D. 1050. The slack-water paleoflood record derived from confined bedrock reaches that are located upstream and downstream from the middle Verde River valley indicates that large-flood frequency began to increase after A.D. 1200. This may have been a catalyst for the aggregation of populations in the middle Verde region in order to consolidate their resources against the onslaught of floods, channel changes, and canal-system damage. We identified further evidence of flooding during the Tuzigoot phase on a low stream terrace in the town of Cottonwood, although the specific magnitude of the flood is unknown.

Climate still remains a valid explanation for some of the cultural changes witnessed in Arizona during the early fourteenth century, but the exact nature of that climatic variability and how prehistoric peoples perceived and reacted to that variability still has to be clarified. The middle Verde region, strategically located in the middle of the state, has largely been overlooked in terms of its paleoenvironmental record in relation to human adaptation. A challenge for archaeologists in the future will be to test the dendrohydrological record with further stratigraphic data from this area. The stratigraphic sample for these large fluvial systems is still dismally small, but the potential to add to the growing database is great, given predicted urban growth in central Arizona and the increased awareness of the value of paleoecological information for understanding the archaeological record. Moreover, such information is of value not only to historical scientists but also to those who want to better characterize the natural systems on which Arizona's growing population depends. To better understand the natural variability in runoff and flooding in Arizona's rivers for resource and natural-hazard assessment, geoarchaeological investigations of river-human dynamics of the past provide useful baseline information. Collaborative work between geologists and archaeologists should continue to provide important insights into the past and present cultural ecology of the U.S. Southwest.

APPENDIX A

Petrographic Analysis of Verde and Tuzigoot Ceramics

Andrew L. Christenson

Petrographic analysis of four sherds from the LOCAP confirmed previous observations that Tuzigoot Plain/Red is tempered primarily with crushed sherds and, possibly, stream sand, and Verde Brown/Red has inclusions that suggest a crushed-rock source.

Previous Research

Ceramic analysis in the middle Verde River region began with Louis Caywood and Edward Spicer's (1935) excavations at Tuzigoot Ruin. The current classification scheme was developed primarily by Albert Schroeder (1975), who worked with surface collections in the late 1940s and completed his report in 1955. Richard Shutler conducted excavations at two pueblo ruins on the east side of the Verde River valley at about the same time and defined 16 varieties of what he called Verde Brown that were based primarily on inclusions (Shutler n.d.). It is not clear how his categories compare to Schroeder's, although some of the descriptions and additional handwritten notes on his manuscript suggest that Shutler may have been describing varieties of Tuzigoot Plain. Wells (1981) addressed variation in Tuzigoot Plain collected from the eastern side of the Verde River valley and defined a number of varieties of the type. Previous ceramic descriptions by Caywood and Spicer (1935), Shutler (n.d.), and Wells (1981) demonstrate the limitations of low-power magnification for paste description. Inclusion categories such as "white opaque fragments" or "small red particles" may represent a variety of materials with very different implications for determining manufacturing tradition and source area.

My own experience with central Arizona pottery began in the 1990s in the Prescott area, where previously described paste variation consisted of micaceous and nonmicaceous categories. Inspired by petrographic studies in southern Arizona (e.g., Miksa 1992; Miksa and Heidke 1995), I began to collect sand samples and compare them with the inclusions found in plain ware sherds from the Prescott area. Although most vessels appear to have been tempered with crushed rock rather than stream sands (Christenson 2000), mineralogical variation in the crushed rock might be helpful in identifying source areas (Christenson 2003). My analysis of a post–A.D. 1300 collection from the Verde River valley reinforced my belief that identification of paste inclusions at low-power magnification, without verification at greater magnification, may be inaccurate and misleading (Christenson 1999). The collection from the LOCAP provided the opportunity for a similar analysis of earlier ceramics in the region.

Paste Inclusions and Ceramic Classification

Two categories of Alameda Brown Ware are believed to have been locally produced in the Verde River valley: Verde Brown/Red and Tuzigoot Plain/Red. Because the presence of a red slip is the only characteristic distinguishing the red type from the brown or unslipped type, these types are discussed collectively.

Verde Brown and Verde Red

Caywood and Spicer (1935:43) described Verde Brown as usually having a dark brown paste with temper consisting of "thirty to fifty per cent of coarse particles of feldspar, sometimes angular, but more generally rounded sand grains." Rock inclusions vary from fine to extremely coarse. Exterior surfaces are smoothed but not polished;

interior surfaces are rough and unsmoothed. Vessel form is mainly large ollas. No slip was used.

This description was the basis for subsequent type descriptions by Colton and Hargrave (1937:167) and Colton (1958:Ware 14, Type 25). In Colton's work (1958), Caywood and Spicer (1935) are quoted as stating that temper "consists of 30 to 50% of medium particles of angular quartz and feldspar, sometimes round sand grains." As discussed below, this is a better description of Verde Brown inclusions than the original quote.

Archaeologists working in the region later have either used the type name without giving a description (e.g., Breternitz 1960a:11; Hudgens 1975:39), quoted Colton's (1958) definition directly (Tagg 1986:62), or provided their own definitions. In their analysis of sherds from Montezuma Castle in the late 1930s, Jackson and Van Valkenburgh (1954:34) described Verde Brown in this manner:

> *Paste.* Usually tan . . . frequently . . . a gray core. *Temper.* Very coarse and abundant; quartz and feldspar predominant, with some mica. *Surface treatment.* . . . most surfaces are rough; seldom is a sherd sufficiently polished to reflect light. There is no slip on this type.

Based on survey work in the Verde River valley, Schroeder (1975:79) presented a formal, revised definition of Verde Brown, which he considered a Hohokam plain ware:

> Temper: Abundant sub-angular quartz sand and occasional feldspar varying in size but mostly large, with occasional small black inclusions, occasional copper colored mica flake, and other rare miscellaneous inclusions. Surface finish: usually roughly smoothed though often rough . . . Not polished. Forms: jars only (?)

Schroeder defined Verde Red as a slipped and polished Verde Brown.

In describing ceramics from stratigraphic excavations at Tuzigoot, Peck (1959:5) added the following observations: "1. Temper—some organic material not burnt out; an occasional tiny uncalcined shell. 2. Rare use of crushed sherds in temper." More recently, Walsh-Anduze (1996) described Verde Brown found at Dead Horse Ranch State Park as "tempered with medium-to-coarse granitic rock, probably diorite, composed of feldspar, quartz, and hornblende. . . . A quartz-tempered variant of Verde Brown was also identified." This report was the first to attribute the inclusions in Verde Brown to a specific rock type.

Although in the original type definition Caywood and Spicer (1935) stated that the temper in Verde Brown was feldspar, most subsequent analysts have observed that both quartz and feldspar are present. Feldspar frequencies may vary regionally, as shown by petrographic comparisons of sherds recovered from the Verde River valley and the Prescott area (Christenson 1999:96).

In a recent petrographic study (Christenson 1999) of three Verde Brown/Red sherds from Tuzigoot Ruin (one from Caywood and Spicer's original sample and two from later excavations at the site), two of the sherds primarily contained plagioclase feldspar, and one primarily contained quartz inclusions. Other inclusions were rare (Christenson 1999:89). The sand-sized inclusions were subrounded to subangular and may have derived from crushed rock intentionally added as temper, if they were not natural inclusions in the clay. They are unlikely to have been sand from alluvial deposits; most alluvial sand in the Verde River valley has a high content of basalt and limestone, neither of which has been found in Verde Brown (Christenson 1999:87–88).

Similarities between Verde Brown and Prescott Gray (a Prescott Gray Ware type) were not mentioned in the original type descriptions, although Edward Spicer helped to define both Verde Brown (Caywood and Spicer 1935) and what is now called Prescott Gray ("plain grey ware") (Spicer 1933). Outside the geographic area for which the types were first defined, however, the two types vary along a continuum and may be hard to distinguish (Walsh-Anduze and Christenson 1998). As initially defined, Prescott Gray contains abundant, coarse, granitic particles, including mica, and has a gray or reddish gray surface color (Spicer 1933:29–32). If the ceramics lack mica and have a browner or redder color owing to greater oxidation, they resemble Verde Brown, as noted by Westfall and Jeter (1977:379) after their work in the Copper Basin area. The sand-sized inclusions were identical in sherds identified as Verde Brown/Red and Prescott Gray from the Neural site north of Prescott (Christenson 1995b). About 4 percent of the ceramics at the site were identified as Verde Brown or Red and were distinguished from Prescott Gray primarily by finer temper (Higgins 1997:25).

Tuzigoot Plain and Tuzigoot Red

All Tuzigoot ceramics were originally named Tuzigoot Red, based on the surface color (Caywood and Spicer 1935:44). The paste color was described as grayish to yellowish buff in the interior and reddish at the surface. Most of "Tuzigoot Red" vessels were not slipped, but a thin, brick-red slip was not uncommon. Caywood and Spicer (1935:44) stated that temper consisted of "feldspar and undetermined darker particles, either angular or rounded in form. Commonly there is also present scattered soft particles of a brick red color." Colton and Hargrave (1937:169), using type sherds from Tuzigoot Pueblo, described the temper as "variable proportions medium fine quartz or feldspar (?) sands and opaque angular fragments, usually reddish or tan, occasionally gray or black."

Schroeder (1975:79–80) proposed the name Tuzigoot Plain for the unslipped variety of Tuzigoot Red, reserving the name Tuzigoot Red for slipped ceramics. He described the temper as "very fine (.1 mm) quartz sand, sometimes slag like. In this base are larger angular fragments, usually sparse or medium-abundant, of many different materials, which appear white, gray, tan, red, brown or black" (Schroeder 1975:80). Colton (1958:Ware 14, Type 19) also presented this temper description as it appeared in the unpublished manuscript. Varieties of Tuzigoot Plain based on temper variation have been defined by Schroeder (1975), Wells (1981), and Wood (1987:48–49). The seven varieties defined by Wells (1981), using ceramics from the Bald Hill locality east of Montezuma Castle, are documented in the ceramic collection at the Museum of Northern Arizona.

In a recent analysis of ceramics from Tuzigoot Ruin and a nearby field house, the GRR site (Christenson 1999), the presence of opaque gray, red, and brown fragments as seen with low-power microscopy was used to identify Tuzigoot Brown/Red ceramics. These fragments were originally assumed to be volcanic in origin, as suggested by Schroeder (1975:80) and Wood (1987:48). After comparing petrographic thin sections of Tuzigoot sherds to the literature on sherd temper and identifying volcanic rock, such as tuff, in thin section, it became clear that most inclusions other than quartz or feldspar were crushed sherds. In oxidation analysis, the opaque inclusions in the Tuzigoot Plain/Red sherds oxidized to a similar range of colors as the paste (Christenson 1999:85, 91). Crushed-sherd temper has been observed in other collections as well; some Tuzigoot sherds believed by Wells (1981) to have volcanic cinder may instead have contained crushed sherd, as determined from the author's review of a type collection in the possession of CNF archaeologist Peter Pilles.

Previous analysts have not recognized sherd temper in ceramics of the region, with the exception of Peck (1959) in his description of Verde Brown. There are several possible reasons. First, when most regional ceramic types were initially defined, the only identified sherd temper in southwestern ceramics was made from crushed white or gray ware and added to white or gray ware vessels. The use of crushed brown or red ware ceramics as temper for brown or red ware vessels was unknown, although it has since been documented in areas such as Anderson Mesa (Wilson 1969:580–589). Second, the carbon in the paste of Alameda Brown Ware generally makes the identification of inclusions difficult (Colton 1958:Ware 14; Schroeder 1975:80). Third, petrographic analysis, which provides a more secure identification of inclusions, was not undertaken for ceramics of the region until 1997 (Christenson 1999).

On the basis of my previous work and the results of the present study, I suggest that crushed-sherd temper is the dominant inclusion type in Tuzigoot Plain and Red ceramics and should be considered a significant attribute for identifying these types. Sand-sized quartz and feldspar and rounded basalt gravel are also frequently present. Archaeologists working outside the Verde River valley have classified sherds and vessels that contain rock inclusions such as schist (Fiero et al. 1980:103) and phyllite (James 1973:21, 1974:107) as Tuzigoot Plain or Red (or varieties of these types) on the basis of color, form, and surface treatment. At Fitzmaurice Ruin east of Prescott, approximately 50 percent of the sherds were identified as Tuzigoot Plain/Red (James 1974:Table 28). I examined a sample of sherds and vessels from the site and found that these ceramics are tempered with crushed, black, metamorphic rock. More research is needed to determine how similar these vessels are to the local Tuzigoot Plain/Red ceramics and whether they should be classified into the same types.

Petrographic Analysis of the Lower Oak Creek Archaeological Project Collection

As part of a larger, ongoing study of ceramic technology in the Prescott–Verde River valley area of central Arizona (Christenson 1999, 2000, 2003), four sherds from the LOCAP collection were selected for petrographic analysis. So little is known about the mineralogy of ceramics from the middle Verde region that even this small sample contributes significantly to our database.

Methods

Four sherds were selected for analysis: one each of the micaceous Verde Brown sherds from AZ O:1:105/AR-03-04-06-838 (ASM/CNF) (Site 105/838) and nonmicaceous Verde Brown from AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745) and two Tuzigoot Plain sherds from Site 105/838 (Feature 13, Level I fill). Sherds were selected so that a portion would remain for future analysis. Thin sectioning was done tangentially to maximize the available viewing area, and all thin sections were stained with two colors to assist in the identification of feldspars.

Thin sections were point-counted at regular intervals by the author to obtain about 200 identified minerals or rocks. The point-counting method used was that suggested by Dickinson (1970) for sedimentary rocks, in which sand-sized or larger minerals are identified as mineral types, and minerals smaller than sand size are counted as the rock of which they are a part.

Results

Tables A.1 and A.2 summarize point-count data for the four thin sections analyzed.

Verde Brown

The two Verde Brown sherds were very similar in mineralogy and were dominated by quartz and plagioclase feldspar. The plagioclase was highly altered and often counted as epidote (a major alteration product of feldspar), rather than plagioclase. Sand-sized particles constituted about one-third of the paste in both sherds. The sherds contained similar amounts of sand-sized biotite.

The biotite mica in these sherds differs in color, but this is probably related to variation in firing conditions. In oxidized areas, the biotite is a golden color and reflects light well. In reduced areas, the biotite is gray or black and reflects light poorly. Biotite is generally black when found in rock, although it can be found in shades of brown and green. The change to a brown or golden color may result from weathering or oxidation during firing (Christenson 1997b).

Tuzigoot Plain

In the two Tuzigoot Plain sherds, like the Verde Brown sherds, quartz, plagioclase, and epidote were the most common minerals. These minerals appeared in much lower densities in the Tuzigoot sample, and the Tuzigoot sherds also contained volcanic rock, usually rounded, and sherd. It is common to find large pieces of rounded gravel in Tuzigoot sherds (Christenson 1999:92–93). This suggests that either the clay was collected from an alluvial context, and these large inclusions were not removed during cleaning, or that rounded sand from an alluvial context was added as part of the temper. Crushed sherd appeared in lower frequencies than rock during point-counting, but the sherd particles may have been underrepresented for two reasons. First, some of the rock in the paste was introduced as part of the sherds. Second, the sherd particles were often similar to the paste in color and texture and could not easily be seen in thin section.

Some of the crushed-sherd temper can be assigned to particular wares or types. One phyllite-tempered sherd fragment from a Wingfield Plain or Red vessel was included in the paste of a Tuzigoot sherd. Several quartz sand-tempered sherds with a fine paste were probably derived from Tusayan White Ware vessel fragments. Most of the sherd particles observed in Tuzigoot paste were fragments of arkosic sand-tempered vessels, probably from Verde types. No sherd-tempered vessel fragments were observed in either of the Tuzigoot thin sections.

Discussion and Conclusions

Verde Brown/Red and Tuzigoot Plain/Red are assumed to be locally produced on the basis of the "criterion of relative abundance," or the notion that pottery was manufactured in the area where it is most abundant (Rice 1987:177). These types apparently do not represent different production areas but may reflect change over time.

The principal differences between Verde and Tuzigoot ceramic ware types appear to be the sherd temper in Tuzigoot, which is less abundant that the rock temper in Verde, and the finer surface finish of Tuzigoot. As determined from my observations of a sample of large sherds (4 Tuzigoot and 46 Verde) in the LOCAP collection, Verde is much more likely to be wiped (39 of 90 surfaces) than is Tuzigoot (1 of 8 surfaces).

There is some evidence of a shift in the frequency of Tuzigoot relative to Verde in the midden at Tuzigoot Ruin (Peck 1959). Verde appears to have been the only or the dominant type in the early part of the sequence, whereas Tuzigoot became important later in the sequence, sometime after A.D. 1100. Sherd temper may have become more common over time because of the increased strength it imparts to vessel walls. Grog, or prefired clay, is known by modern ceramists to limit shrinkage, reduce drying time, and eliminate cracking (Rice 1987:75). Shepard (1971:132) found that sherd temper produced a stronger ceramic than sand, basalt, or ash temper.

During the historical period, crushed-sherd temper was used in brown plain ware manufactured by the Tohono O'odham (Fontana et al. 1962:55–57), Akimel O'odham (Jones 1938; Russell 1975:124–126), and Maricopa (Fernald 1973; Spier 1978). Crushed-sherd temper is also found in prehistoric Lower Colorado Buff Ware and Hohokam plain ware from the Papaguería of southwestern Arizona, the lower Gila River valley, and the Salt River, although not from the middle Gila River valley (Abbott 2000:166; Beckwith 1988:201–207; Gregonis et al. 2001; Mitchell and Lane 1989:80; Rose and Fournier 1981:80; Waters 1982). It would be interesting to track the distribution of this trait through time on a regional scale and to assess its implications for population movements and interaction.

Crushed-sherd temper, an important attribute of Tuzigoot Plain and Red ceramics, would not have been identified without petrographic analysis. Low-power magnification should be routinely supplemented with some petrographic analysis to verify identifications. The identification of ceramic inclusions is especially important for middle Verde region ceramics, where undecorated wares may be distinguished primarily by inclusion type, size, and abundance. Petrographic studies of ceramics and comparative samples of raw material should also be used in the future to accurately describe and quantify paste differences between types and to connect these differences to the regional geology or different manufacturing traditions.

Table A.1. Point-Counts of Identified Inclusions

Inclusion	Ceramic Type, by Site (Sample Record No.)				Verde River Sand
	Verde Brown		Tuzigoot Plain		
	53/745 (3914)	105/838 (4333)	105/838 (4561)	105/838 (4597)	
Minerals					
Quartz	104	99	70	78	72
Plagioclase	100	99	21	70	31
Alkali feldspar	5	1	8	2	19
Unknown feldspar	—	2	2	1	—
Epidote	26	25	8	16	—
Muscovite	—	—	—	—	1
Biotite	1	2	1	1	—
Amphibole/Pyroxene	—	—	4	—	2
Olivine	—	—	—	—	6
Carbonate	—	—	1	—	6
Opaque/Hematite	2	7	7	8	6
Unknown	30	19	13	17	16
Rocks					
Volcanic	—	—	45	35	140
Plutonic	1	—	—	2	4
Sedimentary[a]	—	—	—	—	110
Metamorphic	—	—	2	2	15
Unknown	1	—	5	7	21
Sherd	—	—	43	68	—
Total	270	254	230	307	449

[a] Sedimentary includes limestone, chert, and fine grained.

Table A.2. Recorded Inclusion Types, by Percentage

Inclusion	Ceramic Type, by Site (Sample Record No.)			
	Verde Brown		Tuzigoot Plain	
	53/745 (3914)	105/838 (4333)	105/838 (4561)	105/838 (4597)
Void	—	6	cracked	3
Matrix	63	57	85	76
Rock	37	37	13	15
Sherd	—	—	3	6
Total percentage	100	100	100	100

Note: Percentages may vary from 100 percent because of rounding.

APPENDIX B

Petrographic Analysis of Pottery Presumed to Have Been Made by the Yavapai: Tizon Wiped and Orme Ranch Plain

Andrew L. Christenson

Identifying the type of pottery that the Yavapai made is an archaeological issue, as no known vessels have been collected directly from members of the tribe. The production of this type of pottery had ceased by the time ethnographers were interested in collecting examples. An attempt to revive Yavapai pottery making apparently occurred in the 1930s, but the photographs of this pottery show it to have surface treatment, decorations, and forms similar to Maricopa pottery (Federal Emergency Relief Administration of Arizona n.d.); therefore, its relevance to understanding traditional Yavapai pottery seems minimal.

Basically, it seems to be agreed that the Yavapai made a ceramic ware that has been named Tizon Brown Ware by archaeologists (Euler and Dobyns 1985:84). Unfortunately, Tizon Brown Ware is found over much of western Arizona and southern California; therefore, it was not made exclusively by the Yavapai. Yet there are two pottery types—one that has been formally placed in Tizon Brown Ware (Tizon Wiped) and one that has not been officially placed in a ware (Orme Ranch Plain)—that appear more likely to have been associated primarily with the Yavapai (see Pilles 1981b:167–170). However, Euler and Dobyns (1985:79) stated that we should expect no major difference in the pottery of the Walapai, Havasupai, and Yavapai.

Tizon Wiped was defined by Dobyns (1974:315–317; see also Euler and Dobyns 1958) (Figure B.1). Both Dobyns and Euler originally believed that Tizon Wiped was mostly associated with the Havasupai (Dobyns 1974:317; Euler 1958:94), but work by Euler at Turkey Cave in the Agua Fria River drainage, a site known to have been used by the Yavapai, suggested that it was made by the Yavapai as well (Euler 1958:345).

Orme Ranch Plain was discovered in a cave in the Agua Fria drainage and was subsequently defined by Breternitz (1960b). Originally, it was thought to be a historical-period/protohistoric type, although a connection with the Yavapai was not demonstrated (Figure B.2). Recent work in central Arizona has yielded several more finds of the type, providing a stronger basis for the argument that it may be associated primarily with the Yavapai (Telles and McConnell 2000; Paul V. Long, personal communication 2002).

The goal of this project was to begin to examine the technology and variation in these types and to initiate the process of gathering data that may ultimately yield information about where they were manufactured. Although some of the necessary information can be gathered through a simple examination of sherds without magnification or under a low-power microscope, important information about the composition of the temper can be gained only by high-power examination of thin sections.

The Sample

Table B.1 provides basic information obtained about the sample of 17 sherds by means of macroscopic or low-power microscopic examination. All of the sherds came from historically documented Yavapai territory (see Khera and Mariella 1983:Figure 1).

Three sherds of Orme Ranch Plain were obtained from excavated collections from the type site, Orme Ranch Cave (NA6656), stored at the MNA. Sample 1 is from the surface, Sample 2 is from Level II, and Sample 3 is from Level XY. Sample 3 is a type sherd for Orme Ranch Plain in the MNA Ceramic Repository (AT 10879).

Six sherds—four Tizon Wiped (see Figure B.1) and two Orme Ranch Plain (see Figure B.2)—were obtained from a group of sites north of Drake in the Prescott and Kaibab National Forests investigated by Paul V. Long in his Yavapai Ethnoarchaeology Project (YEAP). YEAP 23 is a multicomponent site, and YEAP 32 and YEAP 33 are single-component artifact scatters containing Tizon Brown

Figure B.1. Tizon Wiped sherd from YEAP 32-1 near Drake; interior view, rim at top.

Figure B.2. Orme Ranch Plain sherds from YEAP 33-1 near Drake.

Ware, Orme Ranch Plain, Jeddito Yellow Ware, and Desert Side-notched points.

One Tizon Wiped sherd was from the midden at Brown's Ranch Rock Shelter (AZ U:1:25 [ASM]; Feature 2, Bag 151) in north Scottsdale (illustrated by Ferg [2002:Figure 44a]). Other Tizon Wiped, possible Orme Ranch Plain, punctate-decorated, and possible Cerbat Brown sherds were present at this site. Another Tizon Wiped sherd was from a small shelter immediately east of Skeleton Cave (AZ U:7:3 [ASM]; SHM 98.197.15), where a massacre of Yavapai by U.S. soldiers took pace in 1872 (sherd is illustrated by Ferg and Tessman [1998:Plate 7.13, upper left]).

One sherd derived from a nearly complete Orme Ranch Plain jar found at site AR-03-04-06-45, in Sycamore Pass, CNF (a photo of this vessel is linked to Northern Arizona University's Ceramic Manual 2001 Web page [http://www2.nau.edu/~sw-ptry/Western%20Apache-Yavapai/Orme%20Ranch%20Vessel%20Pic.htm]). A probable Orme Ranch Plain sherd came from AZ N:7:231 (ASM) (PD 15, FS 2), a site in the Stone Ridge development in Prescott Valley that consisted primarily of prospecting/mining features (Leonard et al. 1999:22–24). A sherd found in the Date Creek area (USGS quad AZ N:9 [SW]) is housed at the Tizon Wiped type collection (AT 18841) at the MNA Ceramic Repository. The sherd, however, had a textured surface similar to that of Orme Ranch Plain, and this attribute should probably be given priority over wiping in type identification.

Two sherds were found at sites that were excavated during the LOCAP. One Orme Ranch Plain sherd (PD 3670) came from the surface of AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745) in the CNF. A Tizon Wiped sherd came from the surface of AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561) nearby.

Finally, a fingernail-indented sherd with hints of pinching came from the surface of AZ N:7:255 (ASM) (Figure B.3), a multicomponent site—also located in Prescott Valley (Leonard et al. 1999:66–68)—that yielded several sherds that appeared to be protohistoric. The fingernail-indented sherd was called Apache Plain, possible Rimrock variety, by the discoverers (Wright et al. 1999:Figure 5), but I prefer not to assign it to a type at the moment, because the cultural and temporal distribution of fingernail indentation is poorly known (Wood 1987:115). Aquarius Orange and possible Tizon Wiped sherds were also recorded during survey of this site.

Petrographic Methods

Samples were cut from sherds to approximately 30 by 20 mm with a lapidary saw. Most of the pieces were submitted to Quality Thin Sections, Tucson, for impregnation with epoxy, staining for potassium and plagioclase feldspar, and thin sectioning parallel to the vessel wall. The LOCAP sherds were prepared at the University of Utah Sample Preparation Laboratory.

Thin sections were scanned at 40× with a petrographic microscope to make general observations on the thin sections. They were then point-counted at 100× to obtain a count of about 200 sand-sized grains. This point-count

Table B.1. Information on Sample Analyzed

Ceramic Type	Site	Sample No.	Form	Temper[a]	Firing		Surface Treatment		Thickness[b] (mm)	Other
					Interior	Exterior	Interior	Exterior		
Tizon Wiped	133/561 (ASM/CNF)	1	jar	fine arkosic	reduced	reduced	wiped	wiped	5	
Tizon Wiped	YEAP 23	1	jar	arkosic	reduced	oxidized	wiped, smudged	wiped		
Tizon Wiped	YEAP 23	2	jar	arkosic	reduced	oxidized	heavily wiped, smudged	wiped		
Tizon Wiped	YEAP 32	1	jar	arkosic	indeterminate	indeterminate	wiped	none	5.3	round, outcurved rim; see Figure 53
Tizon Wiped	YEAP 33	3	jar	fine arkosic	reduced	reduced	none	wiped		
Tizon Wiped	AZ U:1:25[c]	1	jar	fine, low arkosic	reduced	oxidized	wiped, smudged	wiped	6	
Tizon Wiped	AZ U:7:3[c]	1	jar	fine to medium arkosic, minimal gold mica	oxidized	reduced	wiped	wiped	4	
Tizon Wiped/Orme Ranch Plain	no site designation[d]	1		arkosic				pinched		
Orme Ranch Plain	53/745 (ASM/CNF)	1	jar	fine uncertain temper	reduced	reduced	wiped, smudged	wiped, pinched	5	
Orme Ranch Plain	NA6656	1	jar	moderate to high arkosic				pinched		
Orme Ranch Plain	NA6656	2	jar	fine, low arkosic	reduced	reduced	wiped, smudged	pinched		
Orme Ranch Plain	NA6656	3	jar	fine, low to moderate arkosic	reduced		wiped, smudged	pinched, wiped		
Orme Ranch Plain	YEAP 33	1	jar	moderate to high arkosic	reduced	oxidized	wiped, smudged	pinched		see Figure 54
Orme Ranch Plain	YEAP 33	2	jar	low to moderate arkosic; minimal silver mica	reduced	oxidized	wiped, smudged	pinched		
Orme Ranch Plain	45 (CNF)[e]	1	jar	arkosic; minimal silver mica	reduced	reduced	smudged	pinched, smudged	4.5	

continued on next page

Ceramic Type	Site	Sample No.	Form	Temper[a]	Firing		Surface Treatment		Thickness[b] (mm)	Other
					Interior	Exterior	Interior	Exterior		
Orme Ranch Plain	AZ N:7:231[c]	1	jar	arkosic	reduced	oxidized	wiped, smudged	pinched, slight wiping	5.5	
Fingernail indented	AZ N:7:255[c]	1	jar	fine to medium arkosic	oxidized	oxidized	wiped	wiped, finger-nail indented	6	see Figure 55

[a] 10× binocular microscopic examination of temper; texture recorded as fine, medium, or coarse; abundance recorded as low, moderate, or high. Texture medium and abundance moderate, unless otherwise specified.
[b] Measured 1.5 cm below rim.
[c] Full site number includes the designation "(ASM)."
[d] Isolated find plotted on Arizona State Museum/U.S. Geological Survey quadrangle AZ N:9 (SW).
[e] Full site number includes the designation "AR-03-04-06."

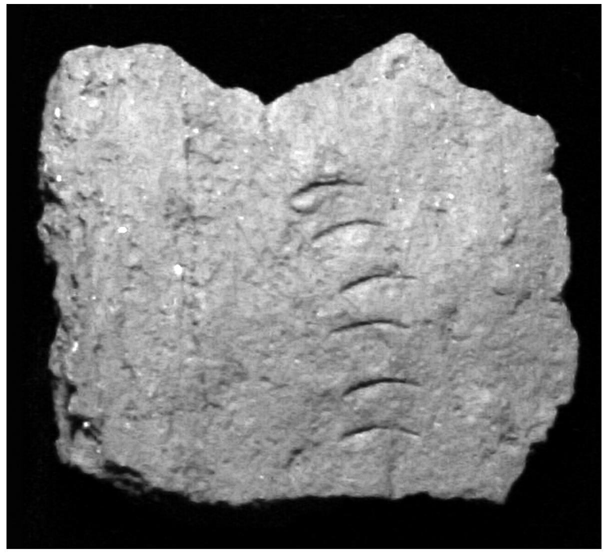

Figure B.3. Fingernail-indented sherd from AZ N:7:255 (ASM) in Prescott Valley. The orientation of the indentations is uncertain. Height of sherd is 45 mm.

technique (Gazzi and Dickinson method) was developed for analysis of sedimentary rocks. Minerals that were sand sized or larger (>0.065 mm) were counted as the mineral, whether free or as part of a rock fragment. Minerals smaller than sand sized but part of a rock fragment were counted as the rock type (e.g., volcanic, igneous plutonic). Mineral or rock fragments smaller than 0.065 mm were considered matrix and were not counted. Minerals and rocks that could not be identified were counted as unknown. A single linear sample of about 100 points was counted to obtain the relative frequency of voids, sand-sized rock, and matrix (silt and clay).

Results

Tables B.2 and B.3 provide point-count information, and Figure B.4 plots quartz, alkali (potassium) feldspar, and plagioclase for 15 of the 17 sherds analyzed. The Tizon Wiped sherd from Brown's Ranch Rock Shelter (AZ U:1:25 [ASM]) did not have sufficient free quartz and feldspar to allow plotting. The Orme Ranch Plain sherd from Site 53/745 was found to contain mostly volcanic rock; therefore, point-counting was not continued. In general, all of the sherds were mineralogically simple; more than 90 percent of the sand-sized mineral inclusions were quartz and feldspar (the term "arkosic" refers to this combination of minerals). Mica was not particularly common in the samples and appears to have constituted natural inclusions in the clay or rock.

For the Prescott Valley and Verde River valley areas, the low diversity of minerals and rocks and a general lack of significant volcanic inclusions have been interpreted either as evidence that the temper is crushed granitic rock or that the clay is a self-tempered clay of granitic origin (Christenson 1999:93, 2000:157). All alluvial sand samples in the two regions that I have examined so far have exhibited abundant volcanic rock, generally basalt. Single fragments of volcanic rock were noted in a couple of the YEAP sherds, but these were no doubt simply stray inclusions. Only two analyzed samples contained a large number of nongranitic inclusions that were certainly temper (i.e., added intentionally by the potter): the Orme Ranch Plain sherd from YEAP 33 that had sherd temper and the Orme Ranch Plain sherd from Site 53/745 that had mostly volcanic-ash (?) temper. One sample from Orme Ranch Cave (NA6656-2) had a stray sherd in the paste, and the Tizon Wiped/Orme Ranch Plain sherd had a few of what appeared to be clay lumps that could also be fine-pasted (i.e., almost temper-free) sherds.

Sherd temper has been reported in a range of prehistoric types in the Southwest as well as in protohistoric and historical-period types; it is the predominant temper in Navajo pottery after the 1750s (Brugge 1963:20). The Yuma/Quechan and the Mohave are both recorded as having used sherd temper, the Mohave specifically in noncooking vessels (Rogers 1936:30, 37). Sherd temper has been recorded in lower Colorado archaeological types, such as Tumco Buff and Needles Buff (Schroeder 1958), and in a historical-period type, Hedges Buff (Schaefer 1994:87), and has been reported as having been "sporadically used in all periods" (Waters 1982:539). The Tohono O'odham (Fontana et al. 1962:57) and the Akimel O'odham (Drucker 1941:107) also used sherd temper.

"Fine gravel or sherds ground on metate" are indicated as the temper for the Western Yavapai (Gifford 1936:281). Wood (1987:115) has indicated that sand and sherd were used as temper for Yavapai Plain Ware, a category in which he included Tizon Wiped and Orme Ranch Plain. It is interesting to note that a male Northeastern Yavapai informant claimed that no temper was added to pottery (Drucker 1941:107). Sherd temper is often very difficult to see, even under the microscope (Christenson 2002); therefore, we can predict that it is more common than has been reported in the sparse literature on central Arizona protohistoric/historical-period pottery.

Important information can be derived from petrographic analysis through an assessment of whether the inclusions in the pottery are likely to be of local or distant origin. Such interpretations, however, can come only after an examination of the geology in the vicinity of the site. Information from site reports, personal observation, and an examination of a small-scale geological map of Arizona (Reynolds 1988) indicates that the YEAP sites are located in an area of Coconino Sandstone overlain by basalt (Paul V. Long, personal communication 2002); that Orme Ranch Cave

Table B.2. Point Counts of Identified Inclusions

Inclusion	Ceramic Type, by Site																
	Tizon Wiped							Tizon Wiped/ Orme Ranch Plain	Orme Ranch Plain								Fingernail Indented
	133/561 (ASM/ CNF) (1)	YEAP 23[a] (1)	YEAP 23[a] (2)	YEAP 32[a] (1)	YEAP 33[a] (3)	AZ U:1:25[b] (1)	AZ U:7:3[b] (1)	No Site Designation[c] (1)	53/745 (ASM/CNF) (1)	NA6656[d] (1)	NA6656[d] (2)	NA6656[d] (3)	YEAP 33[a] (1)	YEAP 33[a] (2)	45 (CNF)[e] (1)	AZ N:7:231[b] (1)	AZ N:7:255[b] (1)
Minerals																	
Quartz	82	109	119	107	64	38	81	100	4	100	89	86	88	104	109	133	117
Quartz/feldspar intergrowth	—	—	1	—	—	142	—	—	—	—	—	—	—	—	—	—	—
Alkali feldspar	2	85	84	14	43	12	27	24	—	12	3	3	76	32	46	6	—
Plagioclase	125	—	2	86	100	7	97	84	13	77	114	102	43	49	47	78	79
Unknown feldspar	2	—	—	—	1	1	63	2	—	22	—	—	1	1	8	3	—
Muscovite	—	present	present	—	—	—	—	—	—	—	—	—	2	5	1	—	—
Biotite	1	—	—	—	present	—	—	—	present	—	—	—	present	—	—	—	—
Unknown mica	—	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—
Pyroxene	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Amphibole	—	—	—	—	—	—	—	11	—	—	—	—	—	—	—	—	—
Epidote	10	—	—	8	—	1	—	10	—	22	8	14	—	—	—	9	—
Hematite	present	—	—	—	—	1	2	1	—	—	—	—	—	—	—	—	—
Opaque	3	1	—	7	14	9	—	3	3	3	—	6	—	1	indeterminate[f]	1	6
Unknown	6	2	1	12	4	4	9	32	—	15	13	27	7	10	2	26	7
Rocks																	
Volcanic	—	present	—	—	present	—	—	—	24	—	—	—	—	—	—	—	—
Plutonic	3	1	1	1	—	1	3	10	—	4	1	1	2	4	—	7	4
Sedimentary	—	1	2 (fine)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sherd	—	—	—	—	—	—	—	—	—	—	1	—	—	34	—	—	—
Clay lump?	—	—	—	—	—	—	—	present	—	—	—	—	—	—	—	—	—
Unknown	—	3[g]	—	1	—	1	1	5	—	—	1	1	—	—	—	—	—
Total	234	202	210	236	226	217	283	284	44	255	230	240	220	240	213	263	214

Note: The number in parentheses following the site number indicates the sample record number. "Present" indicates minerals or rocks seen in the thin section but not encountered in the point count.

[a] Yavapai Ethnoarchaeology Project (YEAP) site.

[b] Arizona State Museum (ASM) site.

[c] Isolated sherd found in vicinity of Date Creek in the southwest quadrant of the AZ:N:9 7.5-minute quadrangle (Arizona State Museum/U.S. Geological Survey).

[d] Museum of Northern Arizona (MNA) site.

[e] Coconino National Forest (CNF) site. Full site number includes the designation "AR-03-04-06."

[f] Opaque minerals not visible because of dark paste.

[g] May be sedimentary.

Table B.3. Paste Constituents, by Percentage

Paste Constituents	Ceramic Type, by Site																Fingernail Indented
	Tizon Wiped							Tizon Wiped/ Orme Ranch Plain	Orme Ranch Plain								
	133/561 (ASM/ CNF) (1)	YEAP 23[a] (1)	YEAP 23[a] (2)	YEAP 32[a] (1)	YEAP 33[a] (3)	AZ U:1:25[b] (1)	AZ U:7:3[b] (1)	No Site Designation[c] (1)	53/745 (ASM/ CNF) (1)	NA6656[d] (1)	NA6656[d] (2)	NA6656[d] (3)	YEAP 33[a] (1)	YEAP 33[a] (2)	45 (CNF)[e] (1)	AZ N:7:231[b] (1)	AZ N:7:255[b] (1)
Voids	7	15	16	9	6	4	1	—	—	2	1	1	13	12	10	5	6
Matrix	74	56	61	62	71	74	67	74	58	49	62	62	55	72	55	58	69
Rock	19	29	23	29	24	23	32	26	42	50	36	37	32	15	35	37	25
Sherd	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—
Total percentage	100	100	100	100	101	101	100	100	100	101	100	100	100	100	100	100	100

Note: The number in parentheses following the site number indicates the sample record number. Percentages may vary from 100 percent because of rounding.

[a] Yavapai Ethnoarchaeology Project (YEAP) site.

[b] Arizona State Museum (ASM) site.

[c] Isolated sherd found in vicinity of Date Creek in the southwest quadrant of the AZ:N:9 7.5-minute quadrangle (ASM/U.S. Geological Survey).

[d] Museum of Northern Arizona (MNA) site.

[e] Coconino National Forest (CNF) site. Full site number includes the designation "AR-03-04-06."

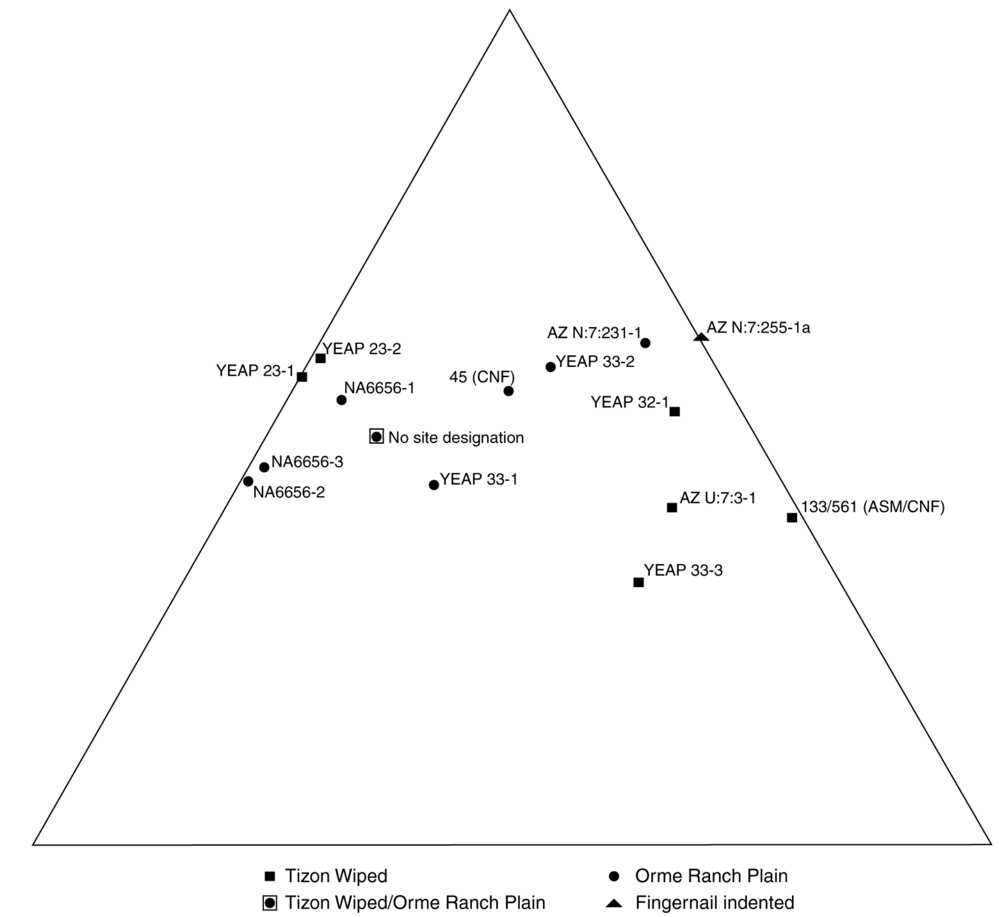

Figure B.4. Ternary plot of samples by quartz (Q), alkali (potassium) feldspar (A), and plagioclase (P). For full site numbers, see Table B.2. "-X" indicates the sample number. "No site designation" indicates an isolated find plotted on Arizona State Museum/U.S. Geological Survey quadrangle AZ N:9 (SW).

(Breternitz 1960b:25), Sycamore Canyon, Brown's Ranch Rock Shelter (Wright 2002:6), and Skeleton Cave are located in areas dominated by volcanic rock; and that the Prescott Valley sites are situated in a granitic-rock area. The LOCAP sites are located in areas characterized by volcanic or sedimentary rock.

As revealed in Figure B.4, the Prescott Valley sherds (N:7:231 [ASM] and N:7:255 [ASM]) exhibited temper of a granitic-rock type not recorded in the area. The two Tizon Wiped sherds from YEAP 23 and the Orme Ranch Plain sherds from Orme Ranch Cave are in an area of the diagram classified as alkali granite. Both of the YEAP 23 sherds contained a small amount of sedimentary rock as inclusions, but their principal constituents were crushed or disintegrated granitic rock rather than crushed local Coconino Sandstone, which contains little feldspar (Krieger 1965:64). These two sherds were so close in composition that they may have derived from the same vessel. I attempted to select sherds that appeared to be from different vessels on the basis of thickness, texture, and color, but brown ware vessels can vary significantly around the circumference; therefore, the elimination of duplicates is not always possible.

The fingernail-indented sherd, one of the Orme Ranch Plain sherds, and two of the Tizon Wiped sherds corresponded to the composition known as tonalite, an uncommon granitic rock, although prehistoric sherds in the Verde River valley sometimes exhibit this exclusive quartz and plagioclase composition (Christenson 1999:Figure 9.2). The remaining Tizon Wiped and Orme Ranch Plain sherds and the Tizon Wiped/Orme Ranch Plain sherd had compositions in the granite-granodiorite range. There seems to be a fair amount of variation between the sherds in the sample that might ultimately allow narrowing down production (or at least temper-source) locations for these vessels.

Summary Information on Types

The two types that constitute the principal focus of this analysis can be summarized as follows (numbers in parenthesis represent the frequency of the attribute under discussion; some attribute information was not recorded).

Tizon Wiped

Both the interior (6/7) and exterior (6/7) surfaces of these jars were usually wiped with a bundle of grass or another object that is about 1 mm wide (see Figure B.1). Smudging (penetration of carbon into the interior of the vessel wall) was sometimes present on the interior (3/6), although it is not possible to determine whether this characteristic resulted from cooking activities or was produced during the firing process. Firing was either oxidized (3/6) or reduced (3/6) on the exterior. The paste contained an estimated 19–32 percent sand-sized grains, and average grain size was 0.3–0.5 mm, with some as large as 2.25 mm.

Orme Ranch Plain

This type is recognized by vertically pinched coils on the exterior of jars that are usually smoothed over (see Figure B.2). The interior was smudged (7/7) and usually wiped (6/7). Two vessel exteriors were wiped, and some wiping marks were visible on the exterior of another. One vessel exterior was smudged. Sand-sized inclusions constituted 16–50 percent of the paste, an enormous range that includes the lowest and highest amounts of "temper" that I have found in central Arizona pottery, with an estimated average size of 0.5–0.7 mm. Breternitz (1960b:28) reported this type as having "angular calcite crystals and pyroclastic material," but only one of the eight sherds analyzed here contained what appeared to be volcanic-ash (i.e., pyroclastic) inclusions.

Conclusions

Although it is not possible to reach definitive conclusions at this preliminary stage, some general observations are in order. The Tizon Wiped, most of the Orme Ranch Plain, and the fingernail-indented sherds were quite similar except for exterior-surface treatment and mineralogical differences that were apparent only at high magnification. The Orme Ranch Plain sherd that contained volcanic temper and the other that contained a significant proportion of sherd were the exceptions to this generalization. The sherds with arkosic temper were also similar to prehistoric Prescott Gray Ware, Verde Brown, and other Tizon Brown Ware types. One thing is very clear about the temper—it suggests a pronounced preference for granitic rock, either crushed or naturally present in the clay, independent of the local bedrock geology. Streams carrying granitic rocks would be one source of rock for temper that could be miles from the nearest granitic bedrock. Only an examination of the geology of streambeds near sites would help answer this question. Although neither the prehistoric inhabitants of central Arizona nor the Yavapai had detailed mineralogical knowledge, they may have developed—through years of experience—a technology for using clay with granitic-rock fragments (either naturally present or added by the potter). In the case of at least all but one of the vessels analyzed here, these ancient potters avoided volcanic and sedimentary rock and stream sands for temper.

Of course, any interpretation concerning the correlations between geology and the mineralogy of pottery would have to consider the following potential factors: the relocation of pots through exchange, the procurement of nonlocal temper or clay, and residential movement. A procurement range of around 100 km has been indicated for the Watarma band of the Northeastern Yavapai (Shackley 1996a:Figure 2.3), although it is unclear whether pottery would normally be carried over such a distance.

Recommendations

Obviously, the first requirement for future analyses would be additional samples of Tizon Wiped, Orme Ranch Plain, and fingernail-indented pottery from good archaeological and ethnohistorical contexts. The sites being examined in the YEAP are particularly worthy of attention because of their potential linkage with dated events in Yavapai history. Geological reconnaissance and sample collection in the vicinity of sites that contain these two types will help in assessing the relationship (or nonrelationship) of local geology and temper, although other analyses will be necessary to determine whether local ceramic production was taking place.

APPENDIX C

Thermoluminescence Dating of Ceramics from the Lower Oak Creek Archaeological Project (LOCAP) Sites along State Route 89A between Cottonwood and Sedona, Arizona

James Feathers

Seven sherds from the LOCAP were submitted for TL dating analysis by SRI. Six sherds came from AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745), and the seventh came from AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561). The sites were located along SR 89A between Cottonwood and Sedona, Arizona. The objective of the dating work was to compare the ages of two chronologically uncertain ceramic types, Orme Ranch Plain and Tizon Wiped, to the ages of three types with better-known chronological ranges. Orme Ranch Plain and Tizon Wiped are thought by some to be restricted to the historical period, but others have suggested a date as early as A.D. 1300 for the emergence of Orme Ranch Plain ceramics and A.D. 800 for Tizon Wiped ceramics (see discussion in Whittlesey and Benaron 1998; see also Breternitz 1960b; Euler and Dobyns 1985; Pilles 1981b). The ceramic type for each sherd, along with the laboratory number and provenience, is listed in Table C.1.

The sherds and associated sediment samples were collected from the present surface. All sherds were fine textured, except for the Orme Ranch Plain specimens, which contained coarse temper particles. Nevertheless, the fine-grain procedure was used to prepare all samples (see below). Sample UW562 had a limited amount of material, which affected the methods used to analyze this sample.

In general, analysis included measurement of the thermoluminescence, radioactivity, and moisture content of each sample and a determination of their equivalent dose plateaus and alpha efficiency. All samples but UW562 were also tested for anomalous fading. Laboratory procedures used in these analyses are detailed and described below.

Procedures for Thermoluminescence Analysis of Ceramics

Sample Preparation: Fine Grain

In the initial stage of sample preparation, the sherd was broken to expose a fresh profile. Material was drilled from the center of the cross section, more than 2 mm from each surface, using either a tungsten carbide or a stainless steel drill bit. The material retrieved was ground gently with a corundum mortar and pestle, treated with HCl, and then suspended in acetone for 2 hours 20 minutes to separate the 1–8 m fraction. These fine grains were then resuspended in acetone and allowed to settle onto a maximum of 72 stainless steel disks as the acetone evaporated. Each disk carries a few milligrams of sample and is simply a convenient way of handling this fine-grain fraction. For a general review of luminescence dating, see Feathers (1997).

Glow Outs

Thermoluminescence was measured by a Daybreak reader using a 9635Q photomultiplier with a Corning 7-59 blue filter, in N_2 atmosphere at 1 C/s–450°C. A preheat of 240°C with no hold time preceded each measurement. Artificial irradiation was given with a ^{241}Am alpha source

Table C.1. Laboratory Number, Ceramic Type, and Provenience for Analyzed Sherds

Sample No.	UW Lab. No.	Site No.	Ceramic Type	Age Range (A.D.)
UW557	TL-1	53/745	Deadmans Black-on-red	900–1100
UW558	TL-2	53/745	Black Mesa Black-on-white	900–1160
UW559	TL-3	53/745	Jeddito Corrugated	1300–1625
UW560	TL-4	53/745	Orme Ranch Plain	unknown
UW561	TL-5	53/745	Orme Ranch Plain	unknown
UW562	TL-6	53/745	Tizon Wiped	unknown
UW563	TL-7	133/561	Tizon Wiped	unknown

Key: UW = University of Washington.

and a ^{90}Sr beta source, the latter calibrated against a ^{137}Cs gamma source. Disks were stored at room temperature for 1 week after irradiation before glow out. Data was collected by a multichannel analyzer and processed by Daybreak TLApplic software.

Fading Test

Several disks were used to test for anomalous fading. The natural luminescence was first measured by heating to 450°C. The disks were then given an equal alpha irradiation and were stored at room temperature for varied times: 10 minutes, 2 hours, 1 day, 1 week, and 8 weeks. The irradiations were staggered in time so that all of the second glows were performed on the same day. The second glows were normalized by the natural signal and then compared to determine any loss of signal with time (on a log scale).

Tests for anomalous fading were conducted on all sherds except Sample UW562, which lacked sufficient material. Figure C.1 shows the results of these tests. Loss of signal with time is indicative of fading. Only Samples UW559 and UW560 exhibited evidence of fading. There was some fading up to 1-day storage for some of the others but no significant fading after that time. Because all sample aliquots were stored for 1 week following irradiation, any fading within the first week was not a concern. Because of fading, the derived ages for Sample UW559 and Sample UW560 must be taken as minima.

Equivalent Dose and Alpha Effectiveness

The equivalent dose is the amount of radiation necessary to reproduce the natural luminescence signal. It forms the numerator of the age equation. The equivalent dose was determined by a combination additive dose and regeneration (Aitken 1985). Additive dose involved administering incremental doses to natural material. A growth curve that plots dose against luminescence can be extrapolated to the dose axis to estimate an equivalent dose, but for ceramics, this estimate is usually inaccurate because of errors in extrapolation owing to nonlinearity. Regeneration involved zeroing natural material by heating to 450°C and then rebuilding a growth curve with incremental doses. The problem here is sensitivity change caused by the heating. When both curves are constructed, the regeneration curve can be used to define the extrapolated area and to correct for sensitivity change by comparing it with the additive dose curve. This works where the shapes of the curves differ only in scale (i.e., the sensitivity change is independent of dose).

The curves were combined using the "Australian slide" method in a program developed by David Huntley of Simon Fraser University (Prescott et al. 1993). The equivalent dose was taken as the horizontal distance between the two curves after a scale adjustment for sensitivity change. Where the growth curves were not linear, they were fitted to quadratic functions. Dose increments (usually five) were determined so that the maximum additive dose resulted in a signal about three times that of the natural, and the maximum regeneration dose, about five times the natural. In the rare case for which sensitivity change in regeneration was dose dependent, the equivalent dose was taken as the dose-intercept for the additive dose adjusted for supralinearity by the regeneration dose-intercept, although this procedure is not considered reliable.

A plateau region was determined by calculating the equivalent dose at temperature increments between 240°C and 450°C and determining over which temperature range the values do not differ significantly. This plateau region was compared with a similar one constructed for the b-value (alpha efficiency), and the smaller of the two plateaus defined the integrated range for final analysis.

Where the size of the sherd prevented a full multialiquot analysis, equivalent dose was determined by the single aliquot regeneration additive dose (SARA) technique (Mejdahl and Bøtter-Jensen 1994). Several aliquots were given additive doses and then, after heating to 450°C, were given

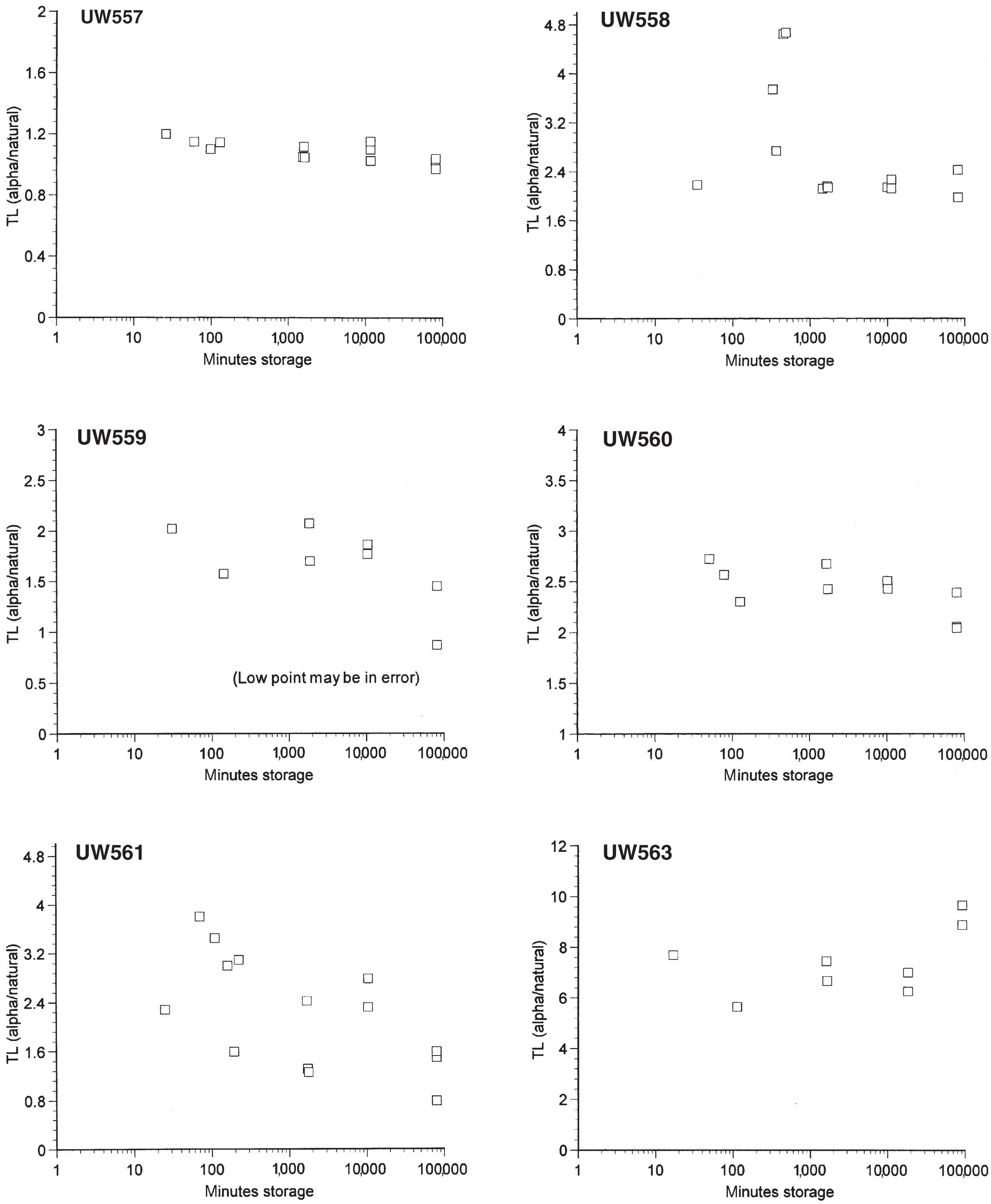

Figure C.1. Results of the anomalous fading tests for all samples but UW562. Note that only Samples UW559 and UW560 exhibit evidence of fading.

regeneration doses on the order of magnitude of the natural signal or the natural signal plus the added dose signal. An apparent equivalent dose was determined from regeneration on each aliquot, but these were not accurate because of sensitivity changes. However, when these are plotted against the original additive dose, a linear relationship can result if the sensitivity change is independent of dose, and an extrapolation to the dose axis provides the true equivalent dose.

Alpha efficiency was determined by comparing additive dose curves using alpha and beta irradiations. The slide program was also used in this regard, taking the scale factor (which is the ratio of the two slopes) as the b-value (Aitken 1985).

The plateau tests for equivalent dose and b-value of the LOCAP samples are shown in Figures C.2 and C.3. The plateaus were generally broad, but the equivalent dose plateaus were confined to lower temperatures for Samples UW560 and UW561, and the b-value plateau was at lower temperatures for Sample UW559. The additive dose and regeneration growth curves, combined by the slide method, are shown in Figure C.4. Scatter was high only for Sample UW561. Most fits to the data were quadratic in form, but the fits for the two with the lowest equivalent dose were linear, a pattern typical of ceramics. Because of its small size, Sample UW562 was also analyzed by the SARA method. The plot of apparent dose vs. added dose is shown in Figure C.5. The equivalent dose from the SARA analysis was higher than that from the slide analysis, although not statistically different, and had lower precision. The slide result was considered more reliable and was used to determine age. Additive dose curves using beta and alpha irradiation are shown in Figure C.6 for all samples. The ratio of these slopes was used to determine b-value, which is used to correct for lower alpha efficiency. Plateaus, equivalent doses (D_E), and b-values are provided in Table C.2.

Radioactivity

Radioactivity was measured by alpha counting in conjunction with atomic emission for ^{40}K. Samples for alpha counting were crushed in a mill to flour consistency, packed into plexiglass containers with ZnS:Ag screens, and sealed for one month before counting. The pairs technique was used to separate the U and Th decay series. For atomic-emission measurements, samples were dissolved in HF and other acids and analyzed by a Jenway flame photometer. K concentrations for each sample were determined by bracketing between standards of known concentration. Conversion to ^{40}K was by natural atomic abundance.

The sherd and an associated soil sample were measured for radioactivity. Where the environment was complex, additional soil samples were analyzed, and gamma contributions were determined by gradients (after Aitken 1985:Appendix H). Cosmic radiation was determined after Prescott and Hutton (1988). Radioactivity concentrations were translated into dose rates following Adamiec and Aitken (1998). The dose rate adjusted for the lower alpha efficiency in producing luminescence served as the denominator of the age equation.

Radioactivity data are presented in Table C.3. Values are fairly typical, except for Sample UW559, which displayed exceptionally high radioactivity. The uranium content was the record high for pottery analyzed at the University of Washington laboratory (the old record being 8.35 parts per million [ppm], also from a sherd found in Arizona). The measurement was taken twice for verification. Sediment radioactivity for Site 53/745 was similar for all samples, suggesting little variation across the site. Dose rates are given in Table C.4.

Moisture Content

Water-absorption values for the sherds were determined by comparing the saturated and dried weights. For temperate climates, moisture in the pottery is taken to be 80 ± 20 percent of total absorption, unless otherwise indicated by the archaeologist. Again, for temperate climates, soil-moisture contents are taken from typical moisture-retention quantities for different-textured soils (Brady 1974:196), unless otherwise measured. For drier climates, moisture values are determined in consultation with the archaeologist. The moisture content was taken as 50 percent of saturated value for the pottery and 10 percent for the sediment samples in this study (Table C.5).

Results

Derived ages are given in Table C.6. As previously noted, the ages for Samples UW559 and UW560 must be considered minima because of anomalous fading, and they could be older. The ages for Samples UW557 and UW558 agree with known age ranges for those types. Sample UW559 is younger, but this is probably because of anomalous fading. One sherd each of Orme Ranch Plain and Tizon Wiped returned ages dating to the twelfth century, which might be taken as confirming that these types extended well into prehistoric times. The other two sherds of these types were historical period in age, although Sample UW560 could be older because of anomalous fading. Because the Orme Ranch Plain sherds probably represent a single vessel, it is difficult to interpret these results. The best interpretation of the dates suggests that Site 53/745 was occupied sometime from the mid-eleventh to the mid-twelfth century, whereas Site 133/561 was historical period in age. The date interpretations conflict with the archaeological evidence, which places Site 133/561 in the prehistoric era (Middle to Late Archaic period and Formative period occupations) and Site 53/745 as a multicomponent site with a possible historical-period Yavapai occupation.

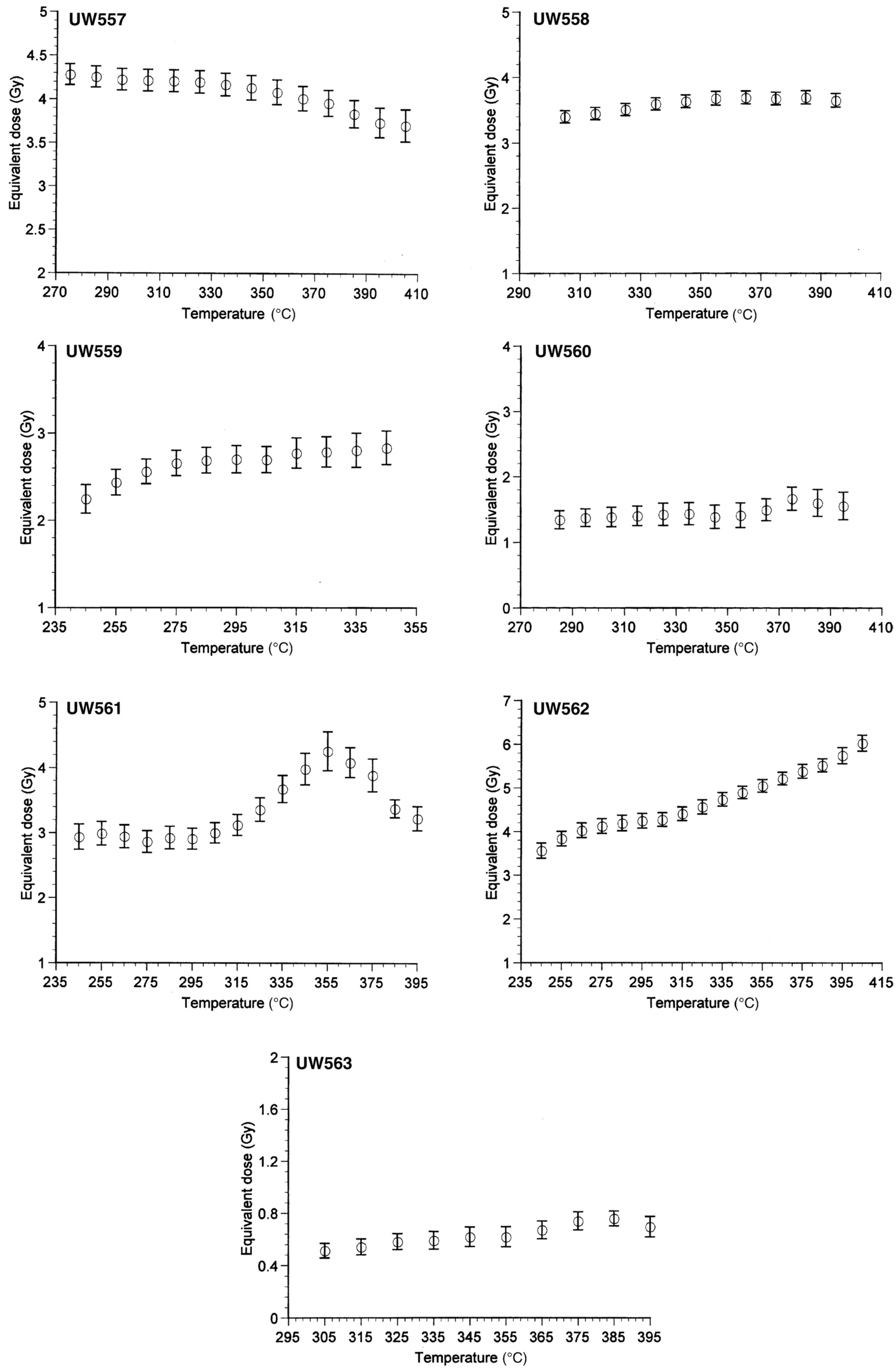

Figure C.2. Equivalent dose plateaus for all samples.

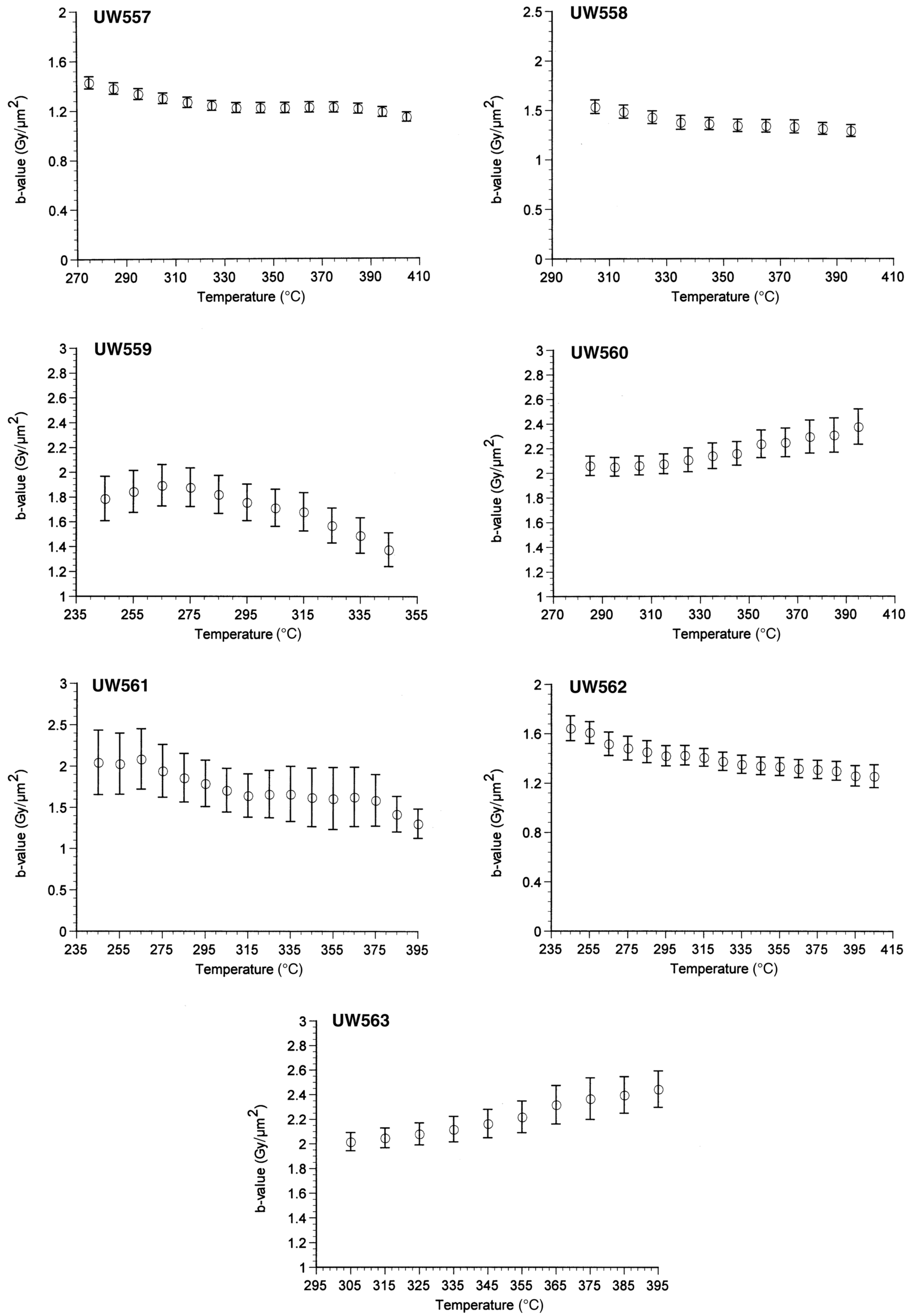

Figure C.3. The b-value plateaus for all samples.

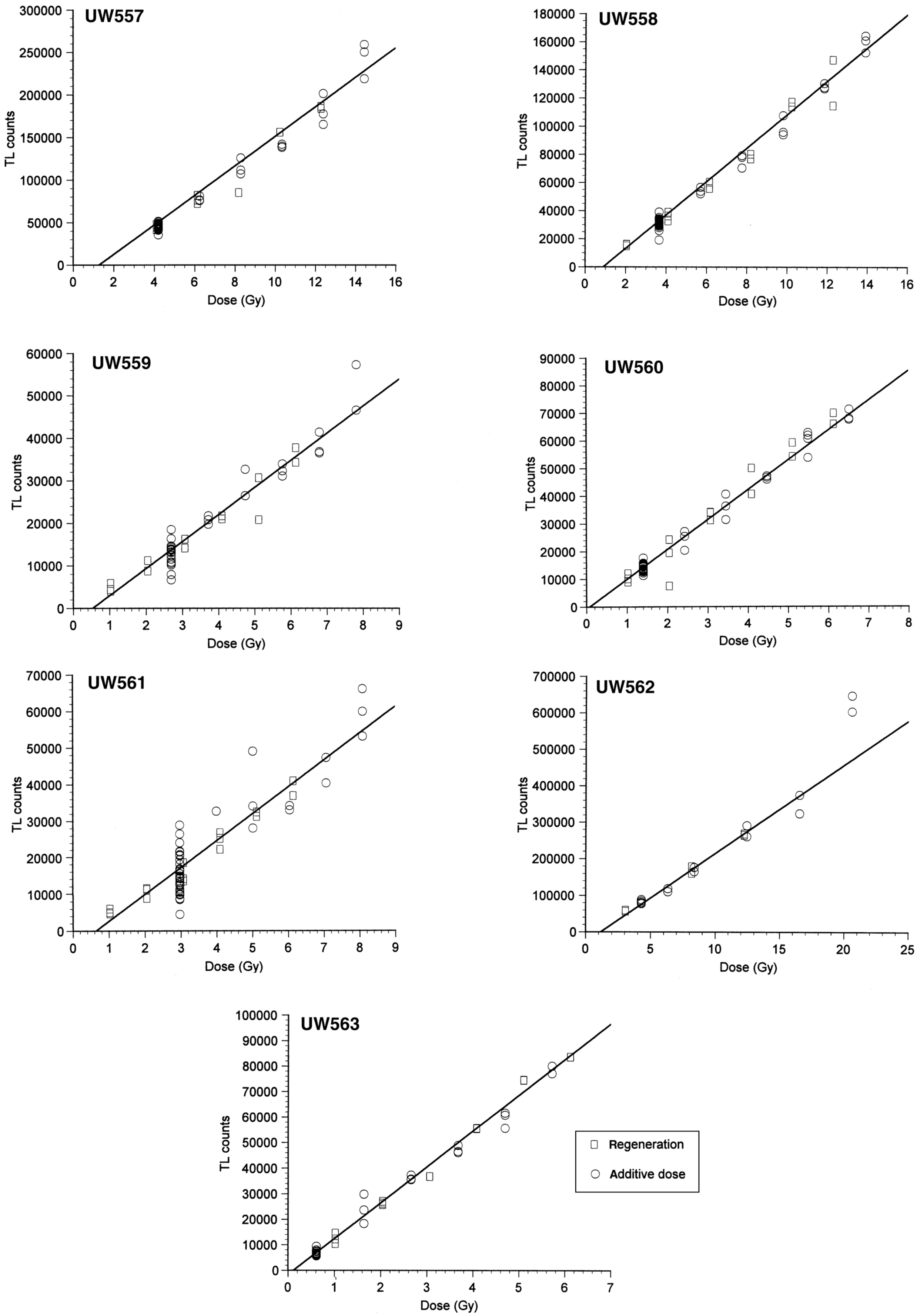

Figure C.4. The additive dose and regeneration growth curves, combined by the slide method, for all samples.

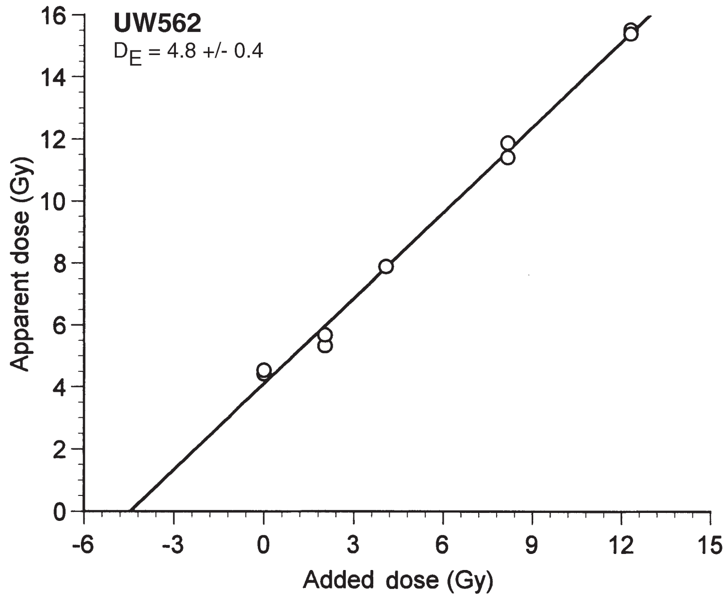

Figure C.5. Apparent dose vs. added dose for Sample UW562.

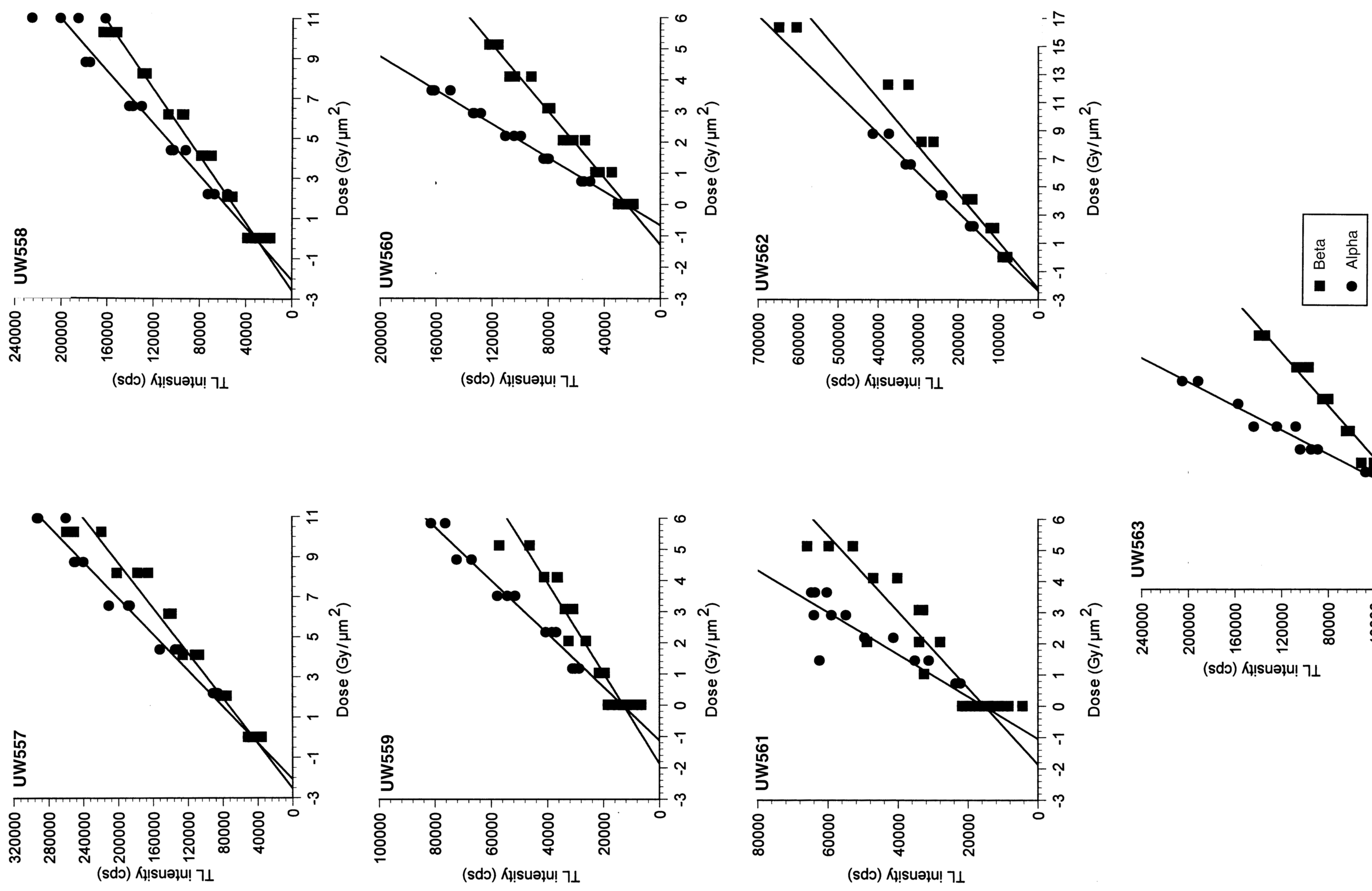

Figure C.6. Additive dose curves for all samples, using beta and alpha irradiation.

Table C.2. Plateaus, Equivalent Doses (D_E), and b-Values

Sample No.	Plateau (°C)	D_E (Gy) Slide	D_E (Gy) SARA	Fit	b-Value (Gy/μm²)
UW557	300–360	4.18 ± 0.27	—	quadratic	1.25 ± 0.04
UW558	330–400	3.66 ± 0.23	—	quadratic	1.34 ± 0.06
UW559	260–320	2.68 ± 0.21	—	quadratic	1.80 ± 0.15
UW560	280–360	1.39 ± 0.17	—	linear	2.04 ± 0.07
UW561	240–320	2.96 ± 0.24	—	quadratic	2.02 ± 0.36
UW562	270–320	4.25 ± 0.28	4.85 ± 0.41	quadratic	1.43 ± 0.08
UW563	320–370	0.61 ± 0.08	—	linear	2.15 ± 0.11

Key: SARA = single aliquot regeneration additive.

Table C.3. Radioactivity Data

Sample No.	U (ppm)	Th (ppm)	K_2O (%)
UW557	3.59 ± 0.27	11.46 ± 1.48	2.47 ± 0.04
Sediment	0.74 ± 0.10	4.14 ± 0.78	0.78 ± 0.01
UW558	4.95 ± 0.32	11.63 ± 1.50	1.70 ± 0.02
Sediment	1.30 ± 0.11	3.79 ± 0.76	0.78 ± 0.01
UW559	9.22 ± 0.59	25.36 ± 2.30	1.65 ± 0.04
Sediment	0.76 ± 0.11	5.78 ± 0.95	0.73 ± 0.01
UW560	1.71 ± 0.15	8.54 ± 1.01	1.82 ± 0.01
Sediment	0.97 ± 0.12	5.84 ± 0.96	0.84 ± 0.01
UW561	0.66 ± 0.16	14.33 ± 1.55	1.55 ± 0.02
Sediment	1.16 ± 0.10	3.82 ± 0.76	0.75 ± 0.01
UW562	1.73 ± 0.18	11.65 ± 1.42	4.28 ± 0.02
Sediment	1.07 ± 0.09	4.20 ± 0.66	0.76 ± 0.02
UW563	1.46 ± 0.12	5.03 ± 0.89	1.28 ± 0.06
Sediment	2.14 ± 0.17	7.27 ± 1.10	2.23 ± 0.02

Table C.4. Dose Rates (Gy/ka)

Sample No.	Alpha	Beta	Gamma	Cosmic	Total
UW557	1.37 ± 0.18	2.36 ± 0.12	0.30 ± 0.02	0.33 ± 0.07	4.36 ± 0.23
UW558	1.74 ± 0.14	2.03 ± 0.08	0.32 ± 0.02	0.33 ± 0.07	4.42 ± 0.17
UW559	4.61 ± 0.40	2.91 ± 0.13	0.43 ± 0.03	0.33 ± 0.07	8.23 ± 0.43
UW560	1.32 ± 0.12	1.58 ± 0.05	0.32 ± 0.03	0.33 ± 0.07	3.55 ± 0.15
UW561	1.49 ± 0.28	1.41 ± 0.06	0.28 ± 0.02	0.33 ± 0.07	3.50 ± 0.29
UW562	1.10 ± 0.12	3.11 ± 0.12	0.33 ± 0.02	0.33 ± 0.07	4.87 ± 0.18
UW563	0.98 ± 0.11	1.12 ± 0.06	0.49 ± 0.03	0.33 ± 0.07	2.93 ± 0.14

Table C.5. Saturated Values

Sample No.	Pottery	Sediment
UW557	0.043 ± 0.02	0.1 ± 0.04
UW558	0.056 ± 0.02	0.1 ± 0.04
UW559	0.063 ± 0.03	0.1 ± 0.04
UW560	0.059 ± 0.02	0.1 ± 0.04
UW561	0.065 ± 0.03	0.1 ± 0.04
UW562	0.080 ± 0.03	0.1 ± 0.04
UW563	0.056 ± 0.02	0.1 ± 0.04

Table C.6. Derived Ages

Sample No.	Ceramic Type	Ceramic-Type Age Range (A.D.)	TL Date (A.D.)
UW557	Deadmans Black-on-red	900–1100	1041 ± 79
UW558	Black Mesa Black-on-white	900–1160	1172 ± 61
UW559	Jeddito Corrugated	1300–1625	1676 ± 30
UW560	Orme Ranch Plain	—	1608 ± 51
UW561	Orme Ranch Plain	—	1155 ± 99
UW562	Tizon Wiped	—	1128 ± 66
UW563	Tizon Wiped	—	1791 ± 29

Note: All samples except Sample UW563 are from Site 53/745. Sample UW563 is from Site 133/561.

Key: TL = thermoluminescence.

APPENDIX D

Lower Oak Creek Archaeological Project (LOCAP) Thermoluminescence Dating Analysis

Stacey Lengyel

Seven sherds from LOCAP Sites AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561) and AZ O:1:53/AR-03-04-06-745 (ASM/CNF) (Site 53/745) (Table D.1) were submitted to the University of Washington Luminescence Dating Laboratory for TL dating analysis (see Appendix C for details). The sherds and their associated sediments were collected from the modern surface of the two sites and consisted of representatives of two prehistoric wares, one prehistoric/protohistoric ware, and two temporally uncertain wares (Orme Ranch Plain and Tizon Wiped). The object of the analysis was to obtain age estimates for the two Orme Ranch Plain and two Tizon Wiped sherds in order to better assess how these wares fit into the use history of the two sites. At present, the date range for Orme Ranch Plain is uncertain, as some researchers have proposed that the type dates specifically to the historical period (Breternitz 1960b), and others have suggested that it could be prehistoric in origin (Pilles and McKie 1998; Whittlesey and Benaron 1998:159). The dating of Tizon Wiped is also somewhat uncertain; it is thought to be primarily a protohistoric and historical-period type that may have origins in prehistory (Dobyns and Euler 1958; Whittlesey and Benaron 1998:159). The TL analysis was undertaken to determine whether these four sherds were prehistoric (pre–A.D. 1450), protohistoric (A.D. 1450–ca. 1540), or historical period (post–A.D. 1540) in age. The three well-dated sherds were submitted as controls for the TL method.

At first glance, the TL date ranges resulting from this analysis appeared to be somewhat scattered (see Table D.1). The date ranges of the two prehistoric sherds overlapped with the accepted date ranges for their respective types; however, the date range for the Jeddito Corrugated sherd seemed to be somewhat later than expected (maximum age of A.D. 1646). The two Orme Ranch Plain sherds exhibited widely different date ranges separated by at least 300 years, although we would expect them to be from the same occupation. Finally, although the Tizon Wiped sherds were recovered from different sites, they appeared to represent prehistoric and historical-period occupations separated by at least 570 years. If these dates are correct, then this is clearly a very long-lived type.

Before accepting these TL dates as accurate estimates of the ages of the submitted sherds, we investigated potential sources of error that could have affected the returned date ranges. There was some concern that the use of surface artifacts for TL dating could have introduced some error. Conventional wisdom suggests that artifacts should be located at least 30 cm below the surface and within fairly homogeneous soils (Aitken 1997:188–189). This practice is suggested to simplify the effects of background radiation absorbed from the surrounding matrix and cosmic rays. However, Dunnell and Feathers (1994) have argued convincingly that surface sherds provide excellent opportunities for TL dating and, in some cases, are to be preferred over sherds from buried contexts. They point out that because most artifacts in buried contexts started off at the surface and were buried through subsequent depositional processes, buried contexts may actually be more complex than those on the modern-day surface (Dunnell and Feathers 1994:131–132). Recently, Seymour (2003) and Dykeman et al. (2002) have run a number of tests on the accuracy of TL dating of surface artifacts. Both studies indicated good agreement between the TL dates and the known or target dates or date ranges, and both emphasized the usefulness of employing TL to date protohistoric and historical-period sherds.

A second potential source of error arises from the variable contribution of radiation from the underlying soil matrix. The sherds from Site 53/745 were of particular concern, because basalt regoliths are located within 15–30 cm of the surface across most of this site. However, only the sheetwash gravels at the site's surface were collected for submission with associated sherds. It was thought that the difference between the mineralogy of the regoliths and the sheetwash could have

Table D.1. Ceramic Type, Ceramic Age Range, and TL Dates for Sherds Submitted for TL Dating

Sample No.	Site No.	Ceramic Type	Age Range (A.D.)	TL Date (A.D.)[a]
UW557	53/745	Deadmans Black-on-red	900–1100	1041 ± 79
UW558	53/745	Black Mesa Black-on-white	900–1160	1172 ± 61
UW559	53/745	Jeddito Corrugated	1300–1625	1676 ± 30
UW560	53/745	Orme Ranch Plain	unknown	1608 ± 51
UW561	53/745	Orme Ranch Plain	unknown	1155 ± 99
UW562	53/745	Tizon Wiped	unknown	1128 ± 66
UW563	133/561	Tizon Wiped	unknown	1791 ± 29

[a] Calibrated for 1 sigma.
Key: TL = thermoluminescence.

led to a gross underestimate of the gamma dose contribution to the total TL signal measured in each sherd. This, in turn, could potentially result in erroneously old TL dates. Because the gamma contribution to the total dose rates was less than 10 percent for all of the sherds from Site 53/745, the effects of the basalt on sherd radiation was trivial (James Feathers, personal communication 2005).

The final identified source of potential error was the presence of anomalous fading in two of the submitted sherds (Samples UW559 and UW560). Anomalous fading refers to the inability of a crystalline material to retain the TL signal in the absence of a zeroing event such as heating or illumination (Aitken 1997:210). Potassium feldspars are particularly prone to exhibiting anomalous fading, and it is usually recommended that quartz-grain inclusions be used for TL studies of younger specimens, because the latent TL signal is generally more stable in these minerals (Aitken 1985; Wintle 1973). Furthermore, by focusing on coarse quartz inclusions, one is able to increase the signal-to-noise ratio and employ more-sensitive measurement techniques for recent samples (Feathers and Rhode 1998:289–290). Unfortunately, this technique was not used to analyze the seven sherds submitted for this project. Instead, these sherds were analyzed via the fine-grained technique, which has a higher likelihood of including feldspars in the analyzed sample (Aitken 1997:195). This is most likely the source of the anomalous fading noted for the Jeddito Corrugated (Sample UW559) and one of the Orme Ranch Plain (Sample UW560) sherds. Because sherds that exhibit anomalous fading may greatly underestimate the true age of firing, the TL ages for both of these sherds should be considered minimum estimates. They very well could be older than the seventeenth-century A.D. ages obtained from this study.

Overall, the validity of the TL dating for this project is supported by the dates returned for the two well-dated prehistoric sherds. Furthermore, the date returned for the Tizon Wiped sherd from Site 133/561 is in agreement with the historical-period age of other sherds of this type (Dobyns and Euler 1958). The Jeddito Corrugated date is slightly later than the accepted date range for this type. Yet when the effects of anomalous fading are taken into account, it appears likely that this sherd does, in fact, fall within the accepted age range. Likewise, the TL date returned for Sample UW560 agrees with the hypothesized protohistoric/historical-period age for Orme Ranch Plain. Because of anomalous fading, the true age of this sherd is probably somewhat older than the returned TL date, but it is likely that it still falls within the protohistoric or early historical period. The only sherds that appear to have returned surprising dates are the Tizon Wiped sherd from Site 53/745 and the second Orme Ranch Plain sherd. Both sherds returned TL dates that were somewhat earlier than the postulated date ranges. However, it has been hypothesized that both of these ceramic types originated in prehistoric times, and the TL dates seem to support this conjecture. It also should be noted that the only source of error that we could confidently identify would cause an underestimation of age, rather than the overestimation that would account for the apparently early ages of these two sherds. Therefore, the TL dates for these two early sherds should be taken as accurate age estimates at this time.

APPENDIX E

An Energy Dispersive X-Ray Fluorescence (EDXRF) Analysis of Obsidian Artifacts from the Lower Oak Creek Archaeological Project (LOCAP) Sites

M. Steven Shackley

This report documents the energy dispersive X-ray fluorescence (EDXRF) analysis of 50 obsidian artifacts recovered from a number of sites during the data recovery portion of the LOCAP along SR 89A between Cottonwood and Sedona, Arizona. The obsidian collection was dominated by artifacts produced from obsidian procured from sources on the Coconino Plateau in the Mount Floyd and San Francisco Volcanic Fields, particularly Government Mountain, west of Flagstaff.

Analysis and Instrumentation

All samples were analyzed whole, with no intensive sample preparation. The results presented here are quantitative, in that they are derived from "filtered" intensity values ratioed to the appropriate X-ray continuum regions through a least squares fitting formula, rather than from plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). More essentially, these data, through the analysis of international rock standards, allow for interinstrument comparison with a predictable degree of certainty (Hampel 1984).

The trace element analyses were performed in the Department of Geology and Geophysics, University of California, Berkeley, using a Spectrace 400 (produced by United Scientific Corporation) EDXRF spectrometer. The spectrometer is equipped with an Rh X-ray tube and a 50 kV X-ray generator with a Tracor X-ray (Spectrace) TX 6100 X-ray analyzer using an IBM PC-based microprocessor and Tracor reduction software. The X-ray tube was operated at 30 kV, 0.20 mA, using a 0.127-mm Rh primary-beam filter in a vacuum path at 250 seconds live-time to generate X-ray intensity $K\alpha$-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^{T}), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Weight percent iron ($Fe^{2}O^{3T}$) can be derived by multiplying the estimated parts per million (ppm) by 1.4297^{10-4}. Trace element intensities were converted to concentration estimates by employing a least squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the USGS, the Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1989). Further details concerning the petrological choice of these elements in Southwest obsidians are available in works by Shackley (1988, 1990, 1992, 1995a; see also Hughes and Smith 1993; Mahood and Stimac 1990). Specific standards used for the best-fit regression calibration for elements Ti through Nb included G-2 (basalt), AGV-1 (andesite), GSP-1 and SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLM-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), all USGS standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques (Govindaraju 1989). In addition to the values reported here, Pb, Ni, Cu, Zn, Ga, and Th were measured, but these are rarely useful in discriminating glass sources and are not generally reported. These data are available on disc by request.

The data from the Tracer software were translated directly into Quattro Pro for Windows software for manipulation and into SPSS for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. Table E.1 shows a comparison among values recommended for three international obsidian and rhyolite rock standards: RGM-1, NBS (SRM)-278, and JR-2. One of these standards is analyzed during each sample run to check machine calibration. The results shown in Table E.1 indicate that the machine accuracy is quite high, particularly for the mid-Z elements, and other instruments with comparable precision should yield comparable results.

Trace element data exhibited in Tables E.1 and E.2 are reported in ppm, a quantitative measure by weight. Source assignment was made by comparison to source standards at Berkeley (Shackley 1995a).

Discussion

Field visits to a number of project sites in the summer of 1998 suggested that most of the obsidian artifacts would be produced from Government Mountain obsidian in the San Francisco Volcanic Field, located 50–60 km north (Figure E.1; see Table E.2) (Shackley 1995a:Figure 1). This proved correct. The RS Hill/Sitgreaves chemical group was also present in the sites and, except for the presence of some large sanidine phenocrysts, is megascopically indistinguishable from the material from Government Mountain. These two sources are only a few kilometers apart. Partridge Creek and Presley Wash source material from the Mount Floyd Volcanic Field also was present. These sources are located about 130 km to the northwest of the project area (Shackley 1995a:Figure 1) (see Figure 11), and the source materials appear frequently in central and northern Arizona collections (see Lesko 1989; Shackley 1995a).

Although some of the sample sizes were near the limit of the capability of EDXRF, and therefore the elemental concentrations were somewhat variant from the published standards, there appears to be greater variability in the Government Mountain elemental concentrations than has been previously recognized (see Figure E.1) (Davis et al. 1998). Not all of this variability can be attributed to small samples; it may indicate prehistoric procurement of nodules with chemistry somewhat different from that of nodules currently available at the source (see Shackley [1995a] for source-standard data). Nevertheless, the assignment to the Government Mountain source is relatively confident based on the plotted continuum along the Rb line and the distinctive megascopic character of this glass.

The obsidian from these sites reflects procurement of the nearest artifact-quality raw material. Contact with groups controlling the Coconino Plateau sources or direct procurement is indicated.

Table E.1. X-Ray Fluorescence Concentrations for Selected Trace Elements of Three International Rock Standards

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Ba
RGM-1 (Govindaraju 1989)	1,600	279	12,998	149	108	25	219	8.9	807
RGM-1 (Glascock and Anderson 1993)	1,800 ± 200	323 ± 7	12,400 ± 300	145 ± 3	120 ± 10	NR[a]	150 ± 7	NR	826 ± 31
RGM-1 (this study)	1,516 ± 58	259 ± 19	13,991 ± 143	152 ± 3	108 ± 2	24 ± 1	226 ± 4	10 ± 1	806 ± 12
SRM-278 (Govindaraju 1989)	1,469	402	14,256	127.5	63.5	41	295	NR	1,140
SRM-278 (Glascock and Anderson 1993)	1,460 ± 270	428 ± 8	14,200 ± 300	128 ± 4	61 ± 15	NR	208 ± 20	NR	891 ± 31
SRM-278 (this study)	1,376 ± 96	372 ± 17	15,229 ± 399	129 ± 2	68 ± 2	42 ± 2	290 ± 3	17 ± 2	1,090 ± 38
JR-2 (Govindaraju 1989)[a]	540	852	6,015	297	8	51	98.5	19.2	39
JR-2 (this study)	343 ± 51	680 ± 17	7,358 ± 65	300 ± 5	10 ± 1	49 ± 3	94 ± 2	16 ± 2	34 ± 6

Key: NR = no report.
Note: The ± values are first standard deviation computations for the group of measurements. All values are in parts per million (ppm) as reported by Govindaraju (1989) and this study. RGM-1 is a U.S. Geological Survey rhyolite standard, NBS (SRM)-278 is a National Institute of Standards and Technology obsidian standard, and JR-2 is a Geological Survey of Japan rhyolite standard. Fe^T can be converted to $Fe_2O_3^T$ with a multiplier of $1.4297(10^{-4})$ (see also Glascock 1991).
[a] Values proposed, not recommended.

Table E.2. X-Ray Fluorescence Concentrations for LOCAP Archaeological Data, by Site

Sample No.	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
28/903									
2557	710.2	506.7	9,827.3	115.2	74.5	18.8	76.5	52.3	Government Mountain
2912	520.0	526.2	9,983.6	118.3	82.8	18.2	80.1	47.9	Government Mountain
2958	703.6	514.9	9,512.8	96.3	62.2	18.3	63.1	36.1	Government Mountain
104/902									
1075	898.7	462.3	9,786.0	98.2	64.1	15.6	70.9	32.0	Government Mountain
1070	708.5	572.6	10,484.9	116.2	80.1	20.8	81.3	54.7	Government Mountain
1320	1,964.2	320.8	15,509.0	92.3	193.0	15.8	137.3	16.5	Presley Wash
77/869									
3345	776.7	487.8	9,627.2	103.3	69.3	21.6	74.5	49.6	Government Mountain
53/745									
6396	932.2	507.5	10,262.9	105.2	74.6	22.5	75.2	58.3	Government Mountain
6414	666.5	477.8	9,395.5	103.0	76.0	21.1	74.5	47.7	Government Mountain
6410	884.9	528.6	10,440.6	107.4	77.5	22.0	74.7	50.8	Government Mountain
6407	700.5	567.2	10,560.1	114.7	78.7	17.2	79.0	52.7	Government Mountain
6403	1,956.3	356.2	16,618.9	90.9	191.9	16.2	132.2	19.7	Presley Wash
6400	778.6	371.0	9,124.8	242.5	4.9	39.7	90.6	50.9	Partridge Creek
105/838									
10916	723.5	341.1	7,489.3	74.4	45.3	15.4	48.5	32.2	Government Mountain[a]
5037	625.8	508.9	9,792.7	105.7	74.2	20.4	67.4	48.5	Government Mountain
2372	529.9	384.3	9,688.0	341.8	3.6	81.7	157.7	225.1	RS Hill/Sitgreaves
2369	550.2	407.0	6,882.3	74.1	51.4	16.1	59.2	41.3	Government Mountain[a]
2368	685.5	508.1	8,319.9	87.1	62.0	21.5	61.1	44.3	Government Mountain[a]
2365	572.6	456.0	7,735.4	87.8	60.0	12.8	65.9	39.4	Government Mountain[a]
2364	643.9	382.9	8,956.8	321.6	6.2	70.8	133.7	199.7	RS Hill/Sitgreaves
2026	549.5	463.8	8,969.5	103.6	69.3	18.7	75.2	53.6	Government Mountain
2022	648.1	484.1	8,911.1	98.1	68.2	14.0	65.5	42.8	Government Mountain
5035	563.3	497.6	8,754.2	105.4	71.2	15.2	72.9	48.5	Government Mountain
1760	523.2	411.6	10,645.4	316.8	5.0	65.4	127.1	189.9	RS Hill/Sitgreaves
2035	518.6	540.1	8,841.7	101.5	72.4	18.9	70.1	52.7	Government Mountain
2034	0.0	500.1	8,533.6	95.0	67.0	19.4	65.8	50.1	Government Mountain[a]
2025	495.3	422.4	8,106.3	92.5	60.3	21.5	64.7	39.9	Government Mountain[a]
1519	795.8	468.3	8,934.3	98.7	67.4	20.2	62.6	34.6	Government Mountain[a]
137/428									
3404	682.7	458.1	8,652.1	94.3	63.4	16.0	64.4	39.6	Government Mountain[a]
3368	947.9	489.0	10,220.8	102.8	70.9	16.9	69.9	47.5	Government Mountain
31/244									
779	520.5	530.0	9,535.8	122.9	78.3	19.2	77.0	46.0	Government Mountain
787	602.7	536.1	9,963.9	113.4	77.8	24.9	75.8	50.7	Government Mountain
133/561									
4154	556.0	376.7	8,638.1	90.2	66.3	22.6	66.5	35.6	Government Mountain[a]
4329	738.1	318.3	7,728.9	76.7	50.8	15.4	46.5	34.6	Government Mountain[a]
4107	766.8	402.6	8,642.5	79.7	51.2	10.8	52.7	31.7	Government Mountain[a]
4372	578.0	523.5	9,774.4	111.6	76.1	16.4	77.2	43.2	Government Mountain

Sample No.	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Source
4348	586.6	530.3	9,750.6	109.6	71.3	20.7	82.1	51.9	Government Mountain
4305	632.0	499.8	9,621.8	134.8	78.3	20.9	74.7	50.4	Government Mountain
4104	637.8	433.7	9,188.7	109.0	71.0	20.6	74.9	51.3	Government Mountain
4115	566.1	529.2	9,640.1	109.4	80.5	22.9	81.1	46.3	Government Mountain
4161	709.3	512.4	9,644.0	108.5	75.6	21.1	73.5	46.3	Government Mountain
4311	837.9	601.2	10,096.1	101.0	66.4	18.9	71.6	38.5	Government Mountain
131/37									
5506	801.6	468.2	10,117.0	99.4	68.8	18.3	73.3	46.6	Government Mountain[a]
5353	659.1	453.7	9,357.8	105.3	68.9	20.2	76.4	43.7	Government Mountain
5922	593.9	536.4	9,495.9	116.2	77.8	20.3	77.1	49.2	Government Mountain
5919	630.8	463.7	9,563.7	114.7	77.8	16.4	80.6	49.4	Government Mountain
134/189									
5030	689.5	485.1	9,705.7	103.1	69.5	20.8	80.7	50.6	Government Mountain
5027	579.5	467.0	9,336.0	108.2	72.2	23.4	77.4	50.6	Government Mountain
135/186									
4721	665.1	342.2	8,344.1	197.4	18.7	32.1	72.0	22.0	Partridge Creek
4720	629.0	497.4	9,639.9	105.1	81.0	21.8	76.6	46.0	Government Mountain

Note: All measurements in parts per million (ppm).

[a] These samples—because of small size or other factors—do not fall within the accepted range of variability for the source standards but are megascopically and chemically very similar and so are assigned this provenance (Davis et al. 1998; Shackley 1995b).

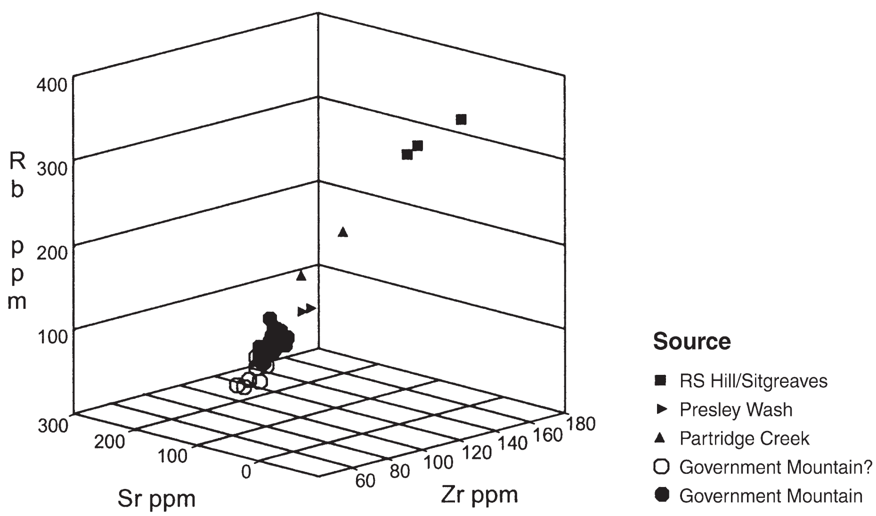

Figure E.1. Three-dimensional plot of Rb, Sr, and Zr elemental concentrations for archaeological samples. Source assignments made on the basis of data from Shackley (1995a).

APPENDIX F

A Lithic-Raw-Material Reconnaissance Study in Central Arizona for the Lower Oak Creek Archaeological Project along State Route 89A, Cottonwood to Sedona, Arizona

M. Steven Shackley

Between July 10 and 15, 1998, a reconnaissance survey of a portion of central Arizona was undertaken in order to determine the location of a still-unlocated geological source of obsidian and to search for other sources of raw materials used for flaked stone tools in the region between the Mogollon Rim north of Sedona, south to Bloody Basin, west to Dewey, and east to Oak Creek in Sedona. Although the geological source of obsidian was not located, steatite or pyrophyllite was located near Mayer, a source of tool-quality basaltic andesite that is megascopically similar to the Hardscrabble Mesa dacite was located near Dugas, and a source of probable "Naco" chert was located just east of AZ O:1:137/AR-03-04-06-482 (ASM/CNF) (Site 137/482) in the project area. Raw materials, including basalt, quartzite, dolomite, and silicified limestone, were also discovered as part of the colloquially known "beavertail gravels" and in the Dry Creek drainage. This appendix offers a discussion of these sources, including the archaeological consequences of the survey.

Field Methods

The methods used during the field reconnaissance were relatively simple. Areas of interest were accessed by four-wheel-drive vehicle, and pedestrian surveys were attempted when deemed necessary. The Universal Transverse Mercator (UTM) coordinates of all discovered source material were recorded on 7.5-minute topographical quads with a handheld Global Positioning System (GPS) unit. Transects across the source were used to collect material for analysis and to generate a sample appropriate for establishing chemical variability (see Shackley 1998a). Except for the fine-grained basalt at Estler Peak near Dugas, this was not necessary, because the raw materials collected were not appropriate for this type of analysis.

Obsidian Source Unknown B

Recently, at three archaeologically tested sites (AZ N:8:27, AZ N:12:14, and AZ:N:12:22 [ASM]) along SR 69 near Mayer, Arizona, four obsidian artifacts yielded an elemental composition that had not been reported before (Shackley 1995b, 1996b). The composition, called "Unknown B," does not match any known source in the greater Southwest (see Shackley 1995a). It has not been recovered from any other contexts analyzed by the X-ray fluorescence laboratory at the University of California, Berkeley, including extensive analyses of sites in the Tonto Basin and along the Mogollon Rim.

During the project, an older resident of Prescott lent the laboratory eight artifacts collected from a site along Walnut Creek in Yavapai County, three of which exhibited elemental chemistry matching that of Unknown B. The artifacts included two bipolar cores with substantial cortex, suggesting that the source was relatively nearby. Because the composition of the artifacts was not determined until recently, no attempt was made to investigate the geology of the Walnut Creek region.

During the reconnaissance, all volcanic fields in the area were investigated through the methods outlined by Shackley (1998a). On July 11 and 12, the sediments located to the east, between Interstate 17 and the Agua Fria River along Bloody Basin Road southeast of Codes Junction, and on the Agua Fria River upstream from this area north of Mayer, were surveyed for obsidian in the alluvium. None was found. Although no rhyolite is mapped in this area on the Yavapai County geological sheet (Arizona Bureau of Mines 1958), this is not unusual at that scale. Both andesite and basalt are mapped in the area, indicating the possibility of bimodal volcanism. This is common in the Basin and Range Province and frequently includes Tertiary silicic volcanism as an early phase in the eruptive history (Shackley 1990).

Volcanic and Metamorphic Raw Materials South of the Project Area

Mayer Steatite or Pyrophyllite

On July 12, during the search for secondary deposits of obsidian along the Agua Fria River east of Interstate 17 and north of Mayer near Sycamore Village, three pieces of well-rounded steatite or pyrophyllite were recovered from the alluvium. This material is similar to that used to make ornaments and arrowshaft straighteners found in the Tonto and Phoenix Basins. It probably is derived from the metamorphics upstream in the Mayer area. Steatite and pyrophyllite are both produced by local metamorphism of previously metamorphosed rock—often from contact with emerging plutons, such as the Precambrian granites in the region. The metamorphism produces talc from the hydration of magnesium silicates. Although the primary source was not located, one of the nodules was 12.7 by 7.5 by 5.1 cm, certainly large enough to serve as a raw material for the production of artifacts. At this time, there is enough information to posit that a talc source is available in the Mayer area, probably at a contact point between the Precambrian pluton or later volcanics and the earlier metamorphics.

Estler Peak Fine-Grained Basalt or Andesite-Basalt

Recently, geochemical analysis of a fine-grained dacite from Hardscrabble Mesa near Strawberry, Arizona, has proved to be an effective method for assessing the non-glassy rock used to produce flaked stone tools in central Arizona (Shackley 1997, 1998b). During this survey, a source of fine-grained volcanics that exhibited megascopic characteristics similar to those of the Hardscrabble dacite was located. Core and flake debris was common on the surface, suggesting that it was used as a source of stone for making tools in prehistory. Much of the prehistoric reduction appears to have been focused on locating the finest-grained material. Density of debitage was as much as 50 artifacts per m^2, and nodules appear to have been broken off bedrock, as well as to have been procured from the Dry Creek alluvium. The source stretches at least 100 m along the creek bottom, essentially focusing on exposures of basalt. Subsequent analysis suggested that this material is a fine-grained basalt or andesite-basalt; it exhibits a chemistry quite different from that of the Hardscrabble dacite to the east (Tables F.1 and F.2). Although a complete oxide analysis would be necessary assess the possibility, some of these samples appear to be intermediate in character (i.e., andesite or dacite), rather than basalt. The locality is on Dry Creek (not the Dry Creek in the project area) at the juncture of the creek and Dugas Road, approximately 2 miles east of Interstate 17 and 0.75 mile west of Estler Peak—a basalt remnant neck (UTM, Zone 12, NAD 27, 0403809 mN, 3805669 mE, on the 1974 Estler Peak 7.5-minute USGS quadrangle). This form of fine-grained basalt was used frequently during the Archaic period for the production of projectile points, as was the Hardscrabble Mesa dacite, and it often is recovered from sites at some distance from the source (Shackley 1990).

Project-Area Hard-Rock Geology

Much of the following short discussion of the regional geology comes from recent mapping of the 30-by-60-minute Sedona quadrangle (Weir et al. 1989) and my own reconnaissance of the area during the field season (see also Elston and DiPaolo 1979).

The area between Sedona and the Verde River is dominated by two major rock groups: basement rocks of predominately Pennsylvanian and Permian fluvial and lacustrine sediments capped by Tertiary volcanics (mainly mafic rocks) and Quaternary alluvium derived from older material. Most of these rock groups could have yielded economically important raw materials in prehistory. My survey of archaeological sites in the project area indicates consistent use of local rocks, particularly chert.

An important sediment mapped as Qg by Weir et al. (1989)—colloquially called "beavertail gravels"—is present on the butte just east of Site 137/482 and forms a cap over older sediments. This gravel is composed of well-rounded cobbles and pebbles of resistant Paleozoic sedimentary rocks, Precambrian metamorphic and igneous rocks, and Tertiary volcanic rocks in a silty or sandy

Table F.1. Elemental Concentrations for Estler Peak Fine-Grained Basalt

Sample	Ti	Mn	Fe	Cu	Zn	Pb	Rb	Sr	Y	Zr	Nb
1	1,957.0	409.4	24,132.1	28.0	53.5	15.5	94.0	139.5	16.8	150.0	13.5
2	2,094.1	548.0	24,457.4	18.4	64.0	30.7	53.2	168.4	25.6	162.8	7.5
3 [a]	15,225.0	1,738.8	84,709.9	71.4	99.4	7.3	7.6	842.7	27.3	118.4	19.7
4 [a]	7,836.1	1,973.9	90,934.1	13.6	142.6	12.9	4.6	297.2	14.2	36.9	4.9
5	17,128.6	2,011.9	87,688.8	58.9	87.9	11.9	14.9	857.3	21.8	143.1	33.2
6	7,460.1	1,118.7	47,692.9	40.0	72.2	14.1	51.4	722.3	24.6	117.3	48.9
7	14,568.2	1,311.7	73,390.3	88.5	95.8	15.2	10.6	730.4	23.8	103.6	23.2
8	15,969.0	2,328.7	78,616.9	116.4	73.9	9.1	16.4	807.1	29.0	128.2	19.8
BCR1 [b]	21,451.9	1,845.3	93,356.2	23.7	122.2	17.2	49.0	349.9	35.2	185.8	11.1

Note: All measurements are in parts per million (ppm).
[a] The chemistry of Samples 3 and 4 suggests that they may be artifacts from another source; this may represent the variability within this basalt flow.
[b] BCR1 is a U.S. Geological Survey Columbia River basalt standard.

Table F.2. Elemental Concentrations for Hardscrabble Mesa Dacite Source Standards

Sample No.	Ti	Mn	Fe	Cu	Zn	Pb	Rb	Sr	Y	Zr	Nb
	Site AZ O:10:32/AR-03-12-04-1357 (ASM/FS): Black Jack Quarry										
BJQ-1-1	2,958.0	660.4	27,166.8	39.2	27.8	55.2	53.2	557.9	12.3	214.8	36.3
BJQ-1-2	3,299.5	623.9	26,265.2	25.1	31.9	60.5	49.6	532.4	15.5	201.3	34.2
BJQ-1-3	3,441.3	664.2	27,657.1	25.3	21.1	62.3	51.5	544.9	11.8	196.8	33.3
BJQ-2-1	3,897.4	715.8	30,557.3	46.8	35.9	65.4	47.9	576.3	14.2	207.6	37.5
BJQ-3-1	3,276.8	674.0	27,425.0	35.9	34.0	61.1	49.3	550.4	16.1	202.5	38.6
	Site AZ O:10:33/AR-03-12-04-1358 (ASM/FS): Twin Buttes Quarry										
TBQ-1-1	3,130.3	659.1	27,290.9	31.5	36.7	58.2	53.9	543.3	15.4	192.4	38.9
TBQ-1-2	3,359.5	589.0	26,084.4	29.7	27.9	72	53.1	520.9	16.6	183.3	31.0
TBQ-2-1	3,375.0	640.0	27,262.2	29.2	19.7	56.8	55.1	540.3	12.4	195.0	38.3
TBQ-2-2	3,525.7	730.5	29,599.2	45.9	25.7	66.9	55.7	555.1	14.8	182.0	30.3

Note: The remnants of Sample TBQ-1-3 were too small for energy dispersive X-ray fluorescence (EDXRF) analysis. All measurements are in parts per million (ppm). Adapted from Shackley (1997).

matrix. Rock types recorded include, by dominance, chert nodules (approximately 80 percent), red quartzite (5 percent), and a balance (approximately 5 percent) composed of partly metamorphosed sandstone; large, rounded, basalt cobbles; various metamorphics; and a type that may be dolomite (Weir et al. 1989). These authors further noted that some of the material is derived from sediments somewhere to the south and is not local, although local material can be included in the sediment. A recent study of cherts in the Mogollon Rim region suggests that the cherts in this area are from the Naco unit, which includes quartzite and limestone found in northern and southern Arizona (Doppler 1998). Doppler's megascopic description of Naco chert closely resembles the specimens recovered from Locality 071298-2 in this area (see site card below for location) and is discussed in more detail below.

According to Wayne Ranney (personal communication 1988), the cherts, quartzites, and limestone currently capping the mesa east of AZ O:1:133/AR-03-04-06-561 (ASM/CNF) (Site 133/561) are not from the Beavertail Butte formation (Tbbu), because their stratigraphic position would be below House Mountain basalt (Tb). Beavertail Butte (Tbbu) and House Mountain basalt (Tb) are nearly contemporaneous, and because the sediments of Tbbu have not been radiometrically dated, this makes the association of these two sediments difficult. Nevertheless, the sediment that contains the generally light-colored chert that supplied raw material for tool production in the region probably will continue to be termed "beavertail." The more likely origin for these sediments (Dry Creek gravels) appears to have included a number of Tertiary sediments in the erosional history of the stream system.

Source Rock in the Dry Creek Alluvium and East of NA19843

A reconnaissance of potential sources in the project area focused on the Dry Creek alluvium at AZ O:1:28/AR-03-04-06-903 (ASM/CNF) (Site 28/903) and the sediments east of Site 137/482. In Dry Creek (Locality 071298-1), two transects across the streambed were undertaken from creek centerline west about 25–30 m. Stone was selected and tested, and a sample was taken of most rocks along the transect. It was immediately noticeable that chert was rare in the streambed. Although I want to stress that this sample is *not* statistically representative, the following is an inventory of the rock types recovered: quartzite (n = 10), basalt (n = 4), chert (n = 4), and sandstone or siltstone (n = 1). All of these are components of the surrounding sediments, as discussed above. The chert specimens appear to be the Naco material derived from the beavertail gravels or the Dry Creek Unit.

Locality 071298-2 on the butte east of Site 137/482, discussed above, yielded a number of economically important rocks. From the author's field notes:

> Locality 071298-2, Sedona 7.5' quad: UTMs 12S 421887 E, 3855739 N (GPS). Chert quarry adjacent to NA 19843. Large strata ≈30m vertical of a mix of fluvial sediments including chert nodules (≈80 percent), red quartzite (≈15 percent), and partly metamorphosed sandstone and possibly dolomite (≈5 percent). There appears to be an eroding basalt cap of rounded basalt cobbles. Density of chert nodules from pea-sized to cobble (20 cm) is >500/m^2. Fist-sized and above ≈10/5m^2. Smaller nodules appear "opalized" by environmental heating. It is impossible to determine whether this area is a mix of sediments from the Quaternary (Qg) gravels, the putative 'Beavertail gravels' thought to be derived from Paleozoic sediments in central Arizona [see Weir et al. 1989].

Knapping attempts of non-heat-treated nodules indicate a very hard material of quite variable quality. It varies from coarse grained and unusable as a biface raw material to almost glassy and quite amenable to the production of bifaces. Debitage from Site 137/482 suggests that it was used for the production of utilized flakes or perhaps large bifaces. Analysis of the assemblage will confirm or refute this.

Continued reconnaissance throughout the Sedona area indicated the presence of this chert on a number of sites. Outcrops of the raw material are present everywhere south of the rim. Doppler (1998:35) described the Naco chert as

> a brilliant, intense orange color most closely resembling Munsel. . . moderate reddish-orange (10 R 6/6) though more vibrant is the most diagnostic feature. [Many of the cobbles from this locality are red-orange under the cortex.] The luster is vitreous to sub-vitreous to dull. Translucency is good to excellent and specimens exhibit good conchoidal fracture. Some specimens are slightly fossiliferous with rounded grains (pellets?), but less so than the chert of the Redwall [Sandstone; about 1/3 of the specimens examined exhibit pellets]. Naco chert also has cubic rounded vugs similar to the Redwall chert. [Many samples exhibit cubic rounded vugs.] Some specimens are highly brecciated and weathered [most of the specimens here are highly brecciated and weathered].

This chert is common on prehistoric sites throughout the Sedona and Cottonwood region and probably was distributed through exchange or residential mobility throughout central Arizona. There is no way, however, to distinguish the various outcrops of Naco chert, which can be found all along the southern scarp of the Coconino Plateau and in southern Arizona (see Doppler 1998).

Conclusion

Although it was disappointing not to locate the obsidian source—determined to be probably west of Prescott—the raw-material study was illuminating. It is apparent that a source of steatite or pyrophyllite is present in the Mayer area, and the Naco chert located in the beavertail or Dry Creek gravels is an important stone tool source, at least in the Sedona-Cottonwood area.

APPENDIX G

Flaked Stone Data

Table G.1. Projectile Points and Bifaces Collected in the Lower Oak Creek Archaeological Project Area, by Site

Artifact ID	PD No.	Type	Temporal Affiliation	Technique	Material	Condition	Length (mm)	Width (mm)	Thickness (mm)	Comments
					Site 104/902					
1145	1	biface preform	?	percussion	quartzite	incomplete		49		
1179	1	biface	?	percussion	chert	fragment				Heat treated.
1317	1	biface	?	percussion	sponge	complete	42	32		
1405	74	projectile point (dart point, side-notched)	Archaic period	percussion, antler	basalt	fragment (base)	24	15	7	Possibly reworked or not completed; unknown tip break.
1409	61	biface (blank?)	?	percussion on flake	basalt	fragment (base)	29	24	9	Bend break, from manufacture? Some obvious reworking after weathering.
1411	56	biface, projectile-point blank	Archaic period	percussion, antler	basalt	fragment (base)	24	20	6	Manufacture break.
1414	52	retouched flake (blank?)	?	percussion, antler	chert	complete	57	33	9	Possibly the earliest stage of projectile point manufacture; curved flake.
1417	2	projectile point blank	?	pressure on percussion biface	basalt	complete	28	17	6	Plano-convex; pressure over convex face; percussion remnant on ventral surface; unfinished?
1427	59	projectile point (arrow point blank)	Formative period	pressure on thin flake	obsidian	complete	21	16	3	Dorsal surface transmedial flaking; ventral edge trimming.
8632	16	projectile point (arrow point blank?)	Formative period?	pressure on flake	chert	complete	23	17	8	Unfinished?
8634	60	biface blank	?	percussion, antler	chert	fragment (tip)	48	31	10	Manufacture break? Probably projectile point blank.
8638	53	projectile point (arrow point)	Formative period	pressure	obsidian	fragment (tip)	17	12	4	Breaks unknown.
					Site 105/838					
1815	242	biface	?	percussion, probably hammerstone	chert/quartz	complete	41	22	12	Possibly aborted point blank.
2021	349	projectile point (arrow point, unnotched)	Formative period	pressure on flake, abrupt edge trimming	obsidian	complete	15	8	2	Usable as is.
2030	30	retouched flake, bifacial edge trimming	?	pressure	obsidian	complete	28	22	6	Possibly early stage of projectile point manufacture.
2205	749	projectile point (dart point)	?	pressure finish, probably on percussion biface	agate	fragment (tip)	22	16	4	Damage of unknown origin.
2242	810	projectile point (arrow point)	Formative period	pressure on thin flake, edge trimming	obsidian	fragment (tip)	15	15	3	Possibly finished but may have broken during manufacture.
5032	810	projectile point blank	Formative period	pressure on thin flake, edge only	obsidian	fragment	16	12	2	Manufacture break at beginning of process.
5033	810	projectile point (arrow point [corner-notched?])	Formative period	pressure, fully bifacial	obsidian	fragment	16	8	2	Break unknown, possibly broken during notching.
5034	810	projectile point blank	Formative period	pressure on thin flake, edge only	obsidian	fragment	16	12	1	Broken in manufacture.
8613	270	projectile point (dart point, Gypsum Cave)	Archaic period?	pressure finish, probably on percussion biface	chert	complete	32	17	6	Slight tip damage, possibly through use.
8644	699	projectile point (dart point, San Pedro)	Late Archaic period	pressure finish, probably on percussion biface	chert	complete	36	18	5	Slight tip damage, possibly through use.
8647	810	projectile point (arrow point, indented base)	Formative period	pressure on thin flake, fully bifacial	obsidian	complete	19	6	1	Either unfinished or reworked after damage or flaking error.
8648	810	projectile point (arrow point)	Formative period	pressure on thin flake, scar remnant on one face	obsidian	complete	18	7	2	Usable as is.
10971	843	projectile point (arrow point)	Formative period	pressure on thin flake, edge trimming	obsidian	complete	21	12	2	Possibly finished, but base unworked.
					Site 85/428					
3406	155	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure on percussion biface	basalt	incomplete	31	19	6	Slight tip break; stem and base lightly ground.
3407	190	projectile point (dart point)	Middle Archaic period	pressure on percussion biface	basalt	fragment (tip)	25	1	4	Unknown break.

continued on next page

Artifact ID	PD No.	Type	Temporal Affiliation	Technique	Material	Condition	Length (mm)	Width (mm)	Thickness (mm)	Comments
8621	2	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure on percussion biface	basalt	incomplete	27	17	6	Impact break on tip; stem lightly ground.
Site 77/869										
8635	3	projectile point (dart point, expanding stem)	Late Archaic period?	pressure finish, probably on percussion biface	obsidian	fragment	28	21	6	Recent-looking tip and side damage, possibly from cattle treading.
8636	2	projectile point (dart point)	Middle Archaic period?	pressure	chert	fragment (midsection)				Deeply serrated.
Site 131/37										
5372	1	biface (blank?)	?	percussion, hammerstone	chert	fragment (tip?)	22	27	9	Manufacture break?
5585	65	projectile point (arrow point blank)	Formative period	pressure on thin flake	obsidian	complete	18	15	2	Not completed.
5698	66	biface (blank?)	?	percussion, antler, some pressure retouch	chert	complete	39	17	9	Indirect percussion? Manufacture discard?
5699	60	projectile point blank	Formative period	pressure on percussion biface	obsidian	fragment	19	23	4	Unknown segment.
5700	68	projectile point (uniface)	?		chert	complete	43	29	6	
5705	4	biface on core flake	?	percussion, hammerstone	chert	complete	43	36	13	Secondary flake; possibly biface core.
5706	10	biface (blank?)	?	percussion, antler	chert	fragment (tip)	19	21	6	Manufacture break; end shock?
5713	75	biface (blank?)	?	percussion, hammerstone	chert	fragment (base)	29	34	10	Manufacture break on flaw; stemming unintentional.
5715	64	biface blank	?	percussion, antler	chert	fragment (base)	29	29	7	Manufacture break.
Site 53/745										
6390	8174	biface blank	?	percussion, antler, on flake	obsidian	fragment (midsection)	26	25	5	"Beat up"; possibly finished broken point.
6395	7358	projectile point (arrow point [blank?])	Late Formative period	pressure on flake	obsidian	fragment (base)	18	14	3	Manufacture break.
6511	1374	biface blank	?	percussion, antler	chert	fragment (base)	33	35	7	Refits to 6626; manufacture break; perverse fracture.
6570	1869	biface blank	?	percussion, antler	jasper	fragment (tip)	20	21	7	Manufacture break? End shock?
6616	2501	projectile point (arrow point [blank?])	Late Formative period	pressure on flake	obsidian	complete	22	15	5	Unfinished; on weathered flake, possibly Archaic period.
6619	2514	biface (blank?)	?	percussion, hammerstone	quartz	fragment (base)	28	38	11	Manufacture break?
6626	2578	biface blank	?	percussion, antler	chert	fragment (tip)	29	7	0	Refits to 6511; manufacture break; perverse fracture.
6637	2678	biface	?		chert (local)	incomplete				
7179	4026	biface blank	?	pressure on secondary flake	chert	complete	35	24	7	Plano-convex, not finished.
7699	4293	projectile point (dart point, Elko Corner-notched)	Late Archaic period	pressure	chert	fragment (midsection)	15	13	4	Unknown breaks.
7729	4266	projectile point (dart point, San Pedro)	Late Archaic period	pressure	basalt	fragment (base)	15	16	4	Impact break.
7904	4651	biface (blank?)	?	percussion, hammerstone	chert	fragment (tip)	32	27	10	Manufacture break?
8045	4779	projectile point blank, uniface	?		dacite	incomplete	36			
8283	6065	projectile point (dart point, Elko Corner-notched)	Late Archaic period	pressure on percussion biface	chert	incomplete	28	22	5	Probably use breaks; possibly some reworking.
8339	5199	biface (blank?)	?	percussion, hammerstone	chert/quartz	fragment (base)	33	26	8	Manufacture break.
8400	5150	biface blank	?	percussion, antler, on flake	chert	fragment (base)	41	32	8	Manufacture break.
8592	5326	biface blank	?	percussion, antler, on flake	chert/quartz	complete	47	29	8	Unfinished; no obvious reason for abandonment.
8619	8232	projectile point (dart point, Elko Corner-notched)	Late Archaic period	pressure, probably on percussion biface	chert	incomplete	40	21	6	One ear missing; well made.
8623	5340	projectile point (dart point, Gypsum Cave)	Middle Archaic period	pressure on percussion biface	basalt	incomplete	25	18	5	Unknown break but looks recent.
8624	2	projectile point (arrow point)	Formative period, Sinagua	pressure on flake	chert	complete	28	9	3	Plano-convex, serrated.
8625	5970	projectile point (dart point blank)	Archaic period	pressure on percussion biface	chert	fragment (base)	24	16	4	Manufacture break; San Pedro point blank?
8626	2999	projectile point (arrow point)	Formative period, Hohokam	pressure	basalt	incomplete	23	10	4	Serrated; ears missing.
8627	3000	projectile point (dart point, San Pedro)	Late Archaic period	pressure on percussion biface	chert	incomplete	44	24	7	Impact break; could be reworked into usable point.
8628	3	projectile point (dart point, Elko Corner-notched?)	Late Archaic period	pressure on percussion biface	chert	fragment (midsection)	25	19	5	Probably use breaks.

Artifact ID	PD No.	Type	Temporal Affiliation	Technique	Material	Condition	Length (mm)	Width (mm)	Thickness (mm)	Comments
8629	2700	biface (blank?)	?	pressure	obsidian	complete	34	15	7	Possibly finished tool.
8643	7995	projectile point (arrow point, side-notched)	Formative period, Sinagua	pressure	obsidian	incomplete	14	8	2	Probably reworked tip fragment; ears missing.
8645	6583	projectile point (arrow point)	Formative period, Hohokam	pressure on thin flake	basalt	fragment (midsection)	16	10	2	Lightly serrated; use breaks? Possibly on Archaic period flake.
9692	7760	projectile point (arrow point)	Late Formative period	pressure	chert	fragment (midsection)	13	9	2	Unknown breaks.
9910	6846	biface	?		sponge	incomplete				
9924	6841	biface blank	?	percussion, hammerstone	chert	complete	42	27	7	Heat-treated, reworked biface fragment, abandoned because of flaw.
10140	8094	biface	?		chert (local)	fragment		30		
10520	8722	projectile point (dart point, Elko Corner-notched)	Late Archaic period	pressure, probably on percussion biface	chert	fragment (midsection)	24	16	4	Impact breaks.
10533	8581	projectile point (dart point [Pinto/San Jose?])	Middle Archaic period	pressure	chert/quartz	fragment (midsection)	22	20	5	Type based on serration type and general proportions.
10580	8560	biface (blank?)	?	percussion, antler	chert	fragment (base)	29	35	9	Hammerstone percussion flake removed from break; bend break.
Site 28/903										
2556	114	biface blank	?	percussion, hammerstone	chert	fragment (tip)	32	27	6	Well thinned; platform preparation; manufacture break.
2558	117	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure	chert?	complete	17	16	5	Reworked to a nub.
2700	6	projectile point (dart point)	?	pressure	obsidian	fragment	18	11	3	Possibly projectile point ear or stem; use break?
2758	8	biface (core?)	?	percussion, hammerstone	chert	complete	43	35	13	Possibly exhausted bifacial core or projectile point blank.
2858	77	biface (core?)	?	percussion, hammerstone, on flake	chert	complete	39	29	9	Possibly early-stage projectile point blank.
2946	167	projectile point (arrow point, side-notched)	Formative period	abrupt pressure, fully bifacial	obsidian	complete	21	13	5	Slightly serrated.
3067	1	biface (knife blank?)	?	percussion, antler	chert	fragment (base)	47	44	9	Manufacture break; well thinned.
8614	219	projectile point (unfinished?)	Archaic period	pressure on percussion biface	basalt	complete	38	21	7	Probably not completed; should be notched/stemmed?
8615	188	projectile point (dart, side-notched)	Late Archaic period	pressure	obsidian	fragment (midsection)	13	19	5	Heavy impact breaks.
8617	138	projectile point (dart point, corner-notched)	Late Archaic period	pressure, probably on percussion biface	chert?	fragment (base)	19	22	5	Bend impact break.
8641	39	projectile point (dart point [side-notched?])	Late Archaic period	pressure	chert	fragment (base)	21	18	3	Impact break.
Site 31/244										
205	1	biface (blank?)	?	percussion, hammerstone	chert	complete	43	32	11	Irregular edges; abandoned.
271	1	projectile point (dart point, side-notched)	Middle Archaic period	pressure on percussion biface	chalcedony	fragment (base)	14	26	4	Probably impact break; possibly Mallory point.
729	279	projectile point (dart point)	Archaic period	percussion, antler, pressure retouch	chert	fragment (tip)	17	20	5	Break on flaw; possibly unfinished.
743	282	biface (blank?)	?	percussion, hammerstone	chert	fragment	38	17	9	Manufacture break on flaw.
766	177	biface (projectile point blank?)	?		chert	complete	62	33		
768	176	biface?	?		sponge	complete	62	46		
780	3	projectile point (dart point)	Archaic period	pressure on percussion biface	obsidian	fragment (base)	19	16	6	Impact bend break.
795	213	projectile point (dart, Pinto/San Jose)	Middle Archaic period	pressure	obsidian	fragment (midsection)	20	22	4	Impact break based on serration style.
798	234	projectile point (dart, corner-notched, San Pedro)	Late Archaic period	pressure	obsidian	fragment (midsection)	14	20	4	Unknown break types.
803	264	projectile point (arrow point, side-notched)	Formative period	pressure, fully bifacial	obsidian	complete	20	13	4	Possibly reworked from larger fragment.
805	274	projectile point (arrow point)	Formative period	pressure	obsidian	fragment (tip)	10	7	2	Impact break.
817	227	biface	?		chert	complete	43	38		
821	240	projectile point (dart, Pinto/San Jose)	Middle Archaic period	percussion, antler	basalt	fragment (base)	19	17	5	Impact break.

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Artifact ID	PD No.	Type	Temporal Affiliation	Technique	Material	Condition	Length (mm)	Width (mm)	Thickness (mm)	Comments
8616	230	projectile point (dart, Pinto/San Jose)	Middle Archaic period	pressure, probably on percussion biface	chert/quartz	incomplete	35	19	5	Tip break, unknown type.
8622	18	projectile point (dart point, indented base [Elko?])	Late Archaic period	pressure on a flake	sponge chert	fragment (base)	18	21	4	Unknown break type.
8637	15	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure on percussion biface	basalt	fragment (base)	24	17	7	Impact break.
8646	141	projectile point (arrow point, side-notched)	Formative period	pressure on thin flake	obsidian	incomplete	17	11	2	Possible use breaks.
					Site 133/561					
3464	1	projectile point preform (uniface)	?		chert	fragment				
3721	1	biface (core?)	?	percussion, hammerstone	chert	fragment	41	51	22	Possibly early-stage blank; manufacture break.
3809	124	projectile point (arrow point or dart, notched)	Archaic period or Formative period	pressure on thin flake	chert	fragment (base)	15	13	3	Break type unknown; lightly serrated.
3817	18	biface	?		chert	complete	59	42		
3834	12	biface	?		chert	complete	61	49		
3835	96	biface blank	Archaic period?	percussion, hammerstone and antler	chert	complete	42	32	10	Could have been made into dart point.
4036	622	projectile point (dart point, San Pedro)	Late Archaic period	pressure or percussion biface	basalt	complete	22	27	6	
4047	623	projectile point (dart point)	Archaic period	pressure	chert	fragment (midsection)	19	21	6	Impact breaks.
4051	61	biface (core?)	?	percussion, hammerstone	chert	complete	48	31	13	Possibly an exhausted bifacial core with an attempt to turn it into a blank.
4378	440	projectile point (dart point)	Archaic period	pressure	obsidian	fragment (base)	19	22	6	Heavy impact breaks; plano-convex.
4513	410	biface blank	?	percussion, antler	chert	fragment (end)	27	19	6	Probably manufacture break of projectile point blank.
8618	700	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure	obsidian	complete	19	22	4	Serrated; heavily reworked.
8620	697	projectile point (dart point, San Pedro)	Late Archaic period	pressure on percussion biface	chert	fragment (base)	29	19	5	Break type unknown.
8630	87	biface blank	?	percussion, antler	chert	fragment (base)	24	28	7	Manufacture break; end shock?
8631	140	projectile point (dart point, bipointed [Lerma?])	Archaic period	pressure and hammerstone percussion	chert	complete	39	15	6	Serrated; plano-convex.
8639	86	projectile point (dart point)	?	percussion, hammerstone	chert	fragment (tip)	25	17	6	Possibly unfinished; possibly manufacture break.
8640	2	projectile point (dart, Pinto/San Jose)	Middle Archaic period	pressure	obsidian	incomplete	22	14	3	Serrated; tip break of unknown cause.
					Site 134/189					
4859	253	biface blank	?	percussion, hammerstone	chert	fragment (base)	25	34	9	Manufacture break; flaking on break, probably projectile point blank.
4876	130	biface blank	?	percussion, hammerstone	chert	fragment (base)	32	41	7	Manufacture break; probably going to be projectile point.
5015	27	biface (blank?)	?	percussion, hammerstone	chert/quartz	fragment (base)	33	27	10	Manufacture break; projectile point blank?
5016	215	biface (preform?)	?		sponge	complete	62	41		Made from core.
5243	469	projectile point (dart point, Pinto/San Jose)	Middle Archaic period	pressure finish, probably on percussion biface	obsidian	fragment (base)	12	18	5	Probably use break.
5244	460	biface (core?)	?	percussion, hammerstone	chert	complete	52	38	12	Possibly exhausted bifacial core, or blank.
5245	422	projectile point (dart point, serrated)	Archaic period	pressure on percussion biface	sponge chert	fragment (midsection)	27	21	7	Use breaks? Serrations look like San Jose point type.
5304	481	biface (blank?)	?	percussion (antler?)	chalcedony	fragment (base)	26	30	7	Manufacture break, on patinated flake? Probably projectile point blank.
8642	526	projectile point (dart point, expanding stem)	Late Archaic period?	pressure on flake	obsidian	complete	25	18	6	Beat up, possibly from use or postdepositional.
					Site 135/186					
4612	60	projectile point (dart point blank)	Archaic period	bifacial percussion, hammerstone	chert	fragment (base)	29	23	11	Manufacture break; heavy bend; possibly end shock.
4829	87	projectile point (dart point blank)	Archaic period	bifacial percussion, hammerstone and antler	chert	fragment (base)	35	24	7	Nearing completion; manufacture break.

Artifact ID	PD No.	Type	Temporal Affiliation	Technique	Material	Condition	Length (mm)	Width (mm)	Thickness (mm)	Comments
					Site 136/663					
6124	5	projectile point (arrow point, side-notched)	Formative period, Pueblo/ Sinagua?	pressure	obsidian	complete	24	16	6	Steep retouch; possibly made on Archaic period point fragment.
6302	344	biface (core?)	?	percussion, hammerstone	chert	complete	54	23	12	On angular piece; overshot flake scar on one side.
					Site 137/482					
5918	25	projectile point (dart)	Archaic period	pressure on percussion biface	obsidian	fragment (midsection)	21	16	5	Use breaks?
5919	48	projectile point (dart)	Archaic period	pressure	obsidian	fragment (midsection)	13	19	6	Use breaks? Recent damage after weathering.
6118	37	projectile point (dart)	Archaic period	pressure	chert	fragment (tip)	14	14	3	Break on flow, use break?

Key: ID = Identification Number; PD = Provenience Designation.

Table G.2. Flaked Stone Tools Collected in the Lower Oak Creek Archaeological Project Area, by Site

ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
						Site 104/902				
835	1	sponge	complete	core	denticulate	unifacial	0–25	54	40	
846	1	chert (local)	complete	flake	denticulate	unifacial	76–100	51	46	
850	1	chert (local)	complete	core	even	unifacial	76–100	31	26	Scraper (two edges).
851	1	chert (local)	complete	flake	even	unifacial	26–50	40	39	
860	1	chert (other)	complete	flake	denticulate	unifacial	26–50	39	30	
919	1	chert (local)	complete	core	denticulate	bifacial	51–75	46	45	Scraper.
928	1	chert (local)	complete	cobble	even	unifacial	0–25	55	42	Scraper.
934	1	chert (other)	complete	flake	denticulate	unifacial	26–50	34	13	Heat treatment (possible).
937	1	chert (other)	complete	flake	denticulate	unifacial	51–75	33	32	Graver.
1060	1	chert (local)	complete	core	denticulate	bifacial	51–75	43	37	
1065	1	quartzite	complete	cobble	denticulate	unifacial	26–50	93	60	Chopper.
1069	1	chert (local)	complete	flake	denticulate	unifacial	26–50	43	28	Burned.
1156	1	chert (local)	complete	core	denticulate	unifacial	51–75	32	23	Heat treatment.
1170	1	chert (local)	complete	flake	even	bifacial	51–75	30	29	
1344	1	chert (local)	complete	flake	denticulate	unifacial	51–75	55	46	
1347	1	chert (local)	complete	flake	even	unifacial	0–25	35	27	Scraper.
1377	1	chert (local)	complete	flake	denticulate	unifacial	0–25	32	26	
1381	1	sponge	complete	flake	denticulate	unifacial	0–25	60	46	
1408	63	chert (local)	complete	flake	denticulate	unifacial	0–25	45	43	
1410	57	sponge	incomplete	flake	even	unifacial	51–75	39	30	Scraper.
1412	55	chert (local)	complete	flake	even	unifacial	51–75	50	23	Scraper.
1413	54	chert (local)	complete	flake	denticulate	unifacial	26–50	40	33	Graver/spokeshave.
1416	14	chert (other)	complete	flake	denticulate	unifacial	76–100	60	30	Scraper (two faces).
5051	58	chert (local)	complete	flake	even	unifacial	51–75	31	29	Scraper.
8633	75	sponge	complete	unknown	even	bifacial	76–100	34	30	Knife/scraper/biface.
						Site 105/838				
1521	1	sponge	complete	core	denticulate	unifacial	76–100	31	26	Scraper.
1599	1	chert (other)	complete	unknown	even	bifacial	76–100	50	35	

ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
1690	1	chert (other)	complete	core	denticulate	unifacial	0–25	42	18	
1851	262	chert (local)	complete	unknown	even	unifacial	26–50	38	20	Scraper.
1852	33	other	complete	cobble	even	unifacial	26–50	95	70	Chopper.
2033	264	obsidian	complete	unknown	denticulate	bifacial	76–100	24	20	Drill/spokeshave.
2132	730	chert (local)	complete	flake	denticulate	unifacial	51–75	49	49	Graver.
2243	810	chert (local)	complete	flake	even	unifacial	26–50	35	40	Scraper.
2292	515	chert (other)	complete	cobble	even	bifacial	0–25	82	52	Knife/scraper.
2373	529	obsidian	incomplete	flake	denticulate	unifacial	0–25	31	21	
2385	699	chert/quartzite	complete	core	even	unifacial	76–100	59	49	Scraper.
2456	389	chert (local)	complete	core	denticulate	unifacial	76–100	66	44	Scraper/biface preform.
						Site 85/428				
3289	104	chert (local)	complete	core	denticulate	unifacial	26–50	68	55	
3409	137	chert (local)	complete	flake	even	unifacial	76–100	42	37	Uniface/scraper.
3412	1	chert (local)	complete	core	denticulate	unifacial	0–25	38	36	
3413	1	chert (other)	fragment	flake	denticulate	unifacial	76–100	35		
						Site 131/37				
5420	1	chert (local)	incomplete	flake	even	unifacial	76–100		23	Uniface.
5445	1	chert (local)	complete	core	even	unifacial	76–100	50	42	Uniface scraper.
5446	1	chert (local)	complete	flake	even	bifacial	76–100	51	44	Scraper.
5507	1	chert (other)	complete	fragment	even	unifacial	0–25	35	19	Burned.
5577	1	sponge	fragment	flake	denticulate	unifacial	0–25	30	20	Uniface.
5583	67	obsidian	complete	flake	even	unifacial	76–100	22	17	Scraper.
5697	38	chert (local)	complete	flake	denticulate	bifacial	76–100	39	42	
5707	74	sponge	complete	flake	even	unifacial	51–75	35	23	Scraper.
5712	11	chert (local)	complete	flake	denticulate	unifacial	76–100	46	37	Uniface/spokeshave.
						Site 53/745				
6424	2196	chert (local)	complete	flake	denticulate	unifacial	51–75	70	68	
6444	788	basalt (fine)	complete	flake	denticulate	unifacial	76–100	75	54	
6617	2510	chert (local)	complete	core	denticulate	unifacial	51–75	61	38	Graver/scraper.

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ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
6623	2529	basalt (fine)	incomplete	flake	even				25	
6627	2579	other	incomplete	unknown	even	bifacial	26–50		26	Dacite scraper.
6631	2583	chert (local)	complete	flake	even	unifacial	76–100	71	50	Uniface scraper.
6867	3336	chert (local)	complete	flake	denticulate	unifacial	51–75	54	48	
7010	3571	chert (local)	complete	core	denticulate	bifacial	51–75	59	43	
7377	3744	chert (local)	complete	flake	even	unifacial	76–100	51	35	
7489	4514	basalt (fine)	incomplete	flake	even	unifacial	76–100	35	17	Uniface.
7669	4334	chert (local)	complete	flake	even	unifacial	0–25	44	24	
7735	4273	chert (local)	complete	flake	denticulate	unifacial	26–50	25	18	Graver/drill.
7764	4251	sponge	complete	core	even	unifacial	51–75	35	33	Scraper.
7909	4645	chert (other)	complete	flake	even	unifacial	0–25	40	25	End scraper.
8084	4827	chert (local)	complete	flake	denticulate	unifacial	76–100	52	37	Uniface (heat treatment).
8196	4916	chert (local)	complete	cobble	N/A	N/A	N/A	65	63	Hammerstone.
8223	4940	chert (local)	complete	core	denticulate	unifacial	26–50	70	54	
8235	4969	chert (local)	complete	flake	denticulate	unifacial	0–25	69	55	
8347	5131	sponge	complete	flake	even	bifacial	26–50	33	20	Scraper (heat treatment).
8355	5176	chert (local)	complete	core	even	bifacial	51–75	44	37	Scraper.
8426	5145	quartzite	complete	flake	even	unifacial	26–50	98	77	
8461	5494	chert (local)	complete	core	even	unifacial	26–50	60	51	Scraper.
8471	5456	chert (local)	complete	flake	denticulate	unifacial	51–75	51	34	
8478	5475	chert (local)	complete	core	denticulate	bifacial	51–75	51	35	Graver.
8582	5329	chert (local)	complete	cobble	denticulate	unifacial	26–50	81	75	Chopper.
8605	5322	chert (local)	complete	flake	denticulate	unifacial	51–75	50	48	
8746	5517	chert (local)	complete	flake	denticulate	unifacial		48	31	Retouched flake/scraper.
8827	5299	chert (local)	complete	flake	even	unifacial	0–25	52	41	Scraper.
8835	5262	chert (local)	complete	flake	denticulate	unifacial	76–100	46	37	
8844	5269	other	complete	flake	denticulate	unifacial	76–100	42	39	Quartz.
8934	6296	chert (local)	fragment	flake	denticulate	unifacial		23	17	Scraper.
8935	6278	chert (local)	complete	flake	even	unifacial	26–50	83	77	Scraper/chopper.

ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
8961	6251	sponge	complete	flake	denticulate	unifacial	51–75	52	50	
9221	6101	chert (local)	complete	flake	denticulate	unifacial	51–75	44	38	
9260	6302	chert (local)	complete	flake	even			45	51	Spokeshave.
9289	6345	chert (local)	complete	flake	even	unifacial	26–50	21	16	Scraper (use wear).
9423	6780	chert (local)	complete	flake	even	unifacial	76–100	89	66	Scraper/chopper.
9454	6678	chert (local)	complete	flake	even	bifacial	51–75	103	75	Scraper.
9475	6666	chert (other)	complete	core	even	unifacial	0–25	76	48	Chopper (battering).
9492	6650	sponge	complete	core	denticulate	bifacial	76–100	61	36	
9607	8964	chert/quartzite	complete	flake	even	bifacial		49	40	
9668	7886	chert (local)	complete	flake	even	bifacial		33	14	Drill?
9719	7752	quartzite	incomplete	flake	denticulate	unifacial	51–75	55	40	
9820	7347	chert (local)	incomplete	core	even	bifacial	76–100		37	
9848	7333	chert (other)	complete	core	denticulate	unifacial	76–100	46	29	
9898	7051	sponge	complete	flake	even	unifacial	76–100	47	28	Hammerstone.
10038	8198	chert (local)	incomplete	core	even	bifacial	76–100	98		Scraper/chopper.
10109	8124	basalt (fine)	complete	cobble	even	unifacial	51–75	78	78	Scraper/chopper.
10121	8123	chert (other)	complete	flake	even	unifacial	51–75	26	31	Scraper.
10214	8477	chert (local)	complete	flake	even	unifacial	26–50	39	29	Heat treatment.
10223	8475	chert (local)	complete	flake	denticulate	unifacial	26–50	69	63	
10290	8365	chert (local)	complete	flake	denticulate	unifacial	26–50	34	41	
10315	8340	quartzite	complete	core	even	unifacial	26–50	140	78	Scraper (battering).
10316	8326	chert (local)	complete	flake	denticulate	unifacial	76–100	55	45	
10345	8280	quartzite	complete	cobble	denticulate	bifacial	26–50	133	110	Chopper.
10352	7997	quartzite	complete	cobble	denticulate	bifacial	76–100	95	90	
10438	8811	chert (local)	complete	core	even	bifacial	76–100	65	25	Biface/graver.
10444	8802	chert (local)	complete	flake	denticulate	unifacial	51–75	69	34	
10489	8745	chert (local)	complete	flake	even	bifacial	26–50	53	42	
10493	8738	basalt (fine)	complete	cobble	even	unifacial	0–25	97	77	

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ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
10494	8737	basalt (fine)	complete	cobble	N/A	N/A	N/A	81	63	Hammerstone.
10495	8735	chert (local)	complete	flake	denticulate	unifacial	76–100	61	34	
10507	8734	chert (local)	complete	flake	even	unifacial	26–50	48	30	Scraper.
10546	8704	chert (local)	incomplete	cobble	denticulate	unifacial	76–100	78		
10557	8691	quartzite	complete	cobble	N/A	N/A	N/A	104	90	Hammerstone.
10656	8612	chert (other)	complete	core	even	unifacial	26–50	32	34	Scraper.
						Site 28/903				
2490	211	chert (local)	complete	cobble	denticulate	unifacial	26–50	55	45	Graver.
2541	199	chert (local)	complete	cobble	denticulate	unifacial	0–25	50	50	
2555	113	quartzite	complete	core	even	unifacial	0–25	84	75	Chopper (core).
2573	194	chert/quartzite	complete	cobble	denticulate	unifacial	0–25	81	62	Graver/drill.
2600	202	chert (local)	complete	cobble	even	unifacial	26–50	72	70	Scraper/chopper.
2619	222	sponge	complete	core	even	bifacial	51–75	70	45	Scraper.
2644	205	quartzite	complete	core	denticulate	bifacial	76–100	89	70	Chopper.
2652	23	chert (local)	complete	core	denticulate	unifacial	76–100	50	36	
2658	41	quartzite	complete	cobble	denticulate	unifacial	26–50	104	88	Chopper.
2772	81	quartzite	complete	flake	denticulate	unifacial	26–50	96	77	
2808	19	chert (local)	complete	core	denticulate	unifacial	0–25	53	41	
2809	19	chert (local)	complete	core	denticulate	unifacial	51–75	43	38	
2909	224	chert (local)	complete	core	denticulate	unifacial	76–100	99	79	Chopper.
2920	233	quartzite	complete	cobble	denticulate	unifacial	51–75	115	112	Chopper.
3010	150	basalt (fine)	complete	cobble	denticulate	unifacial	0–25	100	100	
3031	143	sponge	complete	core	denticulate	bifacial	51–75	86	77	Chopper.
3053	233	chert (local)	complete	flake	denticulate	unifacial	51–75	55	42	
3137	1	chert (local)	complete	core	denticulate	unifacial	26–50	91	64	Knife.
3155	1	chert (local)	complete	flake	denticulate	bifacial	26–50	68	51	
						Site 31/244				
5	208	chert (local)	complete	core	even	unifacial	51–75	85	53	Scraper.
20	201	quartzite	complete	cobble	even	unifacial	26–50	75	41	Scraper.
133	1	chert (local)	complete	cobble	denticulate	unifacial	51–75	50	30	Graver/spokeshave.

ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
135	1	quartzite	complete	cobble	even	bifacial	26–50	59	36	Scraper.
136	1	chert (local)	complete	core	denticulate	unifacial	51–75	47	28	Graver.
138	1	chert (other)	complete	cobble	even	unifacial	0–25	42	31	Scraper.
204	1	sponge	complete	fragment	even	bifacial	26–50	41	27	Scraper.
279	1	chert (local)	complete	unknown	denticulate	unifacial	51–75	39	29	Graver.
291	1	chert (local)	complete	flake	even	unifacial	0–25	52	25	Scraper.
402	1	quartzite	incomplete	cobble	even	unifacial	0–25	62	42	Scraper.
404	1	chert (local)	complete	core	denticulate	unifacial	51–75	50	35	Drill/graver.
406	1	quartzite	incomplete	core	even	unifacial	0–25	70	55	
410	1	chert (local)	complete	unknown	even	unifacial	26–50	39	23	Burned.
498	1	sponge	complete	flake	denticulate	unifacial	26–50	36	24	
518	1	chert (local)	complete	core	denticulate	unifacial	51–75	77	51	
608	1	chert (other)	complete	core	even	unifacial	26–50	32	22	Scraper.
611	1	chert (local)	complete	flake	even	unifacial	26–50	36	34	
735	263	chert (local)	complete	flake	denticulate	unifacial	26–50	44	42	
749	126	quartzite	complete	cobble	even	unifacial	0–25	86	81	
754	269	chert (local)	complete	core	denticulate	unifacial	51–75	77	62	Graver.
763	191	chert (local)	complete	flake	even	unifacial	26–50	91	53	
764	175	chert (local)	complete	flake	even	unifacial	76–100	71	62	Uniface.
772	170	quartzite	complete	core	denticulate	unifacial	51–75	85	70	Chopper (battering).
814	238	quartzite	incomplete	cobble	denticulate	unifacial	76–100		93	
818	229	quartzite	complete	core	denticulate	unifacial	51–75	97	95	Chopper.
830	260	quartzite	complete	core	denticulate	unifacial	51–75	98	96	Chopper.
						Site 133/561				
3719	1	chert (other)	complete	flake	even	bifacial	76–100	42	28	
3720	1	chert (local)	complete	flake	even	unifacial	76–100	51	38	Scraper/preform.
3743	137	chert (local)	complete	core	denticulate	bifacial	76–100	61	42	
3754	157	quartzite	complete	core	even	unifacial	51–75	82	60	Scraper/chopper.
3757	148	chert (local)	complete	core	even	unifacial	51–75	57	47	Scraper.

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ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
3808	66	chert (local)	complete	core	even	bifacial	76–100	48	50	
3825	99	quartzite	complete	cobble	denticulate	unifacial	51–75	95	98	Chopper.
3833	150	sponge	complete	core	denticulate	unifacial	51–75	58	56	
4035	471	chert (local)	complete	core	denticulate	unifacial	76–100	65	49	
4061	151	quartzite	complete	core	denticulate	unifacial	26–50	68	47	
4062	159	quartzite	complete	cobble	denticulate	unifacial	0–25	105	92	Chopper.
4162	380	chert (local)	complete	flake	denticulate	unifacial	76–100	49	39	Uniface.
4292	475	chert (local)	complete	core	even	bifacial	76–100	67	42	Scraper.
4438	453	chert (local)	complete	flake	denticulate	bifacial	76–100	34	41	
4443	465	chert (local)	complete	core	even	unifacial	51–75	53	39	Scraper.
4549	379	chert (local)	complete	core	denticulate	unifacial	0–25	59	41	
						Site 134/189				
4863	217	chert (local)	incomplete	flake	denticulate	unifacial	76–100		31	Uniface.
4896	230	chert (local)	complete	core	denticulate	unifacial	26–50	59	46	
4899	276	sponge	complete	flake	denticulate	unifacial	76–100	47	33	
5017	248	chert (local)	complete	cobble	denticulate	bifacial	26–50	57	39	
5018	239	chert (local)	complete	core	denticulate	unifacial	76–100	51	33	Uniface/preform.
5019	32	chert (local)	complete	core	denticulate	bifacial	76–100	67	51	Scraper.
5020	234	chert (local)	complete	core	denticulate	unifacial	0–25	52	34	
5082	86	chert (local)	complete	flake	denticulate	unifacial	51–75	60	34	
5108	297	chert (local)	complete	cobble	denticulate	unifacial	0–25	61	39	
5113	386	chert (local)	complete	core	even	unifacial	51–75	109	73	
5212	293	chert (local)	complete	flake	denticulate	unifacial	26–50	52	30	
5257	415	chert (local)	complete	flake	denticulate	unifacial	51–75	36	42	
						Site 135/186				
4572	17	chert (local)	complete	core	even	unifacial	76–100	22	17	Scraper.
4643	92	chert (other)	complete	flake	denticulate	unifacial	51–75	39	35	Uniface scraper.
						Site 136/663				
6311	393	chert (other)	fragment	flake	even	unifacial	76–100			Uniface fragment.

ID	PD No.	Material	Condition	Blank	Edge Type	Flaking Type	Edge Angle (°)	Length (mm)	Width (mm)	Comments
						Site 137/482				
5990	330	chert (local)	complete	core	denticulate	unifacial	51–75	45	39	
6038	356	chert (local)	complete	flake	even	unifacial	51–75	39	27	Scraper.
6101	11	chert (local)	complete	flake	denticulate	unifacial	76–100	46	42	

Key: ID = Identification Number; N/A = not applicable; PD = Provenience Designation.

Table G.3. Flaked Stone Counts for Site 104/902, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools			Cobble Tools		Flake Tools			Bifaces			Projectile Points			Total
						Denticulate		Even	Denticulate	Even	Denticulate	Even		Denticulate	Even	Unknown	Denticulate	Even		
						Bi	Uni	Uni	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Bi	Uni	
PD 1																				
Surface	867	424	1	32	31	2	2	1	1	1	8	1	2	1	1	1	—	—	—	1,376
PL																				
Surface	2	2	—	—	1	—	—	—	—	—	3	1	3	2	2	—	2	1	2	21
ST 19																				
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 45																				
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 1004																				
Stratum I	10	3	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
TP 1005																				
Stratum I	16	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
TP 1008																				

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools			Cobble Tools		Flake Tools			Bifaces			Projectile Points			Total
						Denticulate		Even	Denticulate	Even	Denticulate	Even		Denticulate	Even	Unknown	Denticulate	Even		
						Bi	Uni	Uni	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Bi	Uni	
Stratum I	4	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
Feature 2																				
TP 1002																				
Stratum I	2	3	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
Total	903	443	1	38	32	2	2	1	1	1	11	2	5	3	3	1	2	1	2	1,454

Key: Bi = bifacial; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; Uni = unifacial.

Table G.4. Flaked Stone Counts for Site 104/902, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert			Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other	Quartzite						
						Debitage						
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	25	—	—	—	878	903
Flake	marginal platform, feather termination	2	2	43	5	13	2	12	11	2	—	92
	marginal platform, hinge termination	—	1	10	1	—	1	—	—	—	—	13
	marginal platform, missing termination	—	1	2	—	—	1	1	—	—	—	5
	missing platform, feather termination	—	—	—	—	—	—	—	1	—	—	1
	missing platform, hinge termination	—	—	2	1	—	—	—	—	—	—	3
	nonmarginal platform, feather termination	2	12	122	27	35	—	38	30	4	—	270

Artifact Type	Observation	Basalt		Chert			Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other	Quartzite						
	nonmarginal platform, hinge termination	—	7	21	3	4	—	6	5	—	—	46
	nonmarginal platform, missing termination	—	2	3	1	2	—	3	2	—	—	13
Uniface flake	marginal platform, feather termination	—	—	—	—	—	—	—	1	—	—	1
Biface flake	marginal platform, feather termination	—	2	6	—	1	3	3	1	1	—	17
	marginal platform, missing termination	—	1	1	1	—	3	—	1	2	—	9
	missing platform, feather termination	—	—	1	—	—	1	—	—	—	—	2
	missing platform, missing termination	—	3	2	—	—	2	—	—	—	—	7
	nonmarginal platform, feather termination	—	1	—	—	—	1	—	—	—	—	2
	nonmarginal platform, missing termination	—	1	—	—	—	—	—	—	—	—	1
Subtotal		4	33	213	39	55	39	63	52	9	878	1,385
Cores												
Cobble	exhausted	—	—	—	—	—	—	—	1	—	—	1
	good potential	—	1	1	1	—	—	3	—	—	—	6
	some potential	—	—	4	1	—	—	1	1	—	—	7
	tested	—	—	—	1	—	—	—	—	—	—	1
Nodule	good potential	—	—	—	—	—	—	1	—	—	—	1
	some potential	—	—	3	—	—	—	—	—	—	—	3
	tested	—	—	1	—	—	—	—	—	—	—	1
Unknown	exhausted	—	—	2	—	2	—	—	2	—	—	6
	good potential	—	—	2	—	—	—	—	—	—	—	2
	some potential	—	—	2	1	—	—	1	—	—	—	4

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Artifact Type	Observation	Basalt		Chert			Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other	Quartzite						
Subtotal		0	1	15	4	2	0	6	4	0	0	32
						Tools						
Cobble	denticulate edge, unifacial flaking	—	—	—	—	—	—	1	—	—	—	1
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Core	denticulate edge, bifacial flaking	—	—	2	—	—	—	1	—	—	—	3
	denticulate edge, unifacial flaking	—	—	1	—	—	—	—	1	—	—	2
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Flake	denticulate edge, bifacial flaking	—	—	1	—	—	1	1	—	—	—	3
	denticulate edge, unifacial flaking	—	1	6	4	—	—	—	1	—	—	12
	even edge, bifacial flaking	—	1	1	—	—	—	—	1	—	—	3
	even edge, unifacial flaking	—	—	4	—	—	1	—	1	—	—	6
Unknown	even edge, bifacial flaking	—	1	1	—	—	—	—	1	—	—	3
	even edge, unifacial flaking	—	1	—	—	—	—	—	—	—	—	1
	unknown edge, bifacial flaking	—	—	—	1	—	—	—	—	—	—	1
Subtotal		0	4	18	5	0	2	3	5	0	0	37
Total		4	38	246	48	57	41	72	61	9	878	1,454

Table G.5. Flaked Stone Counts for Site 105/838, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
PD 1																	
Surface	262	222	1	5	12	2	—	—	—	—	—	—	1	—	—	—	505
PL																	
Surface	12	5	—	1	2	—	—	1	1	—	1	1	—	1	—	—	25
ST 73																	
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 82																	
Stratum I	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
ST 83																	
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 87																	
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 88																	
Stratum I	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
ST 121																	
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 133																	
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 140																	
Stratum I	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 144																	
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 156																	
Stratum I	6	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
TP 157																	
Stratum I	10	11	1	—	1	—	—	—	—	—	—	—	—	—	—	—	23
TP 158																	
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum I	53	9	—	3	—	—	—	—	—	—	—	—	—	—	—	—	65
TP 173																	
Stratum I	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
TP 189																	
Stratum I	10	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15
Stratum II	—	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	3
TP 258																	
Stratum I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
TR 177																	
Mixed	103	26	—	2	2	—	—	—	—	—	—	—	—	1	—	—	134
TR 747																	
Surface	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
SU 804																	
Surface	1	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	6
Feature 2																	
PL																	
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 3																	
South half																	
Surface	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
Feature 6																	
PL																	

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
South half																	
Fill	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 13																	
North half																	
Fill	180	48	1	2	—	—	—	—	—	—	—	—	—	—	—	—	231
South half																	
Fill	223	72	1	5	5	—	—	—	—	—	—	1	—	—	2	5	314
Feature 15																	
South half																	
Fill	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	5
Feature 21																	
TP 172	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Stratum I	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Profile	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 23																	
Quadrant 1																	
Stratum I	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Fill	20	16	—	1	—	—	—	—	—	—	—	—	—	—	—	1	38
Floor fill	10	3	—	—	—	1	—	—	—	—	—	—	—	—	—	—	14
Roof fall	19	10	—	1	—	—	—	—	—	—	—	—	—	—	—	—	30
Quadrant 2																	
Fill	34	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47
Floor fill	8	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
Floor	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Quadrant 3																	
Floor fill	17	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	23
Fill/roof fall	29	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	34
Fill	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Quadrant 4																	
Fill	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Fill/roof fall	36	17	—	1	—	—	—	—	—	—	—	—	—	—	—	—	54
Floor fill	34	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44
Floor	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
TP 234																	
Stratum I	7	7	—	1	—	—	—	—	—	—	—	—	—	—	—	—	15
TP 319																	
Fill	21	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
Floor fill	6	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
Subfeature 3																	
Floor	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Subfeature 4																	
Fill	7	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	12
Subfeature 5																	
Fill	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Subfeature 13																	
Floor	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Subfeature 19																	
Fill	11	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
Subfeature 24																	
Fill	8	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Subfeature 27																	
Fill	30	6	—	—	1	—	—	—	—	—	—	—	—	—	—	—	37
Subfeature 35																	
Fill	12	9	—	1	1	—	—	—	—	—	—	—	—	—	—	—	23
Subfeature 37																	
Fill	14	3	—	—	—	—	—	—	—	—	—	—	—	—	—	1	18
Feature 25																	
Fill	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 26																	
Stratum I	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Fill	3	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Feature 28																	
Fill	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Feature 29																	
Entry																	
Floor fill	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Feature																	
Fill	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Quadrant 1																	
Fill/roof fall	25	11	1	1	—	—	—	—	—	—	—	—	—	—	—	—	38
Floor fill	16	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23
Quadrant 2																	
Fill/roof fall	10	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11
Floor fill	11	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15
South end																	

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Fill/roof fall	3	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
Floor fill	9	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	10
TP 322																	
Fill	28	15	—	1	1	—	—	—	—	—	—	—	—	—	—	—	45
Fill/roof fall	49	10	—	1	—	—	—	—	—	—	—	—	—	—	—	—	60
Roof fall/floor fill	20	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23
TP 390																	
Surface	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Fill	19	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	22
House fill	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
TP 473																	
Fill/roof fall	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Floor fill	6	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
TP 484																	
Fill/roof fall	7	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
Subfeature 2																	
Fill	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Subfeature 3																	
TP 322																	
Fill	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
Subfeature 5																	
South end																	
Fill	3	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Subfeature 6																	
Posthole fill	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Subfeature 7																	
TP 373																	
Fill	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Subfeature 23																	
Quadrant 1																	
Fill	8	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
Quadrant 2																	
Fill	23	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	28
Subfeature 26																	
Fill	10		—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
Feature 30																	
Fill	1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 31																	
South half																	
Fill	4		—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Feature 37																	
Quadrant 1																	
Fill	53	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	69
Floor fill	39	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	42
Quadrant 2																	
Fill/roof fall	22	27	—	—	—	—	1	—	—	—	—	—	—	—	1	—	51
Floor fill	75	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	89
Quadrant 3																	
Fill/roof fall	38	13	1	—	—	—	—	—	—	1	—	—	—	—	—	—	53
Floor fill	15	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools		Flake Tools				Bifaces	Projectile Points		Total
						Denticulate	Even	Even		Denticulate		Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	
Quadrant 4																	
Fill	19	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
Fill/roof fill	58	19	—	3	1	—	—	—	—	—	—	—	—	—	—	—	81
Floor fill	33	18	1	2	—	—	—	—	—	—	—	—	—	—	—	—	54
Feature 39																	
Fill	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Feature 40																	
Fill	16	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26
Feature 41																	
TP 616																	
Fill	26	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	31
Quadrant 3																	
Fill	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Quadrants 1 and 2																	
Fill	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
Total	1,916	782	11	36	30	3	1	1	1	2	1	2	1	2	4	7	2,800

Key: Bi = bifacial; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; SU = stripping unit; TP = test pit; TR = trench; Uni = unifacial.

Table G.6. Flaked Stone Counts for Site 105/838, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other							
						Debitage						
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	50	—	—	—	1,866	1,916
Flake	marginal platform, feather termination	2	5	186	17	12	7	26	21	2	—	278
	marginal platform, hinge termination	—	1	21	—	2	2	3	4	—	—	33
	marginal platform, missing termination	—	—	6	1	1	—	1	2	—	—	11
	missing platform, feather termination	—	—	5	—	1	1	1	—	—	—	8
	missing platform, hinge termination	—	—	1	—	—	—	—	—	—	—	1
	nonmarginal platform, feather termination	6	5	217	20	26	4	63	31	2	—	374
	nonmarginal platform, hinge termination	—	2	34	2	3	—	6	—	—	—	47
	nonmarginal platform, missing termination	—	1	10	—	2	1	3	2	—	—	19
	indeterminate platform, indeterminate termination	—	—	—	—	—	—	—	—	—	11	11
Uniface flake	marginal platform, feather termination	—	—	5	2	—	—	—	1	—	—	8
	marginal platform, hinge termination	—	—	1	—	—	—	—	—	—	—	1
	marginal platform, missing termination	—	—	1	—	—	—	—	—	—	—	1
	nonmarginal platform, feather termination	—	—	—	—	—	—	—	1	—	—	1
Biface flake	marginal platform, feather termination	—	2	6	2	1	3	1	7	—	—	22
	marginal platform, hinge termination	—	—	1	1	—	—	—	—	—	—	2
	marginal platform, missing termination	—	1	1	—	—	—	—	—	—	—	2

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other							
	missing platform, feather termination	—	—	1	—	—	1	—	—	—	—	2
	missing platform, missing termination	—	1	—	—	—	3	1	2	—	—	7
	nonmarginal platform, feather termination	—	—	—	1	—	—	—	—	—	—	1
Subtotal		8	18	496	46	48	72	105	71	4	1,877	2,745
Cores												
Cobble	exhausted	—	—	1	—	1	—	2	—	—	—	4
	good potential	—	—	3	—	—	—	1	1	—	—	5
	some potential	—	—	—	1	1	—	1	2	—	—	5
	tested	—	—	—	—	—	—	1	—	—	—	1
Nodule	good potential	—	—	1	—	—	—	—	—	—	—	1
	some potential	—	—	4	—	—	—	—	—	—	—	4
	tested	—	—	1	—	—	—	—	1	—	—	2
Unknown	exhausted	—	—	1	—	—	—	—	—	—	—	1
	good potential	—	—	1	—	—	—	—	—	—	—	1
	some potential	—	—	2	1	1	—	1	1	—	—	6
Subtotal		0	0	14	2	3	0	6	5	0	0	30
Tools												
Cobble	even edge, bifacial flaking	—	—	—	1	—	—	—	—	—	—	1
	even edge, unifacial flaking	—	—	—	—	—	—	—	—	1	—	1
Core	denticulate edge, unifacial flaking	—	—	1	1	—	—	—	1	—	—	3
	even edge, unifacial flaking	—	—	—	—	1	—	—	—	—	—	1
Flake	denticulate edge, bifacial flaking	—	—	1	—	—	2	—	—	1	—	4
	denticulate edge, unifacial flaking	—	—	1	—	—	3	—	—	—	—	4
	even edge, bifacial flaking	—	—	—	—	—	1	—	—	—	—	1
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other							
Unknown	denticulate edge, bifacial flaking	—	—	1	—	—	1	—	—	—	—	2
	even edge, bifacial flaking	—	—	1	1	—	4	—	—	—	—	6
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Subtotal		0	0	7	3	1	11	0	1	2	0	25
Total		8	18	517	51	52	83	111	77	6	1,877	2,800

Table G.7. Flaked Stone Counts for Site 85/428, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools		Projectile Points	Total
						Denticulate Unifacial	Denticulate Unifacial	Even Unifacial	Denticulate Bifacial	
PD 1										
Surface	111	73	1	4	—	1	1	—	—	191
PL										
Surface	2	—	—	—	—	—	—	—	3	5
ST 17										
Stratum I	2	—	—	—	—	—	—	—	—	2
ST 29										
Stratum I	5	—	—	—	—	—	—	—	—	5
ST 32										
Stratum I	3	—	—	—	—	—	—	—	—	3
ST 37										
Stratum I	1	—	—	—	—	—	—	—	—	1
ST 55										

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools		Projectile Points	Total
						Denticulate Unifacial	Denticulate Unifacial	Even Unifacial	Denticulate Bifacial	
Stratum I	1	—	—	—	—	—	—	—	—	1
ST 63										
Stratum I	—	3	—	—	—	—	—	—	—	3
ST 70										
Stratum I	—	—	—	—	—	1	—	—	—	1
ST 71										
Stratum I	1	—	—	—	—	—	—	—	—	1
ST 89										
Stratum I	—	1	—	—	—	—	—	—	—	1
ST 90										
Stratum I	—	1	—	—	—	—	—	—	—	1
SU 131										
Cultural	1	—	—	—	—	—	—	—	—	1
SU 132										
Cultural	—	—	—	—	1	—	—	—	—	1
SU 133										
Cultural	1	—	—	—	—	—	—	1	—	2
SU 134										
Cultural	7	2	—	—	—	—	—	—	—	9
Feature 2										
SU 134										
Cultural	9	3	—	—	2	—	—	—	—	14
Feature 3										
South half										
Cultural	—	1	—	—	—	—	—	—	—	1
Feature 4										

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools		Projectile Points	Total
						Denticulate Unifacial	Denticulate Unifacial	Even Unifacial	Denticulate Bifacial	
East half										
Fill	1	—	—	—	—	—	—	—	—	1
Total	145	84	1	4	3	2	1	1	3	244

Key: PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; SU = stripping unit.

Table G.8. Flaked Stone Counts for Site 85/428, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	Debitage											
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	1	—	—	—	144	145
Flake	marginal platform, feather termination	—	1	14	1	1	—	3	3	—	—	23
	marginal platform, hinge termination	—	—	2	—	—	—	—	—	—	—	2
	nonmarginal platform, feather termination	1	6	31	3	1	—	5	5	3	—	55
	nonmarginal platform, hinge termination	1	—	3	—	—	—	—	—	—	—	4
Uniface flake	marginal platform, feather termination	—	—	—	—	—	1	—	—	—	—	1
Biface flake	marginal platform, feather termination	—	—	1	1	—	—	—	—	—	—	2

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter- minate	Total
		Coarse	Fine	Local	Other							
	missing platform, feather termination	—	1	—	1	—	—	—	—	—	—	2
Subtotal		2	8	51	6	2	2	8	8	3	144	234
						Cores						
Cobble	some potential	—	—	1	—	1	—	—	—	—	—	2
Nodule	tested	—	—	—	—	1	—	—	—	—	—	1
Subtotal		0	0	1	0	2	0	0	0	0	0	3
						Tools						
Core	denticulate edge, unifacial flaking	—	—	2	—	—	—	—	—	—	—	2
Flake	denticulate edge, bifacial flaking	—	1	—	—	—	—	—	—	—	—	1
	denticulate edge, unifacial flaking	—	—	—	1	—	—	—	—	—	—	1
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Unknown	denticulate edge, bifacial flaking	—	2	—	—	—	—	—	—	—	—	2
Subtotal		0	3	3	1	0	0	0	0	0	0	7
Total		2	11	55	7	4	2	8	8	3	144	244

Table G.9. Flaked Stone Counts for Site 77/869, by Artifact Class

Unit	Debris	Flakes	Cores	Projectile Points Denticulate Bifacial	Total
PD 1					
Surface	41	31	1	—	73
PL					
Surface	1	—	1	2	4
ST 76					
Stratum I	—	1	—	—	1
ST 142					
Stratum I	—	1	—	—	1
TP 176					
Stratum I	—	1	—	—	1
Total	42	34	2	2	80

Key: PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit.

Table G.10. Flaked Stone Counts for Site 77/869, by Raw-Material Type

Artifact Type	Observation	Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Local	Other							
Debitage										
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	—	—	42	42
Flake	marginal platform, feather termination	8	—	—	1	—	1	—	—	10
	nonmarginal platform, feather termination	14	1	1	—	4	2	1	—	23
	nonmarginal platform, hinge termination	—	—	—	—	—	—	1	—	1
Subtotal		22	1	1	1	4	3	2	42	76
Cores										
Cobble	good potential	1	—	—	—	—	—	—	—	1
Nodule	some potential	1	—	—	—	—	—	—	—	1
Subtotal		2	0	0	0	0	0	0	0	2
Tools										
Flake	denticulate edge, bifacial flaking	1	—	—	—	—	—	—	—	1
Unknown	denticulate edge, bifacial flaking	—	—	—	1	—	—	—	—	1
Subtotal		1	0	0	1	0	0	0	0	2
Total		25	1	1	2	4	3	2	42	80

Table G.11. Flaked Stone Counts for Site 131/37, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools				Bifaces		Projectile Points		Total
						Even	Denticulate		Even		Denticulate	Even	Denticulate	Even	
						Uni	Bi	Uni	Bi	Uni	Bi	Bi	Uni	Bi	
PD 1															
Surface	438	304	3	6	11	1	—	1	1	2	—	1	—	—	768
PL															
Surface	2	2	—	—	—	—	—	1	—	2	2	3	1	2	15
CU 39															
Surface	8	4	—	—	1	—	—	—	—	—	—	—	—	—	13
CU 40															
Surface	45	9	—	—	2	—	—	—	—	—	—	—	—	—	56
CU 41															
Surface	7	7	—	—	2	—	—	—	—	—	—	—	—	—	16
CU 42															
Surface	19	10	—	—	—	—	—	—	—	—	—	—	—	—	29
CU 43															
Surface	10	6	—	—	—	—	—	—	—	—	—	—	—	—	16
CU 44															
Surface	74	14	—	—	3	—	—	—	—	—	—	—	—	—	91
CU 45															
Surface	11	4	—	—	1	—	—	—	—	—	—	—	—	—	16
CU 46															
Surface	20	3	—	—	—	—	—	—	—	—	—	—	—	—	23
CU 47															
Surface	31	6	—	—	1	—	—	—	—	—	—	—	—	—	38
CU 48															

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools				Bifaces		Projectile Points		Total
						Even	Denticulate		Even		Denticulate	Even	Denticulate	Even	
						Uni	Bi	Uni	Bi	Uni	Bi	Bi	Uni	Bi	
Surface	53	11	—	—	7	—	—	—	—	—	—	—	—	—	71
CU 49															
Surface	41	17	—	—	2	—	—	—	—	—	—	—	—	—	60
CU 50															
Surface	14	8	—	—	1	—	—	—	—	—	—	—	—	—	23
CU 51															
Surface	20	16	—	—	5	—	—	—	—	—	—	—	—	—	41
CU 52															
Surface	72	10	—	—	3	—	—	—	—	—	—	—	—	—	85
CU 53															
Surface	45	10	—	—	1	—	—	—	—	—	—	—	—	—	56
CU 54															
Surface	16	2	—	—	—	—	—	—	—	—	—	—	—	—	18
ST 14															
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 24															
Stratum I	1	1	—	—	—	—	—	—	—	—	—	—	—	—	2
TP 18															
Stratum I	2	—	—	—	—	—	1	—	—	—	—	—	—	—	3
TP 83															
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 88															
Stratum I	—	2	—	—	—	—	—	—	—	—	—	—	—	—	2
Total	929	448	3	6	40	1	1	2	1	4	2	4	1	2	1,444

Key: Bi = bifacial; CU = collection unit; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; Uni = unifacial.

Table G.12. Flaked Stone Counts for Site 131/37, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other						
Debitage											
Debris	indeterminate platform, indeterminate termination	485	—	—	—	2	—	—	—	442	929
Flake	marginal platform, feather termination	24	2	64	5	1	3	16	1	—	116
	marginal platform, hinge termination	—	—	7	1	—	1	2	—	—	11
	marginal platform, missing termination	—	—	2	—	—	—	—	—	—	2
	missing platform, feather termination	—	—	2	—	—	—	—	—	—	2
	missing platform, hinge termination	—	—	1	—	—	—	—	—	—	1
	nonmarginal platform, feather termination	122	10	113	10	—	9	27	1	—	292
	nonmarginal platform, hinge termination	1	1	15	3	—	1	3	—	—	24
Uniface flake	marginal platform, feather termination	—	—	1	—	—	—	1	—	—	2
	nonmarginal platform, feather termination	—	—	—	—	—	1	—	—	—	1
Biface flake	marginal platform, feather termination	—	—	3	—	—	—	1	—	—	4
	marginal platform, hinge termination	—	—	1	—	—	—	—	—	—	1
	missing platform, missing termination	—	—	—	1	—	—	—	—	—	1
Subtotal		632	13	209	20	3	15	50	2	442	1,386
Cores											
Cobble	good potential	—	—	1	1	—	—	—	—	—	2
	some potential	—	—	2	—	—	—	1	—	—	3

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Artifact Type	Observation	Basalt		Chert		Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other						
Nodule	good potential	4	—	—	—	—	—	—	—	—	4
	some potential	13	1	—	—	—	—	—	—	—	14
	tested	2	—	—	—	—	—	—	—	—	2
Unknown	exhausted	—	—	1	—	—	—	1	—	—	2
	good potential	3	—	—	—	—	1	—	—	—	4
	some potential	9	—	—	—	—	—	—	—	—	9
Subtotal		31	1	4	1	0	1	2	0	0	40
Tools											
Core	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	1
Flake	denticulate edge, bifacial flaking	—	—	2	—	—	—	—	—	—	2
	denticulate edge, unifacial flaking	—	—	2	—	—	—	1	—	—	3
	even edge, bifacial flaking	—	—	4	1	2	—	—	—	—	7
	even edge, unifacial flaking	—	—	1	—	1	—	1	—	—	3
Fragment	even edge, unifacial flaking	—	—	—	1	—	—	—	—	—	1
Unknown	denticulate edge, bifacial flaking	—	—	1	—	—	—	—	—	—	1
Subtotal		0	0	11	2	3	0	2	0	0	18
Total		663	14	224	23	6	16	54	2	442	1,444

Table G.13. Flaked Stone Counts for Site 53/745, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools				Flake Tools				Bifaces			Projectile Points		Total
						Denticulate		Even		Denticulate		Even	Indeterminate	Denticulate	Even			Denticulate	Even	Unknown	Denticulate		
						Bi	Uni	Bi	Uni	Bi	Uni	Uni	Indeterminate	Uni	Bi	Indeterminate	Uni	Bi	Bi	Bi	Bi	Uni	
PD 1																							
Surface	123	63	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	187
PL																							
Surface	1,972	1,997	19	95	136	3	3	4	5	2	2	2	3	20	6	2	14	5	8	2	17	1	4,318
CU 1851																							
Surface	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
CU 1852																							
Surface	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1853																							
Surface	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1854																							
Surface	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
CU 1855																							
Surface	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1856																							
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 1857																							
Surface	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
CU 1858																							
Surface	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1859																							
Surface	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 1860																							
Surface	3	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
CU 1861																							
Surface	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1862																							
Surface	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 1863																							
Surface	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 1864																							
Surface	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 1865																							
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 1866																							
Surface	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3

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						Core Tools				Cobble Tools				Flake Tools				Bifaces			Projectile Points		
Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Denticulate		Even		Denticulate		Even	Indeterminate	Denticulate	Even			Denticulate	Even	Un-known	Denticulate		Total
						Bi	Uni	Bi	Uni	Bi	Uni	Uni	Indeterminate	Uni	Bi	Indeterminate	Uni	Bi	Bi	Bi	Bi	Uni	
CU 1867																							
Surface	4	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 1868																							
Surface	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 1869																							
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2
CU 1870																							
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 1871																							
Surface	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
CU 1872																							
Surface	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 1873																							
Surface	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
CU 1874																							
Surface	5	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 1875																							
Surface	5	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
TP 1913																							
Stratum I	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
TR 1944																							
Strata I–III	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 1																							
PL																							
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 4																							
PL																							
Surface	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 8																							
PL																							
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Feature 9																							
PL																							
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	2,157	2,105	20	98	137	3	3	4	5	2	2	2	3	20	6	2	14	6	8	2	17	1	4,617

Key: Bi = bifacial; CU = collection unit; PD 1 = general site; PL = point-located artifact; TP = test pit; TR = trench; Uni = unifacial.

Table G.14. Flaked Stone Counts for Site 53/745, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	Debitage											
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	23	—	—	—	2,134	2,157
Flake	marginal platform, feather termination	—	4	597	15	1	4	16	69	4	—	710
	marginal platform, hinge termination	—	—	62	1	—	—	—	11	1	—	75
	marginal platform, missing termination	—	—	12	2	—	1	—	1	—	—	16
	missing platform, feather termination	—	—	9	—	—	—	—	1	—	—	10
	missing platform, hinge termination	—	—	3	—	—	—	—	1	—	—	4
	nonmarginal platform, feather termination	8	3	979	18	4	1	41	113	10	—	1,177
	nonmarginal platform, hinge termination	—	—	94	—	—	—	3	10	—	—	107
	nonmarginal platform, missing termination	—	—	6	—	—	—	—	—	—	—	6
Uniface flake	marginal platform, feather termination	—	—	13	1	—	—	—	2	—	—	16
	nonmarginal platform, feather termination	—	—	4	—	—	—	—	—	—	—	4
Biface flake	marginal platform, feather termination	—	2	53	1	—	2	1	5	1	—	65
	marginal platform, hinge termination	—	—	2	—	—	—	—	2	—	—	4
	marginal platform, missing termination	—	—	6	1	—	2	—	2	—	—	11
	missing platform, feather termination	—	1	4	—	—	—	—	—	—	—	5

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	missing platform, hinge termination	—	—	2	—	—	—	—	—	1	—	3
	missing platform, missing termination	—	—	5	1	—	—	—	2	—	—	8
	nonmarginal platform, feather termination	—	—	—	—	—	—	—	2	—	—	2
Subtotal		8	10	1,851	40	5	33	61	221	17	2,134	4,380
						Cores						
Cobble	exhausted	—	—	2	—	—	—	—	1	—	—	3
	good potential	—	1	28	1	1	—	2	4	—	—	37
	some potential	—	—	14	—	—	—	—	—	—	—	14
	tested	—	—	2	—	—	—	—	1	—	—	3
Nodule	exhausted	—	—	1	—	—	—	—	—	—	—	1
	good potential	—	—	4	2	—	—	—	—	—	—	6
	some potential	—	—	5	—	—	—	—	2	—	—	7
	tested	—	—	2	—	—	—	—	—	—	—	2
Fragment	good potential	—	—	—	—	—	—	—	1	—	—	1
	some potential	—	—	2	—	—	—	—	—	—	—	2
Unknown	exhausted	—	—	9	—	—	—	—	1	—	—	10
	good potential	—	—	12	3	1	—	1	5	—	—	22
	some potential	—	—	22	—	—	—	—	5	2	—	29
Subtotal		0	1	103	6	2	0	3	20	2	0	137
						Tools						
Cobble	denticulate edge, bifacial flaking	—	—	—	—	—	—	2	—	—	—	2
	denticulate edge, unifacial flaking	—	—	2	—	—	—	—	—	—	—	2
	even edge, unifacial flaking	—	2	—	—	—	—	—	—	—	—	2

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	indeterminate edge, indeterminate flaking	—	1	1	—	—	—	1	—	—	—	3
Core	denticulate edge, bifacial flaking	—	—	2	—	—	—	—	2	—	—	4
	denticulate edge, unifacial flaking	—	—	2	1	—	—	—	—	—	—	3
	even edge, bifacial flaking	—	—	4	—	—	—	—	—	—	—	4
	even edge, unifacial flaking	—	—	1	2	—	—	1	1	—	—	5
Flake	denticulate edge, bifacial flaking	—	2	6	—	—	5	—	—	1	—	14
	denticulate edge, unifacial flaking	—	1	16	—	—	—	1	1	3	—	22
	even edge, bifacial flaking	—	—	3	1	—	—	—	4	—	—	8
	even edge, indeterminate flaking	—	1	1	—	—	—	—	—	—	—	2
	even edge, unifacial flaking	—	1	10	2	—	—	1	2	—	—	16
	unknown edge, bifacial flaking	—	—	2	—	—	—	—	—	—	—	2
Unknown	denticulate edge, bifacial flaking	—	—	3	2	—	2	—	—	—	—	7
	even edge, bifacial flaking	—	—	2	—	—	—	1	—	1	—	4
Subtotal		0	8	55	8	0	7	7	10	5	0	100
Total		8	19	2,009	54	7	40	71	251	24	2,134	4,617

Table G.15. Flaked Stone Counts for Site 28/903, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools		Flake Tools		Bifaces		Projectile Points	Total
						Dentic-ulate		Even		Dentic-ulate	Even	Denticulate		Dentic-ulate	Even	Denticulate	
						Bi	Uni	Bi	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
PD 1																	
Surface	523	192	—	6	6	—	1	—	—	—	—	1	—	—	1	—	730
PL																	
Surface	35	5	2	10	9	1	—	—	1	1	—	—	—	1	—	4	69
CU 10																	
Surface	4	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
CU 11																	
Surface	57	19	—	—	3	—	—	—	—	—	—	—	—	—	—	—	79
CU 12																	
Surface	12	7	—	—	1	—	—	—	—	—	—	—	—	—	—	—	20
CU 13																	
Surface	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 14																	
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 15																	
Surface	14	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
CU 16																	
Surface	19	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	23
CU 17																	
Surface	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2
CU 18																	
Surface	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
CU 19																	

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools		Flake Tools		Bifaces		Projectile Points	Total
						Dentic-ulate		Even		Dentic-ulate	Even	Denticulate		Dentic-ulate	Even	Denticulate	
						Bi	Uni	Bi	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
Surface	13	10	1	—	—	—	2	—	—	—	—	—	—	—	—	—	26
CU 20																	
Surface	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
CU 21																	
Surface	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
CU 22																	
Surface	2	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	4
CU 23																	
Surface	4	3	—	—	—	—	1	—	—	—	—	—	—	—	—	—	8
CU 40																	
Surface	3	3	—	—	2	—	—	—	—	—	—	—	—	—	—	—	8
CU 41																	
Surface	4	9	—	—	1	—	—	—	—	1	—	—	—	—	—	—	15
CU 74																	
Surface	23	22	—	—	1	—	—	—	—	—	—	—	—	—	—	—	46
CU 76																	
Surface	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 77																	
Surface	9	5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	15
CU 78																	
Surface	5	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
CU 81																	
Surface	6	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	8

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools		Flake Tools		Bifaces		Projectile Points	Total
						Dentic-ulate		Even		Dentic-ulate	Even	Denticulate		Dentic-ulate	Even	Denticulate	
						Bi	Uni	Bi	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
CU 82																	
Surface	28	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44
CU 83																	
Surface	5	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
CU 84																	
Surface	24	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
CU 85																	
Surface	13	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
CU 86																	
Surface	26	11	1	—	—	—	—	—	—	—	—	—	—	—	—	—	38
CU 89																	
Surface	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 90																	
Surface	19	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
CU 91																	
Surface	7	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
ST 61																	
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 72																	
Strata I and II	6	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11
Stratum II	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum III	42	7	—	1	—	—	—	—	—	—	—	—	—	—	1	—	51
TP 93																	
Strata I and II	24	8	—	—	2	—	—	—	—	—	—	—	—	—	—	—	34

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools		Flake Tools		Bifaces		Projectile Points	Total
						Dentic-ulate		Even		Dentic-ulate	Even	Denticulate		Dentic-ulate	Even	Denticulate	
						Bi	Uni	Bi	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
Stratum III	80	8	—	1	—	—	—	—	—	—	—	—	—	—	—	—	89
TP 115																	
Stratum III	23	13	—	1	—	—	—	—	—	—	—	—	—	—	—	—	37
TP 115[a]																	
Stratum I	9	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
Stratum II	4	2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	7
Stratum III	50	12	—	1	1	—	—	—	—	—	—	—	—	—	—	—	64
TP 185																	
Stratum II	11	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	17
Stratum III	52	30	1	3	7	—	—	—	—	1	—	—	—	—	—	1	95
TP 196																	
Stratum II	10	8	—	—	1	—	—	—	—	—	—	—	—	—	—	—	19
Stratum III	50	26	—	1	2	1	—	—	—	1	1	—	—	—	—	—	82
TP 208																	
Stratum II	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	3
Stratum III	27	13	—	—	1	—	—	—	—	1	—	—	—	—	—	—	42
TP 214																	
Stratum II	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	1	5
Stratum III	31	18	—	1	3	—	1	1	—	—	—	—	—	—	—	—	55
TP 225																	
Stratum III	25	18	—	—	1	—	—	—	—	—	—	—	—	—	—	—	44
TP 231																	
Stratum III	33	12	—	—	2	—	—	—	—	1	—	—	1	—	—	—	49

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools		Flake Tools		Bifaces		Projectile Points	Total
						Dentic-ulate		Even		Dentic-ulate	Even	Denticulate		Dentic-ulate	Even	Denticulate	
						Bi	Uni	Bi	Uni	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
TP 236																	
Strata I and II	9	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
Stratum III	18	12	—	—	3	—	—	—	—	—	—	—	—	—	—	—	33
TP 242																	
Strata I and II	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Stratum III	12	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	18
TR 126																	
Stratum II	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2
Total	1,395	578	5	26	52	2	5	1	1	6	1	1	2	1	3	7	2,086

Key: Bi = bifacial; CU = collection unit; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; TR = trench; Uni = unifacial.

[a] Feature 1

Table G.16. Flaked Stone Counts for Site 28/903, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	Debitage											
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	36	—	—	—	1,359	1,395
Flake	marginal platform, feather termination	1	3	109	10	1	3	17	20	2	—	166
	marginal platform, hinge termination	—	—	10	1	—	—	1	1	—	—	13
	marginal platform, missing termination	—	—	3	—	—	2	—	1	—	—	6
	missing platform, feather termination	—	—	2	1	—	—	—	1	—	—	4

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	nonmarginal platform, feather termination	5	4	246	15	3	—	45	37	3	—	358
	nonmarginal platform, hinge termination	—	—	18	—	—	—	2	6	—	—	26
	nonmarginal platform, missing termination	—	—	4	—	—	—	—	1	—	—	5
Uniface flake	marginal platform, feather termination	—	—	2	—	—	3	—	—	—	—	5
Biface flake	marginal platform, feather termination	—	—	3	1	—	6	—	—	—	—	10
	marginal platform, hinge termination	—	—	—	—	1	—	—	—	—	—	1
	marginal platform, missing termination	—	—	2	—	—	4	—	—	—	—	6
	missing platform, feather termination	—	—	1	—	—	—	—	—	—	—	1
	missing platform, missing termination	—	—	—	1	—	6	—	—	1	—	8
Subtotal		6	7	400	29	5	60	65	67	6	1,359	2,004
						Cores						
Cobble	good potential	—	—	6	1	—	—	3	—	—	—	10
	some potential	1	—	8	1	—	—	1	2	—	—	13
	tested	—	—	—	—	—	—	1	—	—	—	1
Nodule	exhausted	—	—	—	1	—	—	—	—	—	—	1
	good potential	—	—	1	—	—	—	1	—	—	—	2
	some potential	—	—	4	—	—	—	—	1	—	—	5
	tested	—	—	—	—	1	—	1	—	—	—	2
Unknown	exhausted	—	—	1	1	—	—	—	1	—	—	3
	good potential	—	—	2	—	—	—	2	—	—	—	4
	some potential	—	—	7	1	1	—	2	—	—	—	11
Subtotal		1	0	29	5	2	0	11	4	0	0	52

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
						Tools						
Cobble	denticulate edge, unifacial flaking	—	1	2	—	1	—	2	—	—	—	6
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Core	denticulate edge, bifacial flaking	—	—	—	—	—	—	1	1	—	—	2
	denticulate edge, unifacial flaking	—	—	5	—	—	—	—	—	—	—	5
	even edge, bifacial flaking	—	—	—	—	—	—	—	1	—	—	1
	even edge, unifacial flaking	—	—	—	—	—	—	1	—	—	—	1
Flake	denticulate edge, bifacial flaking	—	1	1	—	—	—	—	—	—	—	2
	denticulate edge, unifacial flaking	—	—	1	—	—	—	1	—	—	—	2
	even edge, bifacial flaking	—	—	3	—	—	—	—	—	—	—	3
	even edge, unifacial flaking	—	—	—	—	—	—	—	1	—	—	1
Unknown	denticulate edge, bifacial flaking	—	—	—	3	—	3	—	—	—	—	6
Subtotal		0	2	13	3	1	3	5	3	0	0	30
Total		7	9	442	37	8	63	81	74	6	1,359	2,086

Table G.17. Flaked Stone Counts for Site 31/244, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools		Cobble Tools			Flake Tools			Bifaces	Projectile Points		Total
						Denticulate	Even	Denticulate	Even		Denticulate	Even		Even	Denticulate	Even	
						Uni	Uni	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Bi	Bi	
PD 1																	
Surface	1,085	562	3	43	31	3	2	1	1	2	2	1	3	1	1	—	1,741
PL																	
Surface	16	29	—	16	43	4	1	1	—	2	1	—	2	4	8	3	130
ST 26																	
Surface	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
Stratum I	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 143																	
Stratum III	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 144																	
Strata I and II	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2
Stratum III	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	1,102	591	3	63	75	7	3	2	1	4	3	1	5	5	9	3	1,877

Key: Bi = bifacial; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; Uni = unifacial.

Table G.18. Flaked Stone Counts for Site 31/244, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter- minate	Total
		Coarse	Fine	Local	Other							
						Debitage						
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	5	—	—	—	1,097	1,102
Flake	marginal platform, feather termination	—	—	67	1	17	—	30	12	—	—	127
	marginal platform, hinge termination	—	—	13	—	9	—	5	2	—	—	29
	marginal platform, missing termination	—	—	7	—	3	—	6	—	—	—	16
	missing platform, feather termination	—	—	4	—	1	3	—	1	—	—	9
	missing platform, hinge termination	—	—	2	—	1	—	—	—	—	—	3
	missing platform, missing termination	—		—	—	1	2	—	—	—	—	3
	nonmarginal platform, feather termination	1	2	146	7	51	1	96	31	2	—	337
	nonmarginal platform, hinge termination	—	—	16	—	9	—	15	—	—	—	40
	nonmarginal platform, missing termination	—	1	13	—	2	—	6	2	—	—	24
	nonmarginal platform, unknown termination	—	—	1	—	—	—	1	—	—	—	2
	indeterminate platform, indeterminate termination	—	—	—	—	—	—	—	—	—	1	1
Uniface flake	marginal platform, feather termination	—	—	1	1	—	—	1	—	—	—	3
Biface flake	marginal platform, feather termination	—	—	13	2	1	6	6	5	—	—	33
	marginal platform, hinge termination	—	—	1	—	—	2	2	—	—	—	5
	marginal platform, missing termination	—	—	6	—	1	3	1	1	—	—	12

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter- minate	Total
		Coarse	Fine	Local	Other							
	missing platform, feather termination	—	—	1	—	1	4	—	—	—	—	6
	missing platform, hinge termination	—	—	—	1	—	1	—	—	—	—	2
	missing platform, missing termination	—	—	1	—	—	2	—	—	—	—	3
	nonmarginal platform, feather termination	—	—	1	—	—	—	—	—	—	—	1
	nonmarginal platform, missing termination	—	—	1	—	—	—	—	—	—	—	1
Subtotal		1	3	294	12	97	29	169	54	2	1,098	1,759
Cores												
Cobble	exhausted	—	—	1	—	—	—	—	1	—	—	2
	good potential	—	—	9	1	1	—	2	2	—	—	15
	some potential	—	—	17	—	1	—	2	1	—	—	21
Nodule	good potential	—	—	4	—	1	—	—	—	—	—	5
	some potential	—	—	2	—	1	—	—	—	—	—	3
Fragment	some potential	—	—	1	—	—	—	—	—	—	—	1
Unknown	exhausted	—	—	6	—	—	—	1	3	—	—	10
	good potential	—	—	2	1	—	—	2	2	—	—	7
	some potential	—	—	8	—	—	—	—	3	—	—	11
Subtotal		0	0	50	2	4	0	7	12	0	0	75
Tools												
Cobble	denticulate edge, unifacial flaking	—	—	1	—	—	—	1	—	—	—	2
	even edge, bifacial flaking	—	—	—	—	—	—	1	—	—	—	1
	even edge, unifacial flaking	—	—	—	1	—	—	3	—	—	—	4
Core	denticulate edge, unifacial flaking	—	—	4	—	—	—	3	—	—	—	7

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Fine	Local	Other							
	even edge, bifacial flaking	—	—	1	—	—	—	—	—	—	—	1
	even edge, unifacial flaking	—	—	1	1	—	—	1	—	—	—	3
Flake	denticulate edge, bifacial flaking	—	—	—	—	—	3	—	1	—	—	4
	denticulate edge, unifacial flaking	—	—	1	—	—	—	—	1	—	—	2
	even edge, bifacial flaking	—	1	3	—	—	—	—	—	—	—	4
	even edge, unifacial flaking	—	—	4	—	—	—	—	—	—	—	4
Fragment	even edge, bifacial flaking	—	—	—	—	—	—	—	1	—	—	1
Unknown	denticulate edge, bifacial flaking	—	1	2	—	—	2	—	—	—	—	5
	denticulate edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
	even edge, bifacial flaking	—	—	—	—	—	1	—	1	1	—	3
	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Subtotal		0	2	19	2	0	6	9	4	1	0	43
Total		1	5	363	16	101	35	185	70	3	1,098	1,877

Table G.19. Flaked Stone Counts for Site 133/561, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
PD 1																						
Surface	468	432	1	4	6	—	—	—	—	—	—	—	1	1	—	1	—	—	—	—	1	915
PL																						
Surface	168	58	2	24	22	—	1	1	—	1	—	1	—	—	2	2	2	6	1	2	—	293
CU 129																						
Surface	6	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
CU 130																						
Surface	4	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
CU 131																						
Surface	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
CU 132																						
Surface	5	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
CU 133																						
Surface	8	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 136																						
Surface	8	8	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17
CU 137																						
Surface	23	9	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	35
CU 138																						
Surface	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 139																						
Surface	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
CU 145																						

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
CU 147																						
Surface	3	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
CU 152																						
Surface	6	—	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 155																						
Surface	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
CU 158																						
Surface	84	21	1	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	108
CU 161																						
Surface	25	15	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	42
CU 162																						
Surface	3	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
CU 167																						
Surface	1	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
CU 441																						
Surface	10	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
CU 442																						
Surface	43	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	48
CU 443																						
Surface	18	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	31
CU 444																						
Surface	116	16	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	133
CU 445																						
Surface	70	11	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	82
Surface	30	17	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	48

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
CU 446																						
Surface	32	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	46
CU 447																						
Surface	23	12	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	37
CU 449																						
Surface	56	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	65
CU 450																						
Surface	27	23	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	53
CU 451																						
Surface	8	16	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26
CU 452																						
Surface	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 453																						
Surface	73	34	1	—	2	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	112
CU 454																						
Surface	17	14	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	34
CU 455																						
Surface	38	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	55
CU 456																						
Surface	12	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
CU 474																						
Surface	41	5	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47
CU 475																						
Surface	58	11	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	70

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
CU 476																						
Surface	5	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 477																						
Surface	10	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
CU 479																						
Surface	5	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
CU 480																						
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 546																						
Surface	10	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
CU 547																						
Surface	42	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44
CU 548																						
Surface	17	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
CU 549																						
Surface	18	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23
CU 550																						
Surface	2	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
CU 551																						
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 552																						
Surface	21	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	27
CU 553																						
Surface	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
CU 554																						

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
Surface	15	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
ST 179																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 184																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 190																						
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 240																						
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 256																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 281																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 297																						
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 352																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 383																						
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum II	21	9	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	31
TP 388																						
Stratum I	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Stratum II	13	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
TP 414																						

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Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools				Cobble Tools	Flake Tools				Bifaces			Projectile Points				Total
						Denticulate		Even		Dentic-ulate	Dentic-ulate		Even		Dentic-ulate	Even	Un-known	Dentic-ulate		Even		
						Bi	Uni	Bi	Uni	Uni	Bi	Uni	Bi	Uni	Bi	Bi	Bi	Bi	Uni	Bi	Uni	
Stratum II	3	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
TP 415																						
Stratum II	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 423																						
Stratum II	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
TP 432																						
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum II	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
TP 436																						
Stratum II	3	2	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
TP 499																						
Stratum I	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Stratum II	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
TP 571																						
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 574																						
Stratum I	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum II	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
TP 577																						
Surface	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
TP 585																						
Stratum II	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Total	1,708	868	9	38	47	1	4	2	3	2	1	1	1	1	2	3	2	6	1	2	1	2,703

Key: Bi = bifacial; CU = collection unit; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; Uni = unifacial.

Table G.20. Flaked Stone Counts for Site 133/561, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter- minate	Total
		Coarse	Fine	Local	Other							
	Debitage											
Debris	indeterminate platform, in- determinate termination	—	—	—	—	—	81	—	—	—	1,627	1,708
Flake	marginal platform, feather termination	—	—	151	16	3	18	6	19	—	—	213
	marginal platform, hinge termination	—	—	20	1	—	5	—	3	—	—	29
	marginal platform, missing termination	—	—	3	1	—	3	—	—	—	—	7
	missing platform, feather termination	—	—	1	—	—	3	—	—	—	—	4
	missing platform, hinge termination	—	—	—	—	—	2	—	1	—	—	3
	nonmarginal platform, feather termination	2	—	372	45	5	5	40	33	2	—	504
	nonmarginal platform, hinge termination	1	—	40	4	—	—	2	6	—	—	53
	nonmarginal platform, missing termination	—	—	1	1	—	1	—	1	—	—	4
	indeterminate platform, in- determinate termination	—	—	—	—	—	—	—	—	—	51	51
Uniface flake	marginal platform, feather termination	—	—	3	1	—	2	—	2	—	—	8
	nonmarginal platform, feather termination	—	—	1	—	—	—	—	—	—	—	1
Biface flake	marginal platform, feather termination	—	2	4	1	—	10	—	3	—	—	20
	marginal platform, hinge termination	—	—	—	—	—	2	—	—	—	—	2
	marginal platform, missing termination	—	—	2	—	—	1	—	—	—	—	3

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Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	missing platform, feather termination	—	—	—	—	—	3	—	1	—	—	4
	missing platform, hinge termination	—	—	1	—	—	—	—	—	—	—	1
	missing platform, missing termination	—	—	—	—	—	7	—	—	—	—	7
	nonmarginal platform, feather termination	—	—	—	—	—	1	—	—	—	—	1
Subtotal		3	2	599	70	8	144	48	69	2	1,678	2,623
Cores												
Cobble	exhausted	—	—	4	—	—	—	—	—	—	—	4
	good potential	1	—	1	—	1	—	—	1	—	—	4
	some potential	—	—	5	—	—	—	2	1	—	—	8
	tested	1	—	1	—	—	—	—	—	—	—	2
Nodule	exhausted	—	—	1	—	—	—	—	—	—	—	1
	good potential	—	—	—	—	—	—	1	—	—	—	1
	some potential	—	—	2	1	—	—	—	—	—	—	3
	tested	—	—	—	—	1	—	—	—	—	—	1
Unknown	exhausted	—	1	7	1	—	—	—	—	—	—	9
	good potential	—	—	—	—	—	—	3	1	—	—	4
	some potential	—	—	5	2	—	—	1	2	—	—	10
Subtotal		2	1	26	4	2	0	7	5	0	0	47
Tools												
Cobble	denticulate edge, unifacial flaking	—	—	—	—	—	—	2	—	—	—	2
Core	denticulate edge, bifacial flaking	—	—	1	—	—	—	—	—	—	—	1
	denticulate edge, unifacial flaking	—	—	2	—	—	—	1	1	—	—	4
	even edge, bifacial flaking	—	—	2	—	—	—	—	—	—	—	2

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter- minate	Total
		Coarse	Fine	Local	Other							
	even edge, unifacial flaking	—	—	3	—	—	—	1	—	—	—	4
Flake	denticulate edge, bifacial flaking	—	—	3	1	—	—	—	—	—	—	4
	denticulate edge, unifacial flaking	—	—	1	1	—	—	—	—	—	—	2
	even edge, bifacial flaking	—	—	2	3	—	—	—	—	—	—	5
	even edge, unifacial flaking	—	—	1	1	—	—	—	—	—	—	2
Unknown	denticulate edge, bifacial flaking	—	1	2	—	—	2	—	—	—	—	5
	unknown edge, bifacial flaking	—	—	1	—	—	1	—	—	—	—	2
Subtotal		0	1	18	6	0	3	4	1	0	0	33
Total		5	4	643	80	10	147	59	75	2	1,678	2,703

Table G.21. Flaked Stone Counts for Site 134/189, by Artifact Class

Unit	Debris	Flakes	Unifaces	Biface Flakes	Cores	Core Tools			Cobble Tools		Flake Tools	Bifaces		Projectile Points		Total
						Denticulate		Even	Denticulate		Dentic- ulate	Dentic- ulate	Even	Dentic- ulate	Even	
						Bi	Uni	Uni	Bi	Uni	Uni	Bi	Bi			
PD 1																
Surface	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
PL																
Surface	147	257	3	5	26	1	3	1	1	1	5	2	4	1	2	459
CU 420																
Surface	11	5	—	1	—	—	—	—	—	—	—	—	—	—	—	17
CU 467																

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Unit	Debris	Flakes	Unifaces	Biface Flakes	Cores	Core Tools			Cobble Tools		Flake Tools	Bifaces		Projectile Points		Total
						Denticulate		Even	Denticulate		Dentic-ulate	Dentic-ulate	Even	Dentic-ulate	Even	
						Bi	Uni	Uni	Bi	Uni	Uni	Bi	Bi			
Surface	21	4	—	2	—	—	—	—	—	—	—	—	—	—	—	27
ST 353																
Stratum I	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
ST 372																
Mixed	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
ST 377																
Mixed	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
TP 364																
Stratum II	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	5
TP 368																
Stratum I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stratum II	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Total	188	271	3	8	27	1	3	1	1	1	5	2	4	1	2	518

Key: Bi = bifacial; CU = collection unit; PD 1 = general site; PL = point-located artifact; ST = shovel-test pit; TP = test pit; Uni = unifacial.

Table G.22. Flaked Stone Counts for Site 134/189, by Raw-Material Type

Artifact Type	Observation	Basalt	Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Local	Other							
Debitage											
Debris	indeterminate platform, indeterminate termination	—	—	—	—	4	—	—	—	184	188
Flake	marginal platform, feather termination	—	43	6	—	2	2	13	—	—	66
	marginal platform, hinge termination	—	4	—	—	—	—	1	—	—	5

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Artifact Type	Observation	Basalt	Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Local	Other							
	marginal platform, missing termination	—	1	—	—	1	—	—	—	—	2
	missing platform, feather termination	—	1	—	—	—	—	—	—	—	1
	missing platform, hinge termination	—	1		—	1	—	—	—	—	2
	nonmarginal platform, feather termination	—	119	13	1	—	19	22	—	—	174
	nonmarginal platform, hinge termination	—	14	—	—	—	2	3	—	—	19
	nonmarginal platform, missing termination	—	1	1	—	—	—	—	—	—	2
Uniface flake	marginal platform, feather termination	—	1	—	—	1	—	—	—	—	2
	marginal platform, missing termination	—	—	1	—	—	—	—	—	—	1
Biface flake	marginal platform, feather termination	—	4	—	—	—	—	—	—	—	4
	marginal platform, hinge termination	—	2	—	—	—	—	—	—	—	2
	marginal platform, missing termination	—	—	—	—	1	—	1	—	—	2
Subtotal		0	191	21	1	10	23	40	0	184	470
					Cores						
Cobble	good potential	1	2	—	1	—	4	1	—	—	9
	some potential	—	5	—	2	—	—	—	—	—	7
Nodule	some potential	—	—	1	—	—	—	—	—	—	1
Fragment	good potential	—	1	—	—	—	—	—	—	—	1
Unknown	exhausted	—	—	1	—	—	—	—	—	—	1
	good potential	—	1	—	—	—	—	—	—	—	1
	some potential	—	7	—	—	—	—	—	—	—	7

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Artifact Type	Observation	Basalt	Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeterminate	Total
		Coarse	Local	Other							
Subtotal		1	16	2	3	0	4	1	0	0	27
					Tools						
Cobble	denticulate edge, bifacial flaking	—	1	—	—	—	—	—	—	—	1
	denticulate edge, unifacial flaking	—	1	—	—	—	—	—	—	—	1
Core	denticulate edge, bifacial flaking	—	1	—	—	—	—	1	—	—	2
	denticulate edge, unifacial flaking	—	3	—	—	—	—	—	—	—	3
	even edge, unifacial flaking	—	1	—	—	—	—	—	—	—	1
Flake	denticulate edge, unifacial flaking	—	4	—	—	—	—	1	—	—	5
	even edge, bifacial flaking	—	3	—	1	—	—	—	1	—	5
Unknown	denticulate edge, bifacial flaking	—	—	—	—	1	—	1	—	—	2
	even edge, bifacial flaking	—	—	—	—	1	—	—	—	—	1
Subtotal		0	14	0	1	2	0	3	1	0	21
Total		1	221	23	5	12	27	44	1	184	518

Table G.23. Flaked Stone Counts for Site 135/186, by Artifact Class

Unit	Debris	Flakes	Uniface Flakes	Biface Flakes	Cores	Core Tools	Flake Tools	Bifaces	Projectile Points	Total
						Even	Denticulate	Even	Even	
						Unifacial	Unifacial	Bifacial	Bifacial	
PL										
Surface	99	132	2	13	11	1	1	1	1	261
ST 162										
Stratum I	1	—	—	—	—	—	—	—	—	1
ST 168										
Stratum I	1	2	—	—	—	—	—	—	—	3
TP 179										
Stratum I	4	4	—	—	—	—	—	—	—	8
Stratum II	28	14	—	2	1	—	—	—	—	45
TP 184										
Stratum I	10	4	—	2	—	—	—	—	—	16
Stratum II	—	3	—	—	1	—	—	—	—	4
Total	143	159	2	17	13	1	1	1	1	338

Key: PL = point-located artifact; ST = shovel-test pit; TP = test pit.

Table G.24. Flaked Stone Counts for Site 135/186, by Raw-Material Type

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
Debitage												
Debris	indeterminate platform, indeterminate termination	—	—	—	—	—	5	—	—	—	138	143
Flake	marginal platform, feather termination	—	—	30	15	—	1	4	12	—	—	62
	marginal platform, hinge termination	—	—	6	—	—	—	—	2	—	—	8
	marginal platform, missing termination	—	—	1	—	—	—	—	—	—	—	1
	nonmarginal platform, feather termination	1	1	45	12	1	—	10	8	—	—	78
	nonmarginal platform, hinge termination	—	—	5	2	—	—	—	1	—	—	8
	nonmarginal platform, missing termination	—	—	—	—	—	—	1	1	—	—	2
Uniface flake	marginal platform, feather termination	—	—	—	1	—	—	—	1	—	—	2
Biface flake	marginal platform, feather termination	—	—	7	1	—	—	—	5	—	—	13
	marginal platform, hinge termination	—	—	—	—	—	—	—	1	—	—	1
	marginal platform, missing termination	—	—	2	—	—	—	—	—	—	—	2
	missing platform, missing termination	—	—	—	—	—	1	—	—	—	—	1
Subtotal		1	1	96	31	1	7	15	31	0	138	321
Cores												
Cobble	exhausted	—	—	1	—	—	—	—	—	—	—	1
	good potential	—	—	1	—	—	—	—	—	—	—	1
	some potential	—	—	3	—	—	—	—	—	—	—	3
Nodule	exhausted	—	—	1	—	—	—	—	—	—	—	1
	some potential	—	—	—	—	—	—	—	1	—	—	1
Unknown	exhausted	—	—	2	—	—	—	—	—	—	—	2
	good potential	—	—	—	1	—	—	—	—	—	—	1

Artifact Type	Observation	Basalt		Chert		Chert/ Quartzite	Obsidian	Quartzite	Sponge	Other	Indeter-minate	Total
		Coarse	Fine	Local	Other							
	some potential	—	—	3	—	—	—	—	—	—	—	3
Subtotal		0	0	11	1	0	0	0	1	0	0	13
						Tools						
Core	even edge, unifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Flake	denticulate edge, unifacial flaking	—	—	—	1	—	—	—	—	—	—	1
	even edge, bifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Unknown	even edge, bifacial flaking	—	—	1	—	—	—	—	—	—	—	1
Subtotal		0	0	3	1	0	0	0	0	0	0	4
Total		1	1	110	33	1	7	15	32	—	138	338

Table G.25. Flaked Stone Counts for Site 136/663, by Artifact Class

Unit	Debris	Flakes	Biface Flakes	Cores	Flake Tools	Bifaces	Projectile Points	Total
					Even	Denticulate	Even	
					Unifacial	Bifacial	Bifacial	
PL								
Surface	121	130	4	11	1	1	1	269
TP 86								
Stratum II	1	—	—	—	—	—	—	1
Total	122	130	4	11	1	1	1	270

Key: PL = point-located artifact; TP = test pit.

Table G.26. Flaked Stone Counts for Site 136/663, by Raw-Material Type

Artifact Type	Observation	Chert		Obsidian	Quartzite	Sponge	Indeter-minate	Total
		Local	Other					
		Debitage						
Debris	indeterminate platform, indeterminate termination	—	—	3	—	—	119	122
Flake	marginal platform, feather termination	43	—	2	11	1	—	57
	marginal platform, hinge termination	2	—	—	—	—	—	2
	nonmarginal platform, feather termination	49	—	—	13	3	—	65
	nonmarginal platform, hinge termination	4	—	—	1	—	—	5
	indeterminate platform, indeterminate termination	—	—	—	—	—	1	1
Biface flake	marginal platform, feather termination	—	—	—	1	—	—	1
	marginal platform, missing termination	1	—	—	—	—	—	1
	missing platform, feather termination	1	—	—	—	—	—	1
	missing platform, missing termination	—	—	—	1	—	—	1
Subtotal		100	0	5	27	4	120	256
		Cores						
Cobble	good potential	1	—	—	—	—	—	1
Nodule	some potential	2	—	—	—	—	—	2
Unknown	exhausted	2	1	—	—	—	—	3
	good potential	1	—	—	—	—	—	1
	some potential	1	—	—	3	—	—	4
Subtotal		7	1	0	3	0	0	11
		Tools						
Flake	even edge, unifacial flaking	—	1	—	—	—	—	1
Unknown	denticulate edge, bifacial flaking	1	—	1	—	—	—	2
Subtotal		1	1	1	0	0	0	3
Total		108	2	6	30	4	120	270

Table G.27. Flaked Stone Counts for Site 137/482, by Artifact Class

Unit	Debris	Flakes	Biface Flakes	Cores	Core Tools	Flake Tools		Projectile Points	Total
					Denticulate	Denticulate	Even	Denticulate	
					Uni	Uni	Uni	Bi	
PL									
Surface	63	123	14	8	1	1	1	3	214
Total	63	123	14	8	1	1	1	3	214

Key: Bi = bifacial; PL = point-located artifact; Uni = unifacial.

Table G.28. Flaked Stone Counts for Site 137/482, by Raw-Material Type

Artifact Type	Observation	Basalt	Chert		Obsidian	Quartzite	Sponge	Indeterminate	Total
		Fine	Local	Other					
Debitage									
Debris	indeterminate platform, indeterminate termination	—	—	—	3	—	—	60	63
Flake	marginal platform, feather termination	1	34	2	2	2	5	—	46
	marginal platform, hinge termination	—	2	—	—	—	1	—	3
	marginal platform, missing termination	—	1	—	1	—	—	—	2
	missing platform, feather termination	—	1	—	—	—	—	—	1
	nonmarginal platform, feather termination	1	55	3	1	1	5	—	66
	nonmarginal platform, hinge termination	—	1	—	—	2	—	—	3
	nonmarginal platform, missing termination	—	1	—	1	—	—	—	2
Biface flake	marginal platform, feather termination	—	5	—	4	—	—	—	9
	marginal platform, hinge termination	—	1	—	—	—	—	—	1
	marginal platform, missing termination	—	—	—	1	—	—	—	1
	missing platform, missing termination	1	—	—	2	—	—	—	3
Subtotal		3	101	5	15	5	11	60	200
Cores									
Cobble	good potential	—	1	—	—	1	—	—	2
	some potential	—	1	—	—	—	—	—	1
Nodule	good potential	—	1	—	—	1	—	—	2
	some potential	—	—	—	—	1	—	—	1
Unknown	exhausted	—	1	—	—	—	—	—	1

Artifact Type	Observation	Basalt	Chert		Obsidian	Quartzite	Sponge	Indeterminate	Total
		Fine	Local	Other					
	good potential	—	1	—	—	—	—	—	1
Subtotal		0	5	0	0	3	0	0	8
	Tools								
Core	denticulate edge, unifacial flaking	—	1	—	—	—	—	—	1
Flake	denticulate edge, unifacial flaking	—	1	—	—	—	—	—	1
	even edge, unifacial flaking	—	1	—	—	—	—	—	1
Unknown	denticulate edge, bifacial flaking	—	1	—	2	—	—	—	3
Subtotal		0	4	0	2	0	0	0	6
Total		3	110	5	17	8	11	60	214

APPENDIX H

Archaeobotanical Data

Table H.1. Summary of Macrobotanical Remains by Site Number

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
						105/838						
3	roasting pit					806	no reproductive parts					3,600
13	masonry room			fill	S 1/2, Level 1	810	*Atriplex*	type	charcoal	charred	1	3,500
13						810	*Juniperus*	type	twig fragment	charred	1	3,500
13						810	*Juniperus*	type	charcoal	charred	9	3,500
13						810	*Mentzelia albicaulis*	type	seed	charred	3	3,500
13						810	monocotyledon	type	tissue	charred	2	3,500
13						810	*Platanus*	type	charcoal	charred	1	3,500
13						810	*Prosopis*	type	charcoal	charred	7	3,500
13				floor fill	Level 2	837	cheno-am		seed	charred	1	2,800
13						837	*Juniperus*	type	charcoal	charred	3	2,800
13						837	*Mentzelia albicaulis*	type	seed	charred	1	2,800
13						837	*Prosopis*	type	charcoal	charred	2	2,800
13						837	*Zea mays*		cupule	charred	1	2,800
13		1	firepit	fill	feature	840	cheno-am		seed	charred	1	15,400
13		1				840	"Gramineae" Type 6	type	caryopsis	charred	1	15,400
13		1				840	*Juniperus*	type	charcoal	charred	9	15,400
13		1				840	*Mentzelia albicaulis*	type	seed	charred	1	15,400
13		1				840	*Prosopis*	type	charcoal	charred	11	15,400
13		1				840	*Yucca baccata*	type	seed	charred	1	15,400
13		1				840	*Zea mays*		cupule	charred	3	15,400
13		2	ash pit	fill	feature	841	*Juniperus*	type	charcoal	charred	15	24,700
13		2				841	*Mentzelia albicaulis*	type	seed	charred	5	24,700
13		2				841	*Plantago*	type	seed	charred	1	24,700

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
13		2				841	*Prosopis*	type	charcoal	charred	5	24,700
13		2				841	*Prosopis*	type	seed	charred	8	24,700
13		2				841	*Yucca baccata*	type	seed fragment	charred	1	24,700
13		2				841	*Zea mays*		kernel fragment	charred	1	24,700
13		2				841	*Zea mays*		cob fragment	charred	1	24,700
13		2				841	*Zea mays*		cupule	charred	1	24,700
21	rock-lined firepit			fill	feature	213	*Arctostaphylos*	type	seed	charred	1	9,200
21						213	*Atriplex*	type	charcoal	charred	21	6,400
21						213	*Atriplex*	type	charcoal	charred	20	9,200
21						213	cheno-am		seed	charred	7	9,200
21						213	*Corispermum*	type	seed	charred	1	9,200
21						213	*Gossypium*	type	seed	charred	1	9,200
21						213	"Gramineae" Type 1	type	caryopsis	charred	7	9,200
21						213	"Gramineae" Type 7	type	caryopsis	charred	1	6,400
21						213	*Hordeum pusillum*	type	caryopsis	charred	3	5,800
21						213	*Hordeum pusillum*	type	caryopsis	charred	14	9,200
21						213	*Hordeum pusillum*	type	caryopsis	charred	9	6,400
21						213	*Opuntia* (prickly pear)	type	seed	charred	1	9,200
21						213	*Achnatherum hymenoides*	type	caryopsis	charred	1	9,200
21						213	*Phragmites australis*	type	stem fragment	charred	2	5,800
21						213	*Plantago*	type	seed	charred	2	9,200
21						213	*Scirpus*	type	achene	charred	1	5,800
21						213	*Zea mays*		cupule	charred	1	5,800
23	pit structure				TP 158, Levels 3 and 4	181	cheno-am		seed	charred	1	4,000

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
23						181	*Cycloloma atriplicifolium*	type	seed	charred	1	4,300
23						181	*Phragmites australis*	type	stem fragment	charred	3	4,000
23						181	*Phragmites australis*	type	stem fragment	charred	2	4,300
23				floor fill	Q 1, Level 4	389	cheno-am		seed	charred	7	11,000
23						389	*Gossypium*	type	seed fragment	charred	5	11,000
23						389	*Juniperus*	type	charcoal	charred	1	11,000
23						389	*Mentzelia albicaulis*	type	seed	charred	3	11,000
23						389	*Phragmites australis*	type	stem fragment	charred	3	11,000
23						389	*Populus/Salix*	type	charcoal	charred	10	11,000
23						389	*Zea mays*		kernel fragment	charred	3	11,000
23				floor fill	Q 2, Level 2	414	cheno-am		seed	charred	1	7,400
23						414	*Fraxinus*	type	charcoal	charred	1	7,400
23						414	*Juniperus*	type	twig fragment	charred	1	7,400
23						414	*Phragmites australis*	type	stem fragment	charred	20+	7,400
23						414	*Populus/Salix*	type	charcoal	charred	10	7,400
23				floor fill	Q 3, Level 2	426	cheno-am		seed	charred	2	3,900
23						426	*Phragmites australis*	type	stem fragment	charred	5	3,900
23						426	*Platanus*	type	charcoal	charred	2	3,900
23				floor fill	Q 4, Level 2	490	cheno-am		seed	charred	1	6,400
23						490	*Mentzelia albicaulis*	type	seed	charred	1	6,400
23						490	termite		fecal pellet	charred	1	6,400
23						490	unknown		disseminule	charred	2	6,400
23						490	*Zea mays*		cupule	charred	2	6,400
23		1	hearth/trivet	floor	feature	477	cheno-am		seed	charred	1	5,800
23						477	*Phragmites australis*	type	stem fragment	charred	1	5,800

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
23						477	*Populus/Salix*	type	charcoal	charred	20	5,800
23						477	*Zea mays*		cupule	charred	7	5,800
23		2	posthole	fill	feature	520	cheno-am		seed	charred	1	2,000
23						520	*Phragmites australis*	type	stem fragment	charred	1	2,000
23						520	*Populus/Salix*	type	charcoal	charred	24	2,000
23		3	posthole	fill	feature	522	cheno-am		seed	charred	1	5,600
23						522	*Phragmites australis*	type	stem fragment	charred	1	5,600
23						522	*Sphaeralcea*	type	seed	charred	1	5,600
23		4	storage/trash pit	fill	Level 3	534	cheno-am		seed	charred	3	9,000
23						534	*Echinocereus*	type	seed	charred	1	9,000
23						534	*Phragmites australis*	type	stem fragment	charred	1	9,000
23						534	*Zea mays*		kernel fragment	charred	1	9,000
23						534	*Zea mays*		cupule	charred	4	9,000
23				fill	Level 5	552	no reproductive parts					10,000
23		5	plaster-lined hearth	fill	feature	526	*Phragmites australis*	type	stem fragment	charred	4	3,700
23						526	*Zea mays*		cupule	charred	3	3,700
23		18	disturbance in floor (voided as subfeature)	fill	diturbance	593	*Zea mays*		kernel fragment	charred	4	2,100
23		19	storage/trash pit	fill	Level 3	611	cheno-am		seed	charred	1	8,800
23						611	*Echinocereus*	type	seed	charred	2	8,800
23						611	*Mentzelia albicaulis*	type	seed	charred	1	8,800
23						611	*Phragmites australis*	type	stem fragment	charred	9	8,800
23						611	*Populus/Salix*	type	charcoal	charred	20	8,800
23						611	*Sphaeralcea*	type	seed	charred	1	8,800
23		24	pit	fill	Level 6	715	*Phragmites australis*	type	stem segment	charred	10	5,900

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
23						715	*Populus/Salix*	type	charcoal	charred	20	5,900
23						715	*Sphaeralcea*	type	seed	charred	1	5,900
23		27	pit	fill	Level 2	649	unknown	type	charcoal	charred	2	9,600
23				fill	Level 4	649	*Zea mays*		cupule	charred	8	9,600
23						675	cheno-am		seed	charred	3	6,300
23						675	*Corispermum*	type	seed	charred	1	6,300
23						675	*Mentzelia albicaulis*	type	seed	charred	3	6,300
23						675	*Zea mays*		cupule	charred	3	6,300
23						678	*Juniperus*	type	charcoal	charred	7	12,200
23						678	*Populus/Salix*	type	charcoal	charred	2	12,200
23		29	pit	fill	Level 7	719	*Phragmites australis*	type	stem segment	charred	2	6,000
23						719	*Populus/Salix*	type	charcoal	charred	20	6,000
23		35	pit	fill	Level 3	708	*Juniperus*	type	charcoal	charred	5	7,000
23						708	*Phragmites australis*	type	stem fragment	charred	3	7,000
23						708	*Populus/Salix*	type	charcoal	charred	15	7,000
23				fill	Level 6	716	cheno-am		seed	charred	1	9,000
23						716	*Fraxinus*	type	charcoal	charred	1	9,000
23						716	*Mentzelia albicaulis*	type	seed	charred	1	9,000
23						716	*Phragmites australis*	type	stem fragment	charred	2	9,000
23						716	*Populus/Salix*	type	charcoal	charred	5	9,000
23						716	*Prosopis*	type	charcoal	charred	3	9,000
23						716	unknown	type	bark	charred	1	9,000
23						716	*Zea mays*		cupule	charred	2	9,000
23		37	pit	fill	Level 2	743	cheno-am		seed	charred	5	5,600
23						743	*Corispermum*	type	seed	charred	1	5,600

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
23						743	*Gossypium*	type	seed coat fragment	charred	3	5,600
23						743	"Gramineae"	type	caryopsis	charred	1	5,600
23						743	*Phragmites australis*	type	stem fragment	charred	4	5,600
23						743	*Populus/Salix*	type	charcoal	charred	21	5,600
23				fill	Level 4	749	cheno-am		seed	charred	5	5,800
23						749	*Corispermum*	type	seed	charred	1	5,800
23						749	*Gossypium*	type	seed fragment	charred	2	5,800
23						749	*Phragmites australis*	type	stem fragment	charred	4	5,800
23						749	*Populus/Salix*	type	charcoal	charred	20	5,800
23						749	*Zea mays*		cupule	charred	1	5,800
23				fill	Level 6	755	*Phragmites australis*	type	stem fragment	charred	2	6,200
23						755	*Populus/Salix*	type	charcoal	charred	20	6,200
26	thermal feature			fill	feature	226	cheno-am		seed	charred	3	8,200
26						226	*Juniperus*	type	charcoal	charred	20	8,200
26						226	*Achnatherum hymenoides*	type	caryopsis	charred	1	8,200
27	midden				TP 234	244	cheno-am		seed	charred	1	4,500
27						244	*Mentzelia albicaulis*	type	seed	charred	1	4,500
29	pit structure			floor fill	south end	421	cheno-am		seed	charred	4	5,900
29						421	*Fraxinus*	type	charcoal	charred	6	5,900
29						421	"Gramineae" Type 2	type	caryopsis	charred	1	5,900
29						421	"Gramineae" Type 8	type	caryopsis	charred	1	5,900
29						421	*Mentzelia albicaulis*	type	seed	charred	4	5,900
29						421	*Phragmites australis*	type	stem fragment	charred	1	5,900
29						421	*Populus/Salix*	type	charcoal	charred	5	5,900
29						421	*Zea mays*		cupule	charred	2	5,900

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
29				floor fill	TP 473	475	*Boerhavia*	type	seed	charred	1	4,500
29						475	*Mentzelia albicaulis*	type	seed	charred	10+	4,500
29				floor fill/ roof fall	Q 1	505	cheno-am		seed	charred	4	4,600
29						505	"Gramineae" Type 8	type	caryopsis	charred	3	4,600
29						505	*Mentzelia albicaulis*	type	seed	charred	3	4,600
29						505	unknown		disseminule	charred	1	4,600
29				floor fill	Q 2	516	cheno-am		seed	charred	5	4,700
29						516	*Corispermum*	type	seed fragment	charred	5	4,700
29						516	*Hordeum pusillum*	type	caryopsis	charred	1	4,700
29						516	*Mentzelia albicaulis*	type	seed	charred	3	4,700
29						516	termite		fecal pellet	charred	1	4,700
29		2	hearth	fill	feature	538	*Zea mays*		cupule	charred	1	5,300
29		3	pit	fill	TP 322	540	*Canotia*	type	charcoal	charred	8	6,100
29						540	cheno-am		seed	charred	5	6,100
29						540	"Gramineae" Type 3	type	caryopsis	charred	1	6,100
29						540	monocotyledon	type	tissue	charred	4	6,100
29						540	*Phragmites australis*	type	stem fragment	charred	1	6,100
29						540	*Populus/Salix*	type	charcoal	charred	3	6,100
29						540	*Prosopis*	type	charcoal	charred	2	6,100
29						540	*Zea mays*		cupule	charred	5	6,100
29						540	*Zea mays*		kernel fragment	charred	1	6,100
29		5	pit		feature	544	cheno-am		seed	charred	1	5,100
29						544	*Mentzelia albicaulis*	type	seed	charred	4	5,100
29						544	*Zea mays*		cupule	charred	1	5,100

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
29		6 (voided)	disturbance		TP 322	554	cheno-am		seed	charred	3	3,000
29						554	*Sphaeralcea*	type	seed	charred	1	3,000
29						554	unknown		disseminule	charred	3	3,000
29		7	posthole		feature	582	cheno-am		seed	charred	1	4,300
29						582	*Mentzelia albicaulis*	type	seed	charred	1	4,300
29		23	storage/trash pit		Level 2	714	*Atriplex*	type	charcoal	charred	5	3,500
29						714	cheno-am		seed	charred	6	3,500
29						714	*Ephedra*	type	charcoal	charred	1	3,500
29						714	*Fraxinus*	type	charcoal	charred	4	3,500
29						714	*Juniperus*	type	charcoal	charred	4	3,500
29						714	*Opuntia* (prickly pear)	type	seed	charred	1	3,500
29						714	*Zea mays*		kernel fragment	charred	1	3,500
29						714	*Zea mays*		cupule	charred	2	3,500
29		3			Level 4	720	*Atriplex*	type	charcoal	charred	1	4,100
29						720	cheno-am		seed	charred	4	4,100
29						720	*Fraxinus*	type	charcoal	charred	2	4,100
29						720	*Gossypium*	type	seed coat fragment	charred	5	4,100
29						720	"Gramineae" Type 4	type	caryopsis	charred	4	4,100
29						720	*Hordeum pusillum*	type	caryopsis	charred	1	4,100
29						720	*Juniperus*	type	charcoal	charred	10	4,100
29						720	*Zea mays*		embryo	charred	1	4,100
29	pit structure			fill	Level 6	766	cheno-am		seed	charred	3	5,300
29						766	*Corispermum*	type	seed	charred	6	5,300
29						766	*Fraxinus*	type	charcoal	charred	3	5,300
29						766	"Gramineae" Type 2	type	caryopsis	charred	3	5,300

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
29						766	*Juniperus*	type	twig fragment	charred	1	5,300
29						766	*Juniperus*	type	charcoal	charred	16	5,300
29						766	*Phragmites australis*	type	stem fragment	charred	1	5,300
29						766	*Zea mays*		cupule	charred	1	5,300
29						766	*Zea mays*		kernel	charred	1	5,300
29		26	storage/trash pit	fill	Level 1	827	"Compositae"	type	achene	charred	1	9,800
29						827	*Corispermum*	type	seed	charred	30	9,800
29						827	*Echinocereus*	type	seed	charred	1	9,800
29						827	*Gossypium*	type	seed fragment	charred	3	9,800
29						827	"Gramineae" Type 5	type	caryopsis	charred	3	9,800
29						827	*Hordeum pusillum*	type	caryopsis	charred	4	9,800
29						827	*Juniperus*	type	charcoal	charred	20	9,800
29						827	*Phaseolus vulgaris*	type	seed fragment	charred	1	9,800
29						827	unknown		disseminule	charred	??	9,800
29						827	*Zea mays*		kernel fragment	charred	2	9,800
29						827	*Zea mays*		cupule	charred	2	9,800
31	roasting pit			fill	S 1/2	681	*Atriplex*	type	charcoal	charred	5	4,300
31						681	*Juniperus*	type	charcoal	charred	18	4,300
31						681	no reproductive parts					4,300
37	pit structure			floor fill	Q 1	689	cheno-am		seed	charred	4	2,500
37						689	*Phragmites australis*	type	stem fragment	charred	4	2,500
37						689	unknown		disseminule	charred	2	2,500
37						689	*Zea mays*		kernel fragment	charred	1	2,500
37				fill/roof fall	Q 2	699	cheno-am		seed	charred	1	12,000

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
37						699	*Juniperus*	type	charcoal	charred	2	12,000
37						699	*Prosopis*	type	charcoal	charred	1	12,000
37				floor fill	Q 2	700	*Astragalus*	type	seed	charred	1	6,100
37						700	cheno-am		seed	charred	8	6,100
37						700	*Echinocereus*	type	seed	charred	1	6,100
37						700	*Chamaesyce glyptosperma*	type	seed	charred	2	6,100
37						700	*Phragmites australis*	type	stem fragment	charred	3	6,100
37						700	*Scirpus*	type	achene	charred	1	6,100
37						700	*Zea mays*		cupule	charred	1	6,100
37				floor fill	Q 3	731	cheno-am		seed	charred	10	6,200
37						731	"Compositae"	type	achene	charred	2	6,200
37						731	*Mentzelia albicaulis*	type	seed	charred	2	6,200
37						731	*Portulaca*	type	seed	charred	1	6,200
37						731	*Scirpus*	type	achene	charred	2	6,200
37						731	*Zea mays*		cupule	charred	4	6,200
37				floor fill	Q 4	741	*Atriplex*	type	charcoal	charred	2	8,300
37						741	cheno-am		seed	charred	3	8,300
37						741	*Hordeum pusillum*	type	caryopsis	charred	2	8,300
37						741	*Juniperus*	type	charcoal	charred	4	8,300
37						741	*Phragmites australis*	type	stem fragment	charred	3	8,300
37						741	*Prosopis*	type	charcoal	charred	3	8,300
37						741	unknown	type	root?	charred	1	8,300
37						741	*Zea mays*		cupule	charred	1	8,300
37		1	pit	fill	feature	760	cheno-am		seed	charred	3	6,000
37						760	*Echinocereus*	type	seed	charred	1	6,000
37		3	pit or disturbance	fill	feature	765	*Zea mays*		cupule	charred	1	4,900

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
37		7	posthole	fill	feature	780	no reproductive parts					700
37		10	posthole	fill	feature	770	*Canotia*	type	charcoal	charred	2	5,400
37						770	cheno-am		seed	charred	7	5,400
37						770	“Compositae”	type	achene	charred	1	5,400
37						770	*Fraxinus*	type	charcoal	charred	9	5,400
37						770	*Juniperus*	type	charcoal	charred	2	5,400
37						770	*Prosopis*	type	charcoal	charred	1	5,400
37						770	*Zea mays*		cupule	charred	2	5,400
39	firepit			fill	TP 484; was SF 1 in Feature 29	496	cheno-am		seed	charred	3	6,100
						496	“Gramineae” Type 5	type	caryopsis	charred	1	6,100
						496	*Mentzelia albicaulis*	type	seed	charred	3	6,100
						496	*Zea mays*		cupule	charred	2	6,100
39				floor fill	Q 1	507	cheno-am		seed	charred	10+	4,600
39						507	“Gramineae” Type 8	type	caryopsis	charred	2	4,600
39						507	*Mentzelia albicaulis*	type	seed	charred	3	4,600
39						507	*Sphaeralcea*	type	seed	charred	1	4,600
39						507	unknown		disseminule	charred	1	4,600
39						507	*Zea mays*		cupule	charred	2	4,600
40	roasting pit			fill	Level 5	758	cheno-am		seed	charred	3	5,000
						758	*Juniperus*	type	charcoal	charred	16	5,000
41	roasting pit			fill	was SF 2, Feature 37	761	*Atriplex*	type	charcoal	charred	1	3,700
41						761	cheno-am		seed	charred	14	3,700
41						761	*Corispermum*	type	seed	charred	8	3,700
41						761	“Gramineae” Type 5	type	caryopsis	charred	9	3,700
41						761	*Hordeum pusillum*	type	caryopsis	charred	1	3,700

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Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
41						761	*Mentzelia albicaulis*	type	seed	charred	1	3,700
41						761	*Plantago*	type	seed	charred	1	3,700
85/428												
2	roasting pit			fill	W 1/2, Level 1	147	*Atriplex*	type	charcoal	charred	2	8,000
2						147	*Juniperus*	type	charcoal	charred	1	8,000
2						147	*Pinus*	type	charcoal	charred	1	8,000
2						147	*Zea mays*		cupule	charred	2	8,000
2					SU 134, Level 3	160	*Atriplex*	type	charcoal	charred	1	6,500
2						160	*Juniperus*	type	charcoal	charred	3	6,500
2					SU 134, Level 5	162	*Atriplex*	type	charcoal	charred	8	5,900
2						162	*Canotia*	type	charcoal	charred	4	5,900
2						162	cheno-am		seed	charred	4	5,900
2						162	*Juniperus*	type	charcoal	charred	1	5,900
2						162	*Quercus*	type	charcoal	charred	10	5,900
2						162	*Zea mays*		cupule	charred	2	5,900
2					SU 134, Level 8	170	*Atriplex*	type	charcoal	charred	4	4,900
2						170	*Boerhavia*	type	seed	charred	1	4,900
2						170	*Canotia*	type	charcoal	charred	1	4,900
2						170	cheno-am		seed	charred	20+	4,900
2						170	*Corispermum*	type	seed fragment	charred	1	4,900
2						170	"Gramineae"	type	caryopsis	charred	4	4,900
2						170	*Mentzelia albicaulis*	type	seed fragment	charred	2	4,900
2						170	*Quercus*	type	charcoal	charred	1	4,900
2						170	*Zea mays*		cupule	charred	3	4,900
2						170	"Compositae"	type	achene	charred	1	4,900
2					SU 134, Level 9	171	*Atriplex*	type	charcoal	charred	2	5,300
2						171	*Canotia*	type	charcoal	charred	1	5,300

Feature No.	Feature Description	SF No.	Subfeature Description	Context	Excavation Unit	PD	Taxon	ID Level	Part	Condition	Count	Volume (ml)
2						171	cheno-am		seed	charred	20+	5,300
2						171	*Fraxinus*	type	charcoal	charred	1	5,300
2						171	*Juniperus*	type	charcoal	charred	8	5,300
2						171	*Opuntia*	type	charcoal	charred	1	5,300
2						171	*Prosopis*	type	charcoal	charred	11	5,300
2					SU 134, Level 9, PL	172	*Atriplex*	type	charcoal	charred	3	5,700
2						172	*Canotia*	type	charcoal	charred	6	5,700
2						172	cheno-am		seed	charred	5	5,700
2						172	*Juniperus*	type	charcoal	charred	9	5,700
2						172	*Prosopis*	type	charcoal	charred	9	5,700
2						172	*Zea mays*		kernel fragment	charred	2	5,700
4	roasting pit (rock lined)			fill	E 1/2, Level 1	157	no reproductive parts					4,100
4					W 1/2, Level 1	158	no reproductive parts					4,100
4					E 1/2, Level 3	169	no reproductive parts					3,300
28/903												
					TP 93, Level 3	102	no reproductive parts					2,800
					TP 115, Level 4	119	no reproductive parts					3,800
					TP 115, Level 5	247	no reproductive parts					5,000

Note: Scientific names in quotation marks are synonyms commonly used in the palynological literature. Currently accepted names for these taxa are as follows: “Compositae” = Asteraceae; “Gramineae” = Poaceae.

Key: E = east; PD = provenience designation; PL = point-located; Q = quadrant; S = south; SF = subfeature; SU = stripping unit; TP = test pit; W = west.

Table H.2. Grass-Grain Types 1–8 at Site 105/838

ID No.	PD No.	Feature	Grain Type	Count	Charred?	Broken?	Grain Shape	Length (mm)	Width (mm)	Width (location)	Ratio (L:W)	Thickness (mm)	Thick (location)	Compression	Indented?	Embryo		Facet Profile	Groove?	Striations?	Nerve?	Comments
																Length (mm)	%					
1	507	39	8	2	yes	no	short/sturdy	0.75	0.40	middle	1.88	0.40	middle	rounded		0.15	20.0	widest above embryo		dorsal and ventral		
2	761	41	5	8	yes	no	short/sturdy	1.75	1.05	middle	1.66	0.65	middle	lateral		0.50	28.6	widest above embryo				
3	720	29/23	4	4	yes	no	long/slender	2.50	0.75	equal along length	3.33	0.65	equal along length	dorsal/ventral		0.50	20.0	equal along length		dorsal and ventral	ventral side	
4	840	13/1	6	1	yes	no	long/slender	1.65	0.65	equal along length	2.50	0.65	equal along length	rounded		0.20	12.0	equal along length		dorsal and ventral		
5	540	29/3	3	1	yes	no	short/sturdy	0.70	0.46	middle	1.50	0.46	middle	lateral		0.12	17.3	widest above embryo				
6	766	29	2	1	yes	yes	long/slender	1.85	0.85	at broken edge	2.20	0.50	at broken edge	dorsal/ventral	U-shaped	0.40	<21.6	equal along length?		dorsal and ventral		
7	213	21	1	3	yes	no	long/slender	5.12	1.08	middle	4.74	1.20	middle	dorsal/ventral		0.90	17.5	equal along length	ventral		two on ventral side	additional fragments
8	213	21	7	1	yes	no	long/slender	2.00	0.50	middle	4.00	0.50	middle	rounded		0.25	12.5	widest above embryo				grain tapers at top

Table H.3. Wood-Charcoal Samples from LOCAP Sites by Site Number

ID No.	PD No.	Feature	Excavation Unit	Taxon	Level	Part	Condition	Count	Comments
85/428									
1	159		SU 134	*Rumex*	type	root	uncharred	35	suspected to be modern
105/838									
2	756	29/24	Q 1	*Pinus*	type	charcoal	charred	5	
3	756	29/24	Q 1	*Larrea*	type	charcoal	charred	3	
4	411	30	TP 390	*Juniperus*	type	charcoal	charred	20	
5	810	13	S 1/2	*Juniperus*	type	charcoal	charred	3	
6	715	23/24	Q 2/Q 3	*Populus/Salix*	type	charcoal	charred	2	
7	480	23	Q 4	*Platanus*	type	charcoal	charred	9	
8	600	23/19	Q 3	*Populus/Salix*	type	charcoal	charred	5	
9	599	23/19	Q 3	*Populus/Salix*	type	charcoal	charred	5	
10	409	23	Q 2	*Populus/Salix*	type	charcoal	charred	10	
11	697	23/35	Q 2	*Populus/Salix*	type	charcoal	charred	25	
12	757	29/24	Q 1	*Juniperus*	type	charcoal	charred	3	
13	786	29/24	Q 1	*Juniperus*	type	charcoal	charred	4	
14	786	29/24	Q 1	*Fraxinus*	type	charcoal	charred	1	
15	480	23	Q 3	*Populus/Salix*	type	charcoal	charred	14	
16	491	29	S end	*Platanus*	type	charcoal	charred	3	
17	491	29	S end	*Fraxinus*	type	charcoal	charred	1	
18	486	29	TP 484	*Populus/Salix*	type	charcoal	charred	15	
19	744	23/37	Q 1	*Populus/Salix*	type	charcoal	charred	3	
20	354	29	TP 322	*Fraxinus*	type	charcoal	charred	8	
21	711	23/25	Q 2	*Populus/Salix*	type	charcoal	charred	20	
22	710	23/24	Q 2/Q 3	*Populus/Salix*	type	charcoal	charred	7	
23	743	23/37	Q 1	*Populus/Salix*	type	charcoal	charred	20	

continued on next page

ID No.	PD No.	Feature	Excavation Unit	Taxon	Level	Part	Condition	Count	Comments
24	749	23/37	Q 1	*Populus/Salix*	type	charcoal	charred	6	
25	188		TP 158	*Populus/Salix*	type	charcoal	charred	9	
26	796	13	N 1/2	*Juniperus*	type	charcoal	charred	2	from flotation sample
27	755	23/27	Q 1	*Populus/Salix*	type	charcoal	charred	3	
28	485	29	TP 484	*Platanus*	type	charcoal	charred	1	
29	502	29	Q 1	*Fraxinus*	type	charcoal	charred	1	
30	780	37/7	Q 2	*Prosopis*	type	wood	partially charred	11	post fragments?
31	810	13	S 1/2	*Prosopis*	type	charcoal	charred	2	from flotation sample
32	810	13	S 1/2	*Fraxinus*	type	charcoal	charred	1	from flotation sample
33	719	23/24	Q 2/Q 3	*Populus/Salix*	type	charcoal	charred	20+	
34	429	23	Q 2	*Populus/Salix*	type	charcoal	charred	20+	burned beam on floor
					133/561				
35	458	1	PD 124	*Pinus*	type	charcoal	charred	14	surface
36	458	1	PD 124	*Juniperus*	type	charcoal	charred	6	surface
					28/903				
37	131		TP 126	*Pinus*	type	charcoal	charred	10	^{14}C bulk sample

Key: LOCAP = Lower Oak Creek Archaeological Project; N = north; PD = provenience designation; Q = quadrant; S = south; SU = stripping unit; TP = test pit.

APPENDIX I

Pollen Tables

Table I.1. Values[a] for Pollen Taxa in LOCAP Samples, by Site Number

Provenience	Nonarboreal															Arboreal					Domesticates		Indeter-minate	Other
	Boerhavia type	Cheno-am	"Compositae" Low-Spine	"Compositae" High-Spine	*"Cylindro-puntia"*	*Ephedra*	*Erio-gonum*	*Erodium*	"Gram-ineae"	*Kall-stroemia*	cf. Fabaceae	*"Platyo-puntia"*	Sola-naceae	*Sphaer-alcea*	*Typha*	*Juniperus*	*Pinus*	*Prosopis*	*Quercus*	*Salix*	*Cucurbita*	*Zea*		
85/428																								
TR 128 profile																								
Stratum III (Pleistocene)[b]																								
PD 128																								
Stratum II (Holocene)																								
PD 128	0.5	31.5	10.5	19	—	0.5	6.5	+	7	—	—	—	—	—	—	7	4.5	—	4	—	—	—	8	1
F 2 (roasting pit)																								
PD 167	—	25.5[b]	18	13.5	—	2	17[c]	—	9.5	—	0.5	—	—	—	—	3.5	3	1	5	0.5	—	—	—	1
F 4 (roasting pit)																								
PD 166	4	46[c]	13.5	4.5	—	+	8	4.5	5	—	0.5	—	—	—	—	3.5	0.5	—	2	—	—	—	7	1
105/838																								
Modern surface																								
TP 156																								
PD 184	2.5	34.5	8	11.5	—	0.5	5	2.5	8.5	—	—	—	+	—	—	6	6	+	7.5	—	—	—	6	1.5
F 15 (masonry room fill)																								
PD 803[b]																								
F 21 (hearth)																								
TP 172																								
PD 214	2.5	42[c]	4.5	6	—	3	+	—	16	—	0.5	—	—	0.5	—	3.5	4.5	0.5	3	—	—	—	12.5	1
F 23 (pit structure)																								
Roof fall																								
PD 387	4	48.5[c]	8.5	13	—	—	3	—	6	—	—	—	—	—	—	3.5	6.5	—	5	—	—	—	1.5	0.5
House fill																								
PD 406	14	60[c]	6	5.5	+	+	+	0.5	3.5	1	—	—	—	1	0.5	1.5	1.5	—	3	+	—	+	1.5	0.5
Floor																								
PD 361	7.5	56.5[c]	7	9	—	+	5.5	2	1.5	+	—	—	—	+	0.5	4	2	—	0.5	0.5	1	3	2	1.5
PD 422	12.5	59[c]	5	4	—	—	1.5	1	6[c]	0.5	—	—	—	2	+	3	2	—	1	—	—	7[c]	2	0.5
PD 493[b]																								
SF 1 (thermal feature)																								
PD 527	7.5	57[c]	2	8.5	—	+	0.5	—	1.5	—	—	—	1[c]	1	2	4.5	5	—	3	0.5	—	2[c]	5.5	0.5
PD 528	9.5	53.5	5	6	—	2.5	—	—	4	0.5	—	—	—	2.5	1	4	2	—	5	1	—	3[c]	3.5	—
SF 5 (hearth)																								
PD 530	8	61.5[c]	4.5	3.5	—	—	2	—	+	—	—	—	—	4.5	4	1.5	2.5	+	4	—	—	4[c]	4	—
SF 24 (storage pit)																								
PD 723	6.5	60[c]	2.5	6.5	—	1	—	4.5	5	1.5	—	—	—	2	+	2	3.5	—	+	—	—	+	4	1
SF 35 (storage pit)																								
PD 725	16	55.5[c]	6.5	3	—	—	1.5	—	3.5	—	—	—	—	1	+	+	4	—	2.5	—	—	1	5	1.5

Provenience	Nonarboreal															Arboreal					Domesticates		Indeterminate	Other
	Boerhavia type	Cheno-am	"Compositae" Low-Spine	"Compositae" High-Spine	"*Cylindropuntia*"	*Ephedra*	*Erio-gonum*	*Erodium*	"Gramineae"	*Kallstroemia*	cf. Fabaceae	"*Platyopuntia*"	Solanaceae	*Sphaeralcea*	*Typha*	*Juniperus*	*Pinus*	*Prosopis*	*Quercus*	*Salix*	*Cucurbita*	*Zea*		
F 29 (pit structure)																								
Floor fill																								
PD 679	5.5	56.5[c]	4	7	—	+	0.5	—	6	—	—	—	—	3	—	3	6.5	—	4	—	—	—	3.5	0.5
Floor																								
PD 518	8	63[c]	6.5	2.5	—	1	—	0.5	5.5[c]	2	—	—	1[c]	0.5	—	2	3.5	—	2	—	—	6	2	—
SF 23 (storage pit)																								
PD 717	6.5	61[c]	3	4.5	—	2	+	—	1.5	1	—	—	0.5	4.5	1	3	4	—	1.5	0.5	—	1	4	1.5
F 31 (roasting pit)																								
PD 684	5	36.5[c]	9	21.5	—	1.5	4.5	—	4.5	—	—	—	—	+	—	2.5	5.5	—	2	1.5	—	—	4.5	1.5
F 37 (pit structure)																								
Floor																								
PD 750	16.5	29.5	18	3	—	3	5	—	7	1.5	1	—	0.5	4.5	0.5	0.5	1.5	0.5	4	—	—	4[c]	2.5	1
PD 751	14[c]	26.5	15.5	7.5[c]	—	2	5.5	—	6.5	+	1	—	1[c]	3	2.5	+	3	0.5	3	—	—	2	6	2.5
PD 814	12.5	31	12	5.5	—	1	4	—	9[c]	2	—	+	—	2	1	1.5	6	1[c]	2.5	0.5	—	1[c]	7.5	1
F 40 (roasting pit)																								
PD 758[b]																								
28/903																								
TP 72																								
Stratum III																								
PD 75[b]																								

Note: Scientific names in quotation marks are synonyms commonly used in the palynological literature. Currently accepted names for these taxa are as follows: "Compositae" = Asteraceae; "*Cylindropuntia*" = *Opuntia* (cholla type); "Gramineae" = Poaceae; "*Platyopuntia*" = *Opuntia* (prickly pear type).

Key: F = feature; LOCAP = Lower Oak Creek Archaeological Project; PD = provenience designation; SF = subfeature; TP = test pit; TR = trench.

[a] Percentages of noncultigen pollen types are calculated on the basis of a 200-grain standard sum of all noncultigen pollen; values for cultigen pollen types (*Cucurbita* and *Zea*) are not percentages but are the number of pollen grains encountered during tabulation of the 200-grain standard sum. A plus sign (+) indicates a pollen type observed only in scanning of additional material after tabulation of the 200-grain standard sum.

[b] Pollen was present in insufficient quantities or was not well preserved enough for reliable tabulation.

[c] Indicates a pollen type present in aggregates of 6 or more pollen grains.

Table I.2. Values[a] for Additional Pollen Taxa Listed in the "Other" Column in Table I.1, by Site Number

Provenience	Nonarboreal											Arboreal					
	Artemisia	*Canotia*	Cyperaceae	*Euphorbia* type	*Gilia*	"Labiatae"	*Larrea*	"Liguliflorae"	Rhamnaceae	Rosaceae	"Umbelliferae"	*Abies*	*Acacia*	*Alnus*	*Fraxinus*	*Juglans*	*Platanus*
85/428																	
TR 128 profile																	
Stratum II (Holocene)																	
PD 128	0.5	—	—	—	—	—	—	—	0.5	—	—	—	—	—	—	—	—
F 2 (roasting pit)																	
PD 167	—	—	—	—	—	—	0.5	—	—	—	—	—	—	—	0.5	—	—
F 4 (roasting pit)																	
PD 166	0.5	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Provenience	Nonarboreal											Arboreal					
	Artemisia	*Canotia*	Cyperaceae	*Euphorbia* type	*Gilia*	“Labiatae”	*Larrea*	“Liguliflorae”	Rhamnaceae	Rosaceae	“Umbelliferae”	*Abies*	*Acacia*	*Alnus*	*Fraxinus*	*Juglans*	*Platanus*
	105/838																
Modern surface																	
TP 156																	
PD 184	—	—	—	—	—	—	—	—	0.5	—	—	—	0.5	—	—	—	0.5
F 21 (hearth)																	
TP 172																	
PD 214	—	—	—	—	—	—	—	—	0.5	—	—	—	0.5	—	—	—	—
F 23 (pit structure)																	
Roof fall																	
PD 387	—	—	—	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—
House fill																	
PD 406	—	—	—	—	—	—	—	0.5	—	—	—	—	—	—	—	—	—
Floor																	
PD 361	—	—	—	—	—	0.5	—	0.5	—	—	—	—	—	—	—	0.5	—
PD 422	—	—	—	—	0.5	—	—	—	—	—	—	—	—	—	—	—	—
SF 1 (thermal feature)																	
PD 527	—	—	—	—	—	—	—	0.5	—	—	—	—	—	—	—	—	—
SF 24 (storage pit)																	
PD 723	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	—	—	0.5
SF 35 (storage pit)																	
PD 725	—	—	—	—	—	—	—	0.5	—	0.5	—	—	—	—	—	—	—
F 29 (pit structure)																	
Floor																	
PD 518	—	—	—	—	—	—	—	—	—	—	—	0.5	—	—	—	—	—
SF 23 (storage pit)																	
PD 717	—	—	1.0	—	—	—	—	—	—	—	0.5	—	—	—	—	—	—
F 31 (roasting pit)																	
PD 684	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	—	—
F 37 (pit structure)																	
Floor																	
PD 750	—	0.5	—	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—
PD 751	—	—	1.0	—	—	—	1.0	—	—	—	0.5	—	—	—	—	—	—
PD 814	—	—	—	—	—	—	—	—	—	0.5	—	—	—	—	—	0.5	—

Note: Scientific names in quotation marks are synonyms commonly used in the palynological literature. Currently accepted names for these taxa are as follows: “Labiatae” = Lamiaceae; “Liguliflorae” = Cichorioideae (Asteraceae); “Umbelliferae” = Apiaceae.

Key: F = feature; PD = provenience designation; SF = subfeature; TP = test pit; TR = trench.

[a]Percentages of noncultigen pollen types are calculated on the basis of a 200-grain standard sum of all noncultigen pollen.

Table I.3. Presence of Economically Significant Pollen in LOCAP Samples, by Site Number

Provenience	Nonarboreal								Arboreal	Domesticates		Number of Economic Resources (n)
	"Cylindro-puntia"	Cyperaceae	*Eriogonum*	"Gramineae"	High-Spine "Compositae"	*"Platyo-puntia"*	Solanaceae	*Typha*	*Prosopis*	*Cucurbita*	*Zea*	
85/428												
F 2 (roasting pit)												
PD 167	—	—	17[a]	—	—	—	—	—	—	—	—	1
105/838												
F 23 (pit structure)												
House fill												
PD 406	+	—	—	—	—	—	—	0.5	—	—	+	3
Floor												
PD 361	—	—	—	—	—	—	—	0.5	—	1	3	3
PD 422	—	—	—	6[a]	—	—	—	+	—	—	7[a]	3
SF 1 (thermal feature)												
PD 527	—	—	—	—	—	—	1[a]	2	—	—	2[a]	3
PD 528	—	—	—	—	—	—	—	1	—	—	3[a]	2
PD 530												
SF 5 (hearth)												
PD 530	—	—	—	—	—	—	—	4	—	—	4[a]	2
SF 24 (storage pit)												
PD 723	—	—	—	—	—	—	—	+	—	—	+	2
SF 35 (storage pit)												
PD 725	—	—	—	—	—	—	—	+	—	—	1	2
F 29 (pit structure)												
Floor												

Provenience	Nonarboreal								Arboreal	Domesticates		Number of Economic Resources (n)
	"Cylindro-puntia"	Cyperaceae	*Eriogonum*	"Gramineae"	High-Spine "Compositae"	*"Platyo-puntia"*	Solanaceae	*Typha*	*Prosopis*	*Cucurbita*	*Zea*	
PD 518	—	—	—	5.5[a]	—	—	1[a]	—	—	—	6	3
SF 23 (storage pit)												
PD 717	—	—	—	—	—	—	—	1	—	—	1	3
F 37 (pit structure)												
Floor												
PD 750	—	—	—	—	—	—	—	0.5	—	—	4[a]	2
PD 751	—	—	—	—	7.5[a]	—	1[a]	2.5	—	—	2	5
PD 814	—	—	—	9[a]	—	+	—	1	1[a]	—	1[a]	5

Note: Scientific names in quotation marks are synonyms commonly used in the palynological literature. Currently accepted names for these taxa are as follows: "Compositae" = Asteraceae; "*Cylindropuntia*" = *Opuntia* (cholla type); "Gramineae" = Poaceae; "*Platyopuntia*" = *Opuntia* (prickly pear type). Percentages of noncultigen pollen types are calculated on the basis of a 200-grain standard sum of all noncultigen pollen. Values for cultigen pollen types (*Cucurbita* and *Zea*) are not percentages but are the number of pollen grains encountered during tabulation of the 200-grain standard sum. A plus sign (+) indicates a pollen type observed only in scanning of additional material after tabulation of the 200-grain standard sum.

Key: F = feature; LOCAP = Lower Oak Creek Archaeological Project; PD = provenience designation; SF = subfeature.

[a] Indicates a pollen type present in aggregates of 6 or more pollen grains.

APPENDIX J

Faunal Tables

Table J.1. Native Terrestrial Fauna Found in the Coconino National Forest and Their Preferred Habitats

Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
Amphibians								
Tiger salamander	*Ambystoma tigrinum*						X	X
Couch's spadefoot	*Scaphiopus couchii*				X	X	X	X
Southern spadefoot	*Scaphiopus multiplicatus*	X	X	X	X	X	X	X
Sonoran Desert toad	*Bufo alvarius*				X	X	X	
Woodhouse's toad	*Bufo woodhousii*	X	X	X	X	X	X	X
Southwestern toad	*Bufo microscaphus*			X	X	X	X	X
Red-spotted toad	*Bufo punctatus*		X	X	X	X	X	X
Great Plains toad	*Bufo cognatus*				X	X	X	
Striped chorus frog	*Pseudacris triseriata*	X	X	X	X		X	
Canyon treefrog	*Hyla arenicolor*		X	X	X	X	X	X
Mountain tree frog	*Hyla eximia*	X					X	X
Northern leopard frog	*Rana pipiens*	X	X				X	X
Chiricahua leopard frog	*Rana chiricahuensis*	X	X	X			X	X
Lowland leopard frog	*Rana yavapaiensis*		X	X	X	X	X	X
Bullfrog	*Rana catesbeiana*		X	X	X	X	X	X
Chelonians								
Sonoran mud turtle	*Kinosternon sonoriense*			X	X	X	X	X
Desert tortoise	*Gopherus agassizii*					X		
Spiny soft-shell turtle	*Trionyx spiniferus*				X	X	X	X
Lizards								
Western banded gecko	*Coleonyx variegatus*		X	X	X	X		
Chuckwalla	*Sauromalus obesus*				X			
Desert iguana	*Dipsosaurus dorsalis*					X		
Lesser earless lizard	*Holbrookia maculata*		X		X	X		

continued on next page

Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
Greater earless lizard	*Cophosaurus texanus*				X	X		
Zebra-tailed lizard	*Callisaurus draconoides*				X	X		
Common collared lizard	*Crotaphytus collaris*		X	X	X	X		
Long-nosed leopard lizard	*Gambelia wislizenii*			X				
Desert spiny lizard	*Sceloporus magister*			X	X		X	
Clark's spiny lizard	*Sceloporus clarkii*	X	X					
Eastern fence lizard	*Sceloporus undulatus*	X	X					
Side-blotched lizard	*Uta stansburiana*		X	X	X	X		
Long-tailed brush lizard	*Urosaurus graciosus*				X	X		X
Ornate tree lizard	*Urosaurus ornatus*	X	X			X		
Short-horned lizard	*Phrynosoma douglassii*	X	X		X			
Regal horned lizard	*Phrynosoma solare*		X		X	X		
Desert night lizard	*Xantusia vigilis*				X	X		
Great Plains skink	*Eumeces obsoletus*				X			X
Many-lined skink	*Eumeces multivirgatus*	X	X		X			X
Desert grassland whiptail	*Cnemidophorus uniparens*							
Plateau striped whiptail	*Cnemidophorus velox*	X	X	X				
Sonoran whiptail	*Cnemidophorus sonorae*		X		X	X		X
Western whiptail	*Cnemidophorus tigris*	X	X		X	X		X
Madrean alligator lizard	*Gerrhonotus kingii*	X	X	X				
Gila monster	*Heloderma suspectum*		X	X		X		
				Shrews				
Merrriam's shrew	*Sorex merriami*	X						X
Dusky shrew	*Sorex monticolus*	X						X
Desert shrew	*Notiosorex crawfordi*		X	X	X	X	X	
				American leaf-nosed bats				
California leaf-nosed bat	*Macrotus californicus*					X		X

Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
Sanborn's long-nosed bat	*Leptonycteris sanborni*					X		X
Vespertilionid bats								
Yuma myotis	*Myotis yumanensis*	X	X				X	X
Cave myotis	*Myotis velifer*	X	X	X			X	X
Occult little known bat	*Myotis* sp.	X	X				X	X
Long-eared myotis	*Myotis evotis*	X					X	X
Southwestern myotis	*Myotis auriculus*	X	X				X	X
Fringed myotis	*Myotis thysanodes*	X	X				X	X
Long-legged myotis	*Myotis volans*	X					X	X
California myotis	*Myotis californicus*				X	X		X
Small-footed bat	*Myotis leibii*		X	X	X	X	X	X
Silver-haired bat	*Lasionycteris noctivagans*	X					X	X
Western pipistrelle	*Pipistrellus hesperus*							X
Big brown bat	*Eptesicus fuscus*							X
Red bat	*Lasiurus borealis*	X					X	
Southern yellow bat	*Lasiurus ega*							X
Hoary bat	*Lasiurus cinereus*	X	X				X	X
Spotted bat	*Euderma maculatum*						X	X
Allen's big-eared bat	*Idionycteris phyllotis*	X	X				X	X
Townsend's big-eared bat	*Plecotus townsendii*						X	X
Pallid bat	*Antrozous pallidus*						X	X
Free-tailed bats								
American free-tailed bat	*Tadarida brasiliensis*			X	X	X	X	X
Pocketed free-tailed bat	*Tadarida femorosacca*				X	X	X	X
Big free-tailed bat	*Tadarida macrotis*				X	X	X	X
Western mastiff bat	*Eumops perotis*				X	X	X	X

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Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
Greater western mastiff bat	*Eumops* sp.				X	X	X	X
				Rabbits and hares				
Eastern cottontail	*Sylvilagus floridanus*	X	X					
Desert cottontail	*Sylvilagus audubonii*			X	X			
Black-tailed jackrabbit	*Lepus californicus*		X	X	X	X		
				Squirrels and allies				
Cliff chipmunk	*Eutamias dorsalis*							X
Gray-collared chipmunk	*Eutamias cinereicollis*							X
Harris's antelope squirrel	*Ammospermophilus harrisii*				X	X		X
Antelope ground squirrel	*Ammospermophilus leucurus*				X	X		X
Rock squirrel	*Spermophilus variegatus*							X
Golden-mantled ground squirrel	*Spermophilus lateralis*	X	X					
Abert's squirrel	*Sciurus aberti*	X						
Arizona gray squirrel	*Sciurus arizonensis*						X	
				Pocket gophers				
Botta's pocket gopher	*Thomomys bottae*	X	X	X	X	X		X
				Kangaroo rats, pocket mice				
Arizona pocket mouse	*Perognathus amplus*					X		
Silky pocket mouse	*Perognathus flavus*		X	X	X			
Long-tailed pocket mouse	*Perognathus formosus*		X	X	X			
Rock pocket mouse	*Perognathus intermedius*					X		X
Desert pocket mouse	*Perognathus pencillatus*					X	X	X
Ord's kangaroo rat	*Dipodomys ordii*				X	X		X
Merriam's kangaroo rat	*Dipodomys merriami*					X		X
Desert kangaroo rat	*Dipodomys deserti*					X		X

Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
				Beavers				
Beaver	*Castor canadensis*						X	X
				Mice, rats				
Western harvest mouse	*Reithrodontomys megalotis*		X	X	X	X		X
Cactus mouse	*Peromyscus eremicus*			X	X	X		
Deer mouse	*Peromyscus maniculatus*	X	X					X
White-footed mouse	*Peromyscus leucopus*							X
Brush mouse	*Peromyscus boylii*	X	X	X				
Northern grasshopper mouse	*Onychomys leucogaster*				X			X
Southern grasshopper mouse	*Onychomys torridus*				X	X		X
Arizona cotton rat	*Sigmodon arizonae*				X	X		X
White-throated wood rat	*Neotoma albigula*		X	X	X	X		
Stephen's wood rat	*Neotoma stephensi*		X					
Mexican wood rat	*Neotoma mexicana*	X						
				Voles and allies				
Mexican vole	*Microtus mexicanus*	X	X					X
Muskrat	*Ondatra zibethicus*						X	X
				Porcupine				
Porcupine	*Erethizon dorsatum*	X	X					
				Dogs and allies				
Coyote	*Canis latrans*	X	X	X	X	X		X
Gray wolf	*Canis lupus*	X	X	X	X	X		
Kit fox	*Vulpes macrotis*				X	X		
Gray fox	*Urocyon cinereoargenteus*		X	X	X	X		
				Bears				
Grizzly bear	*Ursus arctos*	X	X	X				

continued on next page

Common Name	Scientific Name	Conifer	Woodland	Chaparral	Semidesert Grassland	Sonoran Desertscrub	Aquatic	Riparian
Black bear	*Ursus americanus*	X	X	X				
	Raccoons and allies							
Raccoon	*Procyon lotor*							X
Coati	*Nasua nasua*							X
Ringtail	*Bassariscus astutus*							X
	Weasel, skunks, and allies							
Long-tailed weasel	*Mustela frenata*	X						
Badger	*Taxidea taxus*				X	X		X
Western spotted skunk	*Spilogale gracilis*							X
Striped skunk	*Mephitis mephitis*							X
Hooded skunk	*Mephitis macroura*	X	X	X				
Hog-nosed skunk	*Conepatus mesoleucus*							X
River otter	*Lutra canadensis*						X	
	Cats							
Jaguar	*Felis onca*							
Ocelot	*Felis pardalis*			X	X	X		X
Mountain lion	*Felis concolor*	X	X	X	X	X		X
Bobcat	*Felis rufus*	X	X	X	X	X		
	Peccaries							
Javelina	*Tayassu tajacu*		X	X	X			
	Deer							
American elk	*Cervus elaphus*	X	X					
Mule deer	*Odocoileus hemionus*	X	X	X	X			
White-tailed deer	*Odocoileus virginianus*	X	X	X				
	Pronghorn							
Pronghorn	*Antilocapra americana*				X	X		
	Sheep							
Bighorn sheep	*Ovis canadensis*				X	X		X

Note: Adapted from Shelley and Cairns (1998). Common and scientific names shown are those used in the original and do not necessarily match names used in Chapter 8 text and tables.

Table J.2. Weathering Stages in Large and Small Mammals

Weathering Stage	Large Mammals: Description	Range in Years since Death	Small Mammals: Description	Range in 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
1	Cracking parallel to fiber structure (longitudinal); articular surfaces, perhaps with mosaic cracking of the 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 dentin.	1–5
2	Flaking of outer surface (exfoliation); cracks are present; cracked 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+
3	Rough, homogeneously altered, compact bone resulting in fibrous texture; weathering penetrates 1.0–1.5 mm maximum; cracked edges are rounded.	4–15	Deep splitting and some loss of deep segments or "flakes" between splits; extensive splitting of teeth.	4–5+
4	Coarsely fibrous and rough surface; splinters of bone loose on surface, with weathering penetrating inner cavities; open cracks.	6–15		
5	Bone falling apart in situ; large splinters present; bone material very fragile.	6–15		

Note: Weathering stages for large animals adapted from Behrensmeyer (1978), for small animals adapted from Andrews (1990). Additions to descriptions for large mammal (in parentheses) are from Johnson (1985).

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