

THE ARCHAEOLOGY OF CA-LAN-192: LOVEJOY SPRINGS AND WESTERN MOJAVE DESERT PREHISTORY



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CONTENTS

1	INTRODUCTION	1
1.1	REGIONAL ENVIRONMENT.....	1
1.2	THE SITE AND ITS SETTING.....	5
1.3	PALEOENVIRONMENTS.....	6
2	HISTORY OF RESEARCH AT CA-LAN-192	9
3	FOUNDATIONS OF RESEARCH	17
3.1	IMPORTANT RESEARCH TOPICS.....	17
3.1.1	Chronology, Settlement Characteristics, And Cultural Affiliation.....	17
3.1.2	Changes In Ground Stone Morphology And Function.....	19
3.1.3	Development Of Semi-Sedentary Village Settlement.....	19
3.1.4	Development and Decline of Inter-regional Exchange.....	20
3.1.5	Development and Distribution of Ground Stone Exchange.....	21
3.1.6	Continuities and Changes in Artifact Types and Subsistence.....	22
3.1.7	Local Desert Floor Settlement and Medieval Climatic Anomaly.....	23
3.1.8	Late Prehistoric Settlement And Cultural Affiliation.....	23
3.1.9	Ceramic Usage.....	24
3.1.10	Protohistoric And Historic Occupation.....	25
3.1.11	Evolution Of Social Complexity Among The Serrano.....	25
3.2	ETHNOGRAPHIC OVERVIEW.....	26
3.2.1	Linguistic And Sociopolitical Landscape.....	26
3.2.2	Patterns Of Land Use.....	29
3.2.3	Hereditary Positions And Titles.....	30
4	GROUND STONE ARTIFACTS	33
4.1	INTRODUCTION TO THE GROUND STONE ANALYSIS.....	33
4.2	LOCAL GEOLOGICAL CONTEXT.....	34
4.3	METHODS.....	35
4.4	TECHNOLOGICAL ANALYSIS.....	35
4.4.1	Raw Material Types.....	36
4.4.2	Ground Stone Descriptive Nomenclature.....	36
4.4.3	Use Wear.....	37
4.4.4	Primary and Secondary Use.....	38
4.5	STUDY RESULTS.....	38
4.5.1	Unprovenanced Materials.....	39
4.5.2	Bob Wubben Collection.....	40
4.5.3	Archaeological Survey Association 1954 Excavation.....	40
4.5.4	UCLA 1968 Salvage Project.....	41

4.5.5	Cerro Coso College 1989 Field Class.....	42
4.5.6	Pyramid Archaeology 1990-9 Monitoring.....	42
4.5.7	Antelope Valley College 1994-96 Monitoring.....	47
4.5.8	Applied EarthWorks Testing and Monitoring.....	49
4.6	DISCUSSION OF RESULTS.....	52
4.7	REGIONAL COMPARISONS AND IMPLICATIONS.....	54
4.8	CONCLUSIONS.....	59
5	PROJECTILE POINTS.....	61
5.1	DESERT SIDE-NOTCHED SERIES.....	63
5.2	COTTONWOOD SERIES.....	64
5.3	SARATOGA SPRING SERIES.....	66
5.4	ROSE SPRING SERIES.....	67
5.5	HUMBOLDT SERIES.....	67
5.6	ELKO AND PINTO SERIES.....	69
5.7	GYPSUM SERIES.....	72
5.8	LARGE LANCEOLATE CONCAVE BASE.....	72
5.9	DISCUSSION.....	73
6	OTHER FLAKED STONE ARTIFACTS.....	74
6.1	METHODS OF FLAKED STONE ANALYSIS.....	74
6.2	THE ASSEMBLAGE.....	75
6.2.1	Obsidian.....	76
6.2.1.1	Bifaces and Bipolar Cores.....	76
6.2.1.2	Projectile Points.....	77
6.2.1.3	Uniface.....	77
6.2.1.4	Drill.....	77
6.2.1.5	Simple Flake Tools.....	78
6.2.2	Non-Obsidian Tools.....	78
6.2.2.1	Heat Treatment.....	78
6.2.2.2	Projectile Points.....	79
6.2.2.3	Formed Flake Tools.....	79
6.2.2.4	Drills.....	79
6.2.2.5	Pick.....	79
6.2.2.6	Unifaces.....	79
6.2.2.7	Bifaces.....	80
6.2.2.8	Cores.....	81
6.2.2.9	Core Tools.....	81
6.2.2.10	Simple Flake Tools.....	82
6.3	PROCUREMENT AND REDUCTION PATTERNS.....	83
6.3.1	Obsidian.....	83
6.3.2	Igneous Stone.....	83
6.3.3	Chert.....	84
6.4	DISCUSSION.....	85

7	LITHIC DEBITAGE	86
7.1	INTRODUCTION	86
7.2	ANALYTIC METHODS AND PROCEDURES	86
7.3	SITE SUMMARY	87
	7.3.1 The Analytic Samples	87
	7.3.2 Material Types	87
	7.3.3 Size Distributions.....	88
	7.3.4 Technological Distributions.....	89
7.4	DEBITAGE ANALYSIS PROTOCOLS	95
8	BEADS AND ORNAMENTS	97
8.1	INTRODUCTION	97
8.2	METHODS	97
8.3	BEADS AND ORNAMENTS	97
	8.3.1 Shell Beads.....	97
	8.3.2 Other Shell Ornaments.....	103
	8.3.3 Stone Beads.....	104
	8.3.4 Other Stone Ornaments.....	104
	8.3.5 Glass Beads.....	105
	8.3.6 Unknown.....	106
8.4	CHRONOLOGY.....	105
	8.4.1 General Site Chronology.....	106
	8.4.2 Analytic Unit Chronology.....	110
	8.4.3 Emergency Excavation Data.....	111
8.5	CHRONOLOGICAL SUMMARY	113
9	NATIVE AMERICAN CERAMICS	115
9.1	THE CERAMIC SAMPLE.....	115
9.2	ANALYTIC METHOD	117
9.3	CERAMIC TYPOLOGY	117
	9.3.1 Introduction.....	117
	9.3.2 Typological Classification of Ceramics from CA-LAN-192.....	122
9.4	CERAMIC VESSELS	124
	9.4.1 Vessel Shapes and Function.....	124
	9.4.2 Vessel Wall Thickness.....	126
	9.4.3 Residue.....	127
	9.4.4 Decorative Techniques.....	128
9.5	WORKED SHERD DISCS	129
9.6	WORKED SHERD TOOLS	130
9.7	PETROGRAPHIC ANALYSIS.....	131
9.8	CHRONOLOGICAL IMPLICATIONS.....	132
9.9	INFERENCES DRAWN FROM THE CERAMIC ASSEMBLAGE	134
9.10	FUTURE RESEARCH	135

10	VERTEBRATE FAUNAL REMAINS	138
10.1	METHODS	138
10.2	TAXONOMIC COMPOSITION.....	139
10.3	DEPOSITIONAL CONTEXT	139
10.4	VERTEBRATE EXPLOITATION AT CA-LAN-192.....	142
10.5	DISCUSSION	144
10.6	SEASONALITY AT LOVEJOY SPRINGS	145
10.7	EFFICIENCY AT CA-LAN-192.....	146
10.8	SITE FUNCTION.....	147
10.9	PATTERNS OF MAMMALIAN EXPLOITATION	149
10.10	SUMMARY	150
11	PALEOBOTANICAL REMAINS	152
11.1	INTRODUCTION	152
11.2	METHODS	152
11.3	RESULTS	153
11.4	DISCUSSION.....	156
12	SUMMARY OF HUMAN REMAINS FROM CA-LAN-192	161
12.1	INITIAL RECOVERY AND DESCRIPTION OF REMAINS.....	161
12.2	SUBSEQUENT ANALYSIS.....	162
12.3	GENERAL OBSERVATIONS AND CONCLUSIONS.....	164
13	SOILS AND STRATIGRAPHY	166
13.1	THE NATURAL LANDSCAPE	166
13.2	GEOARCHAEOLOGICAL INVESTIGATIONS	167
13.3	CONCLUSIONS.....	169
13.4	SITE INTEGRITY	170
14	IMPLICATIONS OF SITE CHRONOLOGY AND CONTENT FOR A REVISED TAXONOMY OF THE WESTERN MOJAVE DESERT	171
14.1	BEADS	171
14.2	PROJECTILE POINTS	172
14.3	CERAMICS	175
14.4	XRF AND OBSIDIAN HYDRATION	177
14.5	RADIOCARBON DATING.....	182
14.6	SUMMARY AND INTERPRETATIONS	182
15	REFERENCES CITED	6.1

1 INTRODUCTION

The Lovejoy Springs Site, CA-LAN-192, is a large prehistoric archaeological site in the Antelope Valley, the westernmost extension of eastern California's Mojave Desert. The site contains deep midden deposits and a diverse artifact inventory. The site is unusual, perhaps unique, for its abundant ground stone and its native ceramics of both desert and southwestern wares. Flaked stone tools and debris are less common than ground stone, as are beads, ornaments, and other items of shell and bone. The best-known trait of the site is a mortuary feature containing the interred remains of nine individuals adorned with several thousand shell beads and ornaments.

Sitting at the foot of the prominent Lovejoy Buttes, the archaeological remains at Lovejoy Springs have attracted the attention of relic hunters and archaeologists for nearly a century. Since at least the 1920s, substantial artifact collections have been made under both controlled and uncontrolled circumstances, but until now these collections have been largely unanalyzed and most work at the site remained unpublished. In 2004 the Los Angeles County Department of Parks and Recreation (DPR) proposed to expand Stephen Sorensen Park, a small park built on the site in 1995 and originally known as Lake Los Angeles Community Park, to accommodate the growing local population and provide needed community services and support. DPR retained Applied EarthWorks, Inc. (Æ) to carry out archaeological studies at the site to help ensure that the County met the requirements of federal and state laws regarding the treatment of cultural resources. As part of that work, Æ obtained as many of the existing collections of artifacts and other materials from the site, cleaned and catalogued those materials in the laboratory according to modern professional standards, conducted various specialized technical analyses, and prepared this report to integrate and synthesize all the available data from the site.

The Lovejoy Springs archaeological site once covered at least 500 by 1,000 meters and has been the subject of several archaeological investigations which are described in detail in Section 2 of the report. The site has suffered considerable damage over the years. A small dam and irrigation reservoir built before 1911, man-made Lake Los Angeles established circa 1968, a housing development, road construction, a large drainage channel excavated just south of Avenue P, and other developments have destroyed substantial portions of the site. In 1995–1996, an intact portion of the site was capped with fill when the original Stephen Sorensen (Lake Los Angeles) Community Park was built. Despite this and other significant impacts, sizeable portions of the site may remain intact.

1.1 REGIONAL ENVIRONMENT

The Lovejoy Springs Site lies in the Lovejoy Buttes area of Antelope Valley, the western-most extension of the Mojave Desert. Antelope Valley is a triangular valley bordered on the south by the San Gabriel Mountains, on the southwest by the Sierra Pelona Range, and on the northwest the Tehachapi Mountains. The western end of the valley is sharply defined by the Tehachapi and

San Gabriel mountains, which form a V-shaped basin that expands eastward and gradually merges with the greater Mojave Desert (Figure 1). The valley presents a typical basin and range landscape with streams that flow from the surrounding mountains down slope into a Pleistocene lake basin. Rogers Lake is 16 miles north of Lovejoy Springs and Highway 395 is 20 miles to the east. Elevations in the region range from 8,214 feet above sea level at the crest of the San Gabriel Mountains to 2,270 feet above sea level at the valley floor. The site lies at 2,700 feet above sea level. Elevations in the surrounding foothills reach 3,500 feet amsl.



Figure 1. The Antelope Valley and Environs

Geologically, the western Mojave Desert is bounded to the north and south by the Garlock and San Andreas faults, respectively. A series of buttes lie within this bounded zone. These buttes—Alpine, Black, Saddleback, Piute, and Lovejoy—are igneous remnants of once higher hills that have been reduced by erosion or buried by debris (Norris and Webb 1990:223). The Mojave Desert geomorphic province contains some of the oldest rocks in California. Younger strata are comprised of marine and non-marine sedimentary, volcanic, and alluvial layers. Granitic rocks like coarse quartz monsonite, red rhyolite, sandstone, tuff, limestone, and basalt form the principal geologic structures in the mountains. Lovejoy Buttes, in particular, contains muscovite and biotite granite, and small amounts of biotite quartz monsonite (Leighton and Cotton 1967). Cobbles and clasts of these materials can be taken from the stream beds draining into the valley bottom. The valley floor itself is mantled in thick deposits of Quaternary alluvial and lacustral

(lakebed) sediments that have filled the West Antelope, East Antelope, and Kramer structural basins. These basins are divided by faulted bedrock that influences groundwater flow between the basins (Dibblee 1960, 1967).

During prehistoric times, native populations sought rhyolites; fine-grained silicates such as jasper, chert, chalcedony, and quartzite; basalt; and schist for the manufacture of flaked and ground stone tools. Good quality rhyolite is available in the Rosamond Hills (Noble 1954; Wright and Troxel 1954) and at the Fairmont Buttes in the western Antelope Valley (Sutton 1982). Fine-grained silicates also occur locally on the eastern edge of the valley, while basalt is present in the Rosamond Hills. Abundant schist and steatite deposits occur in the Sierra Pelona Mountains west of Palmdale. Other materials commonly used by native populations in Antelope Valley, such as obsidian and fused shale, are not local to the area but were available through trade or direct procurement.

Antelope Valley is often referred to as the “high desert” due to the elevations of the playas at 2,270 feet and the surrounding foothills between 3,000 and 4,000 feet. As a high desert in the rain shadow of the steep San Gabriel Mountains, it is secluded from the moderating effects of marine air and experiences wide diurnal and seasonal temperature variations. Typical of a California Mediterranean climate, rain falls in Antelope Valley in the winter, while summers are long and dry. Precipitation averages just more than 5 inches per year, and falls principally as rain and snow during the winter months (October through March); the southern foothills receive more precipitation than the drier, lower plains (Houghton 1969). In any particular year, however, as much as 20 percent of rainfall may occur during August through October from tropical storms originating in the south Pacific (Court 1974; Grayson 1993). Daytime high temperatures average between 56°F in the winter and a 98°F in the summer. Temperatures can drop under 10 degrees Fahrenheit during December and January, and frequently exceed 100 degrees during June, July, and August. Average daytime summer temperature averages about 95 degrees.

The western Mojave Desert is a closed basin distinguished by a playa system consisting of three primary lakebeds— Rosamond, Rogers, and Buckhorn—surrounded by several smaller playas. All run-off from the surrounding mountains flows into the lakebed complex. The three larger playas lie within Edwards Air Force Base, a 301,000-acre (470 square mile) military installation occupying the central part of the valley (Earle et al. 1997). Rogers Lake, the largest of the interior playas, sits at approximately 2,270 feet amsl and covers approximately 46 square miles. Rosamond Lake covers approximately 21 square miles and Buckhorn approximately 2.5 square miles. Today these lakebeds are usually dry, only occasionally covered in water following large winter storms. Earle et al. (1997:3) observed:

In wet years, they become very shallow lakes for many months. In the 1994-95 rainy season, for example, Rosamond Dry Lake was filled up to the vegetation line from December until the beginning of April, and contained significant amounts of water until May.

Lovejoy Buttes lies east of Big Rock Creek, one of the major drainages flowing from the San Gabriel Mountains. Other drainages in the area include Little Rock Creek, which parallels Big Rock Creek to the west and also drains the San Gabriel Mountains; Amargosa Creek, which drains the Sierra Pelona Mountains; Cottonwood Creek and Los Alamos Creek from the Tehachapi Mountains; and an unnamed drainage originating near the town of

Mojave that flows through the Bissell Hills east of Rogers Lake and forms the major fan on its western shore. Additionally, numerous springs occur in the region. Lovejoy Springs, now dry, watered a small valley nestled within Lovejoy Buttes. The larger drainages and springs were likely a major factor in site location throughout the desert region.

During prehistoric times, the most reliable surface water sources were the numerous springs, seeps, and small marshes that dotted the valley. In addition to Lovejoy Springs, reliable surface water was available at Willow Springs, Buckhorn Springs, Indian Water (near Rosamond), Koehn Lake, and several other locations. The water table dropped significantly following the introduction of modern intensive agricultural techniques during the mid-twentieth century, and the subsequent growth of residential populations in the valley. As a result, most surface water sources have disappeared from the valley.

During the late Pleistocene, Antelope Valley contained several springs, seeps, and marshy areas supporting herds of horses, camels, and mammoths (Sutton 1988). As the glaciers retreated between 12,000 and 10,000 years ago, the climate became warmer and drier; vegetation communities shifted to higher elevations, and the animals moved with them. The lake levels fluctuated widely during the early Holocene, and studies of pollen and pack rat middens suggest that desert vegetation began replacing the low-elevation woodlands of the Mojave Desert between 12,000 and 8,000 years ago (Mehring 1967; Parker 2002; Van Devender and Spaulding 1979). However, the modern plant and animal communities of the Antelope Valley did not become established until after 4300 B.P.

Plant communities in the Mojave Desert are distributed along an elevation gradient. The saltbrush scrub community, adapted to high salinity, occurs near the shorelines of the dry lakebeds. Creosote bush scrub is found on the valley floor above the immediate confines of the playas, and the Joshua Tree woodland community is found in the higher elevations on gentle slopes (Holland 1986). Creosote (*Larrea tridentata*), shadscale (*Atriplex convertifolia*.) and other saltbush species inhabit the lake basins, while big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus spp.*), tamarisk (*Tamarix gallica*), and mesquite (*Prosopis spp.*) occupy the surrounding fans and lower slopes. Beavertail cactus (*Opuntia basilaris*), chia (*Salvia columbariae*), buckwheat (*Eriogonum pusillum*), Mormon tea (*Ephedra nevadensis*), and junipers (*Juniperus spp.*) also are present. Joshua trees (*Yucca brevifolia*) are restricted to the desert edges, especially to the north. Shrubs grow from one-half to three meters tall, are widely spaced, and usually have bare ground between. Many species of ephemeral herbs flower in late March and April if the winter rains are sufficient. Various plants were used for foods and medicines by Native American people in prehistoric times and many species provided materials for making weaponry, baskets, cordage, digging sticks, shelter, or fuel. These plant communities also provided habitat for various birds, insects, and reptiles.

Desert scrub habitats generally support a low diversity of wildlife species (Burk 1977). Numerous species of birds inhabit the area either permanently or seasonally (ESA 2006). Among these, species notable for their economic or social value to California Indians include the red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), California quail (*Callipepla californica*), mourning dove (*Zenaidura macroura*), western scrub jay (*Aphelocoma californica*), western kingbird (*Tyrannus verticalis*), and common raven (*Corvus corax*). Other bird species include the greater roadrunner (*Geococcyx californianus*), California towhee (*Pipilo*

crissalis), loggerhead shrike (*Lanius ludovicianus*), western meadowlark (*Sturnella neglecta*), and great horned owl (*Bubo virginianus*).

Important mammalian species inhabiting the immediate site vicinity include California ground squirrel (*Spermophilus beecheyi*), Mohave ground squirrel (*S. mohavensis*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audobonii*), desert kit fox (*Vulpes macrotis*), and coyote (*Canis latrans*). Desert wood rat (*Neotoma lepida*), Merriam's kangaroo rat (*Dipodomys marriami*), and several species of mice can also be found in the immediate area. In addition, desert scrub communities provide foraging habitat and roosting areas for several species of native and migratory bats. Mammals that may have been hunted by Native American groups include small rodents (e.g., kangaroo rats, wood rats, and ground squirrels), black-tailed hare and jackrabbit, cottontail, coyote, spotted skunk, kit fox, bobcat, and mule deer, although their numbers have declined in modern times (Parker 2002). Pronghorn, bighorn sheep, and black bear are presumed to have existed in the region (see Graves 1930; Sutton 1988) and were likely hunted by the native population as well.

Other non-mammalian species that occur locally include several different snakes and lizards. The desert tortoise (*Gopherus agassizii*) may have once inhabited the area, as it is found typically in creosote bush scrub environments, but substantial development around the site may preclude its occurrence at present (ESA 2006).

1.2 THE SITE AND ITS SETTING

Lovejoy Springs is in the western Antelope Valley east of the cities of Palmdale and Lancaster. Most of the land in this portion of the valley and along Little Rock and Big Rock creeks is undeveloped, and reflects the typical terrestrial habitats and plant and animal communities of the valley.

Soils in this part of the valley are typical desert aridosols: chemically saline or alkaline, light in color, well drained, with very little organic matter (Ponti et al. 1981; ESA 2006). At the site itself, subsurface materials in the low-lying areas consist of younger alluvial deposits and dune sands characterized by unconsolidated sand and angular boulders, cobbles, and gravels mixed with silt and clay. Culturally modified anthrosols can be distinguished from these desert sediments by their darker color, greater organic content, altered soil chemistry, and presence of artifacts, dietary refuse, burned rock, and other cultural debris.

The Lovejoy Springs archaeological site, CA-LAN-192, lies in a relatively narrow passage between a set of buttes known collectively as the Lovejoy Buttes. The western butte has two peaks that rise to 2775 and 2825 feet amsl, and have steep slopes of 50-100 percent in the upper elevations (Figure 2). The butte bounding the site on the east has one peak rising to 2825 feet amsl and also has vertical slopes at the summit.

Lovejoy Springs is a natural spring complex that ceased flowing in 1952 following the Tehachapi earthquake. A natural drainage flows northwest from the spring toward the lower elevations of the valley. Where habitats are undisturbed, big sagebrush, rabbitbrush, cheesebush (*Hymenoclea salsola*), and bush buckwheat (*Eriogonum fasciculatum*) grow around the springs



Figure 2. Overview of the Lovejoy Springs site, looking east (1968 photo from UCLA archives)

and drainage, and inhabit the fans emanating from the base of Lovejoy Buttes. Joshua tree woodlands occupy the slopes of Lovejoy Butte to the west of the site.

In the immediate site vicinity, creosote bush grows to the north of the man-made channel that drains the former Lake Los Angeles. Invasive, non-native giant reed (*Arrundo donax*) and tamarisk also are present in this area. A variety of willows (*Salix spp.*) and Fremont cottonwood (*Populus fremontiia*) grow within the man-made channel southeast of the springs and north of the archaeological site. This Mojave Riparian Forest may have been more widely distributed around the spring complex prior to development of the area.

1.3 PALEOENVIRONMENTS

The late Pleistocene Wisconsin Glaciation was the last great glacial episode in the western United States (Grayson 1993). Models of late Pleistocene climatic variation differ in their details, depending on the data sources used to infer climate change, but all are in general agreement that the late Wisconsin glacial maximum around 18,000 years ago was followed by a “slow and relatively uniform transition from cool, mesic conditions to temperature and precipitation values that approximate those of the present” (Weide 1982:23). Over that time summer temperatures increased between 3 and 6 degrees Celsius, and winter precipitation diminished by about 40 percent. The warming and drying became most dramatic over a period of about 2,000 years between 12,000 and 10,000 years ago, during which time precipitation

decreased by more than 30 percent (Ramirez and Bryson 1997). Pinyon-juniper woodlands that once covered the valley floors to the shorelines of the deep pluvial lakes retreated upslope between 700 and 900 meters and migrated northward as much as 2 degrees in latitude, replaced by the more xeric desert scrub vegetation. Herds of mammoths, horses, camels, and other Pleistocene megafauna disappeared from the landscape as the lakes shrank and the flow of rivers, streams, and springs gradually diminished (Grayson 1993; Mehringer 1977; Spaulding 1990; Spaulding, Leopold, and Devender 1982).

Deglaciation during the late Pleistocene produced high lake stands in many of the closed basins in the Great Basin. Lake levels probably fluctuated in response to oscillations in precipitation and other variables. Generally, lake levels remained low during the full glacial period (40,000 to 24,000 years ago) and reached their highest levels between 24,000 and 12,000 years ago (Mehringer 1977). Although the full extent of Lake Thompson, which occupied the basin of Antelope Valley, has not been determined, it likely experienced multiple high water stands comparable to those in the adjacent Lake Mojave. Ore and Warren (1971) identified four high stands of Lake Mojave between roughly 14,500 and 8,000 years ago. It is likely that these high lake stands correlate with periodic reversals of the warming and drying trend during which rainfall temporarily returned to late Pleistocene levels. However, by about 8,000 years ago, Lake Thompson probably receded sufficiently to have split into the present day Rosamond, Buckhorn, and Rogers Lakes (Thompson 1929).

One of the first models of post-glacial climatic change was published by Ernst Antevs, who proposed three major climatic intervals: a cool and moist Anathermal between 10,000 and 7,000 years ago, a hot and dry Altithermal between 7,000 and 4,500 years ago, followed by a Medithermal period from 4,500 years ago to the present during which climatic conditions were essentially modern (Antevs 1948, 1955). Subsequent researchers have found Antevs' model to be oversimplified. Post-glacial climatic changes do not now appear to be uniform in their distribution, degree, or timing, and the subject is quite a bit more complex than envisioned by Antevs. Climatic variability may have differed from region to region within the Great Basin, and factors such as latitude, longitude, elevation and other variables may have affected climatic conditions in any particular locale (Spaulding 1990, 1991; Van Devender and Spaulding 1979; Weide 1982).

Despite regional differences and disagreements among researchers on specific issues, most agree that climatic conditions during the last 8,000 years of prehistory (the middle and late Holocene) have been highly variable, and marked by significant oscillations in temperature and precipitation. Mehringer (1977) opined that modern conditions had become established by about 7,500 years ago, and that the climatic instability of subsequent eras "is no more dramatic than the ecological variation encountered by Great Basin inhabitants within a single year. Variability itself may have been the most important in shaping cultural or technological adaptations" (Mehringer 1977: 148).

To help define the paleoclimatic setting around Edwards Air Force Base, Ramirez and Bryson (1997) modeled local precipitation history to reconstruct paleoenvironmental conditions in the Antelope Valley. Their model suggests that precipitation rates stabilized during the period between 10,000 and 8,000 years ago, but decreased again significantly from 8,000 to 4,300 years ago. During the first part of this interval (8,100 to 6,700 B.P.) the decrease in mean annual

precipitation was more dramatic than during the latter. A precipitation peak may have occurred around 6,300 years ago, but “Overall the drop in modeled precipitation during the middle Holocene is very significant, 24 percent less at Edwards AFB, 43 percent in the San Gabriels, and nearly 23 percent in the Tehachapis” (Ramirez and Bryson 1997:13).

The Late Holocene (after 4,300 B.P.) witnessed some of the most dramatic climatic variations of all of prehistory. At times during the period between 4,300 and 1,900 years ago, precipitation increased and cool-moist conditions similar to those at the beginning of the mid-Holocene may have returned. Mehringer (1977) marshals evidence for an increase in effective moisture between 4,000 and 2,000 years ago, while Ramirez and Bryson’s (1997) precipitation model suggests peaks in precipitation 3,900 and 1,900 years ago. Enzel et al. (1989) argue for a brief “neoglacial” event around 3,600 years ago. For about the past 2,000 years cyclical droughts have been typical (Weide 1982), with average precipitation returning to the level of around 4,300 B.P., with the exception of the “Little Ice Age” around 400 years ago. “However, the lowest precipitation modeled for the entire sequence of the late Pleistocene to the present appears at 300 B.P.” (Ramirez and Bryson 1997:14).

Decreased precipitation and increased temperature during the Holocene prompted movement of plant communities upslope and northward. Floral remains preserved in fossil wood rat middens suggest that some plant communities may have migrated upslope several thousand feet, and that species such as bristlecone and limber pine (*Pinus longaeva* and *P. flexilis*) that now thrive only in the Alpine zone above about 7,500 feet elevation may have occupied the lower mountain slopes prior to 11,000 or 12,000 years ago, while valley floors now hosting salt-tolerant desert scrub species featured woodlands of singleleaf pinyon (*P. monophylla*), juniper (*Juniperus* spp), and sage (*Artemisia* spp.) (Thompson and Mead 1982; Van Devender and Spaulding 1979). Surveying the natural and cultural history of the pinyon pine, Lanner (1981) suggests that until about 8,000 years ago the Mojave Desert may have been a refugium for the warmth-loving singleleaf pinyon, which could not survive the cooler climate of the Great Basin during the late Pleistocene and early Holocene. After 8,000 B.P the woodlands disappeared from the now-warm Mojave Desert as more drought-tolerant species expanded their ranges from the south.

The modern distribution of plant communities in the Mojave Desert probably was not established until after 7,500 years ago (Mehringer 1967). Wood rat middens from Edwards Air Force Base confirm the presence of creosote no later than 5,500 years ago (Rhode and Lancaster 1996), and Schroth (1987) argues that mesquite may not have been established in the Antelope basin before 4,300 B.P. These data suggest that the fully modern vegetation regime of Antelope Valley was not in place before the end of the Middle Holocene, around 4,500 years ago (Grayson 1993).

HISTORY OF RESEARCH AT CA-LAN-192

Since at least the 1920s, substantial artifact collections have been taken from Lovejoy Springs under both controlled and uncontrolled circumstances. The site has been worked by relic hunters, an avocational society, university and community college field schools, and CRM professionals employing standard excavation procedures, emergency salvage methods, and uncontrolled collecting. Although most archaeologists working in the Mojave Desert know of the site, and it is frequently referred to in the literature, information about the site is largely anecdotal as the majority of the collections had not been analyzed to any extent until now and most work at the site remained unpublished.

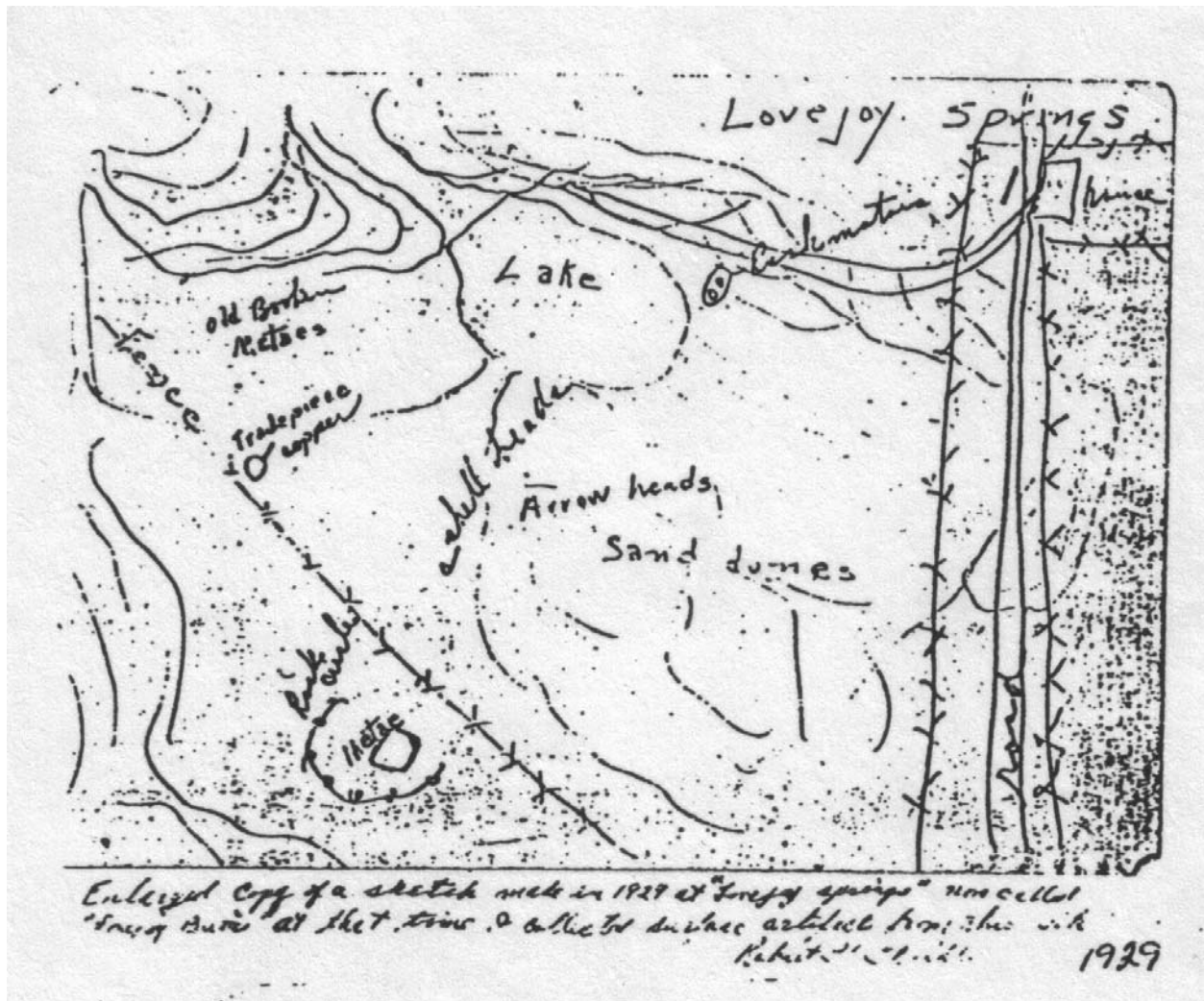


Figure 3. Map of the Lovejoy Springs site produce by Bob Wubben in 1929 (courtesy Santa Barbara Museum of Natural History)

The first known collections from the Lovejoy Springs site were made in the 1920s, when Bob Wubben, a private artifact collector, amassed a small collection of projectile points, ceramics, and other materials from the site. Prior to his death, Wubben donated his materials to the Santa Barbara Museum of Natural History. Although Wubben made no notes on his collection, he did produce a small, unscaled map of the site which is our first graphic representation (Figure 3).

In 1954 the Archaeological Survey Association of Southern California (ASA), a local avocational society, collected artifacts from the surface and excavated four shallow 5 by 5 foot units on the southern side of the site under the direction of Charles Rozaire (Figure 4). This work yielded substantial amounts of chert, obsidian, and other flaked stone tools and debitage, several pieces of ground stone, several pieces of painted ceramics, bone, and other materials. The materials gathered in 1954 were held at the Antelope Valley Indian Museum (AVIM) in Lancaster, where they remained unprocessed until Æ acquired them in 2005. There are no field notes with the collection, and we don't have precise information on the location of units, although we believe they centered on the midden area destroyed by the construction of Avenue P and the large drainage canal. It appears as if ASA divided the site into nine collecting areas.



Figure 4. Archaeological Survey Association of Southern California at CA-LAN-192 in 1954

In 1968 human remains were unearthed at CA-LAN-192 during massive excavations for the artificial Lake Los Angeles. The lake excavation damaged a large portion of the site and redistributed it across other parts of the site (Figure 5). Rozaire and James Toney, Chief Archaeologist of the University of California, Los Angeles (UCLA) Archaeological Survey,



Figure 5. Site Overview showing extent of grading for 1968 Lake Los Angeles Development

directed emergency salvage excavations at that time. The archaeologists removed a “mass burial” initially thought to represent five individuals (Toney 1968) but now thought to be the remains of at least nine individuals (Nelson 1990). More than 3,000 shell beads and other artifacts were interred with these graves; other artifacts salvaged at that time include various flaked and ground stone tools, lithic debitage, ceramic sherds, animal bone, and charcoal. Additionally, two stone features were exposed. These artifacts were processed and catalogued, and Toney (1968) produced a brief summary report on this work; there are also student papers on the beads and burials. Subsequently, Bruce Love (1993) obtained an uncalibrated radiocarbon age of 2720 ± 70 years from the burials. Materials from the 1968 salvage excavation are curated at the Fowler Museum of Anthropology at UCLA, and were graciously loaned to us for this study. The human remains and funerary objects were not included in the loan.

From February-April 1989, an archaeological field class from the Cerro Coso College branch at Edwards Air Force Base excavated seven 1 by 1 meter units under the direction of Love. They sampled a rich midden deposit in the southeast portion of the site, west of the area excavated by UCLA in 1968. The cultural deposit was as much as 260 centimeters deep in some units and yielded primarily faunal remains along with lithic debitage and some flaked and ground stone tool fragments (Figure 6). Although the materials from this excavation remained in their original

level bags in Love's possession until they were acquired by Æ on behalf of Los Angeles County in 2005, the field school collection includes notes and level records prepared by the class; the site map shows unit placement, though it is somewhat difficult to tie to the existing ground today. A final comprehensive report was not produced.

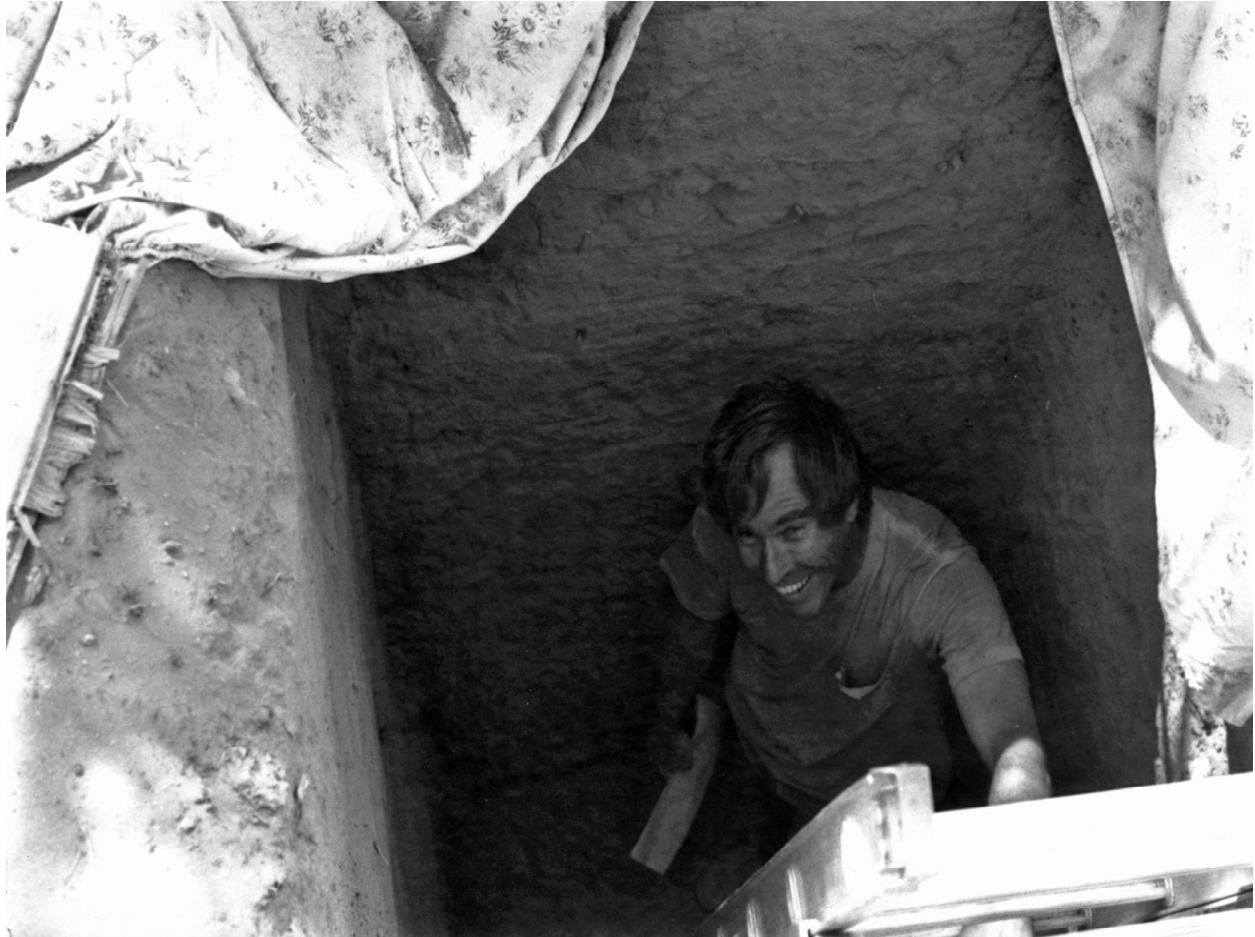


Figure 6. Deep excavation unit, 1989 Cerro Coso College field class

In January 1990, Love monitored excavation of a trench on the northern edge of the site, and in 1992 he monitored massive earthmoving in the same area. This work occurred principally in previously disturbed portions of the site, but an intact roasting feature exposed deep within the trench yielded an uncalibrated radiocarbon age of 2470 ± 120 years (Padon and Love 2004:8). A few pieces of flaked stone and 735 ground stone artifacts were retrieved during the 1990 and 1992 monitoring. Love made rough field notes and a preliminary sort into artifact types, however a catalog was not produced and a draft report remained incomplete (Love 1992). The collection was stored at the Antelope Valley Indian Museum along with ASA's 1954 collections.

While obtaining these collections from the AVIM, Æ discovered one additional box of materials labeled "Lovejoy Springs." These artifacts are attributed to H. Alden Edwards, the founder of the museum, and other local collectors. None of the items have supporting documentation, and provenience is questionable at best, but they are some of the most interesting in the collection.



Figure 7. Lake Los Angeles trench monitoring, 1992

Between 1994 and 1996, Roger Robinson, Professor of Anthropology at Antelope Valley College, performed several site inspections on behalf of the County Department of Parks and Recreation (DPR) and monitored construction of the original Lake Los Angeles Community Park (now Stephen Sorensen Park). During that time, a portion of the remaining, relatively intact midden deposit in the central portion of the site was capped with up to 10 feet of imported fill as a mitigation measure required by the 1990 California Environmental Quality Act (CEQA) Negative Declaration. Unfortunately, the site surface was scarified with a toothed mechanical device prior to placement of the fill, causing substantial damage. Robinson collected more than 1,000 flaked and ground stone artifacts as well as shell beads, bone ornaments, and other materials from the site surface and from shovel tests excavated over a sampling grid; he also catalogued the collection and produced a report (Robinson 1994, 1996). The materials were housed at Antelope Valley College.

In 2004 DPR proposed to expand the existing park to accommodate the growing local population and provide needed community services and support. On behalf of DPR, Beth Padon performed an archaeological survey of the proposed Stephen Sorensen Park expansion area (Padon and Love 2004). As part of that investigation, she summarized the history of archaeological studies

and described the major disturbances that had impacted the site, estimating that as much as 85 percent of the site had been destroyed (Padon and Love 2004:16). Nonetheless, the survey revealed numerous artifacts on the site surface (particularly ground stone fragments), and Padon concluded that intact deposits with scientific research potential could be impacted by the proposed expansion. She therefore recommended additional archaeological studies to define the vertical and horizontal extent of the deposits and acquire other data needed for compliance with relevant federal and state regulations governing archaeological resources.

DPR retained Applied EarthWorks, Inc. (Æ) to carry out those recommendations and help ensure that the County met the requirements of federal and state laws. Under the direction of Barry Price, Æ initially reviewed existing documentation regarding CA-LAN-192 and consulted with representatives of the local Native American community. In December 2004 they performed limited test excavations at the site to determine the level of site preservation within the area that would be affected by the proposed park expansion (Price et al. 2005). Fieldwork included ten test excavation units, two shovel test pits, and nine backhoe trenches to define the site boundary and assess the depth and integrity of the cultural deposit (Figure 8). Detailed field notes, geomorphological interpretations, and unit level records were recorded during the fieldwork. In the laboratory, the collection was cataloged and analyzed, and a final report was prepared (Price et al. 2005). Æ found that prior disturbance had destroyed substantial portions of CA-LAN-192, particularly in areas slated for the 2005 park expansion. Backhoe trenches in those areas revealed truncated soil profiles and thick layers of redeposited sediment, with little or no remaining cultural deposits. Despite the previous disturbance, intact cultural deposits were found on the northeast side of the original park, where midden deposits in relatively undisturbed stratigraphic context yielded faunal remains, shell beads, lithic tools and debitage, and other cultural materials. This area is closest to the areas excavated by UCLA and Cerro Coso College. It thus appeared that the best-preserved part of the site was sealed beneath the existing park, where the central site area had been buried under as much as 10 feet of imported fill.

Following their limited test excavations at the site in 2005, Æ recommended that the County carry out a series of phased studies to mitigate the impacts of park expansion on CA-LAN-192. From August through October, 2005, Æ monitored construction of the park expansion and recorded and collected samples of artifacts exposed at that time. Thirteen archaeological features in varying states of preservation were exposed during construction; these consisted principally of small concentrations of fire-altered rock and ground stone fragments, some with associated ash and charcoal deposits. Æ kept detailed monitoring records, each feature was documented and sampled, and its location was recorded using a Global Positioning System (GPS) unit. Two features were radiocarbon dated; Feature 10 (40 cmbs) yielded a calibrated date at the two sigma range of A.D. 1320-1340, while Feature 8 (119 cmbs) produced a date of A.D. 710-960 (see Section_ of this report for additional details on radiocarbon dating at the site).

During the monitoring, an undisturbed midden deposit was exposed during preparation of the bank and footing for a parking lot retaining wall just north of Avenue P. The midden deposit ran easterly into the developed portion of the park underneath more than two meters of stratified mechanical fill (Figure 9); its characteristics were similar to the deposits underneath the existing park, and included large quantities of charcoal fragments and fire-altered rock features, as well as burned bone in a cultural stratum up to 170 cm thick. The top of the midden was more than 4

meters below the road surface of Avenue P. Æ sampled this deposit with two 1x1 meter test units and two 25x25 centimeter columns placed at the base of the embankment supporting Avenue P (Figure 9). Charcoal from a burned rock feature in one of the 1x1 meter units produced a calibrated radiocarbon date at the two sigma range of A.D. 1450-1650. An *Olivella* shell bead from near the bottom of the same unit produced a date of 1740-1510 B.C.



Figure 8. Applied EarthWorks test excavation, 2004

Finally, in November 2007, Æ performed additional geoarchaeological studies at CA-LAN-192 to ascertain whether intact cultural deposits were present in areas along Avenue P north of the existing park where a sparse scatter of surface artifacts had been identified (Lloyd 2005, 2008). To determine whether additional park expansion in this area would cause significant impacts on the archaeological site, Æ excavated 11 backhoe trenches across the area. Sediment samples from each trench were screened, and detailed stratigraphic profiles of each trench were drawn. The trenches revealed extensive mechanical disturbance, erosion, and slope wash on the slopes in this area precluded the preservation of intact archaeological remains (Lloyd 2008).

Following completion of all field studies, Æ began to carry out the other tasks required to complete the mitigation requirements of the project. Briefly, those included:

- obtaining all existing collections of artifacts and other materials from the site;
- cleaning, sorting, classifying, and otherwise processing those materials in the laboratory according to modern professional standards;
- conducting various specialized technical analyses;
- publishing a professional report that integrates and synthesizes all the available data from the site; and
- curating all extant collections from the site at a single repository where they can be preserved, protected, and made available for future research and interpretation.

This report is the final record of Æ's study of CA-LAN-192. It compiles and reports on all the available information from the site and presents the results of analyses by numerous technical specialists. Through a detailed comparative analysis, we integrate these data into the broader context of local and regional prehistory in an effort to interpret the archaeology of Lovejoy Springs and the western Mojave Desert.



Figure 9. Midden exposed under Avenue P during 2005 construction monitoring

3 FOUNDATIONS OF RESEARCH

Current research on Antelope Valley prehistory, and the specific analyses of archaeological collections from CA-LAN-192, is founded on the archaeological, ethnographic, and historic contexts developed by many prior researchers. This section presents the fundamental contexts within which data are analyzed and interpreted herein. We begin with a discussion of the principal questions that have recently structured archaeological discourse. Questions of cultural chronology are fundamental to the investigation of these research issues, and form the basis for investigation of most other research topics.

A precise and well- delineated archaeological nomenclature is a critically important tool for defining temporal and cultural units, ordering assemblages in time, and making intrasite and intraregional comparisons. Problems of archaeological taxonomy and nomenclature are explored in some detail, and we propose a revised nomenclature that defines separate and independently variable chronological and cultural units.

CA-LAN-192 is located within the traditional ethnographic territory of the Desert Serrano. Serrano ethnography and social organization is summarized in this section, with particular reference to social and political organization and its implications for land use patterns and the development of social complexity.

3.1 IMPORTANT RESEARCH TOPICS

CA-LAN-192 is one of a relatively small number of large and deeply stratified village sites located on the floor of the Antelope Valley. Thus, the site has particular importance as a source of information on local and regional prehistory. Major issues considered of current relevance to the native prehistory of the region are discussed below. Treatments of regional chronology that provide a background to this listing include Warren (1984) and Earle (2004).

3.1.1 Chronology, Subsistence and Settlement Characteristics, and Cultural Affiliations of the Pinto Period

Cultural chronologies developed for the Mojave Desert are frequently employed in characterizing sites and patterns of settlement and subsistence in the Antelope Valley region. These Mojave Desert chronologies have been developed based on the work of Campbell and Campbell (1935), Harrington (1933), Lanning (1963), Rogers (1939), Wallace (1958), and others, and synthesized by Warren (1984) into a regional sequence that recognizes the Pinto Period as a major early-mid Holocene cultural element. The Pinto Period can be placed chronologically at approximately 8,000/7,000-4,000/3,000 years BP.

Societies of the Pinto Period are seen as generalized hunters and gatherers, incorporating the earliest use of ground-stone tools in many parts of the Great Basin. Davis (1963:210) places Pinto Period artifacts within an intermediate stage between preferred-hunting to preferred-gathering patterns. Warren, et al. (1986) present a model in which these patterns could be restated as hunting-focused and gathering focused procurement systems. This contention would appear to be appropriate given the diversified flaked-stone assemblage and the introduction of ground-stone technology in some areas. Site distribution represents a continuing transitory pattern related to fluctuating and dispersed resources. It has been suggested that this is a period of reduced population in desert regions.

The frequency with which sites have been found with both Pinto and Gypsum Period components, and emerging data on changes in rainfall, suggest that Pinto Period sites may often have been occupied towards the end of the Pinto Period, around 4,000-5,000 years B.P.

In the Antelope Valley region, a number of sites have yielded Pinto-type projectile points. As of 1997, some six Pinto Period associated sites had been identified on Edwards Air Force Base. To the north of the base, at North Edwards, a series of Pinto and Gypsum component sites located in ancient lakeshore and pan and dune environments, have been surveyed by this author.

In addition, at Barrel Springs, on the southern margin of the valley, to the south of Palmdale, radiocarbon assay has indicated a Pinto component dating back 5,000 years that is associated with use of bone awls, presumably for basket manufacture.

The presence in the Antelope Valley of sites or site components associated with southern California coastal cultural complexes approximately coeval with Mojave Desert Pinto sites had not been reported in the regional literature. However, recent reports of as-yet unpublished recovery of cog stones/discoidals, a large "display type" obsidian knife/spear blade, sandstone bowls, and other locally unusual artifacts at a site near Palmdale in the southern foothills of the valley suggest a possible local link to coastal cultures such as the Topanga Complex Phase II (circa 5,000-3,000 years BP) and La Jolla Complex Phase II (circa 5,500-4,000 years BP) (Moratto 1984:127, 147). Sites in this southern foothill zone adjacent to the San Andreas Fault were occupied continuously since mid-Holocene times on account of the availability of water sources associated with the fault system.

For the Lovejoy Springs-Piute Butte region, a major research question has been the nature of local occupations during the Pinto Period (8,000/7,000-4,000/3,000 years BP). Lovejoy Springs would appear likely to have had a Pinto Period component, given the apparent antiquity of the spring system associated with the site and the depth of associated midden deposits. This has not, however, been directly confirmed archaeologically. It would be important to confirm whether the artifact assemblages associated with this time period may be typical of those described for Pinto Period sites elsewhere in the Mojave Desert, or may have unusual components suggesting links to the southern California coast.

3.1.2 Changes in ground stone morphology and function

The question of a Pinto Period component at the site is associated with another important research problem, that of the morphological and functional history of ground stone use. CALAN-192 has been well known for the large quantities of ground stone associated with the site. Construction monitoring salvage in 1992 recovered well over 300 pieces of ground stone, and 1995 monitoring recovered another 250. Extensive earthmoving and construction damage to the site has increased our awareness of this class of artifact. Roger Robinson of the Anthropology Department of Antelope Valley College, long familiar with valley sites, agrees that the degree of abundance of ground stone at LAN-192 is unusual. Millingstones and handstones form the great majority of material types recovered, while portable mortars, pestles, and stone bowls are relatively rare. Granite perhaps of local origin, non-local schist, and sandstone were preferred materials, and double-sided granite and schist metates are found with some frequency.

The appearance of millingstones and handstones is associated with the development of plant resource foraging strategies presumably involving hard seeds during early Pinto times. It has been suggested that the processing in the Antelope Valley of acorns imported from nearby mountain zones was a very late adaptation (post- AD 1000), and that hard seed milling was a principal adaptive focus before that time. This date for the advent of historically attested acorn processing may be much too late. However, further research on changes in the abundance, morphology, and functional attributes of milling equipment may help to clarify this issue. Recent technical advances in the study of ground stone make this line of research particularly promising.

3.1.3 The development of semi-sedentary village settlements in the Antelope Valley (presumably during the Gypsum Period.)

The Gypsum Period is represented by a number of sites in the Antelope Valley. CA-KER-303, on the northwest margin of the valley, has basal components dating to this era. CA-LAN-192, located at Lovejoy Springs, was occupied in Gypsum times. A cemetery dating from circa 2,700 years B.P. has yielded human remains and related artifacts, as well as a gypsum projectile point embedded in a human rib. For the Gypsum period, loosely rather than tightly flexed inhumations have been reported for a number of Antelope Valley sites. What was apparently a group inhumation at Ca-LAN-192 at Lovejoy Springs, involving at least nine individuals has been dated to circa 2,700 years BP. This date was derived from both radiometric assay of human bone, and a hydration date from a projectile point embedded in the radiometric assay sample bone from one of the buried individuals, with a close matching of the two resultant dates. The inhumations at CA-LAN-192 included five individuals for whom burial posture information was reported. A young child was interred with over 3,000 *Olivella* shell beads. These included 1,100 spire-lopped *Olivella* beads, dated from circa 3,000-2,400 years BP. outside of the Santa Barbara Channel area (Gibson 1992). The child associated with the beads was found in a tightly flexed position. The four adults in this apparent group burial for which we have information were found lying on their backs in a loosely flexed position. The

other noted grave item found in the burial was an inverted rectangular milling slab colored on one edge with ochre.

The existence of a cemetery at CA-LAN-192, the rather elaborate mortuary goods found in it, and the honoring of a juvenile with quantities of Olivella have all suggested the presence of a semisedentary village at the site in Gypsum times, as well as the possible existence of significant status differentials within the local population at that time. The excavation of features and recovery of artifacts from the Gypsum Period component of the site may shed further light on the development of semi-sedentary village settlement in the region. Particularly important are the issues of possible shifts in subsistence focus, including an increase in diet breadth, and the role played by interregional exchange in permitting more sedentary settlement and the development of status differentials. In considering the Southern California region as a whole, it has been suggested that a shift of population and subsistence focus from coastal to inland areas occurred at around 3,500 years BP. This has sometimes been suggested as linked to the early development of acorn exploitation in Southern California. In addition, it has been proposed that the arrival of Uto-Aztecan speakers in Southern California may date to as early as late Pinto or early Gypsum times (3,500-3,000 years BP), rather than to the late Gypsum Period (2,000 years BP) or the Late Prehistoric (ca. AD 1200-1400). The proposed population and subsistence shift at around 3,500 years BP thus might also be seen as linked to Uto-Aztecan population movements.

Archaeological data recovery may also provide clues as to whether the apparent emergence of semi-sedentary village settlement in the Antelope Valley region during the Gypsum Period could be plausibly associated with the arrival of Uto-Aztecan speakers in Southern California, with an inland movement of population linked to acorn processing, or with other factors.

3.1.4 The development and decline of inter-regional exchange links

Two major exchange items appear to have marked the development of long-distant exchange systems during the Gypsum Period-- Pacific coastal origin shell beads, particularly Olivella, and obsidian from the Coso volcanic field. Spire-topped and barrel-ground Olivellas dating from this period have been found in considerable quantities at Ca-Lan-192. By 2,700 years BP, exchange of Olivella beads from the southern California coast was clearly well developed. At the same time, Coso origin obsidian is found at Antelope Valley sites and in the Tehachapi Mountains region. Obsidian dart points and bifaces have been found, as well as projectile points and a variety of other chipped stone tools made of local rhyolite. A major source of this rhyolite is the extensive complex of quarry sites found at Fairmont Butte, located approximately 24 km. [15 mi.] west of Lancaster.

During Rose Spring/Saratoga Springs times, obsidian imported into the Tehachapi region and the Antelope Valley from the Coso volcanic field some 70 miles [112 km.] to the north of Mojave was used to make finished tools. Chipped stone tools such as projectile points were often imported in semi-finished form, even during the Rose Spring Period,

rather than being locally manufactured from cores. This is indicated by data from sites in the Tehachapis and the northwestern Antelope Valley. That even during the Rose Spring Period the frequency of on-site obsidian tool making may have been limited is indicated by the absence of obsidian cores and high ratios of cryptocrystalline (chalcedony, chert, and jasper) debitage at CA-KER-2357 and other sites. Changes in regional networks of exchange, possibly associated either with the drought episodes or with the movement of Numic-speaking populations in southeastern California, led to a fall off of obsidian importation at the end of the Rose Spring/ Saratoga Springs Period.

Major questions related to the development of exchange networks include the timing of initial appearance of coastal shell beads and Coso obsidian at Antelope Valley sites, and later changes in quantities and types of these classes of artifacts at these sites. Particularly important are data on the relative ratios of rhyolite, local cryptocrystalline, and obsidian chipped stone tool types prior to the end of the Rose Spring/ Saratoga Springs Period. In addition, there is a major decrease in frequency of obsidian use between Rose Spring times and the Late Prehistoric Period, even for higher-value artifacts such as projectile points. A shift over time away from obsidian use for stone tools is noted by Sutton for Ca-Ker-2211 in Fremont Valley, north of Mojave, and elsewhere as well obsidian becomes less common in Late Prehistoric times. While rhyolite continues to be used on a reduced scale, there is a major increase in the use of local crypto-crystallines. The cut-off of Coso obsidian is very marked and regionally widespread, but the reasons for this are still poorly understood. It has been proposed that both Medieval Climatic Anomaly-related drought conditions at circa AD 1100-1300, and the apparently related exodus or migration of Numic-speakers out of southeastern California and across the Great Basin at around the same time may be associated with the collapse of both production and exchange of Coso obsidian. Data relating to a late prehistoric decline in frequency of Coso obsidian at Ca-Lan-192 would contribute significantly to what we know about this phenomenon.

3.1.5 The development and distribution of a regional stone bead and related steatite and schist ground stone exchange industry by the Rose Spring/ Saratoga Springs Period.

The southern foothills of the Antelope Valley to the south and southwest of Palmdale lie in the rift zone of the San Andreas Fault. Metamorphic rock formations in the area include the Sierra Pelona, containing abundant steatite and schist deposits, as well as at least one locality containing fused shale. During the Rose Spring/ Saratoga Springs Period, a number of habitation sites along Amargosa Creek, west of Palmdale, maintained workshops for the production of steatite, chlorite schist, and other types of stone beads. Stone bead assemblages for the AD 500- 1300 era are found over a wide area in the western Mojave Desert, and some types appear to have been made at these sites. Elsewhere in this region, schist millstones and steatite bowls and other artifacts were also manufactured. The temporal associations and areal distribution within the greater Antelope Valley region of artifacts associated with these industries has yet to be fully worked out. Research at Ca-Lan-192 and other nearby sites could be helpful in

developing our understanding of the geographic scope of the distribution of artifacts associated with these regional industries.

3.1.6 Continuities and changes in artifact types and subsistence regimes from the late Gypsum Period through the Rose Spring/Saratoga Springs Period

The Rose Spring/ Saratoga Springs Period is much better represented in the southern Great Basin than is the Gypsum Period. The Rose Spring or Saratoga Springs Period (ca. AD 500 - AD 1100) (Warren 1980; Warren and Crabtree 1986) has also been referred to as the Amargosa II Period (Rogers 1939, 1945), Haiwee Period (Bettinger and Taylor 1974), and the Rose Spring- Eastgate Complex of the Great Basin Archaic Tradition, recently termed "Rosegate" (Thomas 1981). Warren's (1984) later prehistoric chronology for the Mojave Desert has involved a rejection of Bettinger's late dates for both the Cottonwood Triangular series (post-A.D. 1300) and for the arrival of Tatic-speakers in southern California (approximately the same date). Warren's revision appears consonant with our current knowledge (Warren 1984:423-424, 426). It is important to keep in mind that, despite considerable wrangling about this point, Rose Spring and Cottonwood Triangular points do co-occur at the Rose Spring type site and elsewhere during the A.D.500-1000 era (Warren 1984: 423-424; Yohe 1998). Thus, however investigators in the far southern Sierra may demonstrate the plausibility of assigning Cottonwood Triangular points to a late context (post A.D. 1200-1300) it is nevertheless possible that such point types were present in some numbers in the region well before that date, since they certainly appear in the adjacent Western Mojave Desert by A.D. 800-1000.

In the greater Antelope Valley region, the Rose Spring/ Saratoga Springs Period is typified by frequent use of obsidian, and the absence of ceramics and Desert Side-notched points, which appear during the Late Prehistoric. There also appears to be a shift towards greater abundance of schist and other stone beads, which were manufactured in the southern Antelope Valley area. A major development is the substitution of the bow and arrow for the atlatl, reflected in changes in projectile point types found. This shift was once seen as evidence of the initial arrival of Uto- Aztecs or "Shoshoneans" in the region. However, linguistic and other evidence now suggests that the presence of Tatic-speakers in southern California may predate this development.

For complex Antelope Valley sites such as CA-LAN-192, data recovery for the lapse of time encompassing late Gypsum and Rose Spring/ Saratoga Springs times may shed further light on continuities and discontinuities in artifact types and cultural practices during an era of population increase and further development of shell and stone bead and Coso obsidian tool exchange, as well as regional manufacture and exchange of fused shale and steatite artifacts. This era is also marked by the introduction of the bow, which would appear to have major implications for both hunting and warfare in the region. The relative infrequency of excavation of stratified midden sites in the Antelope Valley region has meant that local documentation of proposed sequences of appearance of Rose Spring and Cottonwood Triangular projectile points and phasing out of dart points in a stratified context has been relatively limited, and additional data would be helpful.

3.1.7 Local desert-floor settlement and the Medieval Climatic Anomaly

The late Rose Spring/ Saratoga Springs Period and the subsequent Protohistoric Period have been described as affected by major drought episodes. These involved several major eastern California droughts between AD 900 and AD 1350. Low lake stands observed at Mono Lake during AD 900-1100 and AD 1200-1350 have been associated with these droughts. They were also reflected in long-term drops in lake levels in Mono Lake, Lake Tahoe, and Sierran alpine lakes that provided evidence allowing for the identification of the chronology of these events. These were followed by a return of wetter conditions between AD 1350 and AD 1600 in southeastern California.

Archaeological research in the western Mojave Desert and environs has also shed light on these periods of more xeric conditions. An excavation by Sutton and Everson (1992) at Oak Creek on the eastern edge of the Tehachapi Mountains has lent support to the mesic-xeric-mesic sequence for the western Mojave and Tehachapi areas during A.D. 800-1400. Sutton's work at Koehn Lake, just to the east of the Tehachapis (Sutton 1991), identified a high lake stand there at 586 m, which appears to have ended at about A.D. 1000, when the site was abandoned. This onset of xeric conditions appears to be reflected also at Oak Creek. At that site a Rose Spring component, marked by an artifact assemblage including obsidian thinning flakes and a Rose Spring point, underlay a later component containing Cottonwood Triangular points. An aeolian dune deposit overlies both components, suggesting the onset of drier conditions after A.D. 1000. These dates for drought onset are later than some proposed for the Sierra Nevada region.

These long-term droughts have been suggested as related to the Numic expansion out of southeastern California at around AD 1100. Bettinger has suggested that this expansion into other regions of the Great Basin at this time was facilitated by the adaptation to arid conditions that Numic groups had achieved in southeastern California.

Archaeological research in the Lovejoy Springs/ Piute Butte area can potentially contribute to our understanding of the impact of long-term drought during this era on regional population levels and village settlement characteristics. Indications of change in village population levels, subsistence focus, or local water supply would be particularly important.

3.1.8 Late Prehistoric Period (AD 1250-1750) (Post-Medieval Climatic Anomaly) Settlement and Cultural Affiliation at Lovejoy Springs

Sutton (1991) has characterized the Late Prehistoric Period in the western Mojave Desert and Antelope Valley in the following terms:

A regional boundary of some sort, separating the southern Sierra Nevada/ Fremont Valley and the Antelope Valley, appears to be reflected in the archaeological record (Sutton 1989). This boundary is delineated by the presence of considerable obsidian, brownware ceramics, and Desert Side-notched projectile points in the north with less obsidian, fewer ceramics, and predominantly Cottonwood Triangular points to the south (Sutton 1991:23).

It has been suggested that the relative decline in Coso obsidian importation and the appearance of both Desert Side-notched points and Owens Valley Brown ware and other ceramics may be locally associated with Numic population movements in some way connected to the so-called Numic expansion or spread out of southeastern California. Sutton suggests, as noted above, that the archaeological evidence for a possible Numic presence, as defined by ceramics and desert side-notched points, is stronger for the northern portion of the western Mojave Desert and Antelope Valley environs than for valley areas further south. This argument is suggestive but has yet to be fully confirmed archaeologically. In addition, it has been suggested that the Antelope Valley was more sparsely populated during Protohistoric times than during early Rose Spring/ Saratoga Springs times (AD 500-900). Sutton has proposed that rainfall levels following the drought episodes at the end of the Rose Spring/Saratoga Springs period did not fully return to pre-drought conditions after 1350. This has been suggested as leading to a consequent abandonment of Antelope Valley settlements during the Late Prehistoric Period. Such an abandonment scenario would contrast the Antelope Valley region itself with the nearby southern Sierra Nevada and Tehachapi Mountains, where settlement and population density clearly increase after AD 1300.

This argument has been, in part, based on a correlation of climatic conditions in southeastern California during the AD 1300-1500 era with those in the Southwest, where prolonged drought conditions affected cultural developments in the region. In southeastern California, the period from AD 1350 through 1600 appears to have represented a recovery to rainfall conditions similar to Rose Spring/ Saratoga Springs times. From AD 1600 through AD 1760, a trend of moderately lower average rainfall can be detected. However, the notion that the Antelope Valley region was “abandoned” at time of Spanish contact in the 1770s is demonstrably false, as Earle (1990) has discussed elsewhere. It is to be noted that the distribution of archaeological sites in the Edwards Air Force Base region, the most thoroughly surveyed zone of the Antelope Valley region, does not support the thesis of a fall-off of settlement and population during the Late Prehistoric period.

Research at sites in the Lovejoy Springs/ Piute Butte region can contribute to testing the several generalizations about Late Prehistoric settlement, population, and ethnic affiliation presented above. The possible presence of Numic-type ceramics and Desert Side-Notched points at sites in the area would be of particular significance.

3.1.9 Use of ceramics in late Prehistoric times in the Lovejoy Springs/Piute Butte region and its possible cultural significance.

Surprising quantities of ceramic sherds, quite rare elsewhere in the Antelope Valley, have been found at CA-LAN-192 and at other nearby sites, including Rocky Butte and Piute Butte. These materials have not yet been formally analyzed. Some sherds appear to be associated with Colorado River wares or similar types. It is also possible that some may be of Numic graywares and brownwares. The late prehistoric archaeological incidence of both shell beads and ceramics at sites in the Buttes area may possibly reflect the influence of coastal- trans-Colorado trade and travel which was routed through the Antelope Valley

and the Mojave River Valley during late prehistoric times. Both Hohokam and Pueblo ware have been found in the area. Shell beads have also been found in considerable numbers in contexts of varying antiquity, beads which were a major trade item from coastal southern California to the Colorado River and the Southwest in Late Prehistoric times. Sutton has suggested that some ceramics found in the northern Antelope Valley and the Fremont Valley are of Numic origin, and suggest an ethnic boundary crossing the Antelope Valley from west to east, probably north of Lovejoy Springs and Piute Butte. The identification of the ceramic types found at Ca-Lan-192 and other nearby sites, and the recovery of additional ceramic samples, would help to determine whether these ceramics suggest affiliations with Numic speaking groups or with the Mojave River and Colorado River.

3.1.10 Protohistoric and historic native occupation of Lovejoy Springs

CA-LAN-192 appears to have been occupied by intrusive Numic-speakers originating in the deep desert to the east of the Sinks of the Mojave who moved southwestward after 1830. Small local groups migrated into the western Mojave Desert after the removal of local Serrano speaking populations in the central and southern Antelope Valley to the Franciscan missions between 1800 and 1820. These intrusive populations were of Chemehuevi-Southern Paiute affiliation, and ranged and settled widely across the western Mohave Desert and the San Gabriel Mountains from the 1840s through as late as 1890. They continued to follow a traditional subsistence round and way of life, attracted by the richer plant and animal resources available in Mohave Desert areas closer to the coast that had higher levels of annual rainfall. Both documentary references and the remains of archeologically recent living areas at Ca-Lan-192 indicate their presence at Lovejoy Springs by the mid-19th century. Further archeological evidence of the presence of these groups would be an important objective of research and the site, and at other sites in the region.

3.1.11 Evolution of Social Complexity among the Serrano

King, Sutton and Earle (and others--citations) argue for a complex form of overarching sociopolitical organization for the Serrano. In the western Antelope Valley, deep midden deposits and cemeteries within the sites (not only isolated burials), high status burials with thousands of shell beads per burial, and other archaeological evidence suggests stable societies governed by political and economic elites.

At two sites in the region (in Antelope Valley and southern Owens Valley), juvenile burials with thousands of beads occurs in the Gypsum components dating to around 500 B.C. These clearly suggest ascribed status and affiliation of these individuals with wealthy, prestigious, highly placed families. From that time into late prehistory, high status, wealthy burials with thousands of shell beads continue to be represented in the Antelope Valley without any evidence of a discontinuity.

Elsewhere in the Desert West, including the nearby Owens Valley, shell beads in large numbers do not occur with the exception of the isolated juvenile burial in the southern

Owens Valley. Since the shell beads were not moving further north or east (to any significant extent) then this would seem to lessen the impact or importance of trade. If trade was the engine for this sociopolitical complexity then we should see more obsidian from the nearby Coso source to the north (less than 60 miles to the northeast). However Coso obsidian moves west and only slightly south then abruptly declines outside of Panamint Shoshone and Tubatulabal territories.

3.2 ETHNOGRAPHIC OVERVIEW

Upon their arrival in southern California, the Spaniards named the native people of the San Bernardino Mountains and its surrounding foothills *Serranos*, a term that means “mountain people.” In the twentieth century the name was adopted by ethnographers studying the region, though the native people of the area called themselves *Takhtam* or “people.” As discussed below, Serrano territory extended both north and south of the mountains; at its northern extent, Serrano territory encompassed the western end of the Mojave Desert, including Lovejoy Springs. The total population of the Serrano at the time of the Spanish occupation of California may have been 2500 to 3500.

Serrano ethnography is amply documented in a variety of sources, beginning with Edward W. Gifford’s *Clans and Moieties in Southern California* (Gifford 1918) and followed quickly by Ruth Benedict’s *A Brief Sketch of Serrano Culture* (Benedict 1924) and *Serrano Tales* (Benedict 1926), A.L. Kroeber’s *Handbook of the Indians of California* (Kroeber 1925), and William Duncan Strong’s *Aboriginal Society in Southern California* (Strong 1929). C. Hart Merriam and J. P. Harrington produced extensive ethnographic notes on the Serrano, which have been mined by numerous scholars in recent years. Philip Drucker’s (1937) *Culture Element Distributions V: Southern California* included the Serrano, but little additional work was completed in the years immediately preceding, during, and after World War II. In the late 1950s and 1960s Lowell Bean conducted ethnographic research at Morongo Indian Reservation, which included information drawn from Sarah Martin and other knowledgeable Serranos. Bean’s recent scholarship on the Serrano has yielded several publications of importance (Bean and Vane 1978, 1981, 2002; Bean and Smith 1978; Blackburn and Bean 1978), including his multiple contributions to the California volume of the *Handbook of North American Indians*.

3.2.1 Linguistic and Sociopolitical Landscape

The Serrano language is included in the Uto-Aztecan family, which includes two neighboring subfamilies (Numic and Takic) and one isolate (Tubatulabal). Glottochronological estimates indicate that Takic diverged from Numic-Tubatulabal languages some 3,000 to 4,500 years ago. Kowta (1969) and Moratto (1984) argue for an ancestral presence of Takic speakers represented by the Gabrieliño, Tataviam, and Northern Serrano within their respective territories by ca. 1500 to 1200 B.C. The coastal Chumash languages borrowed heavily from the Takic languages, so this scenario seems plausible.

Ethnographic evidence suggests that the western Mojave Desert was occupied by at least five groups of Uto-Aztecan speakers at the time of first contact with Europeans: four from the Takic family and one from the Numic family. The Takic grouping comprises eight contiguous languages located between the coast and the Colorado River. The largest of the inland language groupings were the Desert Serrano, Kitanemuk, and Vanyume languages, which belong to the Serran group. These three groups may have spoken a closely related language that was a dialect of the same language spoken by their mountain-dwelling brethren to the south (Antelope Valley Indian Museum [AVIM] n.d.; Padon and Love 2004). The Desert Serrano resided along the northern foothills of the San Gabriel Mountains, while their valley floor neighbors the Vanyume resided along the Mojave River in the Victorville region and in the southern and southwestern portions of Antelope Valley; the Kitanemuk occupied the the west end of Antelope Valley (AVIM n.d.), extending east as far as the present-day Lancaster and Palmdale.

To the north, the Numic-speaking Kawaiisu lived in Tehachapi Valley and throughout the southern Sierra Nevada in the vicinity of Lake Isabella and Walker Pass. To the west, the Tataviam, another Takic-speaking group, interceded between the Serrano and the coastal Chumash, occupying the vicinity of the Santa Clarita Valley and Santa Clara River drainage east of Piru and west of Acton. Tataviam territory extended north into the westernmost corner of Antelope Valley, and they also lived in the vicinity of the San Fernando mission.

These groups maintained generally friendly relations with one another; intermarriages among the Vanyume and Serrano allowed for trade in food and raw materials. The Kawaiisu lived amicably with their southern neighbors, the Kitanemuk, and are known to have participated in cooperative antelope drives with the Yokuts of the San Joaquin Valley (AVIM n.d.). Although most of the groups shared similar cultural traits and practices, there were some differences. For example, the Kitanemuk buried their dead while the Serrano typically cremated their deceased. William McHaney, who arrived in the area in 1879, observed that the dead were cremated in their villages, their ashes scattered, and their personal possessions broken up (Walker 1931:18). The practice of burning the possessions of the dead as offerings was shared by the Serrano and many other groups in southern California.

The Serrano's neighbors on the south were the Gabrieliño. Early descriptions of political geography in native southern California placed the boundary between the Serrano and Gabrieliño at the crest of the San Bernardino Mountains. In recent years, however, ethnohistoric research by David Earle, Chester King, and others has shown that tribal boundaries defined by Kroeber (1925), Heizer (1966, 1978), and other early anthropologists are inaccurate for many California groups (Earle 1990, 1991; King 2003; Northwest Economic Associates and King 2004). A key assumption made in many of the early studies was that mountain ranges formed a physical barrier dividing ethnic groups. Earle (1990, 1991), using Harrington's notes and historic diaries, asserted that Serrano territory included the northern slopes of the San Gabriel Mountains, the Mojave River, and Antelope Valley. Based on kinship relationships documented in mission registers, as

well as ethnographic and historical information concerning the boundaries between native groups, King (2003) has confirmed that both the south and north slopes of the San Gabriel Mountains were occupied by Serrano speakers (Figure 2. Use Figure 2 in King 2003).

The territory of the Serrano was divided among a number of politically independent groups referred to as patrilineal, patrilocal corporate clans (Kroeber 1925:615-616). Although these kin groups may or may not have been based on actual genealogical relationships (Tooker 1971), all clan members were thought to be descended from a common ancestor through the father's line. From his analysis of the San Fernando and San Gabriel mission registers and other historical documents, King identified approximately 20 named Serrano clans, each with its own territory, principal settlements, and leadership (Northwest Economic Associates and King 2004). The principal clans in the western Mojave Desert were *Atongaibit*, *Cayyubit*, *Giribit*, *Najayabit*, *Tameobit*, *Tochaburabit*, *Tomijaibit*, and *Topipabet*.

Each clan was further divided into autonomous lineages, each of which had its own territory within the larger clan territory. Each lineage had a chief, or *ki'ka*, with religious and political functions. His office was in general hereditary. His principal subordinate was the *paha*, who assisted him in ceremonial, political, and economic affairs. Despite marital ties with other villages, the villages and village chiefs were politically independent, and did not have to answer to a central authority. Village chiefs did participate in alliances and cooperation with other communities, however. Each village and its surrounding territory, ruled by an independent religious and political chief, was occupied by a clan comprised of families related in the male line.

King provides compelling evidence that the Serrano world was further divided into two equal halves associated with the land and the water and the totemic representations of Coyote and Wildcat (contra Blackburn and Bean 1978). All clan villages were affiliated with either one or the other ceremonial division. Membership in these totemic moieties was symbolically extended to certain specific plants, animals, and other elements of the natural and supernatural world, metaphysically linking all elements of the social, natural, and spiritual worlds together. Serrano clans and moieties were exogamous; i.e., members of the same group could not marry anyone within their group. Post-marital residence was typically patrilocal, meaning the women usually left their own home village to live at their husband's village. Moiety outmarriage meant that partners could not be obtained from half of the neighboring Serrano settlements.

In the western Mojave Desert, Serrano settlements were more dispersed than those in the mountains or on the coastal side of the mountains. This dispersal resulted in marriages linking together very large areas. Many of the settlements had marriage ties with villages more than 50 miles away and not with the nearest neighbor (King 2003; Northwest Economic Associates and King 2004). This pattern of settlement allowed many villages to share resources, and may be linked to the need to integrate larger areas in regions with few and/or undependable food resources.

King suggested that CA-LAN-192 may have been the central settlement of the *Tameobit* clan because the pattern of Mission recruitment of natives from *Tameobit* indicates that the settlement was located somewhere in the western Mojave Desert midway between the San Gabriel and San Fernando missions, and Lovejoy Springs is the nearest oasis to both missions (Northwest Economic Associates and King 2004: 82-83). He cites a remark in J.P. Harrington's Serrano notes describing a place that is seemingly consistent with the geographic character and location of Lovejoy Buttes, and notes that a small number of Mission-period glass beads were recovered from the site, further suggesting that it is the ethnographically described settlement. Earle, however, disagrees with King's suggestion (Earle personal communication 2006). He points out that Manuel Santos, J.P. Harrington's Serrano consultant, identified a different location as *Tameobit*, and argues that the ethnohistoric data for the area are not sufficiently robust to associate CA-LAN-192 with any 18th century settlement named by native people or listed in the sacramental registers of the missions at San Fernando or San Gabriel. The San Fernando registers do name some places that are probably in the region and are as yet unlocated; while it is tempting to match the rancherias named in the mission registers with archaeological sites, at present such efforts are mere speculation lacking supporting evidence.

3.2.2 Patterns of Land Use

Each clan may have had one or more principal villages with as many as 150 inhabitants, occupied seasonally or simultaneously; in addition, there may have been several smaller settlements associated with each principal village. During late prehistory, the principal settlements of the Desert Serrano (those north of Cajon Pass, on the Mojave River and elsewhere) included both canyon mouth villages and those located on the desert floor, either along the Mojave River or at desert springs. In general, the Serrano occupied these villages permanently but dispersed into smaller, mobile gathering groups during the late spring, summer, and fall months to harvest piñon nuts, juniper berries, mesquite, yucca, buckwheat, chia, and other seasonally available foods; hunt deer, antelope, and other animals; and collect whatever other materials the environment or other groups could provide that were deemed necessary or useful. However, the pattern of regular, seasonal upslope and downslope movement between winter and summer settlements is not as distinct for the Desert Serrano as it is for Mountain Serrano clans like the *Yūhavetum* (Pine People), who maintained *A'atsava't* as a principal upland warm-weather settlement in the Big Bear region, and the winter village of *Kutainit* at lower elevations on Santa Ana Creek, below the winter snow line.

Rather, the Desert Serrano occupied the San Gabriel Mountains intermittently, during key times of year, but on a more temporary basis through camping rather than more permanently occupied villages. In the late spring, summer, and fall, canyon mouth winter villages such as *Maviajek*, on Little Rock Creek southeast of Palmdale, dispersed into smaller seasonal camping groups, some of which occupied upland camps in the San Gabriel Mountains. This pattern of land use may reflect the relative scarcity of resources in the mountain zones, which had some pinyon pine (Big Rock region) and much Canyon Live Oak but relatively little else; thus the area was most important as

an autumn gathering zone, with mid and late summer foraging focused on the lower foothills and desert floor, where both juniper berries and mesquite could be obtained.

Ethnohistorically, juniper exploitation was critically important to the Desert Serrano. Other village communities regularly visited *Guapiabit* (which means "Juniper Village") to gather this resource, and to collect Black Oak acorn upslope to the south of Summit Valley. In the fall *Guapiabit* hosted multi-village "fiestas" and shipped acorns out to villages in the desert further down the Mojave River.

To gain access to the San Gabriel or San Bernardino Mountains, Serrano communities located at desert springs and on the Mojave River below Summit Valley would have needed permission to enter the territories of the intervening clan groups. This appears to have occurred; canyon mouth clans invited desert spring clans to join them in pinyon and acorn gathering in the autumn. The nearest access to the San Gabriel Mountains for residents of Lovejoy Springs was the Big Rock Creek drainage around Valyermo, about 14 miles to the south. Ethnohistorically, this Valyermo area featured a rancheria, *Amutskupiat*, apparently associated with the clan territory of *Amutskupibit*, a winter village located to the east in Cajon Pass. It is clear that a settlement existed there on Big Rock Creek before mission times, but it is less clear whether *Amutskupiat* was a political outlier of *Amutskupibit* in the late 18th century, or only later (Earle 2001).

3.2.3 Hereditary Positions and Titles

Social ranking and prestige systems were well developed amongst the Serrano (Blackburn and Bean 1978:567). Each village contained a chief, ceremonial manager, two messengers, as well as various shamans, singers, diviners, and other ritual specialists. Strong (1972:17-18) identified Serrano chiefs that provided for Mourning Ceremonies as *kika* or clan leaders; this hereditary office passed from the chief to his eldest son. The *paha* was another important ceremonial officer who took charge of the sacred bundle containing all the ceremonial paraphernalia, alerted the people when and where ceremonial events would occur, and attended to the distribution of shell money and food. This was also a hereditary office that passed from the titleholder to the most mature son. Boscana noted that it was the custom of the Serrano to appoint as chief or captain the oldest of the families. The male head of the household was given the name *Nu* and the second in power *Eyacque*. The wives of the Chiefs were given special names as well, with the first wife identified by the Spanish as *Coronne* and the second *teppi* (Harrington 1978:84).

Serran sociopolitical organization was unique in that only one moiety had the *kika* and ceremonial house while the opposite moiety possessed the bundle and *paha*. The Coyote moiety had the most important political leaders.

King's study of Spanish mission registers revealed names designating political positions, including those identifying royalty and singers or those in charge of maintaining traditional knowledge. The Spanish assigned names to Serrano individuals that indicated their social position, including: *de los Reyes* (of the Kings), *Regina* (Queen), *Sabino* (to

know, Singers). Daughters of Singers were known as Sabina. Kingly titles were also provided to people from the leading families of the Indian villages.

The Serrano held important ceremonies, celebrations, and fiestas in the early winter months. The foodstuffs stored up from late summer and autumn gathering were still abundant. At the same time, people were freed from gathering activities during winter, with the exception of some hunting, and had time on their hands for social activities. Mourning ceremonies, held periodically to honor recently deceased villagers, brought people from villages far and wide to attend the fiesta. During these ceremonies food and gifts were exchanged, and ritual singing and dancing went on for many days.

Shell bead wealth accumulation seems to have been an important feature of Desert Serrano society. During the eighteenth century, Father Garces had both acorns and shell beads sprinkled over him as a formal greeting at several villages on the Mojave River. The local chiefs were accumulating Olivella beads and ornaments en route from their coastal manufacturing loci eastbound to the Mojave River, presumably prestations to them as hosts on this long distance route of Mohave exchange with the coast. This continued long after the Spanish conquest of coastal California, and we find distinctive post-1800 mission era Chumash-made Olivella beads at historic-era native sites in the desert.

Such wealth accumulation was a very important element of the corporate group social organization among southern California Takic groups. Prestige accumulated not only to the individual, but also to the larger clan group, through what Earle (need citation) has termed a “structured ritual mode of production” revolving particularly around the mourning ceremonies held periodically during the winter. Clan groups accumulated wealth in various forms—goaded by political leaders to wring a surplus from the environment for the purpose of ritual prestations that enhanced corporate group prestige. The surplus was circulated in ritually complex ways between clan groups gathered at the mourning ceremonies. These ritual reciprocity ties ran parallel to marriage links, and were critical in linking the small population interior clan groups in political networks where wealth goods, foodstuffs, permission to forage, and spouses were exchanged. This kind of ritual reciprocity was perhaps more critical to survival in the desert environment than for larger population groups on the coast.

King (2003) argues for a complex form of overarching sociopolitical organization for the Serrano. In the western Antelope Valley, deep midden deposits and cemeteries within the sites (not only isolated burials), high status burials with thousands of shell beads per burial, and other archaeological evidence suggests stable societies governed by political and economic elites.

At two sites in the region (in Antelope Valley and southern Owens Valley), juvenile burials with thousands of beads occurs in the Gypsum components dating to around 500 B.C. These clearly suggest ascribed status and affiliation of these individuals with wealthy, prestigious, highly placed families. From that time into late prehistory, high

status, wealthy burials with thousands of shell beads continue to be represented in the Antelope Valley without any evidence of a discontinuity.

Elsewhere in the Desert West, including the nearby Owens Valley, shell beads in large numbers do not occur with the exception of the isolated juvenile burial in the southern Owens Valley. Since the shell beads were not moving further north or east (to any significant extent) then this would seem to lessen the impact or importance of trade. If trade was the engine for this sociopolitical complexity then we should see more obsidian from the nearby Coso source to the north (less than 60 miles to the northeast). However Coso obsidian moves west and only slightly south then abruptly declines outside of Panamint Shoshone and Tubtulabal territories.

4

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: GROUND STONE ARTIFACTS

With this section we begin to describe the artifacts, features, and other material remains recovered during the various archaeological investigations at CA-LAN-192. Numerous scholars have analyzed and commented on these discrete assemblages of ground and flaked stone tools, lithic debitage, beads and ornaments, ceramic artifacts, faunal and paleobotanical remains, and human remains. We are indebted to the following technical specialists who contributed to these sections of the report.

Barbara Tejada	Ground stone tools
Alan Gold	Flaked stone tools
Mary Baloian	Lithic debitage
Jay Lloyd	Beads and ornaments
Suzanne Griset	Native American ceramics
Nancy Valente	Vertebrate faunal remains
Virginia Popper	Paleobotanical remains
Lisa Anderson	Human remains

4.1 INTRODUCTION TO THE GROUND STONE ANALYSIS

CA-LAN-192 is particularly notable due to its large ground stone component comprising over 1,000 individual specimens, by far the largest artifact type in the total site assemblage. Although large ground stone collections are well known from sites along the southern California coast and inland valleys, equivalent manifestations are rare for the southern deserts, suggesting the possibility of an interesting local desert adaptation for the Antelope Valley. Rather than instituting standard form-function classification procedures, the Lovejoy Springs ground stone collection was studied using a more in-depth technological approach, in the hope of gaining more insight into the unique status of milling stone use in the far western Mojave Desert. Attention was also given to the possible sources of raw material used in the manufacture of milling stones, which may have implications regarding the movements of populations across the Antelope Valley. Finally, some preliminary comparisons to other regional ground stone collections were considered in order to place Lovejoy Springs within a wider cultural context.

4.2 LOCAL GEOLOGICAL CONTEXT

The ground stone assemblage from Lovejoy Springs was manufactured principally from various

types of granite-granodiorite-monzonite series rocks, as well as sandstone, schist, rhyolite and steatite. A few slate pieces also have been found. Local sources of granitic rock can be found throughout the area, since the buttes in the region (including Lovejoy Buttes to the west, Rocky and Alpine Buttes to the northwest, Piute Butte to the north and Saddleback Butte to the northeast) are largely composed of a porphyritic magnetite-biotite monzogranite. This rock is distinguished by pink to tan potassium feldspar, white to gray plagioclase feldspar, gray quartz and accessory magnetite, biotite and rarely hornblende (Burch 2004:11). The rocks of Lovejoy Buttes contain numerous pegmatite dikes that tend to exhibit a “crumbly” texture due to large mineral size and continued decomposition and erosional processes.

The only local source for sandstone in the eastern Antelope Valley is found in the Devil’s Punchbowl feature near Valyermo, approximately 11 miles south of Lovejoy Springs. The Punchbowl is an exposure of Miocene terrestrial deposits (Punchbowl Formation) and Tertiary marine deposits (San Francisquito Formation) within the San Andreas fault zone (Dibblee 1987:207). The Punchbowl Formation consists of medium- to coarse-grained semi-friable conglomeratic arkosic (high feldspar) sandstone (Dibblee 1987:208). The San Francisquito Formation includes a light buff arkosic sandstone and coarse cobble conglomerate interbedded with dark gray micaceous shale (Dibblee 1987:208).

Granitic rocks found within the Devil’s Punchbowl area, the watershed for Big Rock Creek, are largely late Mesozoic-age biotite-granodiorite and quartz monzonite, as well as older formations of gneiss basement rock (Dibblee 1987:208-209). Abundant granodiorite cobbles and lesser amounts of sandstone cobbles can be obtained within the Big Rock Creek drainage. Big Rock Wash, the closest major drainage to Lovejoy Springs, lies approximately three miles west of CA-LAN-192. The wash is fed by Big Rock Creek, which emanates from the northern face of the San Gabriel Mountains near Valyermo and terminates near Piute Butte, just five miles northwest of Lovejoy Springs. The cobbles do not tend to be particularly well-rounded. The wash becomes sandy with fewer cobbles in the vicinity of the Lovejoy Buttes and Piute Butte.

The Pelona Schist is exposed at several locations along the foothills of the San Gabriel Mountains, especially along the San Andreas fault zone. The complex is a Late Cretaceous to early Tertiary terrane formed from a greywacke (poorly sorted sediment) protolith, and was accreted to the basement rock along a low-angle subduction zone. The Pelona Schist includes a gray muscovite-albite-quartz schist, with less substantial deposits of green schist and quartzite in the upper portion of the section (Ehlig 1981). Within the Sierra Pelona range in southwestern Antelope Valley, steatite/soapstone outcrops are known to occur within the Pelona Schist formation.

Extensive prehistoric quarrying of fine-grained volcanic rhyolite and rhyolite tuff are documented for the Fairmont Buttes area, located some 34 miles to the northwest of

Lovejoy Springs on and near what is now the Antelope Valley Poppy Reserve State Park. Other deposits of rhyolitic rocks are found in the Rosamond Hills to the north, and elsewhere throughout the Mojave Desert (Sutton 1988:14-15). Finally, slate deposits are known to occur in the Santa Monica Mountains, approximately 60 miles southwest of Lovejoy Springs, as part of the Santa Monica Slate formation.

4.3 METHODS

Applied Earthworks, Inc. laboratory staff performed initial sorting and cataloging of all ground stone artifacts. Each collection was assigned a unique catalog identification number. Artifacts were then assigned a lot number according to their provenience of collection within CA-LAN-192, and a unique specimen number. Laboratory staff classified each specimen by material type (ground stone), class (handstone, milling stone, decorative, etc.) and type (bead, pendant, etc.), if applicable. Raw material types were then assigned to each artifact and measurements were taken, including length, width and thickness measured in centimeters, as well as weight measured in grams. All specimens were placed into poly bags with labels that included all of the attribute data above.

Further detailed analysis and classification was then undertaken by this author. All specimens were individually examined using a 10x hand lens. Due to the extent of this large collection and constraints on available laboratory equipment, microscopic analysis was not undertaken, except for a couple of specimens as a test case. Lithic raw material type was confirmed or clarified, with assistance from geological reference texts and Dr. Rob Negrini and Dr. Robert Horton in the Department of Geology at California State University Bakersfield.

Observations on attributes and features of each specimen, based upon the aspects of the technological analyses described below, were added to the “Remarks” section of the electronic catalog in Microsoft Excel. The Excel catalog was then sorted according to collection, then artifact class, then raw material type and remarks in order to provide specimen counts and general collection observations.

4.4 TECHNOLOGICAL ANALYSIS

Traditionally, ground stone analysis has been limited to classification into pre-defined types based on form and inferred function. These types are hardly standardized and a “Type I” handstone can mean something entirely different between investigators. Adams (2002) suggests a more encompassing approach to analysis by measuring additional attributes that can relate information about the technology of ground stone production and use. In this way, we may learn more about how prehistoric cultures selected raw materials for specific functions, distinguish both primary and secondary uses of ground stone artifacts, how those uses were physically carried out, and the processes of wear and disposal (Adams 2002:17).

Using the technological-centered approach, rather than simply a form-function approach allows a whole host of research questions to be addressed. A site’s occupation strategy

may be evaluated in terms of settlement continuity, duration and intensity based on ground stone tool use wear and design attributes (Adams 2002:47-49). Food processing activities relating to the intensity of use of ground foodstuffs may be inferred from the tool design, however, data on the materials being ground can only be obtained from pollen and residue sampling and accompanying site-level macrobotanical analyses (Adams 2002:49-52). Certain ground stone tools, such as polishers or “arrow-shaft” straighteners, and their use-wear patterns may also provide information about other types of tools manufactured at the site, as well as the technology involved in their production (Adams 2002:52-54). Finally, design attributes may be studied to help distinguish between cultural affiliations for groups using different ground stone technological traditions (Adams 2002:54-56).

4.4.1 Raw Material Types

The identification and quantification of raw materials used in the production of groundstone artifacts can reveal information about the preference for locally available materials as well as preferences for non-local materials. The degree of abundance of non-local materials within a site has been inferred to directly correlate with the degree of trade relations practiced by the resident community.

Probably less recognized and more difficult to determine, but offering equally important information, is the relationship between raw material type and the types of resources being processed or the processing techniques employed. Various types of residue and microbotanical analyses have been used to help determine the types of materials processed with milling equipment. Additionally, the granularity, durability and texture of rock material have been evaluated as indicators of use preference and function for abrading tools, with the suggestion that certain raw material types may have been used for certain tasks or the processing of certain resources (Adams 2002:19).

4.4.2 Ground Stone Descriptive Nomenclature

Researchers regularly classify milling implements according to “Types” based on morphological features. Unfortunately, these types have not become standardized within the literature and the defining attributes may vary between studies or are poorly described, making direct comparisons of collections difficult at best. In the present analysis, this author has opted to use a descriptive classification of types rather than a numeric “type” designation in order to avoid confusion.

Increasingly recognized in archaeological studies is the concept that form alone does not always define function (Adams 2002:6-7). For this study, although hand-held rounded stones used for grinding down materials against a stationary rock surface are traditionally called manos, the more generic term “handstone” is used in order to avoid implications of one specific use, such as only assuming the grinding of seeds. The handstones in this collection represent a variety of morphological forms, but in general have been described according to the number of wear surfaces, convexity profile of the grinding surfaces, and whether they had been shaped or not shaped.

Milling slabs, or metates, have been divided into three descriptive types: flat slab (exhibiting a flat grinding surface); shallow basin (defined as having a measurable grinding surface concavity roughly between 0.75 to 4.0 cm of maximum depth); and block slab (displaying a flat grinding surface on a rock with a thickness over 10.0 cm).

Certain attributes may give some indication of how an artifact may have been designed or used. The purposeful shaping of ground stone implements implies a strategic plan for manufacture versus the expedient design suggested for non-shaped artifacts (Adams 2002:21). Further questions can then be explored, such as correlations between strategic design and raw material type or processing use. Artifacts with “comfort features” such as finger holds or “turtlebacks” shaped to fit in the hand comfortably (Figure 9), prepared either purposely or chosen and perhaps enhanced from natural formations, suggest a design for intensive use over long durations (Adams 2002:19, 26).

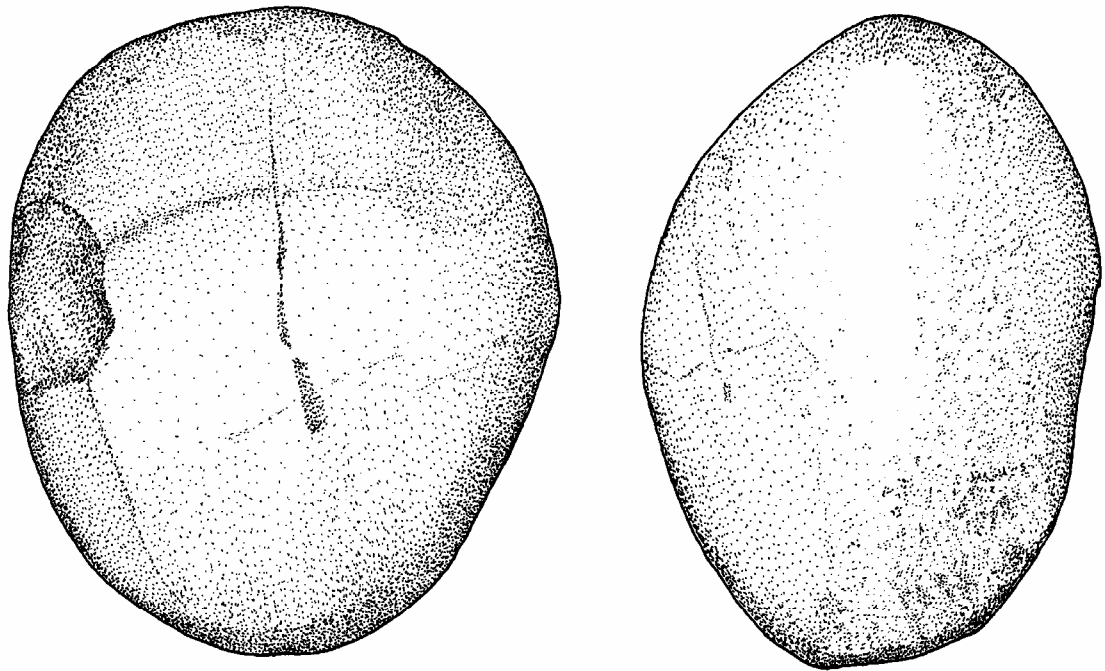


Figure 9. Unifacial handstone with convex domed surface for ease of grasping

4.4.3 Use Wear

Wear-management strategies may have more bearing on tool morphology than has previously been suggested using a form-function approach. For example, the regular rotation of the handstone position distributes wear more evenly over a flat or convex surface whereas limited rotation will create a “wedge”-shaped profile (Adams 2002:25).

The shape of the grinding surface, then, gives an indication of how the milling implements were physically maneuvered. Circular and reciprocal strokes in a metate can

be differentiated by differential face wear on the corresponding manos by multidirectional striations in the former, and by edge wear facets and linear striations for the latter (Adams 2002:102-103). Rocking of the handstone/mano during reciprocal grinding strokes is reflected in the profile or convexity of the grinding surface, which may vary in measurement according to length of wear. Flat surfaces would be produced when the handstone remained in constant contact with the corresponding milling slab of a flat slab or shallow-basin type (Adams 2002:114). For this study, any specimen that exhibited a curved surface was considered “convex” while artifacts that were generally flat across the grinding surface except for some slight curvature at the edges, were considered “flat.” A quantified degree of convexity was not measured due to the large number of artifacts analyzed.

The degree of wear on the grinding surface can provide information that has been inferred to relate to length and intensity of site occupation. Although not specifically utilized for this study, Kolvet and Eisele (2000) provide a useful qualitative three-stage scale that can be used at a macroscopic level to estimate relative stages of surface wear patterns.

Evidence for tool maintenance, through re-pecking or re-roughening indicates another type of use wear. Observations on the degree of maintenance may have implications for the discussion of site use intensity if artifacts are used repeatedly over time.

Tribochemical wear, usually present as tool polish, can be an important indicator of the types of resources processed. Whereas the other forms of wear reduce the volume of the artifact, chemical reactions add residues to the surface (Adams 2002:31-32). Experiments performed by Adams using sunflower seeds have produced a marked sheen on the tools used from the grinding of oily substances. Residue and pollen or phytolith analysis techniques have been used with some success to distinguish classes of materials processed using stone tool artifacts (Yohe et al. 1991; Lawlor 1989).

4.4.4 Primary and Secondary Use

In addition to the most obvious primary use of ground stone artifacts, features of secondary use may also be distinguishable. This secondary use may either be concomitant with the primary use, such as edge battering on a handstone suggesting a possible second use as a pestle-like or pounding tool, or the use may be sequential where tools are recycled into new functions, such as hearth stones (Adams 2002:21). Ground stone artifact use may be categorized into five forms including single use, re-use, redesign, multiple use and recycled (Adams 2002:21-24). Analysis of these attributes can also provide information on the intensity of archaeological site use or available access to raw materials.

4.5 STUDY RESULTS

Details on the history of the individual collections from Lovejoy Springs are provided in Chapter 2 of this report. The ground stone assemblage within each collection from the

site is described below. The artifact descriptions are followed by a summary of general observations regarding the Lovejoy Springs ground stone collection.

4.5.1 Unprovenienced Materials

One box of materials labeled only as “Lovejoy Springs” was obtained from the Antelope Valley Indian Museum. These may have been collected from the site by H.A. Edwards and other local individuals. Although these items have limited and questionable provenience and no supporting documentation, they are some of the most interesting in the collection. The unprovenienced materials were examined for this study, but their interpretive potential must be considered with caution.

Two handstones that may also have been used secondarily as hammerstones are present. Both are bifacial convex and may have been shaped (Table 1). One specimen is made of rhyolite, while the other is a type of intrusive igneous material with extensive polish across all surfaces. A third steatite specimen is a possible unifacial, flat, unshaped handstone. One diorite specimen has been purposefully shaped to a bifacial convex form; however it appears to be too small to be a standard handstone. In addition to the handstones with possible secondary use as hammerstones, the unprovenienced collection contains one quartz monzonite/monzogranite hammerstone with edge battering and no ground surfaces.

Two schist metates are included with the cataloged collections at the Antelope Valley Indian Museum (catalog numbers 082-309-2481 and 082-309-2482). One is a flat slab type with a distinctive circular grinding surface. The other is a shallow basin with an oval to circular grinding surface. Neither appears to have been shaped except possibly on the base for stability (see Table 2).

Three steatite bowls are present. Two of the specimens consist of eleven combined fragments, likely from the same bowl, which exhibits a vertical notch decoration along the rim (Figure 10). A third steatite bowl fragment has thick walls and a flat ground rim with remnants of a possible exterior surface coating.

Two additional bowl specimens are manufactured of sandstone. One specimen includes three rim fragments mended together to form one half of the bowl’s rim. The material is fine- to medium-grained and similar to sandstone handstones found in other collections from the site. One complete sandstone bowl, donated by a local and purported to have been collected from the Lovejoy Springs site over fifty years ago, has been included in the catalog of the Antelope Valley Indian Museum (catalog number 493-43-1). The bowl is made from well-cemented sandstone with fossil shell inclusions, similar to deposits found along the southern California coast. The large, heavy bowl also includes a unique carved oval decoration on one outer wall of the piece. In general, its styling is similar to sandstone bowls found in coastal archaeological contexts, with thick walls and a heavy rounded rim. This is a particularly unique specimen, but its lack of archaeological provenience severely limits its interpretive value.



Figure 10. Steatite bowl with notched rim

4.5.2 Bob Wubben Collection

One complete schist metate was present in this collection (see Table 2). As the artifact was quite large, it remained at the Santa Barbara Museum of Natural History and was not directly analyzed for this study. Based on a photograph of the specimen, it appears to be a large shallow basin metate with a shallow circular depression at the center. The specimen may have been roughly shaped on the edges.

4.5.3 Archaeological Survey Association 1954 Excavation

There are six handstones (Table 1) and one untyped milling slab fragment (Table 2) in the 1954 ASA collection. Three of the handstones (two granitic, one vesicular basalt) are too fragmented to type, but one exhibits a convex grinding surface. One handstone is bifacial, flat, and shaped of local granitic manufacture. Two specimens, one of sandstone and one possibly of silicified sandstone, are bifacial convex and shaped.

Three stone beads in the ASA collection are described in Chapter 8 of this report. One is of steatite; the other two are made of an undetermined material.

The ASA collection also includes one biconically perforated steatite “donut” stone (Figure 11). In general, these types of artifacts are believed to represent digging stick weights, although this hypothesis remains to be tested and proven (Adams 2002:203-204).



Seventeen specimens are ground stone fragments that could not be identified to type. All exhibit some ground or pecked surface that indicate cultural use or modification. Six of the specimens are of granitic material, and four of these are fire-altered. Another specimen, also burned, is comprised of orthoquartzite. Two specimens are formed from a quartz dike in granitic rock, and one is of quartz monzonite (or monzogranite) material.

Figure 11. Steatite “donut stone”

Three specimens, two of slate or steatite and one of schist, are small and thin, possibly representing pendant blanks. Three additional ground stone fragments are of schist manufacture. A final specimen, although complete, is untyped and of an undetermined igneous material.

4.5.4 UCLA 1968 Salvage Project

Six handstones from the UCLA collection were analyzed for this study. Three were diorite material, two were granitic, and one was sandstone. Two specimens were of the unifacial convex type, one being shaped with a distinctive polished “finger hold” and the other not shaped but exhibiting secondary use battering. Two specimens were classified as bifacial convex and shaped, one of these being fire-affected. One specimen is bifacial flat and shaped, and one exhibits a bifacial “wedge” type and is not shaped.

A dense granitic (possibly monzonite/monzogranite?) milling slab with red ocher along one edge was reported in association with Individual E and the child interred in the mass burial excavated by Toney (1968). No additional information on the morphology of the milling slab was provided.

In the 1968 UCLA collection, there is one diorite bipolar conical shaped pestle with a slight curvature (Figure 12). One quartzite hammerstone was identified in this collection.

4.5.5 Cerro Coso College 1989 Field Class Excavation

There is a total of seven handstones analyzed for this collection. Five are of granitic material, including one specimen of diorite. The remaining two specimens are comprised of schist. Four of the handstones were untyped and extremely fragmented and/or decomposing. One specimen is classified as bifacial convex and shaped, one is bifacial convex and not shaped, and the final specimen was typed as bifacial flat with some possible shaping and a polished “finger hold.” Three of the specimens are fire-affected.

Two milling slab specimens are included in the Cerro Coso collection. Both are of schist material. One specimen is an untyped slab metate fragment that has been burned, and the second specimen is a fragment of a basin metate that exhibits a shaped base.

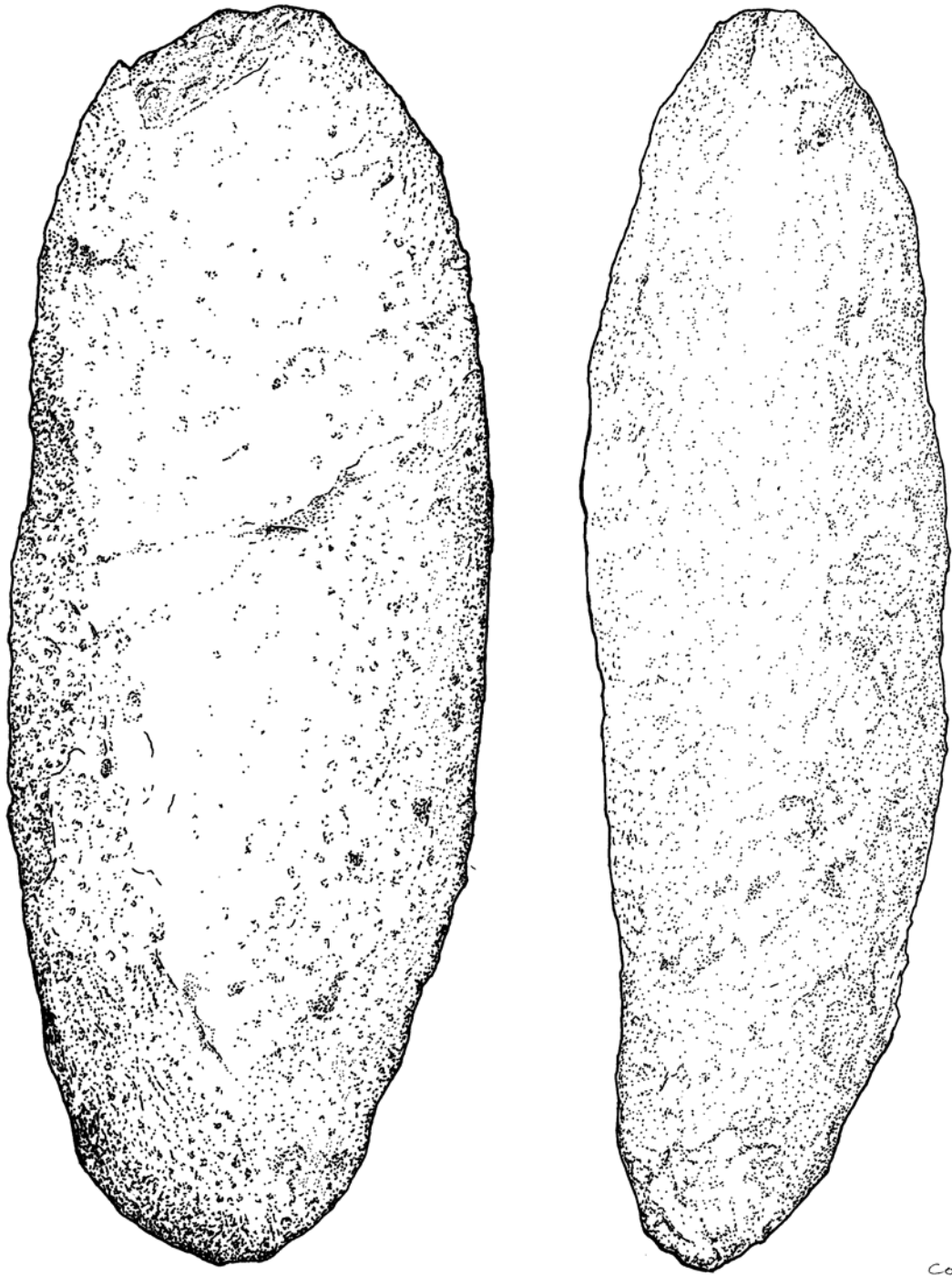
One specimen is classified as the rim of a schist bowl mortar. No other distinguishing features were observed.

The bulk of the Cerro Coso collection is comprised of untyped ground stone fragments. Sixteen specimens are of the unidentified classification, including one possible milling slab fragment. Nine of these specimens (56% of the class) are burned and all are highly fragmented or composed of decomposing rock material.

4.5.6 Pyramid Archaeology/Bruce Love 1990-92 Monitoring Project

A total of 729 handstones, also referred to as manos, are included in this collection. Thirty-five percent (35%) of the total exhibited fire-affected surfaces, at least 3% showed some evidence for re-pecking of the grinding surface, and less than 1% showed end battering as a possible secondary use.

The handstones of this collection provided the widest range of raw material types of any other artifact class. Granitic materials make up 28% of the total, with an additional 8% of the specimens identified as the “local” feldspar-rich crumbly granitics found amongst the Lovejoy Buttes. Those artifacts exhibiting a particularly high composition of biotite and darker minerals were determined to be forms of diorite and make up 16% of this collection. Gabbroic materials account for approximately 3%, although it should be noted that granites, diorites and gabbros are classified along a continuum and can only be definitively separated using petrographic thin section techniques. The total then, for intrusive plutonic lithic materials is 55% of all the handstones. Schist and sandstone are the second (25%) and third (24%) most common stone materials, respectively. One percent (1%) or less of the collection is composed of rhyolite (including rhyolitic tuff), quartz monzonite (or monzogranite), quartzite, gneiss, metasedimentary rocks and mudstone.



Cor

Figure 12. Bipolar conical pestle

Of the total handstone collection, 289 artifacts (40%) were classified as untyped or having only partial attributes accounted for, largely due to the fragmentation of the specimens. From this classification, 81 were discernible as shaped and 21 as not shaped. The distinguishable grinding surfaces were primarily convex (23), while only five untyped specimens exhibited flat surfaces, two were “wedge”-shaped, and one was a combination of convex on one grinding surface and flat on the other. Bifacial ground surfaces were counted on at least 56 specimens.

Of the completely typed specimens, numbering 440 artifacts, purposely shaped handstones accounted for 55% of this collection, leaving 45% characterized as not shaped. Further, 80% of the typed handstones showed bifacial grinding surfaces, almost exclusively on opposing sides of the tool, followed by 14% unifacial specimens and 6% with three or more visible grinding surfaces. Most of the multifaceted handstones were not shaped, and the use of several grinding surfaces appears to be more a result of taking advantage of the natural shape of the cobble, rather than a purposeful design. Although the incidence of re-touched grinding surfaces was generally low in this collection (see above), 80% of the re-pecked surfaces were found on formally shaped artifacts.

Table 1 shows the specific breakdown of morphological “types” identified for all of the collections analyzed. Bifacial convex handstones, both shaped and unshaped, are clearly the predominate forms found within the Pyramid Archaeology/Love collection. Bifacial flat and unifacial convex handstone forms follow in abundance, with lesser numbers of other morphological types. Six of the shaped bifacial flat surface specimens have been noted as possible discoidals.

Six handstones of all types exhibit so called “comfort features.” These consist of what are probably natural indentations in the rock surface that “fit” to the fingers and/or hand, and have extensive polish due to long-term use. Two of these specimens seem to have been intended for use in the left-hand by the manner of their fit.

All of these factors suggest that occupants of the Lovejoy Springs site practiced a relatively high degree of planned design for the production of their milling stone tools. That design was intended to extract the most use possible from each artifact through utilization of the two largest rock surfaces with an eye toward longer-term exploitation. In light of this, that re-pecked grinding surfaces, used to extend the life of the milling tool, remained relatively rare or were not so apparent is an interesting characteristic. Another general observation is that among many of the bifacial artifacts, one of the faces appears to be much less utilized or ground than the opposite side. Whether or not this phenomenon was due to unsuitability of that portion of the handstone or due to premature discard, since many of these had been burned, is difficult to surmise. Perhaps the relative ease of acquiring new stone material nearby outweighed the energy required to rejuvenate the grinding surface. The degree of use wear on each surface was not thoroughly

Table 1. Handstone Counts by Morphological Type and Collection

Morphological Type	Collection Name								Total
	Unprov.	Wubben	ASA 1954	UCLA 1968	Cerro Coso	Bruce Love	AVC/ Robinson	Æ Collections (sample)	
Unifacial convex (S)	--	--	--	1	--	4	n/a**	2	7
Unifacial convex (NS)	--	--	--	1	--	46	n/a	5	52
Unifacial flat (S)	--	--	--	--	--	2	n/a	--	2
Unifacial flat (NS)	1	--	--	--	--	10	n/a	--	11
Bifacial convex (S)	3	--	2	2	1	105	n/a	12	125
Bifacial convex (NS)	--	--	--	--	1	112	n/a	15	128
Bifacial flat (S)	--	--	1	1	1	43	n/a	5	51
Bifacial flat (NS)	--	--	--	--	--	13	n/a	2	15
Bifacial flat/convex (S)	--	--	--	--	--	18	n/a	--	18
Bifacial flat/convex (NS)	--	--	--	--	--	12	n/a	3	15
Bifacial wedge (S)	--	--	--	--	--	14	n/a	--	14
Bifacial wedge (NS)	--	--	--	1	--	26	n/a	1	28
Bifacial convex/irreg (S)	--	--	--	--	--	4	n/a	--	4
Bifacial convex/irreg (NS)	--	--	--	--	--	5	n/a	--	5
Multifaceted (S)	--	--	--	--	--	6	n/a	1	7
Multifaceted (NS)	--	--	--	--	--	20	n/a	--	20
Untyped	--	--	3	--	4	289	55	18	369
Total	4	0	6	6	7	729	130	64	

* = Note that (NS) refers to “not shaped” and (S) refers to “shaped”

** = The author did not have access to the entire collection, therefore was not able to assign the original analyzed collection into the more detailed categories in the above morphological types.

quantified during the present analysis, but would be an attribute of interest to pay closer attention to in future ground stone studies.

A total of 266 milling slab/metate specimens, including fragments, were documented for this collection. Of these, 76 were untyped due to their fragmentary nature. Twenty-nine percent (29%) of the metate specimens appear to have been fire-affected to some degree, including two flat slab types burned only on the grinding surface itself. By far, schist is the most common lithic raw material for milling slabs (68% of the class assemblage), followed by quartz monzonite/monzogranite (22%) with lesser amounts of diorite/granitic (16%), sandstone (2%) and rhyolite (2%).

Thirty-one specimens (16% of the typed specimens) were determined to be shallow basin types. All of these exhibited grinding on one surface (unifacial). Twenty-three of the shallow basin metates were complete enough to measure a reliable maximum basin depth, which ranges from 0.8 mm to 3.5 mm with a mean of 1.6 mm. The basin-shaped milling slabs most often tend to be oval in shape. Only two (6.0%) of the shallow basin metates have been fire affected. At least five shallow basin metates exhibit some intentional shaping, particularly on one or more edges, possibly for ease of use, and on the underside to form a smoother base that would presumably provide a sturdier foundation for grinding activity. The grinding surface of one shallow basin metate has probably been re-pecked.

Three metates (2% of the typed specimens) were classified as block slabs, with flat grinding surfaces prepared from large blocks of rock, in this case, two specimens from quartz monzonite (or monzogranite) and one from schist. The remaining 156 specimens (82% of the typed milling slabs) were classified as flat slab types. Forty-six of these exhibit definite or possible bifacial grinding surface use, however this type of use wear may be underrepresented due to the degree of fragmentation of many of the specimens. At least 16 flat slab metates (10%) show some evidence of shaping. Only two of the flat milling slabs have been re-pecked on the grinding surface.

Ten pestles are counted with this collection, all of which exhibit intentional shaping to some degree, including one pestle “blank” that has been roughly shaped but does not display any ground surfaces of use wear. The two major pestle forms, as described by Kolvet and Eisele (2000), are categorized by seven bipolar conical specimens and one bipolar cylindrical artifact. One specimen is a medial fragment that is untyped. Three pestles have ground surfaces along the shaft of the artifact in addition to use wear at the end(s).

4.5.7 Antelope Valley College/Roger Robinson 1994-96 Monitoring Project

The final report (Robinson 1996) produced for the project included artifact counts according to collection strategy, artifact class and rough morphological type. The ground stone types were simply divided by raw material type, then by complete versus fragmentary, bifacial versus unifacial or untyped, and for the metates, basin-shape versus

slab-shape. This author only had direct access to twenty specimens out of the approximate total of 250 ground stone artifacts mentioned in the final report.

Robinson (1996) counts 150 handstones, or manos, in his collection. Of these, 72 (48%) are described of granitic composition, 34 (23%) are schist, 22 (15%) andesite, twelve (8%) sandstone and ten (6%) gabbro. These rock material classifications should be considered with some caution however. In the small sample of sixteen handstones evaluated for this study, six (35%) of the specimens were counted as granitic, four (24%) were schist, two each (12%) were sandstone and diorite, and one specimen each (5%) was quartz monzonite (or monzogranite) and quartzite. This is a much greater variety of materials than Robinson's analysis revealed. In addition, since Robinson did not specifically distinguish fire-affected specimens, it is suspected that the "andesite manos" may actually have represented burned granite or diorite artifacts, since andesite handstones have not been identified within any of the other collections for the Lovejoy Springs site. Additionally, andesite deposits, comprised of a dark-colored extrusive volcanic rock, are not known from this part of the Antelope Valley.

In Robinson's analysis, 40% of the manos exhibited bifacial grinding surfaces, 15% were unifacial, and 45% remained untyped. In comparison, for the small sample subset directly analyzed for this report, eleven (69%) were untyped due to the greatly fragmented nature of the collection, four (25%) were bifacial and one (6%) was unifacial. These numbers are consistent with trends identified during the analysis of the Pyramid Archaeology collection. Additionally, eleven (69%) of the sample specimens were fire-affected to some degree.

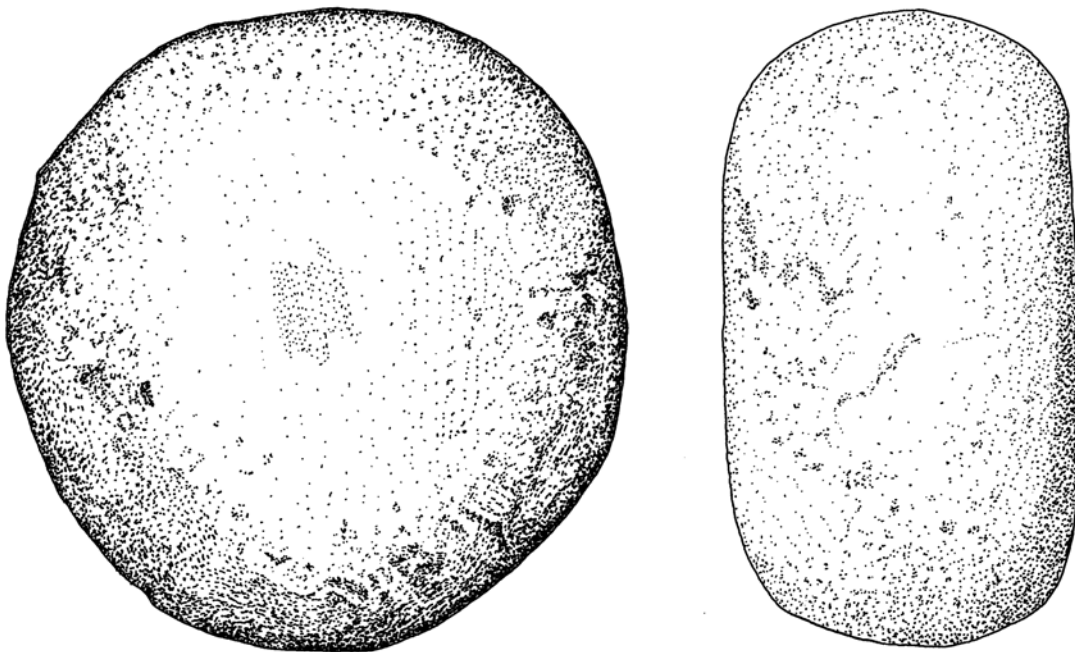


Figure 13. Bifacial flat handstone

A total of 99 milling slab, or metate, specimens were counted in the Robinson collection. Of these, 62 (62.7%) were too fragmented to type. Sixty-one percent (61%) were of schist material, followed by granite at 37%, and rhyolite and gabbro accounting for 1% each of the collection. Only two milling slab fragments were directly analyzed from the sample for this study. Both were untyped, one specimen being granite and burned, the other quartz monzonite/monzogranite with no evidence of having been affected by fire.

Of the 37 artifacts that could be typed, Robinson (1996) classified seven as basin-shaped and thirty as slab-shaped. Further, eleven (30%) specimens exhibited grinding surfaces on two sides, while the majority (70%) was unifacial. Again, these findings were consistent with the other Lovejoy Springs collections analyzed for this study.

4.5.8 Applied Earthworks Collections

The number of ground stone specimens collected from the effects assessment and emergency excavation activities was quite small. In contrast, the monitoring activities recovered 412 specimens. Due to time constraints, only a sample of these collections was analyzed for discussion in this report. A 30% random sample of the 2005 monitoring collections was analyzed. Additionally, all of the Applied Earthworks collections were purposely left unwashed in anticipation of a future protein residue and/or pollen/phytolith analysis program.

Out of the monitoring sample, 64 artifacts are classified as handstones. Of these, 15 specimens are untyped and four additional handstones can only be characterized by partial attributes. Burned handstone specimens account for 32% (N=22) of the sample. Only one handstone shows evidence of a re-pecked grinding surface and two handstones display possible end battering.

The dominant raw material used is intrusive granitics, counting for 31 (48%) of the specimens, plus the closely related diorite (8%), followed by 15 (23%) schist handstones, nine (14%) sandstone specimens and 3% or less of orthoquartzite, quartz monzonite (or monzogranite) and an unknown rock type.

From the 46 handstones that could be completely typed, the majority (59%) were classified as bifacial convex, either shaped or not shaped (see Table 1). Artifacts that were unifacial convex and bifacial flat each number seven and represent 15% of the sample. Handstones that are not shaped outnumber those that are intentionally shaped by 26 (57%) and 20 (43%), respectively.

Eighteen milling slabs are identified for the monitoring sample, as well as seven additional possible milling slab fragments. Eleven (44%) slabs and fragments are composed of granitic material, including six from the "local" butte pegmatite formation, seven (28%) are composed of quartz or (monzogranite), six (24%) of schist, and one (4%) specimen formed from a type of conglomeratic sandstone.

Table 2 – Milling Slab Counts by Morphological Type, Raw Material, and Collection

Type	Collection Name								Total
	Unprov.	Wubben	ASA 1954	UCLA 1968	Cerro Coso	Bruce Love	AVC/ Robinson	Æ Collections (sample)	
Flat Slab Schist	1	--	--	--	--	97	5	3	106
Shallow Basin Schist	1	1	--	--	1	3	4	--	10
Block Slab Schist	--	--	--	--	--	1	--	--	1
Flat Slab Granitic/Diorite	--	--	--	--	--	10	23	--	33
Shallow Basin Granitic/Diorite	--	--	--	--	--	5	3	1	9
Block Slab Granitic/Diorite	--	--	--	--	--	--	--	4	4
Flat Slab Monzonite	--	--	--	--	--	36	--	--	36
Shallow Basin Monzonite	--	--	--	--	--	20	--	--	20
Block Slab Monzonite	--	--	--	--	--	2	--	1	3
Flat Slab Other*	--	--	--	--	--	6	2	--	8
Shallow Basin Other*	--	--	--	--	--	3	--	--	3
Block Slab Other*	--	--	--	--	--	--	--	1	1
Untyped Schist	--	--	1	--	1	80	51	2	135
Untyped Granitic	--	--	--	--	--	1	11	5	17
Untyped Monzonite	--	--	--	--	--	2	--	1	3
Untyped Other*	--	--	--	--	--	--	--	--	0
Total	2	1	1	0	2	266	99	18	389

* = Other includes rhyolite (tuff), sandstone, and conglomerate.

Twelve (48%) milling slabs have been fire-affected, most of these being the untyped fragments. Block slabs make up 28% (7) of the sample, followed by two (8%) flat “thin” slabs and one (4%) shallow basin metate. Fourteen (56%) of the milling slabs are classified as untyped. Seven (28%) specimens exhibit some degree of purposeful shaping, particularly of the basal portion of the block slab metates. Only one flat slab potentially shows two opposing ground surfaces. Only one flat slab specimen exhibits possible grinding surfaces on two sides.

Within the monitoring sample, three bowl fragments were identified, including one specimen each of general metamorphic, schist and sandstone materials. The sandstone fragment was fire-affected.

Three pestles were identified in the monitoring sample. Two are composed of granitic material and one particularly nice specimen is made from steatite/soapstone with incised lines on the narrow end to produce a “paw-like” feature (Figure 14). Pecking or battering, and a possible ground side surface is also visible on this interesting piece. One of the granitic pestles shows some evidence of burning at the end.



Figure 14. Steatite pestle with “paw”-like incising

Twenty-eight specimens are described as untyped to an artifact class (i.e. handstone, milling slab). Of these, 16 (57%) are burned and all are highly fragmented or composed of decomposing rock material.

4.6 RESULTS DISCUSSION

Based on the collections analyzed for this study, a number of general observations on the ground stone industry of the Lovejoy Springs site can be made. Handstones and milling slabs are clearly the dominant ground stone artifacts encountered at the site and detailed analysis can reveal important patterns about raw material acquisition, ground stone implement design and usage.

Milling slabs are almost equally comprised of schist and granitic/monzogranite materials at 30% and 27% respectively. The granitic materials are more massive and were probably extracted directly from Lovejoy Buttes and maintained onsite at all times as site “furniture.” The schist materials, used for milling slabs with greater portability, would likely have been transported from sources in the foothills of the San Gabriel Mountains, at least fifteen miles away.

Flat slab metate types are the most common (78% of the total typed milling slab assemblage), and the thinner schist materials are particularly prevalent (58%) for this category. Fifteen percent of the milling stone assemblage exhibits bifacial ground surface use, primarily on these schist flat slabs. The more massive granites and monzogranites, not surprisingly, make up most (71%) of the shallow basin and the block slab metates. These larger milling slab forms are more likely to have been intentionally shaped, primarily on the basal side in order to “steady” the large rock block during use. All milling slabs exhibit both oval-shaped and circular grinding surfaces and, although this attribute was not defined quantitatively, the oblong surfaces and depressions appear to be much more common.



Figure 15. Typical block slab metate

This finding would seem to agree with the classification of the handstones, where most of the typed artifacts (71%) have at least one convex grinding surface, reflecting the use of reciprocal grinding motions. The reciprocal motion (i.e. rocking the handstone back and forth) would have the effect of creating an elongate grinding surface on the corresponding milling slab (Adams 2002). Analogously, handstones with flat grinding surfaces, generally attributed with being used in a circular motion, form a flat or circular ground face on the milling slab. These forms make up approximately 22% of the typed Lovejoy collection, including combination flat/convex bifacial specimens.

Those handstones with use wear on two or more faces account for 86% of the total assemblage, while the remaining 14% are described as unifacial. Interestingly, most (88%) of the unifacial specimens are not shaped. As well, 74% of the multifaceted handstones are not shaped. This is likely a result of all the “natural” faces of the original cobble being used. Formally shaped handstones number 45% of all typed artifacts, and is most apparent among the bifacial forms, equaling 52% of the manos ground on two surfaces. Virtually all of the bifacial handstones are ground on opposing sides, with only a handful of exceptions.

Re-roughening of the grinding surfaces seems to be rare, although this practice may have been utilized several times before the artifact was finally discarded into the archaeological record showing smooth ground surfaces. Without good intrasite provenience, discard practices at Lovejoy Springs are virtually impossible to reconstruct, however due to the large number of burned handstones (approximately 35% of the specimens identified to class), and to a lesser degree, milling slabs (approximately 30%), we can postulate that the recycling of utilitarian ground stone artifacts into a secondary use as hearth stones appears to have been widely practiced. It is interesting to note that Greenwood (1969:23) has postulated that smaller milling equipment, such as handstones, tended to wear down more quickly than larger milling slabs, accounting for the disproportionate ratio of handstones to milling slabs often found at archaeological sites.

Mortars, pestles and bowls are rare, making up only a small portion of the total Lovejoy ground stone assemblage. Some of these, due to use of non-local materials and interesting design variations, may have been transported or traded in from other areas of southern California. Other types of ground stone, which includes possible ornamental artifacts, are also rare, but do include stone beads, a perforate steatite “donut stone,” and slate pieces or discs.

4.7 REGIONAL COMPARISONS AND IMPLICATIONS

Since the Lovejoy Springs site has experienced extensive disturbance and re-deposition, good spatio-temporal context is difficult to construct. However, we can use chronometric dating techniques and comparisons to other regional archaeological sites that have been well studied in an attempt to gain some understanding of the Lovejoy Springs site chronology and nature of occupation. Based on the radiocarbon dates retrieved thus far at Lovejoy Springs, there appears to have been significant Gypsum (2000 BC- AD 500) and Rose Spring/Saratoga Springs (AD 500-1200) occupation, with some Protohistoric components and a possible minor Pinto Period (5000-2000 BC) use. That the Lovejoy site has such an extensive milling stone assemblage and a relative paucity of flaked stone materials provides a starting point for comparison to other regional sites, although it should be noted that this comparison is only preliminary.

Throughout southern California, from the Santa Barbara coast to San Diego County, several prehistoric sites with particularly large assemblages of milling implements have been documented. This “Milling Stone (Millingstone) Horizon” is generally characterized by large numbers of handstones (manos) and milling slabs (metates), few mortars/pestles, abundant scraper planes and core-cobble tools, small numbers of projectile points, and a few discoidals and/or cogged stones (Basgall and True 1985:3.11-3.121). Typically, the presence of manos and metates has been related to the processing of hard seeds. Several archaeological complexes are recognized that fit the “Milling Stone” description including the Oak Grove, La Jolla, Pauma, Topanga, and Sayles.

At 6000-3000BP, or extending as far as back 8000 BP or up to A.D. 1 in some locations, the chronological placement of the coastal Milling Stone Horizon is roughly coincident

with the Pinto and early Gypsum periods defined for the inland and desert regions. The wide range of dates attributed to the Milling Stone Horizon, combined with the corresponding moister Medithermal climatic period suggests that the manifestation represents more of an adaptational technology rather than a discrete cultural-chronological unit as early researchers first suggested (Basgall and True 1985).

The Oak Grove culture (circa 5100-2000 B.C.) was the oldest Milling Stone Horizon complex described for the Santa Barbara coastal region, and was defined by abundant milling implements, including narrow deep-basined metates and a few crude projectile points. Oak Grove sites were located toward coastal foothills to take advantage of inland rather than marine resources (Moratto 1984). To the south, the La Jolla Complex, roughly dated between 8000-2000 BP and largely found in relation to estuarine shell middens from Orange County to central Baja California, is predominated by wide oval basin-shaped millingstones, unshaped manos/handstones, flaked cobble tools, as well as a few Pinto-like projectile points, perforated and imperforate discoidals, and cogged stones (Wallace 1954: 119; Moratto 1984:147; Basgall and True 1985). Nearby in inland northern San Diego County, the milling stone assemblages of the Pauma Complex are quite similar to those of the La Jolla, and may in fact represent an inland variant (Moratto 1984:152).

The Las Montañas site (CA-SDI-10246), located in inland San Diego County, is an example of a small Milling Stone site (see Yohe and Chace 1995). It is dated to 2650 ± 200 radiocarbon years BP and likely has an affinity to the Pauma Complex. Within the ground stone collection from this site, most of the handstones are made on local metavolcanic and metasedimentary river cobbles, with only a small portion (less than 10%) showing any intentional shaping. Approximately 70% of the complete handstones had bifacial use. Although not quantified, several specimens exhibited secondary end battering and/or were fire-affected. Milling slabs consisted of slab and block types, with the latter more common. One discoidal of volcanic material was identified.

Within Los Angeles and Ventura counties, several Milling Stone sites were investigated in the 1940s through 1960s. In Topanga Canyon, three phases were defined within the so-called "Topanga Complex." All phases were characterized by large milling stone assemblages, but differed in their flake and core tool industries. Phase I yielded numerous "scraper planes," choppers and core hammerstones, while Phase II was distinguished by the presence of incised and cogged stones, fewer core tools, and increased numbers of small projectile points. A third phase included mortars and pestles in addition to a wider variety of flaked tools and the emergence of earth ovens (Moratto 1984:127; Basgall and True 1985). In general, deep-basined metates are the most common form found in Topanga sites, with few flat slab types. Handstone forms, potentially providing important information based on use wear and design features, have not been discussed at any length, as they are seen by some researchers as non-diagnostic (Basgall and True 1985).

Similar Topanga Complex components have been identified at other sites, such as the Little Sycamore site, located on the coast near the Ventura-Los Angeles County line

(Wallace 1954). The milling implements at Little Sycamore, all of sandstone material, predominately consist of large basin-shaped milling slabs and unifacial non-shaped handstones, with only a few mortars and pestles and ornamental ground stone items (Wallace 1954).

The Browne site (CA-VEN-150), affiliated closely with the Topanga Complex and located ten miles inland along the Ventura River drainage midway between Ventura and Ojai, yielded a very large number of ground stone implements, especially handstones. Two-thirds of the handstone assemblage was classified as bifacial (46% bifacial parallel and 23% bifacial “wedge”), the remainder of the collection being unifacial, with only a handful of manos exhibiting use wear on more than two faces (Greenwood 1969:18). A large number of the handstones exhibit re-pecked surfaces (35% of the unifacial specimens and 60% of the bifacial artifacts), probably due to the fact that the sandstone material used almost exclusively wears down relatively quickly (Greenwood 1969:18). No distinction was made between intentionally shaped and non-modified handstones.

Of the total metate assemblage from the Browne site, 10% were of the “flat” slab type, while basin or platform milling stones comprised 87% (Greenwood 1969:22). There was no distinction made between deep or shallow basin forms, only by the pattern of wear on the grinding surface, which was dominated (65% of the basin metates) by the “push-pull” or oval-shaped type. Only 21% of the milling slabs exhibited any intentional exterior shaping and 22% had been “killed.” As in other Milling Stone Horizon sites, mortars and pestles were rare. Also included in the assemblage, although in very small numbers, were discoidals, perforate “donut” stones, serpentine beads, bowls, ground stone balls, and two effigy figures.

The inland manifestation of the Milling Stone Horizon appears to occur later than along the coast, and to blend with desert adaptations, such as the Pinto Basin Complex (Kowta 1969). Warren’s (1968) “Campbell Intrusion” has been proposed to explain the occasional Pinto projectile points found in relation to Milling Stone components as being the result of a new hunting-based cultural tradition moving into the territory of and influencing traditionally Milling Stone peoples. The debate continues over whether this “Intrusion” was due to actual population migrations or merely to increased trade between coastal and desert peoples (Moratto 1984:164). Certainly by the end of the Early Period coastal Milling Stone Horizon circa 1500-1200 B.C., the Takic branch of Uto-Aztecs had moved into the southern California area from the deserts as part of the great migration commonly known as the “Shoshonean wedge” (Moratto 1984). Even then, the evidence suggests that the Milling Stone Horizon “replacement” was of a more gradual nature as new archaeological materials become incorporated into the existing technological assemblage (Basgall and True 1985:10.20-10.21).

The influence from this migration may be reflected in the so-called Inland Millingstone adaptation, which has been studied relatively extensively for the San Bernardino Valley and Cajon Pass regions, based in part on research conducted by Kowta at the Sayles site (CA-SBR-421), as well as Basgall and True (1985) and others at sites in the Crowder Canyon archaeological district. Kowta (1969:1) has noted that the Sayles Complex

represents a post-Shoshonean (1000 B.C.) remnant of an earlier Milling Stone Horizon-Pinto Basin tradition continuum extending across the Transverse Ranges. The Sayles complex is most closely related to Topanga, which Kowta (1969:44) believes to have “interdigitated” with the Pinto Basin Complex in the vicinity of the Cajon Pass. Similarities between the complexes include high frequencies of handstones (manos) and milling slabs (metates), scraper planes and core-cobble tools, and generally small numbers of mortars and pestles, projectile points, discoidals and coggled stones (Basgall and True 1985:3.12). Although use for the grinding of hard seeds is certainly suspected, the Crowder/Sayles milling stone industry has also been implicated in the processing of fibers, such as yucca and agave. The Millingstone Horizon for Crowder Canyon dates to approximately 3000-1000 BP (Basgall and True 1985:10.1).

Basgall and True (1985) provide a detailed ground stone analysis that can be directly compared to the collections from the Lovejoy Springs site. At the Ridge site (CA-SBR-713) in Crowder Canyon, 46% of the metate assemblage is of the slab type and 34% are basin-shaped, most of these being classified as deep basin forms with ground surface depths in excess of 5.0 cm (Ruhstaller 1985). Further, 92% of the milling slabs exhibit oval or oblong-shaped grinding surfaces in contrast to only three specimens with circular-shaped surfaces. Over 50% of the specimens show evidence of being fire affected, two-thirds have had some intentional shaping, and the preferred milling slab material was schist as evidenced in over 60% of the total metate specimens (Ruhstaller 1985).

Of the Ridge site handstones, over 70% appear to have been fire-affected and 66% employ secondary use battering. Locally available granitic and gneissic materials were preferred, accounting for 79% of the handstone assemblage. Flat grinding surfaces were documented for 29% of the manos, while 52% exhibited convex surfaces. Of the typed handstones, 80% showed bifacial use and the remaining 20% employed use wear on one face only. Up to 60% of the handstone specimens displayed evidence for pecking of the grinding surface. Unfortunately, the degree of intentional shaping of the ground stone implements was not noted for this study.

Additionally, six mortars, including two bowl-shaped fragments, and four pestles were recovered from the Ridge site. Fifty-six flat ground stone beads, probably of schist material, and five stone ornaments or perforated pendants (three slate, one schist and one volcanic tuff) complete the ground stone assemblage from the site.

In general, similar patterns of utilitarian ground stone use and morphology were shown for Loci C and D of the Sayles site, which also produced a large ground stone assemblage. However, there was a slightly greater number of “thick” slab over shallow basin metates than at the Ridge site. Interestingly, a small number of the manos recovered were described as “atypically small” (Basgall and True 1985:7.26, 8.28).

Beyond the Milling Stone sites documented for southern California, some sites to the north have produced large ground stone assemblages as well that can be analyzed for comparison with the Lovejoy site. In the southern Owens Valley, CA-INY-30 sits on an alluvial fan near Lubkin Creek and the Alabama Hills. Occupation of the site extends

from the Lake Mojave-Little Lake period (5500-3200 BP) through the protohistoric (Basgall and McGuire 1988). The milling equipment identified at the site consists of bedrock milling slick and mortars, milling slabs, and handstones.

Millings slabs at INY-30 were predominately (72%) of the “thin slab” type, with a quarter of these exhibiting bifacial grinding surfaces. “Thick” slabs and block slabs are also found, but in limited abundance. Local conglomerate sandstones and granitics were the primary material sources for the milling slabs, with lesser amounts of non-local schist and volcanics. Less than 20% of the total slab assemblage reflect any purposeful shaping. Flat grinding surfaces are more common than those with either shallow or deeper concavities.

Among the handstone assemblage, Basgall and McGuire (1988) feel that “shaped” specimens are more reflective of secondary use wear rather than intentional modification. Forty of the handstones are described as shaped, and all of these have bifacial wear. Flat grinding surfaces account for 41% of the bifacial shaped handstones with the remaining 59% of the specimens ranging from slightly convex to rounded surfaces. Of the 82 unshaped handstones, 39% are ground on one surface only, an equal amount are ground bifacially, six are ground on three faces, and fourteen are untyped. Locally available granitic cobbles make up a large percentage of the material used in handstone manufacture. Eighteen additional handstones are described as “incipient” with only light or marginal use apparent. A large proportion of all types of handstones were burnt and/or fragmented.

Due to better spatio-temporal controls placed on the excavations at INY-30, Basgall and McGuire (1988) were able to make several observations on the temporal patterns of the ground stone assemblage. Bifacial surface use of both milling slabs and handstones is most common in deposits dating to the Newberry Period (3200-1350 BP), as well as a high degree of burned artifacts, which suggests more intensive milling equipment use patterns, both primary and secondary, during this time. Additionally, the quantity of ground stone artifacts from Newberry contexts is relatively high. The ground stone assemblage from Haiwee Period (1350-650 BP) contexts is small, but all specimens show unifacial ground surface use. The milling slabs from Marana Period (650 BP to historic) deposits all lack measurable grinding surface concavity and the handstones are generally unshaped with roughly equal numbers of unifacial and bifacial specimens as well as fewer burned specimens, indicating a later trend toward more expedient use of milling equipment.

There have also been some suggestions of similarities between the southern California Milling Stone Horizon and the Cochise culture of southeastern Arizona (Wallace 1954:121-122), where large numbers of ground stone artifacts are a distinguishing feature of this pre-ceramic Southwest tradition. The Chiricahua Cochise (3500-1500 B.C.) is defined by cobble (presumably unshaped) handstones and shallow milling slabs, along with scraper and chopper tools and primarily side-notched concave base projectile points (Cordell 1984:160). The later San Pedro phase of the Cochise culture (approximately 1500 B.C. to A.D. 1), in addition to changes in projectile points, includes more basin-

shaped milling slabs and the introduction of mortars and pestles (Cordell 1984:160-162). Whether or not these similarities between Cochise and the Milling Stone Horizon are real, coincidental or just reflect a wider Desert Culture influence is a much larger research question that is beyond the scope of this study.

4.8 CONCLUSIONS

Detailed analyses, or any analysis at all, of ground stone assemblages in the western Mojave Desert are certainly rare. Much more focus has generally been placed on the flaked stone assemblages, viewed to be more reliable as temporal and cultural markers. It is hoped that more of the large Antelope Valley ground stone collections, from sites such as Barrel Springs, receive similar levels of analysis to this study in the near future so to achieve a better understanding of the regional ground stone industry. Further, descriptions of the ground stone assemblages for many of the southern California Milling Stone Horizon sites are sufficiently general that direct detailed correlations with the Lovejoy Springs site are rather limited, however an attempt will be made here to do so.

The Lovejoy Springs site ground stone collections appear to “bridge” the Milling Stone Horizon components of inland southern California types at Crowder Canyon in the Cajon Pass, with more desert-adapted toolkits found at Great Basin sites such as INY-30. The high number of handstones with bifacial wear at Lovejoy is similar to the proportions found among sites attributed to the inland Sayles and Topanga complexes. As well, secondary use of milling implements, especially through recycling into hearth stones, seems to have been commonly practiced at both Lovejoy and in Crowder Canyon. Although the number of intentionally shaped handstones is somewhat less at Lovejoy Springs than at the Ridge site, it remains far higher than at INY-30, where few if any handstones are described as shaped.

On the other hand, the high incidence of flat slab milling stones from the Lovejoy Springs site is more comparable to those at INY-30 and these tend not to be shaped at all. The Ridge site had a greater number of basin-shaped milling slabs, particularly of the deep-basined type, and there were more shaped thin slab types than the thick slab metates.

Although certain ground stone classes found at Lovejoy may be similar to coastal types, such as the “donut” stone, bowls and possible discoidals, in general the coastal sites are dominated by unshaped unifacial handstones and deep-basined milling slabs, attributes which are quite the opposite among the Lovejoy collections. Therefore, similarities in artifact classes are likely a function of trade relations rather than temporal or cultural affiliations. Additionally, one would expect the adaptational contexts for use of milling equipment to vary significantly between the coast and the western Mojave Desert. In all cases, materials used for ground stone tools were largely available locally. This would make sense given the great weight of certain stone blocks and lack of wheeled or domesticated animal transport in prehistoric California.

Overall, the closest comparable affiliation of the Lovejoy Springs site would be to the Sayles Complex as defined in the Crowder Canyon sites. The differences noted between

the two ground stone assemblages are likely related to local floral resource availability. The macrobotanical study for the Ridge site revealed the presence of chaparral-type plants such as California juniper (*Juniperus californica*), chamise (*Adenostoma fasciculatum*), bigberry manzanita (*Arctostaphylos glauca*), sugar bush (*Rhus ovata*), tarweed (*Hemizonia* sp.), trefoil (*Lotus* sp.), mustard family (*Brassicaceae*), and the grass family (*Poacea*). Plants identified during analysis of the Lovejoy Springs site included saltbush (*Atriplex* sp.), red maids (*Calandrinia* sp.), goosefoot (*Chenopodium* sp.), bush seepweed (*Sueda* sp.), and the sunflower (*Asteraceae*), mustard (*Brassicaceae*), mallow (*Malvaceae*) and grass (*Poaceae*) families, all plants found in a desert spring environment (Popper 2006).

Based on the comparison to the Crowder Canyon district, a tentative temporal context for the greatest ground stone use can be assigned to the Gypsum Period, with some likely overlap into the Saratoga Springs Period. This is also coincident with the Newberry Period at INY-30, to which the ground stone tools date that exhibit evidence of more intensive use most similar to the majority of the assemblage at Lovejoy. The Gypsum period is known to have been a time of cooler and moister climate, when occupation of the Mojave Desert generally intensified, and spring seed plant resources, such as those that Lovejoy Springs likely provided, would have become particularly important in the desert subsistence pattern. As indicated for INY-30 and the Crowder Canyon sites, use of the Lovejoy site was likely in terms of a seasonal residential base camp occupied regularly over an extended period of time.

Basgall and True (1985:10.23) have noted that the southern California Milling Stone adaptation “represents a generalized gathering economy having a strong focus on vegetal resources.” The evidence from the Lovejoy Spring site would seem to fit this model quite well, and it is posited that Lovejoy represents one of several sites in the Antelope Valley that make up a local desert manifestation of the inland Milling Stone “Horizon.” Certainly, additional comparative collections should be examined and future ground stone research should be undertaken to a comparable level of detail using a technological approach, but the Lovejoy Springs site provides just another interesting piece of the puzzle toward unraveling the prehistory of the Antelope Valley.

5

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: PROJECTILE POINTS

In total, 31 projectile points were complete enough to allow classification as to type. These points were identified from both surface collection and subsurface excavations at the Lovejoy site (Table 3). Classification of these forms, in most cases, follows previously defined designations (Gilreath and Hildebrandt 1997; Lanning 1963; Wallace 1977). Using, in part, the metric attributes identified by Thomas (1981, 1983), most points were easily classified into standard Great Basin and Mojave Desert types. The projectile point inventory provides examples of several types commonly found throughout the Desert West. These projectile points suggest that the Lovejoy site was initially occupied during the Middle Holocene Period and cultural activities appear to have been represented there through the end of the Late Holocene.

The assemblage includes points assignable to the Pinto (2), Elko (2), Gypsum (1), Humboldt Basal-notched (1), Saratoga Springs (3), Rose Spring (5), Cottonwood (17), and Desert Side-notched (1) series. One relatively complete specimen—a large lanceolate, concave base, dart point—did not allow categorization according to standard typologies (see below for further discussion). Additionally three fragmentary arrow points were not complete enough to be differentiated as to their particular series.

Looking solely at their typological affiliation, two points were possibly Middle Holocene age, five were assigned to the Initial Late Holocene interval, seven to the Intermediate Late Holocene age, and 16 to the Terminal Late Holocene Period. The majority of the stone materials used in the manufacture of the projectile points are exotic to the immediate site area. Chert or chalcedony is the most abundant material and is represented by 18 (53%) of the classified specimens. Points manufactured from both Franciscan and Monterey chert were identified ($n = 3$, 9%). This form of toolstone material originated from coastal environs over 50 miles southwest of the Lovejoy site. Other materials used in the manufacture of the projectile points are rhyolite ($n = 5$, 15%), basalt ($n = 1$; 3%), quartz (1, 3%), and obsidian ($n = 9$, 26%).

Most of the obsidian points were analyzed to trace their geochemical source and for their hydration measurements to independently estimate their age. Nine points were manufactured from obsidian originating at the Coso Volcanic Field—specifically West Sugarloaf Mountain or Sugarloaf Mountain proper (Skinner 2006). The Coso obsidian hydration readings exhibit values that increase in size, as expected, from the most recent Desert series ($n = 2$, mean = 3.3 microns), to the intermediate aged Rose Spring and Saratoga Spring ($n = 2$, mean = 3.85 microns), through the most ancient Elko and Pinto points ($n = 3$, mean = 6.2 microns). As shown in Table 4, the obsidian hydration measurements for the various point forms generally conform to the expected ranges for the various types of points as to the respective time periods that have been identified.

Table 3. Projectile Point Attributes

Lot Number	Specimen	Field Collection	Provenience	ML	AL	MW	BW	Th	DSA	PSA	Wt	Material	Point Type	Hydration Rim Width
1	1	BWC 1920	Surface	64	64	35	16	7	180	85	14.5	Fr. Chert	G	
1	3	BWC 1920	Surface	17	14	14	14	5	NA	NA	0.8	Chalcedony	CT	
1	4	BWC 1920	Surface	26	22	13	13	5	NA	NA	1.2	Chalcedony	CT	
1	5	BWC 1920	Surface	15	15	11	11	3	NA	NA	0.5	Moss Agate	CT	
1	6	BWC 1920	Surface	27	25	14	14	5	NA	NA	1.7	Rhyolite	CT	
1	7	BWC 1920	Surface	19	19	13	13	3	NA	NA	0.8	Rhyolite	CT	
1	8	BWC 1920	Surface	19	16	12	12	5	NA	NA	0.8	Rhyolite	CT	
1	10	BWC 1920	Surface	20	20	14	14	4	NA	NA	1.2	Rhyolite	CT	
1	19	ASA 1954	Surface	15	15	12	12	6	150	130	1.2	Quartz	RS	
2	8	ASA 1954	Surface	18	16	12	12	3	NA	NA	0.7	Chert	CT	
4	14	ASA 1954	Surface	33	33	9	16	5	185	95	2.8	Chert	RS	
4	15	ASA 1954	Surface	53	53	23	23	4	NA	NA	5.2	Obsidian	SS?	3.8/7.2
4	16	ASA 1954	Surface	32	32	16	16	4	NA	NA	2.0	Chalcedony	CT	
4	18	ASA 1954	Surface	29	29	10	13	5	NA	NA	2.0	Obsidian	CT?	3.4/6.5
4	20	ASA 1954	Surface	30	30	15	15	5	NA	NA	1.6	Chert	CT	
4	21	ASA 1954	Surface	24	24	5	12	2	200	100	0.7	Chert	RS	
4	24	ASA 1954	Surface	37	32	22	22	7	NA	NA	4.8	Chert	SS	
4	25	ASA 1954	Surface	25	22	10	10	4	NA	NA	0.9	Basalt	CT	
4	26	ASA 1954	Surface	17	11	12	12	3	NA	NA	0.4	Chalcedony	DSN	
4	27	ASA 1954	Surface	26	26	7	16	5	150	130	0.5	Obsidian	RS	3.9/5.3
4	29	ASA 1954	Surface	16	13	12	12	5	NA	NA	0.9	Rhyolite	CT	
4	28	ASA 1954	Surface	25	20	18	18	3	NA	NA	2.0	Obsidian	CT/HBN	3.2
4	22	ASA 1954	Surface	39	39	21	21	8	190	145	9.8	Mnt. Chert	P	
1	2	UCLA 1968	Burial E	34	34	30	25	3	160	130	3.7	Obsidian	ECN ¹	5.5
2	1	UCLA 1968	TP 4, 0-6 in.	25	25	18	8	3	110	125	0.7	Obsidian	E	5.5
1	1	BL 1990-92	Trench, 0-20 cm	55	50	28	28	7	NA	NA	17.4	Fr. Chert	IND	
4	42	ASA 1954	SC4 Surface	39	40	34	(27)	6	170	130	6.9	Obsidian	P	7.8
4	13	ASA 1954	SC13 Surface	22	22	11	11	4	NA	NA	.8	Obsidian	CT	4.0
4	12	ASA 1954	SC4 Surface	39	39	23	23	7	NA	NA	5.9	Obsidian	SS	3.8/7.2
082-039	3722	AVIM ²										Rhyolite?	RS?	
082-039	1819	AVIM ²										Chert	CT	
082-039	1820	AVIM ²										Chert	CT	

¹ Eccentric point

² AVIM projectile points were unavailable for analysis. Typological attributions are based solely on on-line photos and subjective determinations of affinities. Provenience also is unknown but likely from surface contexts.

TABLE 3 KEY: AL- axial length; BW- basal width; DSA- distal shoulder angle; ML- maximum length; MW- maximum width; NA- not applicable; PSA- proximal shoulder angle; Th- thickness; Wt- weight.

Field Collection Codes: ASA = Archaeological Survey Association of Southern California; AVIM = Antelope Valley Indian Museum; BL = Bruce Love; BWC = Bob Wubben Collection; UCLA = University of California, Los Angeles.

Point Type codes: CT = Cottonwood; ECN = Elko Corner-notched; ESN = Elko Side-notched; G = Gypsum; IND = Indeterminate; HBN = Humboldt Basal-notched; RS = Rose Spring; P = Pinto; SS = Saratoga Springs

All measurements in millimeters. Weight in grams.

5.1 DESERT SIDE-NOTCHED SERIES

Desert Side-notched points are small, triangular forms usually weighing less than 1.5 g with notches placed high on their margins (Baumhoff 1957; Baumhoff and Byrne 1959). Only one such point was recovered from the site. The age of Desert Series points is well established based on radiometric and other evidence. Most archaeologists agree that these points date to a time interval after AD 1200 (Bettinger and Taylor 1974; Gilreath and Hildebrandt 1997; Thomas 1981). However these points appear as a group to be increasingly later in age as one moves north and east out of the southern Owens Valley. Delacorte (1995) first recognized this trend and argues that these points may in fact be distinctive marker artifacts of Numic groups - indicating their spread and population movement from a homeland in the Owens Valley less than a thousand years ago.

As well, Sutton (1988) and other researchers (Warren 1984) remarked that Desert Side-notched points become less frequent (as a smaller percentage of the projectile point inventory) as one moves south from the Owens Valley and out of the Numic heartland into the Mojave Desert. Archaeological studies conducted in the historic territories of aboriginal groups who spoke languages affiliated with the Takic branch of the Utoaztecan linguistic stock present a pattern of infrequent occurrence of Desert Side-notched projectiles (Warren 1984:423-424, 426). Such a pattern appears to be supported in the current sample with only one Desert Side-notched point identified and a far greater number (n = 15) of Cottonwood Series points represented in the assemblage (see below).

In 1954, the single example of a Desert Side-notched point (specimen 4-26; Figure 16)

was collected from the surface of the site by the Archaeological Survey Association. That point is manufactured from a cryptocrystalline material that mineralogists often identify as chalcedony.



Figure 16. Desert Side-notched projectile point

Table 4. Frequency Distribution of Lovejoy Points by Period

Projectile Points	Measured OH Samples	Obsidian Hydration Range	Estimated Years B.P.	Sequence
16 Cottonwood 1 Desert side-notched	3.2, 3.4, 4.0	<3.3	< 650	Terminal Late Holocene
5 Rose Spring 3 Saratoga Spring	3.8, 3.8 3.9	3.3-4.4	650-1,500	Intermediate Late Holocene
2 Elko corner-notched 2 Gypsum 1 Humboldt	5.5, 5.5	4.4-6.8	1,500-4,000	Initial Late Holocene
2 Pinto	7.8	6.8-14.4	4,000-7,000	Middle Holocene
		14.4-19.0	7,000-13,500	Early Holocene/ Late Pleistocene

5.2 COTTONWOOD SERIES

Cottonwood points are small (usually <1.5 g) triangular points lacking notches with margins typically straight to slightly concave and bases that are straight to deeply concave or notched (Riddell 1951). Examples of the Cottonwood Series having markedly convex bases and blades are referred to as Cottonwood Leaf-shaped points, others are typically identified as Cottonwood Triangular (Heizer and Baumhoff 1961; Lanning 1963; Thomas 1981). Both variants are recognized in the present collection. Most evidence, including radiocarbon assays and other indicators, suggests that in eastern California many of these points are contemporaneous with the Desert Side-notched series (AD 1200-post contact).

Other data, from sites further south in the Mojave Desert, suggest an earlier initiation date there and some researchers believe that Cottonwood points begin during the Intermediate Late Holocene (Warren 1984). Evidence from the Oro Grande site indicates that Cottonwood points were in use there beginning ca. AD 800 (Rector et al. 1979). As such, Cottonwood Series points at Oro Grande were several hundred years more ancient than in eastern California and would overlap in time with the earlier Saratoga Spring form (Justice 2002; Rector et al. 1979). A total of 17 Cottonwood points was identified at the Lovejoy site (Figure 17).

Three of the 17 Cottonwood points (20%) were manufactured from obsidian. The remainder were made from a variety of toolstone materials including rhyolite (n = 4 or 23%), cryptocrystalline (n = 9 or 53%), and basalt (n = 1 or 6%). It appears that rhyolite may have been used as a common material for projectile points only during the time from AD 1200 – contact. The three obsidian specimens had hydration measurements of 3.2,

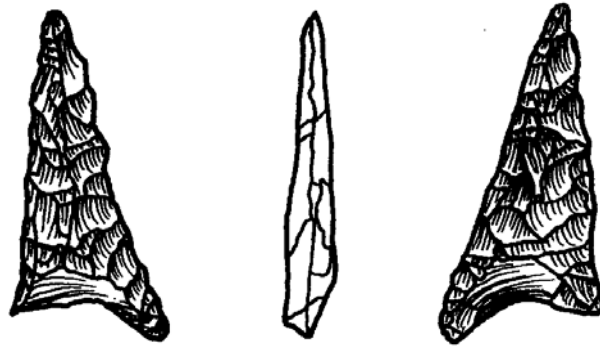
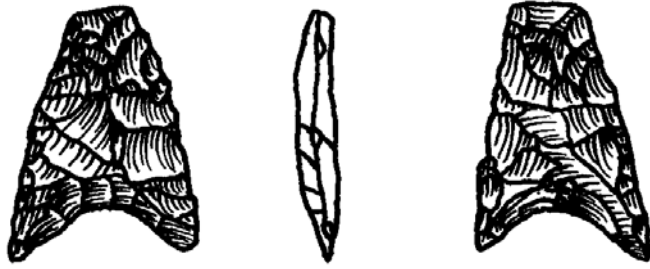


Figure 17. Selected Cottonwood Triangular points

3.4, and 4.0 microns. The first two measurements fall generally within the predicted range of Coso obsidian hydration readings for this era. The 4.0-micron hydration measurement is slightly larger than expected and might represent a somewhat older date. This single measurement provides some limited support to an earlier inception for the Cottonwood Series as noted by some researchers. One caveat with that suggestion is it is sometimes difficult to differentiate simple bifaces from true projectile points and hence this specimen could have been misclassified. As well, obsidian hydration dating is at best a means for relative dating and is lacking in precision. Inferences derived from obsidian hydration measurements have a number of potential problems and the hydration rim readings themselves have sigma values plus or minus .2 microns in size based on typical observation errors characteristic of the method used for reading these measurements.

5.3 SARATOGA SPRING SERIES

Large triangular points, significantly more robust and outside the traditional range of the metric attributes for the Cottonwood Series, have been routinely identified as Saratoga Spring points (Gilreath and Hildebrandt 1997; McGuire and Hall 1987:75; Wallace 1977). Points of this series have been identified in Death Valley, the Coso Range, inland southern California, and the western Mojave Desert. Such forms are rarely identified in sites north of the Mojave Desert, such as the Owens Valley, and the Inyo-Mono region. Saratoga Spring points appear to date from ca. AD 500 to 1200 and as such are associated with the transition from dart to bow and arrow use.

Three examples of points generally conforming to this type were identified. All are surface occurrences - two were manufactured from Coso obsidian and the other from a white chert. Both obsidian points had multiple hydration readings with identical measurements; the smaller rim was 3.8 microns and the larger 7.2 microns. The larger reading probably represents an older period of use and dual rims are most likely indications of scavenging behavior. It is generally recognized that older previously worked pieces of obsidian might be collected from archaeological sites by aboriginal peoples and reused during more recent cultural periods. The smaller rim, we believe, represents the more recent age and one that appears to be associated with this style of point and conforms to the expected range of hydration measurements (3.3 - 4.4 microns) associated with the time period characteristic of the form (AD 500 – 1200).

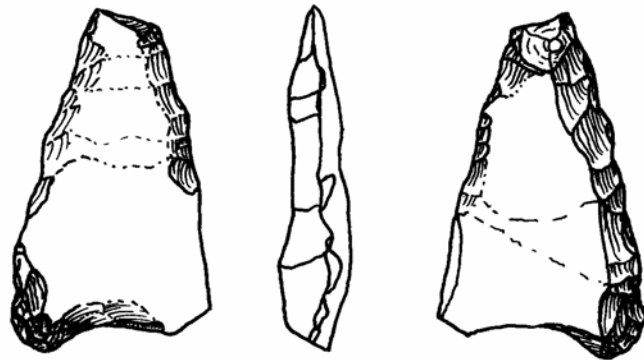


Figure 18. Saratoga Springs projectile point

Converting the obsidian hydration measurements to calendric (radiocarbon) dates using the EHT modified Basgall and Hall (2000) equation provides a mean age of 888 years before present or ca. AD 1062 for these two obsidian points. Such a date would place the

two points within the more recent portion of the temporal span when these arrow points typically occur.

5.4 ROSE SPRING SERIES

Five Rose Spring Series points were collected from the Lovejoy site. Rose Spring points were originally recognized from the type-site of that same name, located in southern Owens Valley at the edge of the Coso Range (Lanning 1963). The Rose Spring type is a small, narrow, triangular arrow point with a variety of stem forms. Rose Spring points are time markers for the interval from ca. AD 500-1200 in the Mojave Desert (Basgall and McGuire 1988; Bettinger and Taylor 1974; Gilreath and Hildebrandt 1997; Thomas 1981; Yohe 1992). These points are thought to represent projectiles associated with the introduction of the bow and arrow. Growing evidence now suggests an initiation date for these points several centuries earlier than initially posited and are now thought to have been introduced in eastern California ca. AD 200/300 (Sutton in press; Yohe 1992).

Two of the Rose Spring points were chert, one is Coso obsidian, one quartz, and the other rhyolite. The obsidian artifact (specimen 4-27) provided two hydration measurements, 3.9 and 5.3 microns. The smaller of the two readings would likely date the most recent use of the specimen. That measurement, when converted to a calendar date using the Basgall and Hall equation modified for the Lovejoy EHT, provides an age of 944 rcybp (present = AD 1950) or ca. AD 1006. Such a date falls within the expected age range associated with these points. The dual rims on the obsidian Rose Spring point again most likely indicate scavenging and reuse of obsidian that was discarded at an earlier date. These earlier discards were sometimes collected by Native peoples who scavenged older cultural deposits containing artifacts dating to a more ancient era.

5.5 HUMBOLDT SERIES

Heizer and Clewlow (1968) originally proposed the Humboldt type based on archaeological materials from the surface of the Humboldt Lakebed Site (NV-Ch-15) in western Nevada. These points are unshouldered, lanceolate forms with slight basal concavities to deep basal notches. Three variants of Humboldt Series points were described initially: Concave Base A, Concave Base B, and Basal-notched. Most researchers subsequently merged the first two types into a simple Concave Base variant (Heizer and Hester 1978). In the southwestern Great Basin, stratigraphic contexts and obsidian hydration readings argue for chronological placement of the Humboldt Concave Base type roughly synchronous with the Elko series and the most recent temporal span of Pinto points, placing them in time from ca. 4000 to 1350 B.P. (Basgall and McGuire 1988; Delacorte 1999; Delacorte and McGuire 1993; Gilreath and Hildebrandt 1997; Hall 1983; Hall and Jackson 1989; Jackson 1985).



Figure 19. Selected Cottonwood, Rose Spring, and Saratoga Springs projectile points

Morphological confusion occurs between the Humboldt Basal-notched form and the look-alike types of the Pinto “Shoulderless” (Harrington 1957) and Sierra Concave Base (Moratto 1972) forms. The former type is part of the Little Lake series and dates to the Middle Holocene Period in the local chronological sequence. It is very difficult to differentiate small proximal basal fragments of Pinto Shoulderless points from the Humboldt Basal-notched type. Also, researchers differ in their views as to whether the Pinto Shoulderless form should be collapsed with the Humboldt Basal-notched type (Delacorte et al. 1995: 68; Pearson 1995; and Schroth 1994 favor conjoining the forms and Basgall and Giambastiani 1995, among others, favor differentiation).

With respect to the Sierra Concave Base and Humboldt Basal-notched confusion, it is rather difficult to make that distinction based on the similarity in the morphologies of these two forms (cf. Stevens 2001). Additionally, obsidian hydration data for Sierra

Concave Base forms from the southern Sierra foothills indicates that this type may have a lengthier duration than the Humboldt Basal-notched form in the Great Basin and Mojave Desert (Stevens 2001). The wide variant of the Humboldt Basal-notched form appears to abruptly terminate when in full fluorescence (ca. A.D. 800) while the Sierra Concave Base type continues until the later prehistoric era perhaps as recently as ca. A.D. 1300 (Garfinkel and Yohe 2004; Stevens 2001).

A recent comprehensive review of the typological and chronological parameters of the Humboldt Basal-notched form led researchers to identify wide- and narrow-based sub-types (Garfinkel and Yohe 2004). It was suggested that the former was more recent, dating from 1150-2450 B.P., while the latter was most popular during an earlier interval, from 2450-5950 B.P.

Only one Humboldt Basal-notched biface fragment was recovered from the Lovejoy site. This is a fragmentary example representing the “ear” from a larger obsidian biface (specimen 4-28). These Humboldt Basal-notched bifaces often break along this plane and are commonly found as small fragmentary remnants. This specimen is unusual in that it appears to have been reworked into a style conformable to the Cottonwood Series. Perhaps the item was originally scavenged from an older site, or from the Initial Late Holocene Period component at the Lovejoy site itself, and re-used.

Hydration measurements indicate that projectiles of this style (Wide Humboldt Basal-notched bifaces) date to an age equivalent to Elko and Gypsum points (2000 BC to AD 500) with some limited persistence into the Initial and Intermediate Late Holocene Periods (2500 – 1150 BP). Many eastern California prehistorians corroborate this pattern and agree with the dating of these forms (Basgall and McGuire 1988; Gilreath and Hildebrandt 1997; Hall and Jackson 1989). This reworked point is manufactured from obsidian and was discovered in 1954 by the ASA. The obsidian hydration measurement of 3.2 microns appears to conform to its most recent use as a Cottonwood point and not to its more ancient form. That hydration measurement provides an age estimate with the Coso rate for Lovejoy of 556 rcybp (present = AD 1950) or ca. AD 1394.

5.6 ELKO AND PINTO SERIES

Heizer and Baumhoff (1961) were the first to define Elko points. This series is composed of large, heavy, notched dart points with variable stem characteristics (Heizer et al. 1968; O’Connell 1967). Four examples are represented in the present collection; two are corner-notched (1-2, 4-42), one is side-notched (9-22), and one is undifferentiated as to sub-type (2-1). For this discussion, contracting stem Elko Series forms are assigned to the Gypsum type (see below). In the western Great Basin and Mojave Desert, Elko points consistently occur in contexts dating from ca. 2000 BC to AD 500 (Basgall and McGuire 1988; Bettinger and Taylor 1974; Gilreath and Hildebrandt 1997; Heizer and Hester 1978: 163; Justice 2002; Thomas 1981). Such a chronological position is demonstrated by a plethora of radiocarbon, stratigraphic, and obsidian hydration data, although it is becoming increasingly apparent that large corner-notched and side-notched forms also occur in earlier contexts.

Gilreath and Hildebrandt (1997) discerned that more robust Elko points, especially those thicker than 6.5 mm, regularly produced obsidian hydration measurements that are larger than those of the more gracile artifacts. One explanation for this problem is the difficulty in identifying between more ancient Pinto points and more recent look-alike Elko forms (cf., Basgall and Hall 2000; Vaughan and Warren 1987). Two Elko specimens (1-2 and 2-1) recovered from Lovejoy are rather thin, both measure only 3 mm in thickness. A third specimen, an Elko Corner-notched form (4-42), is more robust and considerably thicker (6 mm) and has a hydration rim of 7.8 microns that would equate with an age of 4800 years BP and as such would conform more closely to those hydration measurements characteristic of Pinto points. We therefore tentatively identify this point as a member of the Pinto series.

The fourth Elko series point (9-22) is a side-notched variant and is manufactured of Monterey chert. That point is 8 mm thick and would, if the Gilreath and Hildebrandt distinction is generally valid, possibly represent a similarly ancient use of the site and would be more akin to Pinto Series points in age and typological affiliation. Hence, this point has been defined as a member of the Pinto Series as well.

One of these artifacts, although classified as an Elko Corner-notched “point”, is more of an eccentric than a conventionally defined projectile point. One margin is corner-notched and the other is side-notched with an irregular edge. This eccentric “Elko Corner-notched point” derives from Burial E in the group of burials identified by Toney and was discovered during the salvage excavations conducted in 1968. That projectile was found either “embedded” in a human rib or situated within the chest cavity of that individual and as such may have been either located there from an old wound that had healed, may have been the cause of death, or most likely was simply a mortuary offering.

This artifact was analysed for its hydration measurement and (Toney 1968:6; his specimen 534-13, Applied Earthwork catalogue 1-2) produced multiple readings from two laboratories (University of California, Los Angeles and Sonoma State University). These studies provide us with a series of different obsidian hydration measurements (Love 1992):

	<u>UCLA</u>	<u>Sonoma State</u>
Projectile Point Notch	6.1	5.5
Point Edge	5.2	5.5
Point Edge	5.5/17.5	5.5/14.2

Dismissing the largest outlying readings as a product of either scavenging or a non-cultural, natural break, the hydration measurements from either laboratory average about 5.5 microns. Using the Basgall and Hall Coso hydration rate (Basgall and Hall 2000) and modifying that formula for the EHT of Lovejoy provide a date, somewhat more recent, but generally conformable with, the radiocarbon age derived from the cemetery of 2201 rcybp (present = AD 1950). That date is about 500 years more recent than the radiocarbon age provided by the WSU radiocarbon assay of 2720±70 rcybp. However

that assay, it must be remembered, is a conventional determination provided by the mean age from a composite sample of the skeletal remains combined from two distinct interments (Burials C or E and A) located in the common burial area (cemetery).

Both Toney (1968) and Love (1992) have speculated that the Lovejoy aggregated interments might be a mass burial of individuals interred simultaneously. Sutton (1988:53) also noted such a mass burial as a possibility. He remarked that if such an occurrence were to be firmly supported, it would be a unique example within the archaeological literature for the western Mojave Desert. Nonetheless it does seem that the burials identified within a concentrated area of the Lovejoy site were interred during a fairly restricted time period based on the identical obsidian hydration measurements provided by the two obsidian points found in direct and general association with the burials.

As is discussed elsewhere, the infant burial (Toney's individual A), interred with over 3,000 *Olivella* beads, appears to closely conform and support the dating provided by the obsidian hydration measurements of the two Elko-like artifacts (both have obsidian hydration measurements averaging 5.5 microns), and the radiocarbon assay. This infant burial contained 2,135 small dorsal ground *Olivella* saucer beads (G4 series) and 1,101 small oblique spire ground *Olivella* beads (A2a) (Bennyhoff and Hughes 1987). Those ornaments have a suggested temporal span dating to Phase 2 of the Middle Period (M2a phase) or perhaps the later part of the M1 phase in southern California. The M2a phase bridges the time from 2000 to 1500 BP and the M1 phase immediately predates it ranging in time from 2000 to 2700 BP (King 1981, 1990, 2002).

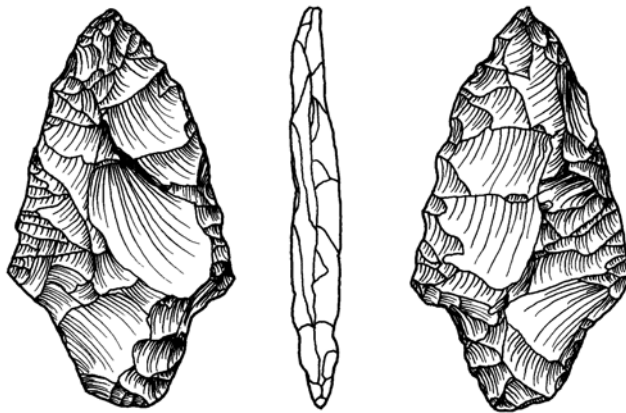
One of the two obsidian projectile points (specimen 2-1) is similar in appearance to points classified as Eastgate specimens. However, based on its obsidian hydration measurement (5.5 microns) and general spatial association within the area of the burial complex at the Lovejoy site, the point is more likely an especially gracile example of the Elko series. This projectile point (Toney 1968:6; Specimen 534-12) derives from near the cemetery complex and was retrieved from salvage excavations conducted by Toney (1968). It was recovered from level one (0-6 inches) in his Unit 4. The point is manufactured on a flake of Coso obsidian and is pressure retouched only along the margin on both the ventral and dorsal faces. It has an expanding stem, incurvate edges, and a triangular blade.

If that point does relate to the nearby burials then one would expect that its' obsidian hydration measurement would be similar to the other point found with the burials. This single somewhat enigmatic form does have an identical hydration measurement as the Elko eccentric from within the burial complex of 5.5 microns. Using the Basgall and Hall Coso hydration rate (Basgall and Hall 2000) and modifying that formula for the EHT of the Lovejoy site provides a date of 2201 rcybp (present = AD 1950) for that point as well.

5.7 GYPSUM SERIES

Large contracting-stem points were originally identified by Mark Raymond Harrington (1933) at Gypsum Cave in southern Nevada. Morphologically similar forms have been identified as Elko contracting-stem types (Heizer and Baumhoff 1961; Heizer et al. 1968; O'Connell 1967). Thomas (1981) calls similar points from Central Nevada Gatecliff Contracting-stem. Apart from their designations, these different terminologies also reflect apparent differences in chronology. The Gatecliff series attribution is meant to characterize a group of earlier, pre-Elko points, with dates ranging from 4950 to 3150 B.P. (Thomas 1981).

Evidence from the southwestern Great Basin consistently shows that the Gypsum form



is fully synchronous with Elko points dating from 2000 BC to AD 500. (Basgall and Giambastini 1995; Bettinger and Taylor 1974; Hall 1983; Hall and Jackson 1989). One specimen conforming to this type was found on the surface of the Lovejoy site. It is manufactured from a mottled pink chert and appears to have been heat treated to improve the flaking qualities of this material.

Figure 20. Gypsum point

5.8 LARGE LANCEOLATE CONCAVE BASE

Bruce Love recovered a large lanceolate concave base point during trenching from 1990-1992. It is akin to Humboldt points but is far too large for the concave base form and has a basal configuration that is too shallow to conform to the attribute range characteristic of Humboldt Basal-notched (cf. Garfinkel and Yohe 2004). Given its dimensions and weight, it is obviously a dart point and so predates the introduction of the bow and arrow, being more ancient than ca. AD 200/300. It is rather robust, both in thickness and weight and could possibly predate the Initial Late Holocene, represent a Middle Holocene component (4000 – 7000 BP). The nearly complete specimen (Figure 20) was manufactured from Franciscan chert, most likely quarried along the coast.

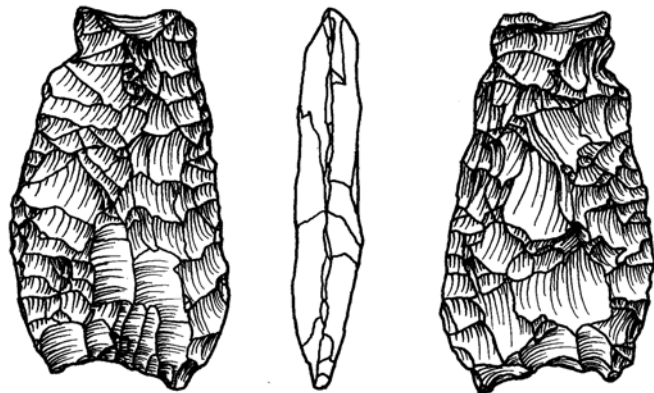


Figure 21. Indeterminate basal notched point

5.9 DISCUSSION

Most all (n = 25, 73.5%) projectile points from Lovejoy were found as surface discoveries during early studies that occurred over half a century ago (Table 3).

The earliest identifications are attributed to the Wubben Collection from the 1920's and consist of eight examples. The next assemblage hails from the work of the Archaeological Survey Association of Southern California in 1954 and forms the lion's share of these items, with 18 specimens. Salvage excavations of the aboriginal cemetery by Toney in 1968 facilitated the discovery of two obsidian points and Bruce Love identified one other point during the 1990-1992 mechanical trenching study. It appears that these early surface collections, looting, and various disturbances associated with subsequent commercial development of the site area, must have precluded the identification of any further surface finds from the more recently conducted studies. Three of the four Initial Late Holocene age points derive from subsurface contexts. All of the Monterey and Franciscan chert points also date to the Initial Late Holocene or perhaps earlier.

It is rather remarkable, given the amount of scientific attention and excavation that the Lovejoy site has drawn, that the entire projectile point inventory is limited to so few specimens - totaling only 29 artifacts. When we include the fragmentary examples, that number increases to just 32. One can only assume, given the enormous collection of other artifacts - predominantly milling equipment and shell beads, that the procurement of large game was a rather minor component and of limited importance with respect to the cultural activities conducted at the site.

All Initial Late Holocene points are manufactured of exotic stone. Three are manufactured from imported chert and derive from the coast and two are made of obsidian from the Coso Volcanic Field. From this small sample of early dart points it appears that those points of nonlocal stone were obtained either from long distance travel, by direct acquisition, or most likely, through trade relations with neighboring groups. The more local lithic materials appear to have been reserved, during this early period, for more mundane tasks than hunting. The use of local stone increases with the advent of the Terminal Late Holocene (650 BP to contact) as seen in the common application of rhyolite toolstone for the manufacture of Cottonwood Series projectiles.

6

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: OTHER FLAKED STONE ARTIFACTS

6.1 METHODS OF FLAKED STONE ANALYSIS

Analysis of flaked stone has two major goals: characterizing the chipped stone assemblages within the various site components of the Lovejoy Springs site and describing the types of toolstone reduction that occurred. With these objectives in mind, all formalized flaked stone tools were weighed and measured. Additionally the form of their working edges was described and the type of modification documented. As well, the condition of the tools was recorded (e.g. complete, basal fragment, or margin). The strategy employed is based on the approach developed by Flenniken (1980) known as replicative systems analysis. Projectile points have been previously described in a separate section of this monograph but are also summarily treated here. Debitage receives technological analysis in an independent chapter.

In the present discussion bifaces are described as to the extent and character of their reduction. The reduction stage is assessed and this determination is consistent with the continuum along the blank-preform-product manufacturing cycle (cf. Callahan 1979). The initial stage in the continuum represents artifacts that are in a very preliminary and crude state. Routinely these Stage 1 bifaces are asymmetrical and irregular in plane view. They are often rather thick in cross-section with percussion-flaked removal scars and sinuous edges. Bifaces attributed to Stage 2 are similarly flaked via percussion yet they have margins that are more regular and are also a bit narrower in cross section having received more intensive reduction. Bifaces that are more reduced, lacking pressure flaking, yet identifiable as percussion thinned preform are identified as Stage 3. Finally bifaces considered as Stage 4 or 5 are classified as such due to the presence of pressure flaking. Stage 4 forms are further reduced and manifest considerable pressure flaking. The final stage in the continuum, Stage 5 bifaces, are extensively pressure flaked and are considered finished forms, exemplified by bifacial knives, dart, or arrow points.

Formal tools are artifacts manifesting extensive retouch and steep, intrusive flake scarring. The latter are conformable with items routinely identified as unifacial scrapers, bifacial knives, drills, etc. Such artifacts normally contain edges that bear fractures from pressure retouch or use wear. The margins of such forms often exhibit noticeable wear in the form of step fractures, crushing, polish or rounding. Narrow and elongated tools evidencing noticeable diamond-shaped cross-sections are identified as drills. In general metric characteristics, raw material, condition and form of edge modification are recorded for all formal tools.

Edge-modified flakes are discussed in this chapter as well. These artifacts are simple flake tools the product of slight use wear or minimal modification. Such items bear the

effects of modification from use and are often referred to as utilized flakes, expedient, or casual tools. With these items their shape has retained the sinuous outlines of an otherwise unmodified flake.

Blocks or chunks of stone that are cobble-like in form but bear evidence of being reduced are generally known as cores and are described here. Some of these artifacts have been further modified from considerable use as tools, while others are simply a source for the manufacture of flakes. Cores are classified according to technomorphological criteria into five types. This classification is based on the manner of flake removal and they consist of: unidirectional, bidirectional, bifacial, non-patterned, and bipolar. Besides these technological characteristics, other elements of the cores are identified including toolstone type, condition, cortex presence/absence, and whether use wear is evidenced.

6.2 THE ASSEMBLAGE

The flaked stone assemblage recovered from the Lovejoy Spring site includes 180 flaked stone artifacts. Casual, use-modified, simple flake tools dominate, followed by a number of projectile points and cores, with the balance composed of core tools and formalized flaked stone implements (Table 5). The latter tools are comprised of high proportions of chert (cryptocrystalline) toolstone, with a substantial amount of fine grained igneous, a small percentage of obsidian, and trace amounts of other stone materials.

Flaked stone studies involved first characterizing the assemblage; identifying the technology that produced them; considering whether there are any changes in the character of tools or technology for the various components, and lastly the significance such interpretation might have for the reconstruction of the prehistoric lifeways exhibited at the site.

Table 5. Flaked Stone Assemblage Inventory for CA-LAN-192.

Projectile Points	34
Bifaces	28
Formed Flake Tools	7
Casual Flake Tools	61
Core Tools	16
Cores	34
<hr/>	
Total	180

At the level of the catalogue five toolstone materials were documented. These included the following: obsidian, quartzite, quartz, fine grained igneous (felsite, rhyolite, basalt, and siltstone) and several varieties of cryptocrystalline materials (chert, jasper, chalcedony, agate, and opalite).

6.2.1 Obsidian

Twenty-six (26) artifacts of obsidian were classified as either cores, formed tools (bifaces, unifaces, points, or drills), or simple utilized flakes. All but six (6) of these items were discovered on the surface of the site. Eight (8) were analyzed to determine their obsidian hydration measurements. Thirteen (13) were examined with x-ray fluorescence to attribute them to geographical source. Not surprisingly, most were identified as artifacts manufactured from Coso obsidian (the Sugarloaf or West Sugarloaf subsources). Additionally one Stage 3 biface fragment (4-35) was traced to the Queen source. One edge-modified flake (9-19) was visually distinctive, yet could not be traced to a known obsidian quarry through XRF analysis. This artifact may have been manufactured from Grimes Canyon Fused Shale or possibly Browns Bench obsidian.

6.2.1.1 Bifaces and Bipolar Cores



Figure 22. Bipolar obsidian core

Three (3) artifacts are Stage 2/3 bifaces and one artifact (13-4) is a Stage 5 biface. All are incomplete. These are all percussion worked implements with manufacturing breaks or structural flaws as the reason for their rejection. All are triangular in cross section. One of the three (64-96/1) was geochemically traced to the Coso source and exhibited two hydration measurements of 3.0 and 5.5 microns. That artifact was discovered in Unit 107 at the 30-40 cm. level. Its dimensions were 31 x 19 x 9 mm and weighed 4.8 g. This multipurpose tool exhibited use wear on two margins and showed heavy rounding and abrasion. The remaining two (64-96/1 and 9-20) fragmentary bifaces were surface finds and have seen a number of flakes shaved off their margins through bipolar reduction.

Five obsidian artifacts might best be identified as bipolar cores (Figure 22). Two of these are some of the largest pieces

of obsidian discovered at the site. These two large fragments of rounded obsidian cobbles refit together and were discovered near one another on the site's surface during studies conducted in 1954. They appear to be some of the more recent cultural materials recovered from the site as they have a very fresh and unsullied appearance. Supporting that interpretation is an obsidian hydration measurement of 1.3 microns on that artifact that was also chemically traced to the Coso quarry. These two artifacts (8-18 and 8-19) weigh 40.4 and 51.6 grams respectively and exhibit irregular and non-patterned forms with crushing and pitting evident on their arrises caused by reduction of the stone cobbles.

One other bipolar core (88-149/4) was traced to the Coso source and provided a hydration reading of 6.2 microns. It was recovered during the 2004 investigations by Applied Earthworks and was discovered in the 20 to 30 cm level of unit 110.

6.2.1.2 Projectile Points

Nine (9) obsidian projectile points were recovered from the site. Detailed discussion of their age attributions and typological affinities are presented in another section of this monograph. Suffice it to say, obsidian appears to have been a preferred stone for imported projectile points throughout the prehistoric periods represented at the site. Within this assemblages are one Pinto, two Elko, one Rose Spring, two Saratoga Springs, and three Cottonwood points. All these obsidian points were surface finds with the exception of the two Elko Series artifacts. One of these Elko "points" is almost certainly a mortuary offering and is fashioned into an unusual, eccentric form with two different notch opening morphologies. This unique artifact was discovered within the chest cavity of Burial E of the mass burial feature during the salvage excavations of Toney. The other obsidian Elko point was found in Test Pit 4 in the 0 to 6 inch level at some short distance from the burials. Both are part of the Initial Late Holocene Age upper midden component.

6.2.1.3 Uniface

One obsidian flake (68-3) was recovered during the 1989 excavations and was discovered in Unit 6 at a depth of 180 to 190 cm. This artifact was unifacially pressure flaked and measures 35 by 22 by 10 mm. It weighs 8.0 g.

6.2.1.4 Drill

One obsidian drill (4-19) exhibits moderate use wear and was found on the surface of the site. It is manufactured on a 6 mm thick percussion flake that was bifacially pressure flaked along two parallel margins. Portions of the drill tip and proximal end have been damaged by snap fracture. Maximal dimensions are 28 x 21 mm. The artifact is made from an unknown source of volcanic glass.

6.2.1.5 Simple Flake Tools

Seven simple flake tools were recovered from Lovejoy (Figure 23). These display a variety of edge damage patterns from use and/or manufacture. All are small (mean = 3.1 g) and incomplete examples, probably fragments of larger artifacts. Usually one or two modified edges exist per tool. Those edges exhibiting damage have microchipping extending, on average, for 30 mm along the straight edge, or 40 mm along a convex-shaped edge. Only one of those utilized flakes (15-18) derives from a subsurface context or was analyzed for its hydration thickness and source. That artifact was discovered during the 1954 ASA study in Test Pit 1A at the 0 to 6 inch level. It was manufactured from Coso obsidian and exhibited a hydration measurement of 7.5 microns.



Figure 23. Simple obsidian flake tools

6.2.2 Non-Obsidian

6.2.2.1 Heat Treatment

Many of the flaked stone tools manufactured from cryptocrystalline materials (chert) exhibit evidence that this toolstone was transformed by heat treatment (cf. Crabtree and Butler 1964). Numerous artifacts of chert have a lustrous or waxy finish and their color sometimes has changed from those items we recognize as not undergoing such modification. Artifacts that are identified as made of jasper, chalcedony, agate, or opalite were most commonly heat treated. It has been determined that incidental thermal

alteration does not produce the same surface qualities of gloss and luster and such casual, nonintentional heating leaves these artifact surfaces dull and without sheen. It is only after thermal alteration, when the toolstone surface is actually modified and flaked that the change in surface appearance is noticeable. The heating process when applied to chert causes the toolstone to lose weight, change color, and improve in flaking quality and workability.

6.2.2.2 Projectile Points

Twenty-five (25) non-obsidian projectile points were recovered. Detailed discussion of their age attributions and typological affinities are presented in another section of this monograph. Within this assemblages are one Pinto, one Gypsum (aka Elko Contracting Stem), four Rose Spring, one Saratoga Spring, fourteen Cottonwood, and one Desert Side-notched. All these non-obsidian points were surface finds. A large number of the Cottonwood points are manufactured from locally quarried rhyolite.

6.2.2.3 Formed Flake Tools

Formed flake tools are of great interest since they indicate that certain domestic and manufacturing tasks occurred that are consistent with extended or intensive occupations.

6.2.2.4 Drills

Two drills, one of white (4-23) and the other pink chert (4-30), exhibit moderate use wear and were found as surface artifacts during the 1954 ASA investigations. The first is manufactured on a 5 mm thick percussion flake that was bifacially pressure flaked along two parallel margins. Portions of the drill tip and proximal end have been damaged by snap fracture. Maximal dimensions are 32 x 11 mm. The second was fashioned on a 4 mm thick percussion flake that was also bifacially pressure flaked along its margins. The tip of the drill tip is damaged. Maximal dimensions are 22 x 13 mm. Both artifacts show evidence of heat treatment. Both tools fit comfortably between forefinger and thumb and as such could be employed with ease.

6.2.2.5 Pick

One elongate, pick-like tool (9-17) was discovered in the 1954 ASA surface collection. It measures 125 x 36 x 30 mm. It is a slender yet slightly domed object of resilient stone (felsite?) that has a rounded and abraded working end. Seven major flake removals shaped the object through hard hammer percussion.

6.2.2.6 Unifaces

Four chert artifacts showed unifacial edge retouch along their lateral margins. All were discovered on the surface of the site and most (n = 3) have steep edge angles averaging about 70 degrees. One multipurpose artifact (304-1) exhibits extensive use wear on its margins – one working edge is concave, while the other convex. The latter artifact has

cortex over 20% of its surface and measures 44 by 19 by 10 mm. It weighs 12 g. and is fashioned on a piece of brown and white chert. The artifact is fragmentary - about half of the original. The tool was a surface discovery made during the 2005 monitoring activities conducted by David Earle.

6.2.2.7 Bifaces

Eight bifaces were unearthed in subsurface contexts. A Stage 3 biface fragment (18-3) was found during the 1954 ASA investigations and was recovered from Test Pit 2A at a depth of 0 to 6 inches. It exhibits pressure flaking on one face and has unifacial edge damage on the other. It is a shiny (heat treated) red jasper material and is 9 x 12 x 3 mm. It weighs .6 g. Nearby at Test Pit 2B at the same depth a Stage 4 biface (19-3) was discovered. Also of chert, this artifact had been truncated for use as a blade and bears unifacial edge damage. It measures 32 x 6 x 4 mm and weighs .9 g.

Several bifaces were discovered during the 1989 investigations at Lovejoy. A Stage 5 biface (77-3), most likely the tip of a projectile point, was retrieved from Unit 7 at 10 to 20 cm. It is a finely pressure flaked object with perhaps 25% of the entire artifact covered cortex and is composed of white chert toolstone. It measures 32 x 16 x 3 mm and weighs 1.4 g.

A Stage 4 biface (7-5) was identified from the 60-70 cm level of Unit 1. It is possibly a margin fragment of a basally notched dart, knife, or thrusting spear point of beige chert. The object is mostly percussion flaked with some minimal pressure retouch. Its dimensions are 32 x 25 x 10 mm and weighs 10.8 g. Another artifact was recovered from Unit 1 at a depth of 100 to 110 cm. It is a Stage 3 biface edge fragment (60-2) that exhibits evidence of use wear on three margins. Two of the working edges were convex and one concave. The fragmentary implement is 35 x 25 x 4 mm and weighs 2.1 grams. At a slightly great depth (130-140 cm / Unit 4) another biface was uncovered (63-4). This object was also a Stage 3 biface fragment but was manufactured from basalt toolstone. It measures 46 x 25 x 9 mm and weighs 10.4 g.

One Stage 1 biface (28-41/1) originated from the 60-70 cm level of Unit 103 and was recovered during the 2004 Applied Earthwork field work. It is a rough percussion flaked midsection with the tip and base missing. It measures 34 x 20 x 6 mm and weighs 6.9 g.

Lastly, during the 2005 Emergency Excavations a small Stage 3 biface fragment was identified in Test Unit 1 at a depth of 140-150 cm. The artifact was a small (25 x 25 x 7 mm, 6.9 g), bifacially pressure retouched, and manufactured from a dark brown and white Franciscan chert. It exhibits hinge fractures on both faces and might have been hafted when employed.

Sixteen other bifaces were surface discoveries. The majority (n = 13) of these were manufactured from various chert materials with only minor representation of other toolstone (basalt, n = 2; rhyolite, n = 1). All but the final stage of biface reduction was represented, with 50 percent representing early stage bifaces (Stage 1 and 2, n = 8) and

the other half characterized as later stages in the reduction process (Stage 3 and 4, n = 8). All were fragmentary examples of bifaces that were broken during the reduction process or during thinning activities. None of these artifacts exhibited any evident use wear or edge damage other than the technological damage incurred during manufacture.

Dimensions of these various implements seem to indicate that chert bifaces were initially percussion flaked into a rough form having the dimension of about 100 mm in length, 15 mm in width, and 10 mm in thickness when fashioned in this preliminary state. No cortical materials were noted as remnants on the biface collection, hence much of the early reduction activities must have taken place off site at nearby quarries.

6.2.2.8 Cores

Only two cores were uncovered in subsurface contexts. The first (63-5), a chert core fragment, was discovered during the 1989 investigations at Lovejoy. The core is translucent brown chert and was retrieved from Unit 6 at a depth of 130 to 140 cm. It is a non-patterned, multi-directional core (20 x 20 x 20 mm., 16.5 g.). The second (65-2) was a tan and white mottled chert core that appears to have been incidentally exposed to fire. It is an angular chunk of shatter that was identified during the 2005 excavations and was found in Column 2 at a depth of 130 to 140 cm. (30 x 25 x 15 mm., 17.2 g.).

The remaining 27 cores were all surface finds and varied greatly in size but included some of the largest and heaviest flaked stone artifacts identified at the site (e.g., 9-15, 95 x 80 x 40 mm., 378.4 g. [quartzite]; 541-1, 75 x, 75 x 66 mm., 674.0 g. [rhyolite]). This collection includes cores manufactured from siltstone, quartzite, basalt, opalite, chert, and indeterminate igneous fine grained materials. The smallest specimen was manufactured from a piece of milky-white opalite with a cortical surface over half the artifact (6-23, 22 x 11 x 7 mm., 4.6 g.).

6.2.2.9 Core Tools

Sixteen (16) core tools were recovered at the site. Unfortunately only one (65-2) of these implements was retrieved from a subsurface context and hence their age is somewhat difficult to establish. A large (110.2 g.) split cobble of basalt was discovered in association with Feature 15 during the 2005 Phase 2 Monitoring investigation conducted by David Earle. That artifact was a plano-convex core still exhibiting cortex over 15% of its surface and having a working edge approaching 90 degrees. The core was fashioned with eight major flake removals and bears no significant technological or functional damage along its margins.

The raw materials used to fashion the core tools are restricted to igneous toolstone and other more rarely represented materials. It is likely that most of the cores and core tools of non-obsidian stone materials identified at the site come from nearby environs since many (n = 10, 62.5%) still possess cortex. Water-rounded cobbles with cortex are, in fact, the most common form.

This suggests that dense, largely intractable, lithic materials were preferentially selected for the manufacture of core tools or suitable flakes. Alternatively the battering, hinge fracture, pitting, and polish on the arrises of the tools might have been technological damage from platform preparation. Prehistorians in this area of the western Mojave Desert have sometimes hypothesized that rhyolite was quarried and processed into transportable blanks or cores and less often employed as tools (Sutton 1993).

However, in the present instance, thirteen (13) artifacts are unidirectional tabular core tools, most using cortical platforms. Three (3) are bidirectional core tools. These large and heavy artifacts (n = 216 g.) frequently have macroscopic evidence of use wear. In fact, many show several kinds of damage including edge rounding, unifacial or bifacial microchipping, edge flaking, and battering. Step fracturing is also common, as is dulling. All damage forms occur on a variety of edge angles but most have broad angled edges (mean = 75 degrees) that provide a larger area of contact during use.

Replicative use-wear studies support the conclusion that little damage is done to stone tools when used for shredding or pulping of soft plant materials (*sensu* Dodd 1979:233; Toll 1978:60; contra Kowta 1969). However when such tools strike a hard stone backing, when employed with an anvil, or in contact with other stone, they exhibit damage characterized by abrasive rounding and edge blunting. The Lovejoy large flake removal core tools differ from the remaining cores in the flaked stone assemblage with respect to the extent of damage, especially battering, supporting the conclusion that the damage exhibited in the present collection is from use (functional) rather than reduction activity (technological).

It is likely that these implements served in a variety of pounding and scraping activities. A very large number (n = 1000+) of milling implements was recovered from the Lovejoy site. Many of them show evidence of formal shaping and were, by necessity, regularly refurbished. Prehistorians have long recognized that milling slabs and handstones need to be resharpened periodically (sometimes as often as every five days when in daily use) in order to keep them serviceable (Bartlett 1933:4; Schlanger 1991:462). That resharpening was accomplished by pecking their grinding surfaces with a hammerstone or *core*. It is likely that most of the cobble core tools discovered at the site were used in this fashion to maintain an appropriately roughened surface on both handstones and milling slabs in order to effectively grind plant and perhaps more rarely animal foods.

6.2.2.10 Simple Flake Tools

Consistent with other prehistoric settlements, expedient flake tools are many times the most frequent chipped stone tool at a site. In total 54 use-modified flakes were discovered within the non-obsidian flaked stone materials. Of these 43 are made of chert, ten of igneous, and six of other materials.

A number of casual flake tools derive from subsurface contexts. Six of these (15-3, 15-14, 15-17, 15-21, 16-2) were discovered during the early 1954 ASA studies. Five were unearthed in Test Pit 1A in the 0 to 6 and 6 to 12 inch level. The sixth came from Test

Pit 2A in the 0 to 6 inch level. All exhibit unifacial edge damage on relative straight or sinuous working edges. Two edge-modified flakes (3-8 and 87-4) were discovered during the 1989 investigations. The first was recovered from Unit 1 in the 20 to 30 cm. level. The other was discovered deep within the midden deposit in Unit 7 at a depth of 110-120 cm.

Most recently, five additional utilized flakes (26-3, 30-12, 37-1,44-2, 129-3) were identified during the 2005 monitoring efforts by Applied Earthworks. These artifacts were derived from Feature 1B at the 0-10 cm. level, unit 05-07-01 at the 30-40 cm. level, and an undesignated test excavation unit at the 30 to 40 cm. level. Deeper within the deposit at the 80 to 90 cm level of Column 6 and at the 130 to 140 cm level of Column 2 two other simple flake tools were recovered. All of these artifacts are unifacially edge damaged chert flakes.

The remaining 30 flakes were all surface finds. Most (n = 27) exhibit slight to moderate unifacial edge damage and were likely used in light duty scraping activities. Three had bifacial edge wear and were likely employed as cutting implements.

6.3 PROCUREMENT AND REDUCTION PATTERNS OF TOOLSTONE MATERIALS AT LOVEJOY SPRINGS

6.3.1 Obsidian

As shown on Table 6, obsidian comprises less than 15 percent of the Lovejoy flaked stone tool assemblage. Obsidian, in most cases, appears to have reached the site in the much reduced form of finished artifacts. Very few cortical flakes, no core tools, and only a few cores were present in the assemblage indicating that obsidian was most often procured as formal tools either as bifaces or projectile points in Stages 3, 4, or 5. Obsidian reduction was nearly exclusively directed toward the repair, rejuvenation, or final finishing of bifaces and points. The low frequency of obsidian toolstone belies the fact that it was only acquired in very small quantities by the occupants of the Lovejoy site. Light percussion and pressure flaking appears to have served to resharpen, rejuvenate, and replace broken forms. This pattern of obsidian acquisition and manufacture resulted in a meager deposit of very small waste flakes (see chapter on debitage), broken biface fragments, and incomplete projectile points.

Nevertheless there is evidence that bipolar reduction practices were exclusively reserved for artifacts manufactured from obsidian. This practice was not restricted to any particular temporal period as artifacts of Coso obsidian with varying hydration measurements (1.3, 3.0, and 6.2 microns) were uniformly reduced using this specialized technology.

6.3.2 Igneous

Fine grained igneous materials were often acquired locally in a tabular or rounded nodules within the nearby environment. This toolstone appears to have been percussion

flaked into two or perhaps three pieces. The larger pieces of material were destined for cores or core tools. The manufacture of these cores and core tools most often occurred off-site since the debitage collection rarely contains unmodified igneous fine grained toolstone artifacts (see Debitage Chapter). Additionally, surprisingly few formal or informal flake tools (<15%) were manufactured from either local rhyolite or felsite. Such a pattern emphasizes the close correlation of igneous fine grained cobbles and their acquisition in a ready made natural form for use as split cobble, core-hammers.

Basalt appears to have been brought on-site with most of its cortex removed and then was reduced by direct percussion to produce cores, core tools, and large flake blanks. Debitage study supports the notion that a greater amount of basalt was being reduced earlier in time during AU 1 period as recognized in the lower midden deposit than in the upper midden (AU2).

Table 6. Raw Material Types for CA-LAN-192 Flaked Stone Artifacts.

	<u>Obsidian</u>		<u>Chert</u>		<u>Igneous</u>		<u>Other</u>		<u>Total</u>
	No.	%	No.	%	No.	%	No.	%	
Projectile Points	9	26	18	53	6	18	1	3	34
Bifaces	4	14	20	71	4	14	0	0	28
Formed Flake Tools	1	14	5	71	1	14	0	0	7
Casual Flake Tools	6	10	43	70	6	10	7	10	61
Core Tools	0	0	0	0	14	87	2	13	16
Cores	5	15	5	15	17	50	7	20	34
Total	25	14	91	50	48	27	16	9	180

Key: Obsidian = All types of volcanic glass. Chert = Includes stone identified as jasper, chalcedony, opalite, agate, and Monterey or Franciscan Chert. Igneous = Rhyolite, felsite, and basalt. Other = Quartz, quartzite, siltstone, or indeterminate materials.

6.3.3 Chert

Cryptocrystalline toolstone also appears to have been acquired locally based on the routine presence of cortical flakes and cores. Bifaces were most likely roughed out at nearby quarry loci and introduced into the site in reduced forms. The lack of chert cores (<15%) and its over-representation as bifaces and points attests to a preferential selection of this toolstone for bifacial cutting tasks, piercing, and its use for arrow and dart points.

As might be expected, chert material was more often shaped by pressure flaking than was fine grained igneous materials as it is more successfully reduced using that method.

6.4 DISCUSSION

There is no indication that the technological needs for the Lovejoy site inhabitants changed significantly over time, as it seems lithic reduction strategies and toolstone procurement patterns remained relatively similar throughout time (see Chapter on Debitage Analysis). Such technological shifts would be anticipated if there were fundamental changes in site function or adaptive strategy.

The toolstone use and procurement changes that occurred were more a matter of degree than radical shifts over time. Nevertheless, there is some evidence that AU2, the Middle Holocene lower midden component, does show statistically greater use of basalt and obsidian than AU1. Yet it is probable that the surface materials recovered from the site relate more to AU2, Initial Late Holocene, than AU1. This conclusion was reached when considering the age of the Lovejoy groundstone assemblage and we would posit that the characteristic dearth of projectile points and presence of a significant number of “scraper-plane” like implements suggests similarities of the Lovejoy cultural assemblage to other Late Millingstone Horizon settlements that are described for the inland and coastal Southern California (Basgall and True 1985; Kowta 1969).

Given the Middle Holocene age of AU2 a pattern of stone tool use evincing an emphasis on reduction of largely intractable stone (basalt) is not unexpected. As has been long recognized by prehistorian Middle Holocene (Pinto Period) sites display a greater emphasis on the use of basalt stone tools industries than more recent temporal periods and cultural traditions.

However, decreased use of obsidian in AU 1, Initial Late Holocene, is surprising. This time span is generally considered to be the peak period for eastern California obsidian biface production and the time of fluorescence for trans-Sierran exchange and export of volcanic glass artifacts. Perhaps, given our small sample of debitage analysed the pattern is not strongly attested and may be questioned or maybe local conditions were more influential at Lovejoy than the regional patterns occurring over larger areas.

Nevertheless, the representation of a relatively high percentage of formal tools (points, bifaces, drills, uniface scrapers, and core tools) within the context of the rather modest flaked stone assemblage (n = 4,200 pieces of debitage) at Lovejoy argues for a significant expression of tools used to fabricate and rejuvenate other implements. These are exactly the types of artifacts one might expect to occur in a longer term residential settlement. Such an interpretation is consistent with other elements of the cultural assemblage recovered from the Lovejoy site.

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: LITHIC DEBITAGE

7.1 INTRODUCTION

Flaked stone debitage from CA-LAN-192 is classified and described in this section. Debitage includes all flakes, flake fragments, and shatter that have a humanly produced fracture and do not exhibit evidence of subsequent flaking from modification or use. A flake is defined as any piece of chippable stone that exhibits a ventral (interior) surface and a dorsal (exterior) surface. A ventral surface is marked by a hertzian, bending, or wedging initiation; a bulb or force; or compression rings. A dorsal surface is marked by previous detachments of debitage or cortex. Shatter is defined as cubical or irregularly shaped chunks that lack a clear point of initiation, lack a platform, and lack any systematic alignment of fracture scars on the various faces. Debitage thus includes all debris detached from larger pieces during the manufacture, use, and maintenance of both flaked and ground stone tools.

7.2 ANALYTICAL METHODS AND PROCEDURES

The objectives of the analysis are to classify and describe the sampled assemblage, and to analyze its distributions as they relate to morphological and technological dimensions of variability. The debitage was analyzed following a two-step process involving size sorting and technological classification of individual flakes. These methods and procedures are described in greater detail below following Harro et al. (2000).

All debitage was graded by size through nested 1/2-, 1/4-, and 1/8-inch square wire mesh sieves. The size-grading screens were shaken in an up-and-down (not a side-to-side) motion. Debris that fell through the smallest screen, which is equivalent to the field screen size (1/8-inch mesh), represents an unsystematically recovered sample, and was not analyzed further. A weight and flake count for each size class was recorded per material type. The second step for the analysis involved assigning all flakes to predefined technological classes based on data derived from replication studies. The debitage coding system used for this project was adopted from Harro et al. (2000). This method compares archaeological samples with debitage profiles from reduction experiments. Analytic meaning is assigned to the archaeological samples based on their similarity with the experimental profiles. Importantly, assemblages are not interpreted solely by their most prevalent flake type, a method that has been correctly criticized by numerous researchers (e.g., Ahler [1989], Sullivan and Rosen [1985]).

7.3 SITE SUMMARY

7.3.1 The Analytic Sample

More than 4,200 pieces of debitage were recovered from the site during the various investigations. Most of the assemblage was manufactured from cryptocrystalline (e.g., chert, chalcedony, jasper, opalite, and agate); however, a wide variety of materials including basalt, obsidian, quartz, rhyolite, schist, granite, mudstone, and nonspecific sedimentary and igneous rock are represented. Many of these items were collected from the site surface or from contexts with no clear temporal affiliation. In order to identify changes in the morphology and technology over time, the selected analytical sample was drawn from contexts with temporal information. Specifically, the sample includes 1,009 pieces of debitage: 748 items were selected from Analytic Unit (AU) 1 in Units 1, 6, and 7, and 261 items from AU 2 in Units 6 and 7. AU 1 dates to the Initial Late Holocene (Gypsum) Period (1550 BC – AD 500) while AU 2 dates to the Middle Holocene (Pinto) Period (6,550 – 1,550 BC).

7.3.2 Material Types

Most of the analyzed sample is manufactured from cryptocrystalline, other material types present include obsidian, basalt, granite, quartz, and an unknown fine-grained igneous. Table 7 illustrates the relative frequency of each material type by analytic unit. Cryptocrystalline, basalt, and obsidian are the three most prevalent materials used in tool production for both AUs with cryptocrystalline making up more than half of the debitage assemblage. Fine-grained cryptocrystallines such as chert, chalcedony, and jasper are relatively local, occurring on the eastern edge of the valley. Basalt and quartz are also readily available-quartz can be extracted from the Lovejoy and Piutte Buttes while basalt may be obtained from Rosamond Hills. Obsidian, however, is not local to the area and had to be acquired through trade or direct procurement. Much of the obsidian recovered from the site comes from the Coso volcanic field 34 kilometers north of Inyokern, California.

Table 7
Debitage Raw Material Counts and Relative Frequencies
for Analytical Units 1 and 2

Raw Material	AU 1		AU 2	
	Count	Percent	Count	Percent
Basalt	69	9.22	53	20.30
Cryptocrystalline	588	78.61	146	55.93
Granite	2	0.26	0	0
Obsidian	51	6.81	50	19.15
Quartz	36	4.81	12	4.59
Unknown	2	0.26	0	0
Total	748	100%	261	100%

While cryptocrystalline debitage dominates both the AU 1 and AU 2 assemblages, the relative frequency of obsidian and basalt debitage in AU 2 is greater than that in AU 1. This suggests that use of these materials declined in favor of cryptocrystalline in the initial Late Holocene Period. This pattern is mirrored in the flaked stone tool assemblage. Eight flaked stone tools were recovered from AU 2, five (63%) cryptocrystalline, two (25%) obsidian and one (12%) basalt. Eight flaked stone tools also were recovered from AU 1; however, seven (88%) are manufactured from cryptocrystalline and only one (12%) from basalt. Earle (2004) reports a decrease in obsidian use with a correlating increase in the use of cryptocrystallines following the Intermediate Late Holocene (Saratoga Springs) possibly relating to onset of drought conditions or with movement of Numic speaking peoples. The data here suggests that obsidian use at CA-LAN-192 may have begun to drop off earlier during the Initial Late Holocene (Gypsum Period).

The debitage data also shows variability in the use of other raw materials through time. Schist and rhyolite debitage were recovered from CA-LAN-192 in fairly substantial numbers, however, none was observed in the analyzed sample. Rhyolite is available at the Fairmont Buttes west of the site and schist deposits occur in the Sierra Pelona Mountains. The absence of these materials in the AU 1 and 2 assemblages may suggest that they were not sought after as toolstone options until later in the occupation. Several rhyolite cores and flakestone tools were recovered from the site including five rhyolite Cottonwood series points. Cottonwood points are typically found in assemblages dating to the Late Holocene. Alternatively, it is possible that the absence of these materials in the sampled assemblage relates to functional variation in site use.

7.3.3 Size Distributions

Size sorting the debitage by analytical unit revealed that for each AU, more than half of the flakes fall within the 1/8-inch size category, while over 30 percent of the debitage falls within the 1/4-inch size category. Less than 10 percent of the debitage in each AU falls within the 1/2-inch or greater size category (Figure 24).

Debitage sizing, along with technological analyses, can provide clues about lithic manufacturing behavior. Patterson (1983) noted that the flake size distribution produced by biface manufacture is an exponentially shaped curve skewed toward higher percentages of smaller size flakes. That is, the majority of the flakes fall in the smallest size class with the second largest number of flakes in the next larger size, and so on. This curve remains the same regardless of the number of bifaces manufactured or the “stage” of biface production. In contrast, debitage produced during flake core reduction will often produce a size curve that peaks in the next to smallest size class (Rondeau and Rondeau 1993).

Size sorting the debitage assemblage by AU and the most prevalent raw material types revealed that the cryptocrystalline, obsidian, and basalt debitage all display flake size distributions synonymous with biface manufacture (Figures 25-27). However, because other manufacturing techniques (e.g., bipolar reduction) may also produce a “biface” type curve (Rondeau and Rondeau 1993) the size data is view in conjunction with a technological analysis to better understand flake stone reduction at the site.

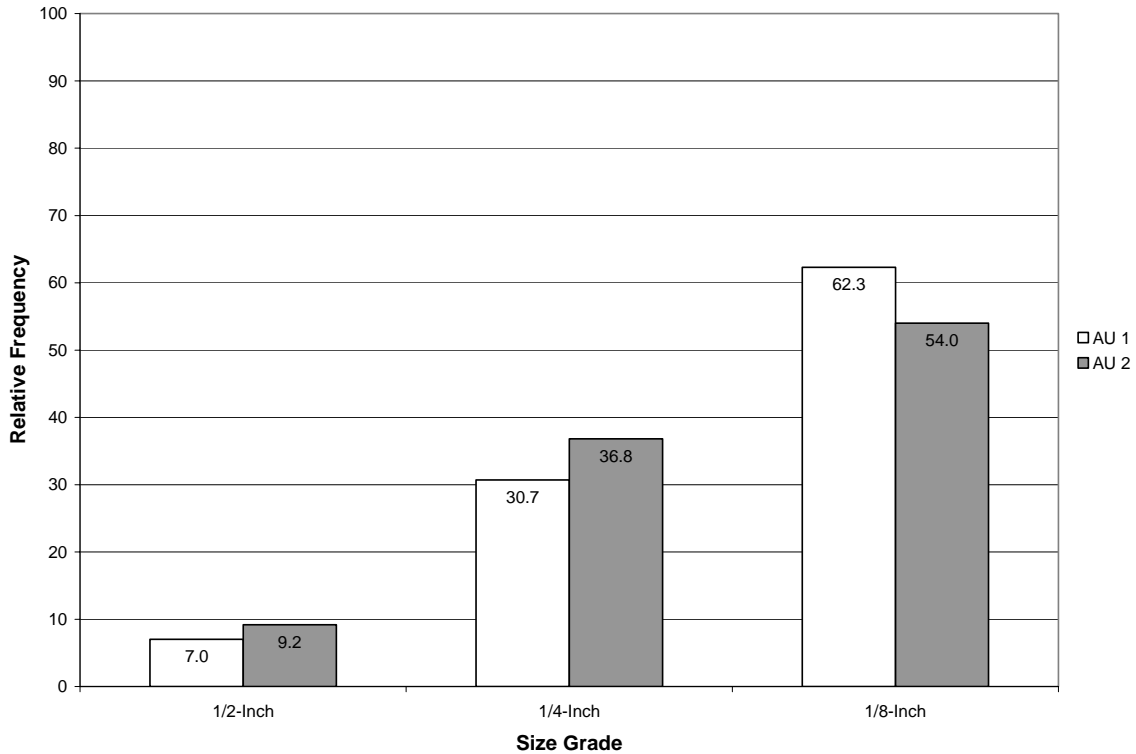


Figure 24. Size Distribution of Debitage for AUs 1 and 2

7.3.4 Technological Distributions

All debitage specimens were typed into technological classes based on their flake attributes. As illustrated in Tables 8-9, each AU is dominated by small nondiagnostic interior percussion flakes (Type 7), while the remaining diagnostic flakes are primarily distributed between early and late bifacial thinning flakes (Types 4 and 5), pressure flakes (Type 6), and shatter (Type 2). Very few primary flakes with cortex (Type 1), detachment scars (Type 3), or bipolar flakes (Type 8) were identified.

Technological profiles (Figures 28-30) for the most prevalent materials types (cryptocrystalline, basalt, and obsidian) for each analytic unit were constructed following Harro et al. (2000) to allow for a comparison of flake type distribution based on replication studies (Figure 31). Note, only flake types 1-5 are presented in the replication figures; these are percentages of all debris retained by 1/4-inch and larger screens. Because most of the flakes analyzed were small interior percussion flakes that lacked the defining characteristics of Type 1, 2, 3, 4, or 5, the values in the subsequent charts are low.

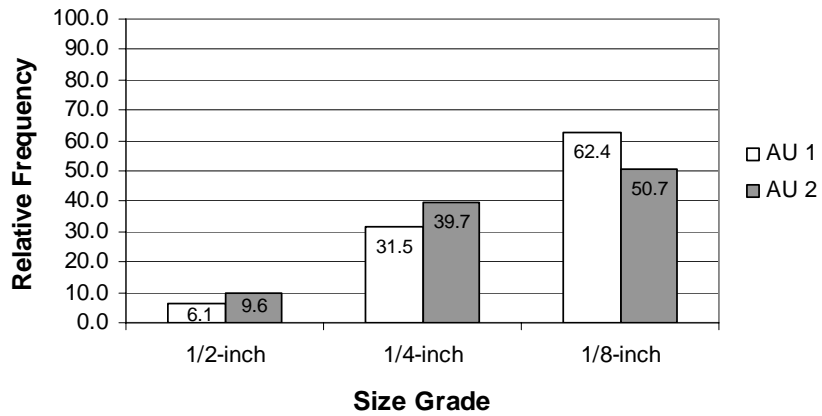


Figure 25. Size Distribution of Cryptocrystalline Debitage for AU 1 and AU 2

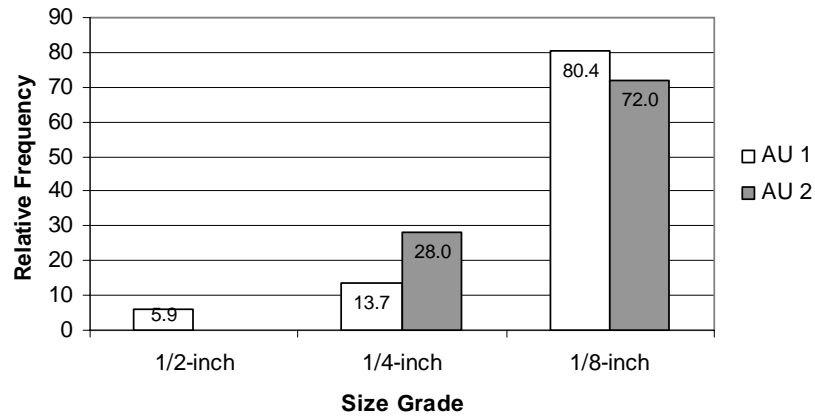


Figure 26. Size Distribution of Obsidian Debitage for AU 1 and AU 2

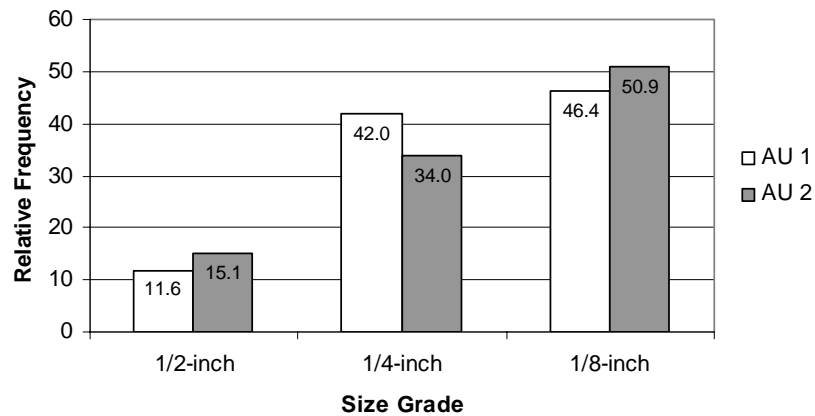


Figure 27. Size Distribution of Basalt Debitage for AU 1 and AU 2

The profile for the cryptocrystalline material from both AUs 1 and 2 (Figure 25) shows a varied distribution of flake types with a slightly greater representation of shatter (Type 2) and biface thinning flakes (Types 4 and 5). This suggests cryptocrystalline material was reduced for usable flake blanks as well as manufactured into bifacial cores to produce smaller, refined bifacial tools. Because of the few number of cryptocrystalline flakes exhibiting cortex (Type 1), as well as low frequency of 1/2-inch and larger size flakes (Figure 25), it is likely that cryptocrystalline cores were initially reduced off-site and brought to the site with most of their cortex already removed. Additionally, the high frequency of shatter and small flake size suggests that much of the cryptocrystalline material may have originated as smaller rounded cobbles and was possibly reduced by bipolar percussion. Bipolar percussion flakes often go undetected in an assemblage particularly if the flakes are small, broken, and of poorer quality material (e.g., quartz or heterogeneously composed cryptocrystallines, etc.). The cryptocrystalline debitage from CA-LAN-192 includes an assortment of chert, chalcedony, jasper and other fine grained silicates which vary greatly in terms of their knappable qualities.

Table 8
Technological Types of Debitage by Size Grade and Raw Material for AU 1

Raw Material	Size Grade	Flake Type								Total
		1 Ct.	2 Ct.	3 Ct.	4 Ct.	5 Ct.	6 Ct.	7 Ct.	8 Ct.	
Basalt	1/2-in.	1	2	1	1	--	--	3	--	8
	1/4-in.	2	5	--	--	--	--	22	--	29
	1/8-in.	--	2	--	--	--	1	29	--	32
	<i>Total</i>	<i>3</i>	<i>9</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>1</i>	<i>54</i>	<i>0</i>	<i>69</i>
Cryptocrystalline	1/2-in.	5	5	4	2	--	--	19	1	36
	1/4-in.	--	16	1	4	9	1	154	--	185
	1/8-in.	--	9	--	--	--	14	344	--	367
	<i>Total</i>	<i>5</i>	<i>30</i>	<i>5</i>	<i>6</i>	<i>9</i>	<i>15</i>	<i>517</i>	<i>1</i>	<i>588</i>
Obsidian	1/2-in.	--	--	--	--	1	--	2	--	3
	1/4-in.	--	--	--	1	2	--	4	--	7
	1/8-in.	--	1	--	--	--	14	26	--	41
	<i>Total</i>	<i>0</i>	<i>1</i>	<i>0</i>	<i>1</i>	<i>3</i>	<i>14</i>	<i>32</i>	<i>0</i>	<i>51</i>
Quartz	1/2-in.	--	1	1	--	--	--	--	--	2
	1/4-in.	--	2	--	--	--	--	6	--	8
	1/8-in.	--	2	--	--	--	--	24	--	26
	<i>Total</i>	<i>0</i>	<i>5</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>30</i>	<i>0</i>	<i>36</i>
Other	1/2-in.	--	--	1	--	--	--	2	--	3
	1/4-in.	--	--	--	--	--	--	1	--	1
	1/8-in.	--	--	--	--	--	--	--	--	--
	<i>Total</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>3</i>	<i>0</i>	<i>4</i>
All Material	1/2-in.	6	8	7	3	1	--	26	1	52
	1/4-in.	2	23	1	5	11	1	187	--	230
	1/8-in.	--	14	--	--	--	29	423	--	466
	<i>Total</i>	<i>8</i>	<i>45</i>	<i>8</i>	<i>8</i>	<i>12</i>	<i>30</i>	<i>636</i>	<i>1</i>	<i>748</i>

Table 9
Technological Types of Debitage by Size Grade and Raw Material for AU 2

Raw Material	Size Grade	Flake Type								Total
		1 Ct.	2 Ct.	3 Ct.	4 Ct.	5 Ct.	6 Ct.	7 Ct.	8 Ct.	
Basalt	1/2-in.	1	--	1	--	--	--	6	--	8
	1/4-in.	--	3	--	1	--	--	14	--	18
	1/8-in.	--	3	--	--	--	--	24	--	27
	<i>Total</i>	<i>1</i>	<i>6</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>44</i>	<i>0</i>	<i>53</i>
Cryptocrystalline	1/2-in.	2	1	1	1	--	--	7	2	14
	1/4-in.	1	3	1	3	4	--	45	1	58
	1/8-in.	--	6	--	--	--	3	65	--	74
	<i>Total</i>	<i>3</i>	<i>10</i>	<i>2</i>	<i>4</i>	<i>4</i>	<i>3</i>	<i>117</i>	<i>3</i>	<i>146</i>
Obsidian	1/2-in.	--	--	--	--	--	--	--	--	0
	1/4-in.	--	--	--	1	7	--	6	--	14
	1/8-in.	--	1	--	--	--	8	27	--	36
	<i>Total</i>	<i>0</i>	<i>1</i>	<i>0</i>	<i>1</i>	<i>7</i>	<i>8</i>	<i>33</i>	<i>0</i>	<i>50</i>
Quartz	1/2-in.	1	--	--	--	--	--	1	--	2
	1/4-in.	--	--	--	--	--	--	5	1	6
	1/8-in.	--	--	--	--	--	--	4	--	4
	<i>Total</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>10</i>	<i>1</i>	<i>12</i>
All Material	1/2-in.	4	1	2	1	--	--	14	2	24
	1/4-in.	1	6	1	5	11	--	70	2	96
	1/8-in.	--	10	--	--	--	11	120	--	141
	<i>Total</i>	<i>5</i>	<i>17</i>	<i>3</i>	<i>6</i>	<i>11</i>	<i>11</i>	<i>204</i>	<i>4</i>	<i>261</i>

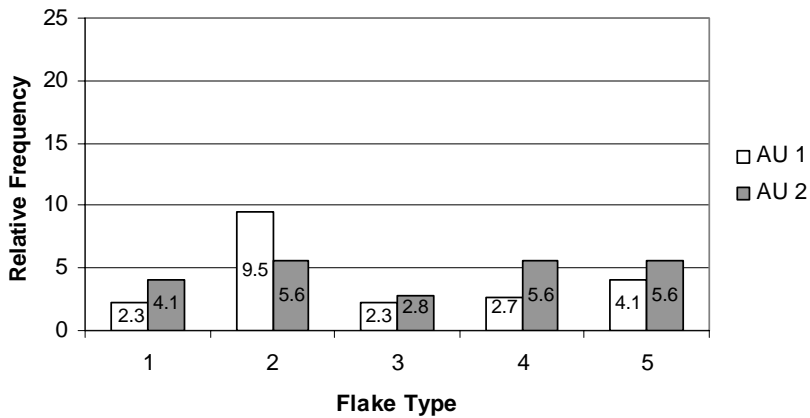


Figure 28. Technological Profile of Cryptocrystalline Debitage from AUs 1 and 2

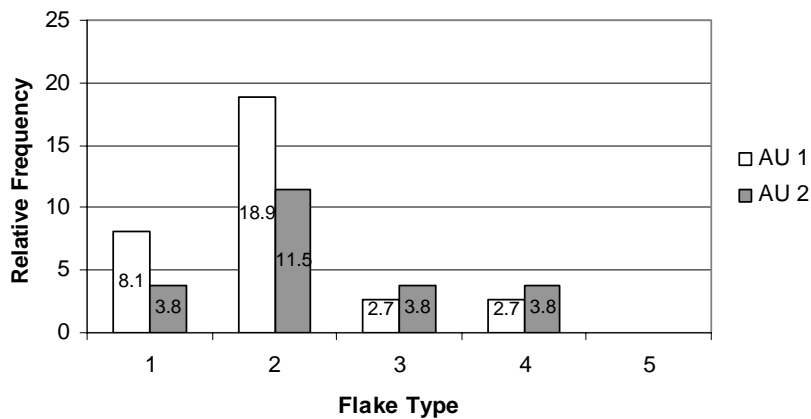


Figure 29. Technological Profile of Basalt Debitage from AUs 1 and 2

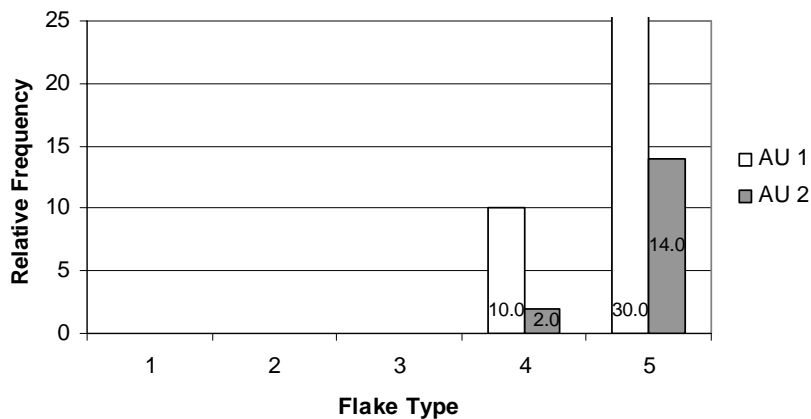


Figure 30. Technological Profile of Obsidian Debitage from AUs 1 and 2

The technological profile for basalt debitage from AUs 1 and 2 (Figure 29) most closely matches the replication profile generated for early stage core reduction (Figure 31) suggesting that basalts clasts were reduced on-site using direct percussion techniques for presumably core tools or to produce large useable flake blanks. Again, because few primary flakes were observed, it is likely that the clasts arrived on site with most of their cortex already removed.

The technological profile for the obsidian materials (Figure 30) shows a predominance of late stage biface manufacture. The absence of flakes with technological attributes akin to early core reduction suggests that obsidian arrived at the site as performs or already finished artifacts and reduction on site was oriented toward resharping, shaping, or finishing late stage tools.

Interestingly, the technological profiles between AUs 1 and 2 are similar in each raw material class suggesting that there was little to no change in the reduction of these materials between the Middle and Initial Late Holocene periods at the site.

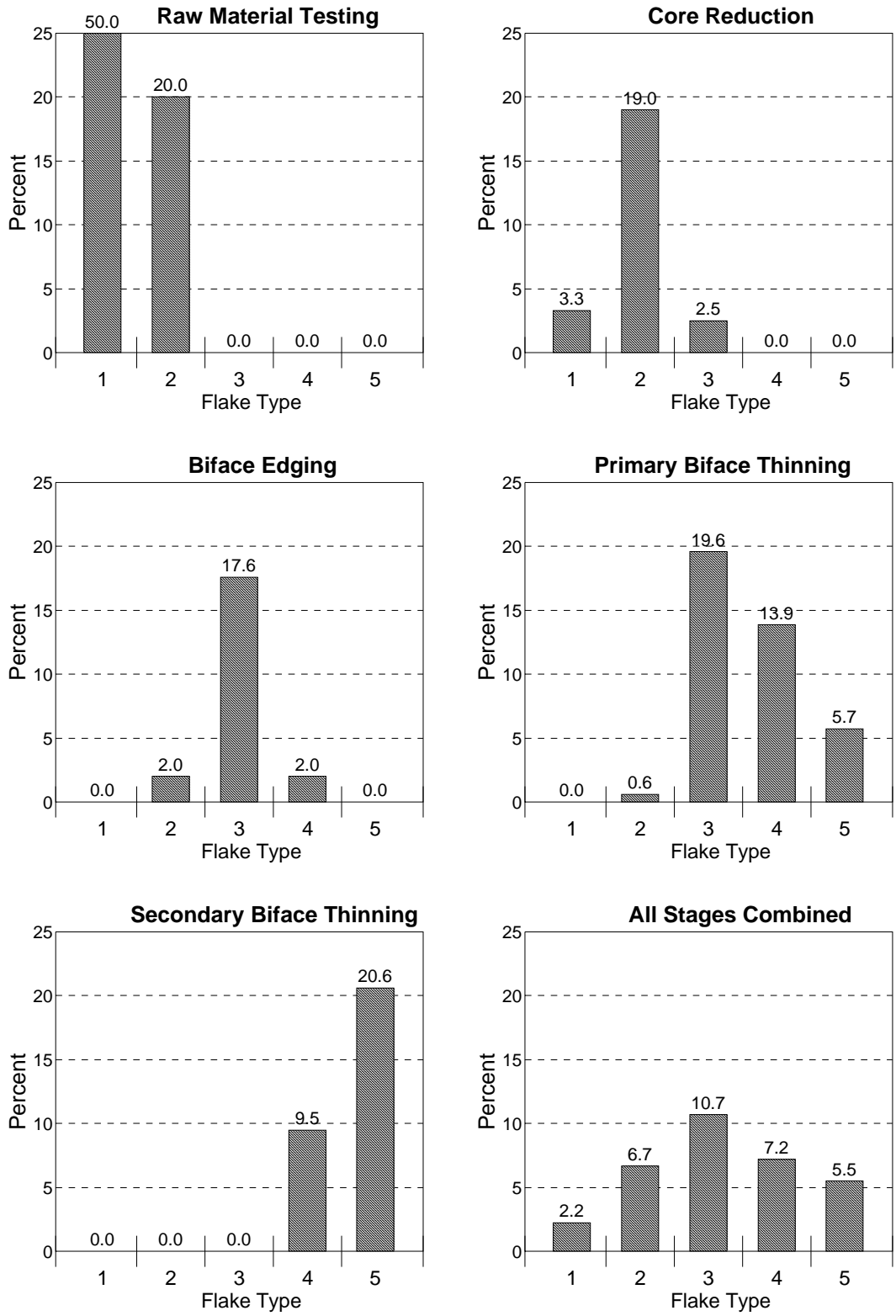


Figure 31. Technological Profiles Generated from Replication Studies (Harro et al. 2000)

7.4 DEBITAGE ANALYSIS PROTOCOLS

The debitage coding system was adopted from Root et al. (1995). For a detailed explanation of the theoretical underpinnings of this analytical framework, please refer to the original report.

Type 1

Type 1 flakes have cortex covering the entire dorsal surface. The platform can be either cortical or noncortical. These flakes are produced during raw material testing and the initial stages of all reduction technologies.

Type 2

Type 2 flakes do not possess clearly defined ventral and dorsal (interior and exterior) surfaces. Type 2 flakes are often produced when bending initiations that have little or no propagation phase are created, or when the raw material fractures along natural flaws. These fractures produce shattered pieces that lack features such as platforms and feather, hinge, or plunging terminations. Pieces that retain clearly defined ventral and dorsal flake surfaces are not classified as Type 2 flakes but are placed in one of the other flake classes. Type 2 flakes are produced during all percussion reduction technologies. It is produced in largest proportions, however, in cobble testing, freehand core reduction, and bipolar core reduction (Root 1992).

Type 3

Dorsal surfaces of Type 3 flakes retain a remnant of the ventral surface (or detachment scar) of the flake blank from which they were struck. Flakes that retain remnant detachment scars are most commonly produced during Stage 2 bifacial edging of flake blanks but may also be generated in significant numbers during later stages of flake blank reduction.

Type 4

Type 4 flakes possess curved longitudinal sections; extremely acute lateral edge angles (if complete); little or no cortex on the dorsal surface; at least three dorsal flake scars, at least one of which originates from a direction other than that of the flake itself; and a flattened or diffuse bulb of force, or a bending initiation without a bulb of force (Cotterell and Kamminga 1987:690). Flakes with platforms have either single or multiple faceted noncortical platforms. Furthermore, these flakes usually have some, but not necessarily all, of the following attributes: feathered flake terminations (but they can have step or hinge terminations), an expanding shape in plan view, and a lip at the intersection of the striking platform and flake ventral surface. They may not retain a remnant detachment scar from the original flake blank on their dorsal surface. This class is linked primarily with Stage 3 bifacial thinning, though these flakes are occasionally produced during Stage 2 bifacial edging, during bifacial core reduction, and during Stage 4 bifacial thinning.

Type 5

Type 5 flakes display longitudinal sections that are almost flat or gently curved, extremely acute lateral edge angles, an expanding shape in plan view, a flattened or diffuse bulb of force or a bending initiation without a bulb of force, no cortex, and four or more dorsal flake scars from previous flake removals that originate from varying directions, especially in directions other than that of the flake itself. Additionally, these flakes are relatively thin in comparison to early stage bifacial thinning flakes. Flakes with platforms have multiple faceted platforms, which are often ground. These flakes often have a lip at the intersection of the striking platform and flake ventral surface. This class is mainly linked with late stage percussion bifacial thinning, but some of these flakes are produced during early stage bifacial thinning. Many other types of flakes are produced during late stage thinning, and bifacial thinning flakes generally make up much less than one-half of all debitage produced by this technology.

Type 6

Type 6 flakes are generally retained by 1/8-inch mesh but can be larger. They are relatively thin with multifaceted platforms that usually are ground. Type 6 flakes often have platforms that are at an oblique angle to the long axis of the flake, producing a characteristic dogleg plan view. These flakes are associated with the final stages of bifacial tool manufacture and with parallel pressure flaking. A few small bifacial thinning flakes produced during the final stage of percussion flaking may occasionally be classified as Type 6 flakes. Type 6 flakes all retain platforms.

Type 7

Type 7 flakes lack the defining characteristics of Type 1, 2, 3, 4, 5, 6, and 8 flakes. They have evidence of a ventral surface and can be oriented according to their proximal (initiation) and distal ends (termination). In the larger size grades, these flakes are relatively thick, have steep lateral edge angles, have pronounced bulbs of force, and often have subdued undulations. Dorsal surfaces show one or more previous flake detachments, but do not retain detachment scars. Flakes with and without platforms are placed in this class, as are flakes with and without cortex. These flakes are associated with all bipolar and nonbipolar percussion techniques. The larger flakes (>1/4 inch) are most likely produced by percussion. Smaller flakes and fragments (retained by a 1/8-inch mesh) placed in this class are commonly produced in the later stages of all percussion technologies and occasionally by pressure techniques

Type 8

Type 8 flakes (bipolar flakes) have shattered or pointed platforms with little or no surface area; evidence that force has been applied to both ends of the flake, such as crushing on opposite ends; an angular and polyhedral cross section with surfaces tending to intersect at steep angles (nearing right angles); no bulbs of force (because of wedging flake initiations); pronounced compression rings (because of compression-controlled flake propagation); and a generally parallel-sided flake form (Ahler 1986:70; Cotterell and Kamminga 1987:689). Bipolar flakes do not exhibit positive

bulbs of force on opposite ends of the same flake interior surface (Crabtree 1972:42; Flenniken 1981:30). Distinguishing bipolar flakes from bipolar cores is often difficult.

Experimentally, bipolar flakes were produced almost exclusively by hard hammer bipolar percussion. A few flakes classified as bipolar, however, were produced by hard hammer, freehand percussion technologies as indicated by their wedging initiations. Many flakes produced during bipolar percussion do not have the defining attributes of bipolar flakes and are therefore classified as nonbipolar (Root 1992). Bipolar flakes have wedging initiations, but during bipolar flaking bending and hertzian initiations also occur. Thus, nonbipolar flakes are commonly produced during bipolar flaking (Cotterell and Kamminga 1987:688–689).

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: BEADS AND ORNAMENTS

8.1 INTRODUCTION

The following chapter presents the results of the bead and ornament analysis from the various CA-LAN-192 collections. The analysis includes unprovenienced collections recovered in 1954 by the ASA and in 1968 by UCLA. It also includes provenienced collections from the 1989 Cerro Coso College field class, the 2005 emergency excavations by Æ, and the 2005-2006 monitoring effort also conducted by Æ. The analysis does not include the 2000+ beads collected from Burial A by UCLA during the 1968 effort, although a preliminary report on those beads prepared by Chester King (King 2002) is included in the chronological assessment of the site.

8.2 METHODS

A total of 375 beads and ornaments were analyzed during the course of the project. Information regarding each bead and ornament was entered into an Access database management program. A separate entry was made for every artifact and each entry contained information on provenience (when available), type (when applicable), measurements (typically maximum diameter, maximum width, maximum thickness, and perforation diameter), the degree of fragmentation, weight, a categorization of the degree of edge grinding, presence or absence of evidence of burning, the shape of the perforation when viewed in cross-section, and additional comments concerning the condition and/or special attributes of the bead or ornament.

8.3 BEADS AND ORNAMENTS

8.3.1 Shell Beads

A total of 363 shell beads and ornaments were examined. Species represented include *Olivella biplicata*, *Haliotis rufescens*, *Mytilus californianus*, *Cypraea spadica*, *Megabalanus californicus*, *Tivela stultorum*, *Dentalium* sp., and *Megathura crenulata*. All of the recorded species, with the exception of the *Dentalium* which is found only on the northern coast, are local to the near-shore environment of central California. Descriptions, nomenclature, and temporal designations for all bead types follow Bennyhoff and Hughes (1987) and King (1990) except when noted. The following types are represented in the CA-LAN-192 collection:

A1 Simple Spire-lopped (6). Spire-lopped *Olivella* are nearly complete shells from which the spire has been removed perpendicular to the body axis. Spire removal may be broken off, waterworn, or ground down. When apparent, removal technique was

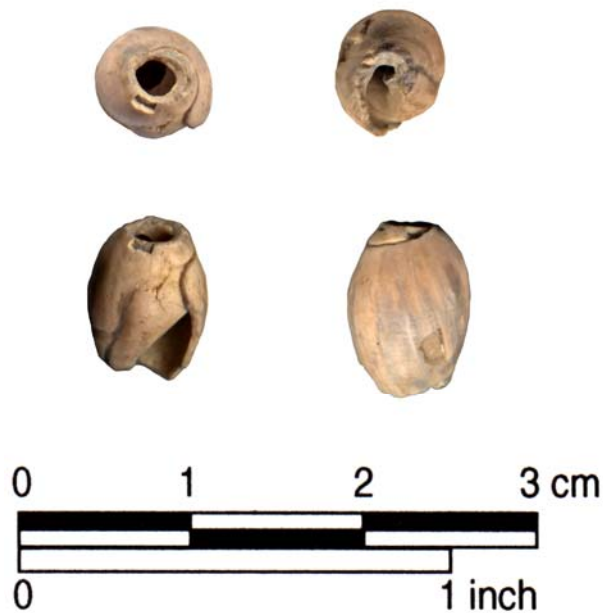


Figure 32. Simple spire-lopped *Olivella* beads

recorded in the database. Six examples were collected representing Bennyhoff and Hughes' (1987:117) three divisions based on maximum diameter (small: 3.0-6.5 mm; medium: 6.51-9.5 mm; and large: 9.51-14.0 mm). Due to the variable amount of both end grinding and natural wear, bead length is not used as a dividing attribute. The maximum diameter divisions are used for all A, B, and O series beads. Simple spire-lopped beads can occur during any time period.

One Simple Spire-lopped recovered from the 120-130 cm level of TEU 1 during the 2005 Emergency Excavation was submitted for radiocarbon dating. It had a 2 Sigma calibrated range of 3700-3460 B.P. (1750-1510 B.C.)

A2 Oblique Spire-lopped (74). This type differs from A1 beads in that the spire is removed diagonally. Sixty-four of these beads were recovered from the site. Most (95%, n = 70) are classified as A2a (small) while 5% (n = 4) are classified as A2b (medium). Although 57 of the A2 beads come from the 1968 UCLA collection, it is not known what association they have (if any) with the 1000+ A2 beads associated with Burial A which was excavated during the 1968 effort. The Burial A grave goods (including the 1000+ A2 beads) remain curated at the Fowler Archaeology Museum at UCLA and it is not clear if the UCLA effort included excavation in any areas *other* than the mortuary area. A short description of the Burial A grave beads by Chester King (King 2002:2) noted that a "concentration of over 1000 obliquely ground olivella shells was found in the pubic area of Burial A" and referred to this concentration as a "mass burial bead net." It is curious that the only beads received from the UCLA collection are of the same type (A2 and G4) as those recovered from the burials. In southern California, A2 beads are placed in the Early/Middle period Transition and early Middle Period (Bennyhoff and Hughes 1987:119; King 2002: 2)

A3 Drilled Spire-lopped (1). A3 beads consist of a nearly complete spire-lopped shell with a drilled perforation in the body whorl. Bennyhoff and Hughes (1987:119) note that many A3 specimens may be the result of the borings of predatory marine molluscs, however, the specimen from CA-LAN-192 is clearly conically drilled from the exterior. Further, its placement just above the canal may indicate that the piece may have been strung as an inverted (canal up, spire down) pendant. In southern California, A3 beads represent the Early Period and Phase 1 of the Late Period.

A4 Punched Spire-lopped (3). A4 beads consist of a spire-lopped bead with a single perforation punched into the body whorl. Three specimens are part of the CA-LAN-192

collection – two large (A4c) and one small (A4a). Their temporal significance is uncertain.

B2 End-ground (27). Class B2 beads were made by removing both the spire and base by grinding or chipping. Due to minimal basal grinding, the maximum bead diameter remains toward the spire. Eighty percent (n = 21) of the B2 beads are small and the remainder (20%, n = 5) are medium. End-ground beads are most common during the Early period and in Phase 1 of the Late period.

B3 Barrel (4). Barrel beads are similar to B2 beads in that the bead had been formed by grinding down both the spire and base. However, they differ from B2 beads in that they possess more extensive basal grinding resulting in a bead with its maximum diameter in the middle. All four B3 beads are classified as small. Barrels occur from the Early Period through the Protohistoric.

B4 Cap (6). Cap beads consist of a spire-lopped shell with virtually the entire aperture removed leaving the upper one-third of the shell. All six of the B4 beads are small. Cap beads are most emphasized in the late and terminal Early period, and the late Middle period into the early Late period.

B5 Spire (1). Spire beads are a cuplike bead made from the shell spire only. They first appear during the middle of Phase 1 of the Late period and continue into the Historic time.

C3 Split Oval (1). Split shell beads generally consist of a half-shell that can possess a full shelf, or quarter-shell with shelf edge or no shelf. All of the edges are ground and the beads can be of variable size. Split Oval beads are medium-sized with a central perforation and usually have no shelf. They mark the Middle/Late period Transition.

C7 Split Amorphous (1). C7 beads consist of a quarter-shell and have a highly variable form. They can be oval to rectanguloid and have chipped edges and partial edge grinding. Although they appear to be unfinished, their widespread occurrence in central California led Bennyhoff and Hughes (1987:125) to posit that they are a finished form. In central California they are a marker type for the Middle/Late period Transition.

C8 Split Rough (2). Split Rough beads are similar to the Split Amorphous in that they consist of a quarter-shell of variable form and possess chipped edges. However, they do not exhibit the partial edge grinding observed with the C7 beads. Split Rough beads are marker types for the Middle/Late Period Transition.

E1a Round Thin Lipped (3). Lipped beads can be round to oval and are normally made from the upper callus/inner lip portion of the shell and retain variable amounts of the adjacent body whorl (see Bennyhoff and Hughes 1987:127 for a full description of the E series). Thin lipped beads are round to oval with about half of the exterior surface consists of the thick callus and half is thin body whorl. This combination results in a bead which is decidedly asymmetrical in cross section. Round Thin Lipped beads have a

central perforation that is generally biconically drilled through the callus. The asymmetrical cross section and large size distinguish the bead from the ancestral cupped (K series) beads. The three Round Thin Lipped beads from the collection are Normal (E1a1) as opposed to Lipless (E1a2). They are considered marker types for early Phase 2 of the Late period in central California but are also common at the beginning of the Protohistoric period.

E1b Oval Thin Lipped (1). Oval Thin Lipped beads are distinguished from the E1a beads by bead shape. These beads have the same two variants, Normal and Lipless, as the E1a beads. The one Oval Thin Lipped bead in the collection is Lipless (E1b2). Similar to the E1a beads, E1b beads are marker types for early Phase 2 of the Late Period.

E2a Full Lipped (1). Thick Lipped beads (E2) are oval with a central perforation drilled conically from the exterior. They are distinguished from the E1 beads by less callus at the thicker edge, greater curvature, and a symmetrical cross section. The thick lipped beads are further divided into two sub-groups, Full Lipped (E2a) and Deep Lipped (E2b). There are four minor variants of the Full Lipped group – normal (E2a1), lipless (E2a2), shelf edge variant (E2a3), and shelved variant (E2a4). The one Full Lipped bead from the Lovejoy collection is normal. These beads are marker types for Phase 2 of the Late period but persist into the Historic period.

G1 Tiny Saucer (17). Saucer beads are circular wall beads made from the main body whorl and have central perforations usually drilled conically from the interior and have fully ground edges. They are distinguished from disks (Class H) by their greater curvature, larger perforation diameters, and ground edges. The Tiny Saucer is classed with the other saucer beads as it is flat and circular. It can occur in any period.

G2 Normal Saucer (4). Normal Saucers are circular, shallow wall beads with central conical or biconical perforations and fully ground edges. Normal Saucers are further divided on the basis of maximum bead diameter. Two of the specimens are classified as G2a (Small Saucer – 5.0 to 7.0 mm) and two are classified as G2b (Large Saucer – 7.1 to 10.0 mm). In southern California, Normal Saucers occur throughout the Middle period although metrics on large lots can be used to distinguish temporality.

G4 Ground Saucer (33). Ground Saucers are similar in shape and appearance to both Normal Saucers (G2) and Rings (G3) except that the exterior surface has been ground flat, presumably to thin the bead for drilling. They are considered a marker type for the early phase of the Middle period although King (1981:208) notes that the smallest examples are most common in phase M2a (300-200 B.C.) and larger specimens continue through A.D. 300. All 33 of the Lovejoy G4 beads came from the 1968 UCLA collection. As noted in the discussion of the Oblique Spire-lipped (A2) beads, it is not clear whether the analyzed G4 beads are associated with the mortuary area at Lovejoy it is curious that 1) UCLA presumably only worked within the mortuary area; and 2) the burials and associated grave goods are still curated at the Fowler Archaeological Museum; and 3) the beads received for analysis are of the same two types (A2 and G4) as those

found associated with the mortuary complex. Chester King's 2002 analysis of the burial beads indicated that more than 2000 Ground Saucers were found around the head and chest of Burial A at Lovejoy. He concluded that it was likely that all of the Ground Saucer beads from LAN-192 were from one necklace (King 2002:1).

H1a Ground Disk (4). Disks are shallow, circular wall beads with very small central perforations. They are noted for their fully ground edges and very small perforations (diameters averaging 1.0 mm) indicating that they were drilled with metal needles. Context and metrics distinguish them from Tiny Saucers. Ground disks are temporally associated with the Early Mission period, ca. A.D. 1770-1800.

H1b Semi-Ground Disk (1). Semi-ground disks are consistent with the description provided for ground disk beads except that their edges are only partially ground. They are associated with the Late Mission period, ca. A.D. 1800-1816.

J Wall Disk (7). Wall disks are medium-sized beads that are round to oval in outline and have fully ground edges. In central California they are a marker type for the protohistoric but probably begin in Phase 1 of the Late period in southern California.

K1 Cupped (88). Class K (Callus) beads are small, thick, and circular and made from the upper callus so that the resulting artifact is substantially thicker than the wall beads (Classes G, H, and J). They are generally conically drilled from the interior, they nest evenly, and feature a symmetrical cross-section. K1 beads are the most common form for the K series and are indicative of Phase 1 of the Late period.

K2 Bushing (12). K2 beads are a smaller and thinner version of the Cupped beads. They are considered a marker type for Phase 2 of the Late period.

K3 Cylinder (17). Cylinders have the smaller diameter of the Bushings but retain the thickness of the Cupped beads. However, the most telling characteristic is the larger, cylindrical perforation which results in a substantially thinner bead wall. As with the K2 beads, Cylinders are considered marker types for Phase 2 of the Late period.

O1 Drilled Whole Shell (2). These beads consist of a whole shell bead (in contrast to A3) with a conical perforation drilled into the body whorl. The two Lovejoy specimens are both classified as large based on maximum diameter. They represent Phase 1 of the Late Period.

O2 Punched Whole Shell (1). This bead consists of a whole shell bead (in contrast to A4) with an irregular perforation punched into the body whorl. The single O2 bead recovered from the site is classified as large based on maximum diameter. As with the O1 beads, it represents Phase 1 of the Late Period but can also occur in the Early period.

Q1 Tube (3). Q Series beads are long tubular beads made from the columella portion of the *Olivella* shell. They occur during late Phase 2 of the Late period.

Transitional (29). Thirty beads from the ASA collection have been tentatively identified as a transitional form corresponding to a shift from Callus (Series K) beads to Lipped (Series E) beads. Callus beads are an ancestral form of Lipped beads (Bennyhoff and Hughes 1987:127, 137), giving way to the later form as bead production moved from the callus portion of the shell toward the outer lip. Series K beads are identified by being round, symmetrical in profile, measuring 3.0-7.0 mm in diameter, having a curvature (thickness) between 2.0 and 3.0 mm, and nesting evenly with the adjacent bead when strung together. Series E beads are distinguished from the K Series beads by being round to oval, having an asymmetrical profile, measuring 5.0 to 9.0 mm in diameter, having a curvature of 3.0 to 4.0 mm, and nesting irregularly with the adjacent beads. K1 beads are the most common form of the K series and are indicative of Phase 1 of the Late period. Lipped beads are considered marker types for early Phase 2 of the Late period in central California but are also common at the beginning of the Protohistoric period.

The Transitional beads identified are all from the ASA collection and have traits from both series, as befits a transitional form.

Characteristic	Cupped		Transitional		Thin Lipped
Shape	Round	X	Round to oval	X	Round to oval
Symmetry	Symmetrical		Neither		Asymmetrical
Diameter	3.0-7.0 mm	X	4.39-5.77 mm		5.0-9.0 mm
Curvature	2.0-3.0 mm	X	2.34-3.8 mm	X	3.0-4.0 mm
Perforation	2.0 (mean)	X	1.66 (mean)	X	2.0 (mean)
Nesting	Yes, evenly	X	Yes, evenly		Yes, irregular
Chronology	Phase 1 Late period		mid Late period?		Early Phase 2 Late period

As Table 10 shows, the Transitional form exhibits characteristics that are consistent with both the chronologically earlier Cupped beads and the later Lipped beads. The round-to-oval shape of the beads is consistent with the Lipped series but bead diameter falls into the established ranges for Cupped beads. The range of curvature measurements spans the upper end of Cupped beads and the lower end of Lipped beads and the perforation diameter is even. The Transitional form nests evenly with the adjacent bead as do the Cupped beads. Perhaps most telling, is that the Transitional beads do not exhibit the symmetrical cross-section characteristic of the Cupped beads but nor are they “markedly asymmetrical in cross section (Bennyhoff and Hughes 1987:127).” Assuming that these beads are, in fact, a transitional form between the K and E bead series, they most likely date to latter part of Phase 1 of the Late period, prior to the establishment of the E series beads in early Phase 2.

Dentalium pretiosum (1). One tubular *Dentalium* bead fragment was examined as part of the 1954 ASA surface collection. It has been broken at both ends. Due to its weathered condition, it is unclear whether the breaks were cultural modifications or a result of post-depositional breakage.

Megabalanus californicus (6). Six Red-striped Acorn Barnacle beads were collected from the site during the 1954 ASA effort. Each of these beads has an irregular punched perforation through the carapace.

Tivela stultorum (3). Two Pismo Clam disc beads were part of the 1954 ASA collection. They are both circular, fully ground, with central biconical perforations. One has been facially incised with shallow linear striations. The earliest clam disks date to more than 7,000 years in age. Specimens of similar size (comparatively thin with small diameter) have been recovered from both early Early Period contexts (Gibson 1992:35; King 1990:109, 237) and from the Late Period (Gibson 1992:35; King 1990:188–192, 237).

One Pismo clam cylinder bead was also part of the ASA collection. It exhibits a partly glossy partly chalky appearance. All of its perimeter is ground but grinding facets are visible. The ends are slightly tapered and rounded with flat-ground centers. King (1990:237, 240-241) shows clam disc and cylinder beads during the Early period through Phase 1 of the Middle period (5500-200 B.C.) and during the Late period (A.D. 1150-1804). Clam disc and cylinder beads are rare outside the Santa Barbara Channel region between the Early period and Phase 1 of the Middle period (ibid. 108-110), and appear to lack the tapering observed in the cylinder bead from Lovejoy. Beads of similar size and shape are illustrated for the Late period (King 1990:240-241) and were commonly used throughout much of California.

Megathura crenulata (1). One small (or juvenile) Giant Keyhole Limpet shell bead/ornament (Specimen 11-2-15) was recovered from the site and part of the ASA collection. The entire perimeter of the specimen has been ground and the aperture is egg-shaped with a flattened margin. The bead/ornament exhibits dorsal polish and beveling at the wider end of the aperture. King (1990:250-255) shows *Megathura crenulata* ring ornaments during the early part of the Middle period through Phase 2a of the Late period (200 B.C. – A.D. 1650). These artifacts are found in comparatively high frequencies throughout much of Southern California during the Middle period, after which they become much rarer (ibid. 124-127). Although large shells were preferred, artifacts of similar size to 11-2-15 are also depicted.

8.3.2 Shell Ornaments

Cypraea spadica (2). Two Chestnut Cowrie shell pendants. Each of these consists of a complete shell with a single punched perforation at one end. One of the pendants has been burned, removing all traces of the characteristic chestnut coloring.

Haliotis rufescens (1). One partial abalone ring pendant. Following the Bennyhoff and Hughes (1987:145) shell ornament typology it can be classed as a *uC(C)3f*. This is a *Haliotis rufescens* (u) Simple Ring (CC) with a single edge perforation (3) and notched edges (f). The parentheses around the second C for Simple Ring denote that the likely form has been reconstructed.

8.3.3 Stone Beads

Unknown material (4). Three centrally perforated stone disc beads (11-2-1, 11-2-2, and 12-3-1) of unknown material are in the 1954 ASA collection. Artifact 11-2-1 measures 5.34 mm in diameter, is 2.01 mm thick, and has a 1.25 mm wide perforation. Artifact 11-2-2 measures 4.92 mm in diameter, is 1.29 mm thick, and has a 1.98 mm wide perforation. Artifacts 11-2-1 and 11-2-2 are both made from a grayish brown stone and both have biconical perforations, equally drilled from the ventral and dorsal surfaces.

Artifact 12-3-1 measures 4.42 mm in diameter, is 3.59 mm thick, and has a 1.57 mm wide perforation. It is made from a pearly white stone and has a biconical perforation.

Artifact 17-3-1 was recovered from the 20-30 cm level of Cerro Coso College's Unit 2. It measures 7.04 mm in diameter, is 2.42 mm thick, and has a 1.51 mm wide biconical perforation.

Steatite (2). Both steatite disc beads (Specimens 7-3-1 and 108-2-1) were collected during Æ's 2005 Emergency Excavations. 7-3-1 was recovered from the 60-70 cm level in TEU 1 and is a stone disc measuring 4.41 mm in diameter, is 2.31 mm thick, and has a 1.67 mm wide perforation. It is biconically drilled.

Item 108-2-1 was recovered from COL 5 from the 50-60 cm level. It measures 6.13 mm in diameter, is 2.11 mm thick, and has a 3.23 mm wide perforation. It is biconically drilled.

Quartzite (2). Both of the quartzite disc beads (Artifacts 33-3-1 and 87-3-1) were recovered during the 2005 excavations by Æ. Item 33-3-1 measures 4.37 mm in diameter, is 1.1 mm thick, and has a 1.12 mm wide straight-sided perforation. It was recovered from the 30-40 cm level of TEU 2.

Item 87-3-1 measures 3.95 mm in diameter, is 1.5 mm thick, and has a 1.75 mm wide perforation. It is biconically drilled and was recovered from the 20-30 cm level of COL 4.

8.3.4 Stone Ornaments

Steatite (1). One partial steatite ornament was collected during the ASA effort. Although the Bennyhoff and Hughes ornament typology is not explicitly extended to include stone ornaments, it is used here for descriptive purposes. Following that system, the ornament is a *B(A)3j*. This is a Short Oblong (BA), single edge perforation (3) plain (j) pendant. The parentheses around the A in BA note that the form is reconstructed. The pendant has been broken at the distal end.

Granitic (1). One granitic pendent (9-11-1) was collected by ASA. It consists of a water-rounded granitic rock with a single, conical perforation at one end. It measures

39.14 mm long by 23.05 mm wide and is 15.09 mm thick. It exhibits some staining on the exterior face, possibly the result of colored pigment.

8.3.5 Glass Beads

Glass (2). Two glass drawn-cane trade beads were included in the ASA collection. Specimen 11-3-1 measures 6.94 mm in diameter with a 3.14 mm central perforation. Heavy carbonization from burning precludes determining the original color. Specimen 11-2-15 is opaque white and measures 3.24 mm long by 3.35 mm wide and is 2.62 mm thick. Its perforation measures 1.0 mm.

Drawn-cane beads were made by gathering a mass of molten glass on the end of a blowing rod and blowing a bubble of into the center. Once the bubble was formed, the glass was drawn into a hollow tube or cane. Once the cane was cool, it was broken into segments of the desired bead size. The beads were then finished into rounded shapes by rolling the cut segments in a drum containing hot sand and ash (Kidd and Kidd 1970). The two glass beads indicate a site occupation during post-European contact times.

8.3.6 Unknown

Unknown (1). One specimen (7-11-12) from the ASA collection could not be positively identified with respect to bead type or material. It is consistent with a hard, white shell but may possibly be formed from a mammal tooth. It is a disc bead measuring 5.15 mm in diameter with a 3.0 mm wide perforation and has a beveled edge at the exterior perimeter equator. Approximately 80-100% of the perimeter is ground. One face is polished and shows an encircling ridge (not ground flat). The other face is partly chipped and partly ground flat.

8.4 CHRONOLOGY

The chronological assessment of the CA-LAN-192 bead assemblage is somewhat problematic in that the majority of beads in the artifact collection do not have any provenience. This lack of any kind of spatial anchor precludes pairing particular bead types with other artifacts and/or radiocarbon dates in order to build a subsequent refined chronology from these data. Additionally, many of the established bead chronologies have been constructed in concordance with collections from sites that range throughout California and the Great Basin. These extant collections, while useful, can only be used to approximate general tendencies and time periods. With that said, the chronological assessment will follow two paths. First, general site chronology will be addressed by examining the temporal distribution of each diagnostic bead type found at Lovejoy Springs regardless of provenience (or lack of). Second, the 1989 Cerro Coso College collection will be analyzed with respect to the Analytical Units proposed for these units. These data will then be compared to results of the 2005 Æ emergency excavation and the 2005-2006 Æ monitoring effort.

8.4.1 General Site Chronology

As previously noted, a total of 375 beads were analyzed as part of the current effort. A total of 27 unique *Olivella* shell bead types were identified with several of these types partitioned further on the basis of size. Three of the bead types (A1, B3, and G1) can occur in any time period and are not considered further. The temporal placement of a fourth type (A4) is uncertain and is also not considered further. Four other types all exhibit temporal significance over multiple periods. Punched Whole Shells (O2), Drilled Spire-Lopped (A3) beads, and End-Ground (B2) beads are all significant during Phase 2 of the Late period and also during the Early period. Cap (B4) beads are emphasized in the late and terminal Early period, late Middle period, and into the early Late period. This, coupled with the lack of provenience for each bead type, precludes determining which temporal expression is most likely.

Following the chronology set forth in Bennyhoff and Hughes (1987:116-145), the beads from Lovejoy Springs span at least 3,000 years from the Protohistoric/Early Mission period to the Early period (Table 11). While many of these beads have associations that are fairly broad and general (i.e. "Late Middle period), several examples, particularly those dating to the Protohistoric/Mission period, warrant a closer examination.

Insert Table X-x: Relative Frequencies of Diagnostic Bead Types...

Protohistoric/Mission period (ca. post-1700). Artifact 11-3-1 is a glass drawn-cane trade bead of undetermined color and artifact 11-2-15 is an opaque white drawn bead. Glass beads were an important tool of social negotiations during the early Spanish exploration of the New World. Europeans traded the imported beads for native products and subsistence items. Glass beads became highly valued by the local populations, becoming an integral part of their material culture. These beads were readily accepted because they had a preexisting role in native material culture but were still exotic (Arnold 2001:278). All glass trade beads post-date ca. 1700. Although further refinement is possible with larger sample sizes, that is not possible with only two unprovenienced artifacts.

Four ground disk (H1a) beads (artifacts 4-7-1, 7-11-2, 7-11-3, and 7-11-4) were part of the ASA collection. A single tradition of Series H disk beads has been documented based primarily on the straight-sided narrow perforations which are ostensibly drilled with metal needles acquired through trade with Europeans. The series has been further refined following a progressive shift from fully ground edges (H1a) to rough disks (H2) to chipped disks (H3) that is associated with an increase in size. The *H1a* beads in the Lovejoy collection all exhibit fully ground edges and straight-sided perforations which range in diameter from 0.98 mm to 1.30 mm and have diameters which range from 4.6 mm to 6.25 mm.

**Table 11. Temporal Placement of Diagnostic *Olivella* Shell Beads
(following chronologies of Bennyhoff and Hughes (1987) and King (1990a))**

Type	#	Mission Era	Late Period		Middle Period	Early Period
			Phase 2	Phase 1		
Semi-Ground Disc (H1b)	1	<----->				
Ground Disc (H1a)	4	<----->				
Barrel (B3)	4	<----->				
Spire (B5)	1	<----->				
Wall Disc (J)	7	<----->				
Normal round thin lipped (E1a1)	3	<----->				
Full Lipped (E2a1)	1	<----->				
Bushing (K2)	12		<----->			
Cylinder (K3)	17		<----->			
Tube (Q1)	3		<----->			
Oval Thin Lipped (E1b2)	1		<----->			
E/K Transition	29		<----->			
Cupped (K1)	88			<----->		
Drilled Whole (O1)	2			<----->		
Punched Whole (O2)	1			<----->	<----->	
Drilled Spire Lopped (A3)	1			<----->		<----->
End Ground (B2)	27			<----->		<----->
Capped (B4)	6			<----->		<----->
Split Oval (C3)	1			<----->		
Split Amorphous (C7)	1			<----->		
Split Rough (C8)	2			<----->		
Normal Saucer (G2)	4				<----->	
Ground Saucer (G4)	33				<----->	
Oblique Spire Lopped (A2)	74				<----->	

Seven wall disk (J) beads were also part of the ASA collection and appear to post-date contact between Native Americans and Europeans. Previous work documented in Bennyhoff and Hughes (1987:136) note that Series J beads probably begin in Phase 1 of the Late period and continue until ca. A.D. 1816. Six of the beads in the Lovejoy collection exhibit straight-sided perforations with diameters ranging between 0.75 mm and 0.97 mm. Similar to the Ground Disk beads, the description of the six bead perforations is consistent with those described for protohistoric/mission era beads. A seventh wall disk bead exhibits a conical (from the interior) perforation measuring 1.44 mm in diameter. Wider, conically-drilled perforations are not inconsistent with protohistoric beads as it is likely that bead manufacturing with stone tools continued for some time after the introduction of metal needles. However, these particular characteristics tend to be associated with the chronologically earlier beads.

Phase 2 Late period (ca. 1450–1700 A.D.). In addition to the one wall disk bead noted above, five other bead types are exclusively associated with Phase 2 of the Late period. Callus Bushings (K2), Callus Cylinders (K3), Columella Tubes (Q1), and Normal Full Lipped (E2a1) all signify this time period. The fifth bead type, Lipless Oval Thin Lipped (E1b2) are considered a marker type for Phase 2 but are most common after 1600 A.D.

Phase 1 Late period (ca. 1200 – 1450 A.D.). Two bead types from the Lovejoy collection have exclusive Phase 1 Late period expressions. Cupped (K1) and Drilled Whole Shell (O1) beads are both associated solely with this time period. Three additional types - Punched Whole Shells (O2), Drilled Spire-Lopped (A3), and End-Ground (B2) beads, are all associated with both Phase 1 of the Late period and with the Early period.

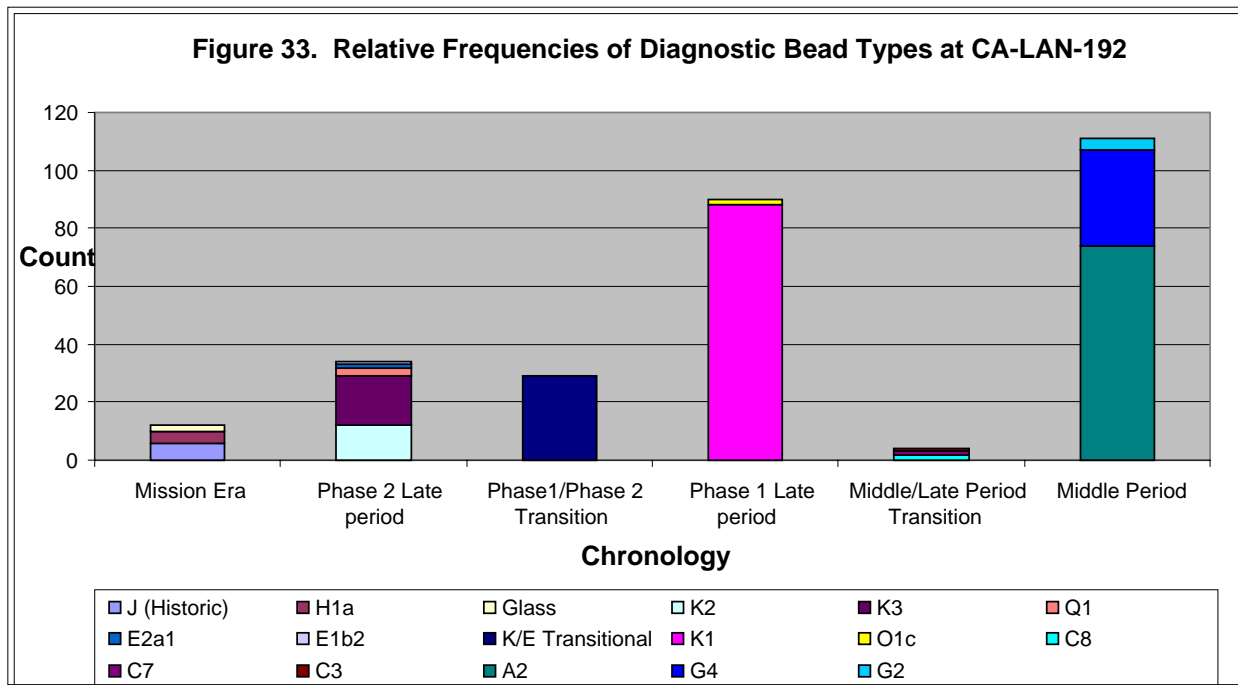
Middle/Late period Transition (ca. 1200 A.D.). All three of the C Series beads date to the Middle/Late period transition in California, although the C3 (Split Oval) beads also have an Early period expression in the Great Basin. Both the C7 (Split Amorphous) and C8 (Split Rough) are considered marker types for this time.

Middle period (ca. 800 B.C. – 1200 A.D.). Two bead types in the Lovejoy collection are exclusive to the Middle Period. Normal Saucers (G2) can occur throughout the period while Ground Saucers (G4) are considered a marker type for the early part of the Middle period. Southern California examples of Oblique Spire-Lopped (A2) beads are placed in the early part of the Middle Part but can extend back to Early/Middle period transition.

Examination of the 1968 UCLA salvage excavation collection (King 2002) revealed 2000+ Ground Saucers and 1000+ Oblique Spire-Lopped beads associated with a mortuary area at Lovejoy Springs (these beads were not provided for analysis). King notes that “small oblique ground olivella shells are found in early Middle period contexts and are often associated with dorsal ground saucer beads (King 2002:2).” A single radiocarbon date from the burial area provided a date of 2720 ± 70 B.P. (770 ± 70 B.C.) which is consistent with an early Middle period interpretation.

Early period (pre 800 B.C.). As noted above, four bead types recovered from the site can be indicative of the Early period, though none exclusively. Punched Whole Shells (O2), Drilled Spire-Lopped (A3) beads, and End-Ground (B2) beads can each signify the Early period but are also present during Phase 2 of the Late period. Cap (B4) beads are emphasized in the late and terminal Early period but also show up during the late Middle period and into the early Late period. Due to the lack of an exclusive Early period bead type, the current data preclude establishing an Early period presence at CA-LAN-192 based solely on bead data.

As shown in Figure 33, beads associated exclusively with the Middle period show the highest relative frequency at Lovejoy Springs. Phase 1 Late period associations are also quite high but the site exhibits a marked decrease in the number of beads exclusively associated with Phase 2 of the Late period. The downward trend continues into the Mission Era. Interestingly, the Phase 2 assemblage exhibits the greatest variety of bead types.



8.4.2 Analytical Unit Chronology

Analysis of soil profiles from the 1989 Cerro Coso College excavation, obsidian-hydration (OH) rim measurements, radiocarbon dating, and diagnostic tool types resulted in the identification of three Analytical Units (AUs) at Lovejoy Springs. The AU definitions are shown in Table 12. Based on unit and excavation depth, beads were assigned to one of the Analytical Units.

Analytical Unit	Excavation Unit	Depths
1	Units 1, 4 Units 2, 3, 5, 6, 7	20-100 cm 0-100 cm
2	Units 1, 6, 7	100-140 cm
3	Unit 6	160-?? cm

The Cerro Coso College collection is comprised of 38 beads. The breakdown of beads from the Cerro Coso collection by AU, along with associated bead chronologies, is listed below in Table 13. Four of the bead types (A2, B2, B3, and Q1) are present in both Analytical Unit 1 and 2. One bead type (B4) is present in both Analytical Unit 1 and 3. Four bead types (E2a1, G1, G2b, and one stone disc) are present only in AU 1. Further complicating the AU division is the multiple temporal assignments of all of the types except for G2b (Middle period), and Q1 (Phase 2 Late period) *and* that the two types with single expressions co-occur. Several interpretations of the above data seem possible. First, there has been substantial intermingling of the AUs and the divisions exhibited in the OH readings are not reflected in the bead data. This is problematic in the fact that a situation in which the beads have become stratigraphically intertwined while the analyzed obsidian artifacts have not is highly unlikely. Second, there is the possibility that the AUs are intact but the beads are not indicative of the chronologies applied to them. This is also problematic in that the established chronologies for each bead type are the result of pairing the bead with either radiocarbon dates and/or diagnostic artifacts. Admittedly, these chronologies have been established, as previously mentioned, from collections ranging throughout California and the Great Basin. However, revising the temporal expression of entire bead classes based on such a small sample and without clear corroborating data does not result in a satisfactory explanation. A more likely explanation is some combination of both possibilities. It is highly probable that there has been some mixing of the archaeological deposit. This is more of an issue for bead typing than it is for reading OH rims which, for the most part, only exhibit a single measurement. The upward or downward movement of an artifact that represents a substantial timeframe (i.e. “the Middle period) can seriously skew the analytical results of a particular sample, particularly if the sample is relatively small.

Table 13
Analytical Units and Cerro Coso College
Bead Distribution

AU 1			AU 2			AU 3		
Type	No.	Chronology	Type	No.	Chronology	Type	No.	Chronology
A2	8	Early-Middle period transition, Early Middle period	A2	3	Early-Middle period transition, Early Middle period			
B2	12	Phase 1 Late period, Early period	B2	2	Phase 1 Late period, Early period			
B3	3	Early period through protohistoric	B3	1	Early period through protohistoric			
B4	2	Early Late period, Late Middle period, Late Early period				B4	1	Early Late period, Late Middle period, Late Early period
E2a1	1	Phase 2 Late period						
G1	2	any time period						
G2b	1	Middle period						
Q1	1	Phase 2 Late period	Q1	1	Phase 2 Late period			
Stone disc	1	??						

8.4.3 Emergency Excavation Data

Applied Earthworks' 2005 Emergency Excavation resulted in the recovery of 21 shell beads and 4 stone beads. Analysis of the site stratigraphy, OH measurements, diagnostic tools, and radiocarbon dates did not result in the identification of any Analytical Units for the 2005 excavation. However, due to the fact that the artifacts were recovered from recorded proveniences, some interpretation can be attempted.

The 21 shell beads represent a span of time possibly extending from Early period to the Mission era. Several of the bead types (A1, G1, and B3) are not indicative of any particular time period and can occur throughout prehistory. Four of the classes (A2, B2, B3, and B4) all have multiple expressions and cannot be assigned to a particular period. One bead type (G2a – Small Saucer) is considered a marker type for the Middle period. Two of these beads were recovered, one each from TEUs 1 and 2 and both from the 60-70 cm level.

As shown in Table 14, it is difficult to use the 2005 Emergency Excavation data to further understand the chronology of Lovejoy Springs without a larger sample of beads possessing more refined temporal expressions. While these data are consistent with the

Table 14
2005 Æ Emergency Excavation Bead Frequencies

Bead Type	No.	Unit	Level (cmbs)													
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	
A2 Late and terminal Early period, Late Middle period, Early Late period	6	TEU 1				x		x		x						
		TEU 2						x		x						
		COL 5											x			
Any time period	7	TEU 1					x			xxx						
		TEU 2				x					x		x			
Middle period	2	TEU 1								x						
		TEU 2								x						
Any time period	1	TEU 2											x			x (3580 B.P.)
Early period to Mission era	1	COL 5										x				
Early period, Phase 1 Late period	1	TEU 2							x							
Stone disc	4	TEU 1								x						
		TEU 2					x									
		COL 4				x										
		COL 5								x						

overall site chronology, it is not possible to use them to establish a more sophisticated picture of the CA-LAN-192 timeline.

Interestingly, one possible correlation with the Cerro Coso College collection exists. Although the inferred time periods from the three AUs do not appear to extend to the Emergency Excavation beads, the *bead types* are almost completely identical. All seven of the bead types (6 shell and 1 stone) noted in this section were also recovered during the Cerro Coso College effort. In fact, there are only two bead types noted in Section 8.4.2 that are not represented in the Emergency Excavation collection (types E2a1 and Q1 – both Phase 2 Late period beads). This may indicate a spatial continuity between the material excavated from the existing Stephen Sorensen Park and the midden located adjacent to Avenue P. Further, the absence of any Phase 2 Late period beads in the Avenue P midden may be a result of the mechanical truncation of the midden during historic/modern times.

8.5 CHRONOLOGY SUMMARY

The bead and ornament collection from CA-LAN-192 is particularly rich in material, quantity, and variety. Although this variety is useful from a purely typological and/or descriptive point of view, the lack of provenience for the majority of the artifacts precludes providing anything other than rough estimates with respect to site formation, use, and interpretation.

The breakdown of bead types indicates a site occupation beginning possibly as far back as the Early period and extending into the Mission era. Based on the relative frequency of bead numbers, CA-LAN-192 was most intensively occupied during the Middle period with a sharp decrease at the end of Phase 1 of the Late period. The presence of exotic marine shell and stone bead material matches the diversity observed in the flaked stone tool assemblage. This supports the idea that Lovejoy functioned not only as a semi-permanent residency but a valuable trade location as well.

Analysis of the provenienced beads uncovered during both the 1989 and 2005 excavations did not lead to the detection of identifiable stratigraphic associations that could be defined on the basis of bead type and/or morphology. However, a spatial connection between the midden along Avenue P and the portion of the site under the existing park is possibly exhibited by the continuity of bead types between the two areas.

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: NATIVE AMERICAN CERAMICS

9.1 THE CERAMIC SAMPLE

The ceramic sample from CA-LAN-192 contains 116 items (not counting fragments of the same item) and includes locally-made brown ware, Lower Colorado Buff ware, Tizon/Southern California Brown ware, Hohokam Red-on-buff ware, and an intermediate brown/buff ware herein referred to as California Desert Intermediate. Of these, 107 sherds are fragments of utilitarian vessels; seven sherds have been reworked into other tool forms; and two specimens are baked or unbaked clay. Only eight vessel rim sherds (7%), compared to 99 body sherds (93%), were recovered.

Table 15 details the origin of the ceramic sample from five investigations of CA-LAN-192. These investigations include a surface collection by Bob Wubben (BW); surface collection and test units excavated by the Archaeological Survey Association of Southern

TABLE 15. Origin of the CA-LAN-192 Ceramic Sample.

Collector	Coll. ID ¹	Year	Sample Type	# of Rims	# of Body Sherds	# of Worked Sherds (WS)	Other	Total
BW	7	1920s	Surface	-	-	1 disk		1
ASA	4	1954	Surface/ Test Exc	6	67	4 disks 1 WS 1 WS? ²		79
UCLA	6	1968	Surface	1	4			5
Cerro Coso	5	1989	Test Exc		1		1 baked clay (4 frags)	2
AE	11	2005	Test Exc	1	27			28
Unprov.	10	?	?				1 un-fired? clay daub	1
TOTAL	-	-	-	8	99	7	2	116

¹Unique ID number assigned by AE to each collection.

²Originally classified as a rim; appears to be a sherd from the neck of a narrow mouth vessel that has been reworked as a tool

California (ASA); surface collection by the University of California at Los Angeles (UCLA); a test excavation by Cerro Coso College (Cerro Coso); and test units excavated by Applied EarthWorks (Æ) during park construction in 2005.

Table 16 describes the subsurface distribution of the sample. Sixty-nine sherds (64%) were collected from the surface and represent the broadest range of variation in ceramic types. Thirty-eight sherds (36%) derive from the subsurface; upon further examination, this is an inflated number and percent since the bulk of the subsurface collection comes from the two units excavated by Æ, and each unit has multiple small to tiny fragments of an individual pot. This suggests that there was considerable churning of the midden at these locales by the time they were excavated by Æ.

By far the largest and most diverse collection of ceramics from the site (77 specimens; 66% of the total ceramic sample) was collected from the surface in 1954 by ASA, and included a wide range of buff and brown wares, all but one of the worked sherd tools, and the bulk of the decorated ceramics (including the Hohokam sherd). Only one of the worked sherd disks was collected by another investigation; the single disk collected by Wubben in 1920. If the ASA and Wubben collections were excluded from the site sample, a very different picture would have been drawn of the ceramic industries represented at Lovejoy Springs.

Although precise information on the location of ASA units is not known, it reportedly centered on the midden area destroyed by the construction of Avenue P and the large drainage canal. It appears that ASA divided the site into nine collecting areas, of which SC 2 and SC 3 had the greatest density of ceramics (25 and 23 sherds respectively); SC 1 had half the number of sherds (12) as SC 2 and SC 3. Both SC 2 and SC 3 had a mixture of brown and buff wares. The remaining surface units and the three shallow test pits (TP 1A, 1B, and 2B, maximum depth of six inches below surface) had six or fewer sherds. The three sherds currently tallied in TP1B formerly were a single sherd when reported in Price (2002).

TABLE 16. Distribution of the Ceramic Vessel Sample (cm below surface).

Collector	Surface	0-10*	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
ASA	64	9								73
UCLA	5									5
Cerro Coso				1						1
Æ				2	4	16	1	3	2	28
TOTALS	69	9		3	4	16	1	3	2	107

*ASA's subsurface collection derived from 0-6" below surface.

9.2 ANALYTICAL METHOD

Æ laboratory staff processed the five ceramic collections: the sherds were placed in polyethylene bags labeled with new prefixes so that the original specimen catalog numbers remained intact, but each collection could be identified by the unique prefix (labeled Collection ID # in Table 1). All ceramic specimens were weighed, measured for length, width, and thickness, and the Munsell color was noted for interior and exterior surfaces. Special features were noted, and all data were entered into an electronic catalog that was provided to the ceramic analyst.

Upon receipt of the collections, the analyst verified the data and entered any changes into the electronic catalog (e.g. Munsell colors were not recorded for sherds with colors obscured by carbon). Additional variables were recorded, including the degree of oxidation; type, direction, and placement of wiping marks on the vessel; evidence of paddle/anvil use; degree of smoothness; presence and type of non-plastics and vugs visible on the surface; and other evidence of manufacturing techniques. Surfaces were also examined for evidence of: use wear patterns and residues; post-deposition residues; type and placement of decoration; and decorative elements.

A freshly broken edge of each sherd was examined under a binocular microscope to observe gross clay and nonplastic percentages and degree of mixing; the grain shape and size; and mineral content. Vessel rim sherds were coded for form; estimated mouth diameter (for sufficiently large sherds); and shape and thickness of the lip. Rim sherd profiles were drawn, and vessel form was recorded when possible. Worked sherds were drawn and examined for evidence of use wear. Type or ware assignments were made wherever possible (see typology below).

Several of the pieces of baked clay appeared to have basketry impressions. Femo® modeling clay was used to make positive impressions; none was sufficiently clear to enable identification of the kind of basketry, only that random individual stitch impressions were present.

Ten sherds were selected for petrographic thin-section analysis. Because clay samples were not collected during any of the five investigations at the site, comparisons to the local geology were restricted to the published literature.

9.3 CERAMIC TYPOLOGY

9.3.1 Introduction

Archaeologists have long used ceramic typologies to aid them in ascribing geographic, temporal, and cultural meaning based on changes in ceramic manufacturing techniques, vessel forms, decorative techniques, and design elements. These are presumed to have a genetic relationship, originating in an ancestral type that then evolves into new variations on the original type. This schema is especially useful in Southwestern archaeology,

where decorated ceramics are plentiful. Colton and Hargrave (1937) viewed ceramic traditions with a genetic model in mind: ancestral types produced other types that were “genetically” related, but differed more the further they were removed in time or space from the ancestral type. According to their hierarchical classification, pottery can be assigned to a specific localized *type*, within a regional *series*, within the overarching *ware*. They defined *type* as “a group of pottery vessels which are alike in every important characteristic except (possibly) form” (1937:2). These characteristics include surface color, method of handling the clay, texture of the core, chemical composition of the temper, chemical composition of the paint, and styles of design in decorated pottery. A *series* is “a group of pottery types within a single ware in which each type bears a genetic relation to each other...” (1937:3). A *ware* is “a group of pottery types which has a majority of (the above) characteristics in common but that differ in others” (1937:2).

The rules for naming types, series, and wares stipulated that names begin with a geographic term followed by a descriptive term (Kidder 1927; Gladwin 1930). A type might be named for a specific site or local area (e.g. Topoc Buff); a series is a regional designation; and a ware should refer to a large geographic area with ceramic types that share the same manufacturing technique and similarly colored-clays (e.g. Lower Colorado Buff Ware). In practice, many of the ware designations (such as Hohokam Buff Ware, Mogollon Red Ware) are broad cultural/regional descriptions.

There are four primary ceramic manufacturing techniques in the New World: (1) modeling, (2) coiling, (3) molding, and (4) slab building. Modeling involves pinching small bowls or other forms using the fingers to shape the vessel. Coiling begins with a flat pancake of clay for the vessel base, to which coils of clay are added in a spiral fashion. Molding involves pouring a clay slurry into a vessel mold. Slab-building involves pinching the edges of flattened pieces of clay to build larger vessels. Although modeling was used to make small bowls, pipes, and figurines from the earliest examples of baked clay forms in the Southwest and southern California, and continued to the present, larger utilitarian pots were and continue to be made by the coiling method. There are, however, two broad traditions for shaping and thinning coiled vessel walls: they can be scraped to remove the excess clay, or they can be thinned by placing a stone or ceramic anvil on the interior of the vessel and striking the exterior opposite the anvil with a wooden paddle. Puebloan, Great Basin, and Owens Valley ceramic traditions are coil-and-scrape; Hohokam and Patayan ceramics of western/southern Arizona and southern California are paddle-and-anvil. The origin and significance of this broad regional and cultural division in finishing techniques remain unknown.

In addition to Hohokam Buff Ware of central and southern Arizona, two paddle-and-anvil wares have been identified for western Arizona and southern California: Tizon Brown Ware, named for prehistoric ceramics from northwestern Arizona (and later extended to include coastal southern California) and Lower Colorado Buff Ware, from both sides of the lower part of the river and adjacent desert regions. Both of these wares are primarily plain, undecorated products, which makes it difficult to discriminate types and series within each ware.

Malcolm Rogers developed the first typology of plain wares from the Mojave sink, the Colorado River, and adjacent desert areas in Arizona and California, but he never published his typology. His ceramic notes were used and reused by others to publish subsequent typologies in ways that were not always in accord with Rogers' original schema (see Waters 1982a:279 discussion of the confusion of Topoc Buff by Schroeder). Rogers' notes include as many as 75 types (1945b), as he sought to distinguish regional differences.

Schroeder (1952) consulted Rogers' type collections and notes at the San Diego Museum and published descriptions of 30 types of Lower Colorado Buff Ware within six regional series (Parker, La Paz, Palo Verde, Salton, Gila Bend, Lower Gila). He added a seventh series (Barstow) in 1958 and ultimately published 31 types within Lower Colorado Buff Ware (LCBW), included three types previously published by Colton (1939a) (Topoc Buff, Needles Red-on-buff and Pyramid Gray). Schroeder named a separate type for each surface treatment: undecorated, red slipped, stuccoed, red painted, and fugitive red wash. Tizon Brown Ware was described first for northwestern Arizona (Dobyns and Euler 1958), then extended to include a southern California type named Palomar Brown (Euler 1959).

May (1978) also examined Rogers' notes and published a typology of ceramics from southern California; it contained five named series within Tizon Brown Ware (Peninsular, Laguna, Gulf, Mohave, and Mission) and two series of Lower Colorado Buff Ware (Salton and Carrizo). May also created separate types for undecorated and decorated ceramics within a series.

Waters' (1982a, b, c) examination of Rogers notes and type collections focused solely on the Lower Colorado Buff materials from the Lowland Patayan cultural area, which consists of the lower part of the river, the areas surrounding the Salton Sea shorelines, and only slightly eastward into western Arizona. He lists 17 types, generally a plain and a decorated type for each ceramic tradition, with stucco incorporated as a variant surface treatment on the plain rather than segregated as another type. Waters does not identify series within his Lowland Patayan ceramic tradition, and he does not use three types listed in Rogers' (1945b) last list of ceramic types (El Rio, Blythe, and La Paz). The more dramatic difference between Schroeder's and Waters' reworking of Rogers data occurs in the dating of individual types. As seen in Table 3, most are nearly reversed in their placement in the chronology; only Parker Buff is similar. Most recent ceramic analyses on either side of the Colorado River have used Waters' typology (1982a, b, c) for Lower Colorado Buff Ware.

Lyneis (1988d) critiqued extending Tizon Brown Ware to southern California without first documenting the ceramic types in the intervening areas between northern Arizona and cismontane southern California. Griset (1996) described the Southern California Brown Ware tradition without identifying specific types, and had noted earlier (1986:91) that sherds made from clays intermediary between the coastal mountains and the southern California desert were also transitional in color between brown and buff.

TABLE 17. Comparison of Lower Colorado Buff Ware Typologies (based on type sherds observed at the Western Archaeological and Conservation Center, Arizona State Museum, and sherds loaned by Waters to Mike Foster, SWCA).

SCHROEDER (1958)			WATERS (1982a)		
TYPES	TIME PERIOD	<i>Griset observations</i>	TYPE	TIME PERIOD	<i>Griset observations</i>
Black Mesa Beige Red Polychrome	post A.D. 1150-?	<i>distinctive clay with clay pellets; same in both typologies</i>	Black Mesa Buff Red-on-buff (red wash)	A.D. 700- 1000 Patayan I	
Colorado Beige Red Red-on-beige	post A.D. 1150-Historic	<i>resembles a polished version of Parker</i>	Colorado Beige Red Red-on-beige	A.D. 700- 1050 Patayan I	
Pyramid Gray (sample viewed at WACC)	A.D. 900- 1150	<i>clay similar to Black Mesa with added crushed granitics</i>			
Tumco Buff Red-on-buff Stucco	pre A.D. 900- post 1400?		Tumco Buff (includes stucco) Red-on-buff	A.D. 1200- 1400 Patayan II	<i>untempered; with crushed clay particles</i>
			Salton Buff (& stucco) Red-on-buff	A.D. 1000- 1500 Patayan II	
Topoc Buff Red-on-buff Fugitive Red Stucco	post A.D. 1150-?	<i>Erroneously listed as the only type within "Salton" series, contra Rogers</i>	Topoc Buff (stucco) Red-on-buff	A.D. 900- 1150 Patayan II	<i>=oxidized version of Colton's Pyramid Gray; does not = Colton's Topoc Buff, but similar to Schroeder's samples</i>
Palomas Buff Stucco	post A.D. 1150-?		Palomas Buff (stucco) Red-on-buff	Patayan II & III	
Parker Buff Buff; Red-on-buff	pre A.D. 900- post 1900		Parker Buff (stucco)	A.D. 1000- Historic Patayan II &	

Black-on-red Stucco			Red-on-buff	III	
			<i>Colorado</i> Buff (<i>stucco</i>) Red-on-buff (<i>red wash,</i> <i>red-on-red;</i> <i>black-on-</i> <i>red; black-</i> <i>on-buff</i>)	A.D. 1500- Historic Patayan III	= <i>Colton's</i> <i>Topoc Buff</i> & <i>Schroeders?</i> <i>Needles</i>
<i>Needles Buff</i> Buff Red-on-buff Beige Red-on-beige Red Black-on-Red Stucco	A.D. 1150? - ?				
<i>Gila Bend</i> <i>Plain</i> Plain Red Beige Stucco	post A.D. 1150 - ?				

Other analysts have added new categories to these typologies, particularly for the transitional areas between the brown and buff burning clays of the California cismontane and desert, respectively. Unfortunately another source of confusion has been added by mixing typological layers in the process. As described above, Colton prescribed a typological hierarchy of wares, regional series within each ware, and types within the series (Colton and Hargrave 1937; Colton 1939a). Schaefer (1995:IX-10) added Tahquitz Brown but equated it with both Salton Brown (a type) and Tizon Brown (a ware). Subsequently, Hildebrand et al. (2002) proposed Salton Brown as a third ware, based on its intermediary clays that are not purely residual or alluvial. Unfortunately, the name Salton has been used already to designate both a series and a type within Lower Colorado Buff; its selection to name a new ware adds to an already confusing nomenclature.

Margaret Lyneis described granitic brown sherds with paste and color that was intermediate between residual brown and sedimentary buff. She also detected a group of ceramics with a paste texture that intergraded with both the grainier [brown] and the non-granular [buff] textures in the assemblages from Fort Irwin, approximately 150 miles northeast of Lovejoy Springs (Lyneis 1988a, b, c; 1989a; 1990). Lyneis' Intermediate Brown was easily distinguished from Owens Valley Brown Ware or Great Basin Brown since those wares are finished by scraping rather than paddling, and both often have distinctive wiping marks in opposing directions on the interior and exterior surfaces.

Lyneis concluded that the intermediate paste's tendency to intergrade "is likely a reflection of the dominance of ceramics made from clays available along the Mojave River valley and its environs" although she also cautioned that there were insufficient data to rule out the presence of fine clean sedimentary clay deposits in the uplands of Fort Irwin or the adjacent Mojave River Valley. She noted that Drover and Bugge (1979:140, Table 13, cited in Lyneis 1988b:E3) found a deep bed of fine clay near the center of East Cronise Lake.

A more generic term that can include additional intermediate clays such as those observed in the Fort Irwin and Lovejoy Springs ceramic assemblages would remove some of the typological confusion. For the purposes of this report, we have used a geographical/descriptive term, California Desert Intermediate Ware, to describe this tradition of local manufacture with clays that are between brown and buff. Tahquitz Brown and Salton Brown would fit as types or series (if there are multiple types described for each) within this overarching regional ware. Southern California Brown Ware is used herein to denote the brown ceramics of cismontane southern California formerly lumped under Tizon Brown Ware.

Additional controversy has raged over whether these different ceramic wares reflect differences in manufacturing techniques, regional geology, or an associated cultural pattern. They are found in an area where land use practices featured a pattern of mobile resource gathering within territories of varying sizes. It is conceivable that the same people could have made both buff and brown ceramics, depending on the resources at hand. The area also included multiple linguistic boundaries that are difficult to discern from the homogeneous archaeological pattern. However, there are clearly certain vessel shapes in the early buff ceramics that are not found in the brown. The proposed chronological evolution of vessel form has not been verified with direct dates; in fact, recent data suggest these differences in shape may not have clear cut chronologies.

At present, the Yuman/Patayan/Hakatayan debate appears to have evolved in favor of the neutral term Patayan being applied to lowland desert areas on both sides of the lower Colorado River, west to the Transverse Ranges, and east to somewhere around Welton, Arizona (Colton 1939b, 1945; Gladwin and Gladwin 1934; Rogers 1945a; Schroeder 1952, 1982; Waters 1982a). How the Mojave Desert fits within this debate remains to be discerned.

9.3.2 Typological Classification of Ceramics from CA-LAN-192

The ceramic assemblage from Lovejoy springs was compared with published type descriptions (Waters 1982a,b,c; Schroeder 1958), Malcolm Rogers' unpublished notes on ceramics from the Mojave and Colorado deserts (Rogers 1945b), and May's (1978) publication of Rogers' notes. In addition, the author consulted type collections at the Arizona State Museum and National Park Service Western Archeological and Conservation Center in Tucson, as well as private type collections loaned by Michael Waters and collections from Lake Mead previously analyzed by Schroeder.

Given the site's location midway between the Colorado River and the Pacific Coast on a well-known and well-used trade corridor, it was anticipated that the ceramics might reflect a broad range of ceramic types, and this proved to be the case. As shown in Table 4, sherds from four archaeologically-identified ceramic wares are present: Southern California Brown (58 specimens), California Desert Intermediate (16 specimens), Lower Colorado Buff (39 specimens), and decorated Hohokam Buff (one specimen).

These gross categories are discerned by combinations of the differences in:

- Surface color Brown (containing more iron) vs. Buff (less iron)
- Clay texture/sorting Residual (coarse) vs. Sedimentary (fine)
- Non-plastics shape Angular vs. Rounded

TABLE 18. Distribution of Ceramics by Ware and Type.

SOUTHERN CALIFORNIA BROWN	58
CALIFORNIA DESERT INTERMEDIATE	14
Cronese Red-on-brown	2
LOWER COLORADO BUFF	3
Pyramid Gray	1
Colorado Beige	2
Colorado Red	3
Colorado Red-on-buff	1
Parker Buff	15
Parker Stucco	4
Topoc Buff	8
Topoc Red-on-buff	1
Tumco Buff	1
HOHOKAM BUFF	
Santa Cruz/Gila Bend Red-on-buff	1
Total	114

Of course, these attributes can be misleading unless their combinations are taken into account. A finely-textured, sedimentary buff-colored clay may have crushed rock rather than sand added as temper; a brown residual clay may also have crushed rock, as a result of grinding the rock-full clay.

Rogers (1945b) described two brown types specific to the Mojave sink area (considered in this report under the California Desert Intermediate Ware category). Cronese Brown

and Crucero Brown (the latter also has a red variant labeled Crucero Red) are difficult to separate on the basis of Rogers' notes. Cronese has "Residual (?) clay in appearance but due to its pink burning qualities and the fact that the spar with its inclusions are not decomposed, is probably of sedimentary origin" (Rogers 1945b). Rogers found no visible inclusions up to 20 power, but states that the temper consists of crushed feldspar, mostly translucent white or pink with strong biotite embedded in the spar, some hornblende, and traces of specular iron and magnetite. Cronese is usually brown in color, but may also appear reddish brown, and it decomposes easily.

Crucero Brown is a "rare type," with the same paste as Cronese, yet Rogers states that it burns to seal brown/greenish brown, or maroon brown when oxidized. Green spar is more common and the temper is less micaceous and very finely ground. Rogers makes no discrimination between naturally occurring non-plastics, and purposely added temper, although it would appear that he considers both of these types to have added temper. He states that Cronese Brown has more bronzite and less magnetite than Crucero; Crucero Brown has a smoother floated surface, occasionally burnished, and a burnished red slip.

Rogers found both types only in the Mojave Sink, with Crucero restricted to the southern portion of the sink. Flat rims occur in both types, which Rogers found difficult to explain since he placed both in the Yuman II period based on horizontal stratigraphy.

9.4 CERAMIC VESSELS

9.4.1 Vessel Shapes and Functions

Six rim sherds, two neck sherds, and one probable base sherd were identified in the ceramic assemblage, however, only five vessel shapes were identified: one bowl, two wide-mouthed pots (ollas), and a medium-wide olla (Table 6; Figure 1). The shapes are reconstructed from rim profiles and diameters; reconstructed shapes are based on comparison with whole vessels in museum collections for the various ceramic types. Two Parker Buff rims, both with direct, flat lips, were too small to project the vessel shapes.

One of the Southern California Brown Ware rims had a wide mouth (34-36 cm); the other had a medium-wide diameter at the rim (10 cm) and carbon deposits on the exterior which suggest that it was likely used as a small cooking pot. Another medium-wide vessel is represented by the Topoc Buff rim, which measures an estimated 20 cm diameter. The other wide-mouth pot (36 cm dia.) and the only bowl (10 cm dia.) are Colorado Red vessels. The bowl was fairly shallow and small; the small size and the polished red-slipped interior suggest that it was probably used for serving or holding a small portion of food or other valued commodity. No narrow-mouth ollas, such as might be expected to store or transport water or food, were recovered among the ceramic assemblage.

Table 19. Vessels Recovered from Lovejoy Springs.

Spec #	Ceramic Type	Vessel Form	Rim Form	Lip Form	Rim Diameter (cm)	Period*
4-1-14	Colorado Red	Shallow bowl	Direct	Rounded	10	PI (A.D. 700-1000)
4-1-15	Colorado Red	Wide-mouthed olla	Slight Recurve	Rounded/Flat	36	PI (A.D. 700-1000)
4-9-3	Southern California Brown	Wide-mouthed olla	Slight Recurve	Rounded/Flat	34-36	
6-1-10	Topoc Buff	Medium-wide jar	Direct	Rounded/Flat; Incised	20	PII (AD 1000-1400)
11-5-5	Southern California Brown	Medium-wide cooking pot	Direct	Rounded/Flat	10	

*Waters 1982a; Bayman and Ryan 1988

**dubious measurement

The two Colorado Red vessels were collected from SC1 of the 1954 ASA investigation. Based on the curvature of the everted direct rim, the shallow bowl (4-1-14; Figure 1) was probably no deeper than 5 cm maximum. The rounded lip measures 4.5 mm thick, and the vessel wall thickness quickly increases to 10 mm at 4 cm below the rim. Polishing marks are vertical on the red-slipped interior, and horizontal on the exterior surface. The exterior surface has a fire cloud (a black or gray area caused by exclusion of oxygen during firing or by incomplete oxidation of carbon particles deposited from smoke); the interior has manganese nodules deposited on the broken chip off the rim lip and a few on one of the edges.

The second Colorado Red vessel (4-1-15; Figure 1) is a wide-mouthed pot 36 cm in diameter at the rim, with a very slight recurve just below the rim, and a rounded flat lip measuring 8.5 mm thick at the lip, and 5.5 mm just below the neck. The smoothed surfaces have horizontal wiping marks at the rim, and vertical marks on the exterior body. This rim has a biconically drilled mend hole (3.5 mm in diameter, 9 mm in diameter on the exterior surface, 8.5 mm on interior) located 2.2 cm below the rim and 1.0 cm from the broken vertical edge of the sherd. The adjacent sherd likely had a similar hole used to lace the crack to hold it together. There is no evidence of any mastic having been applied to the crack, so one may assume that the jar continued to serve as a storage vessel for dry goods rather than liquids.

One Southern California Brown, a wide-mouth olla (4-9-3; Figure 1) from ASA unit SC9, has an estimated diameter of 34-36 cm, a slightly recurved rim, and a rounded flat

lip projecting to the exterior and measuring 7 mm at the lip. The vessel surface was smoothed but is generally rough and has horizontal wiping marks on both surfaces. There are tiny manganese nodules on the exterior surface.

The other Southern California Brown vessel is a micaceous brown cooking pot (11-5-5; Figure 1) recovered from TEU 1 in the Æ 2004 excavation. The jar was 10 cm in diameter at the mouth, with an incurving, direct rim, and a rounded flat lip 6 mm thick. Horizontal wiping marks are visible on both surfaces, and non-plastics, including mica, are visible on the exterior surface. Carbon deposits on the exterior suggest that it was a cooking pot or olla. All of the sherds from this unit appear to be from this single vessel. A different sherd (11-5-6) from the same level (40-50 cm b.s.) of TEU1 was submitted for thin-sectioning.

Two vessel shapes were observed among the five sherds in the UCLA surface collection: one Topoc Buff Jar (6-1-10; Figure 1), 20 cm in diameter, with a direct rim, rounded flat lip measuring 7.0 mm. The vessel wall thickness quickly decreases to 5.5 mm below the rim. The exterior surface is smoothed but uneven; the interior has horizontal wiping marks just below the rim, otherwise it too is smoothed. The lip has been decorated with three small incised tick marks, made when the clay was wet. They average 3 mm in length, run down the middle of the lip, parallel to the vessel surfaces, and are spaced 3-5 mm apart. The other vessel shape observed in the UCLA collection (but not included in the table or illustrations) is projected from a Southern California Brown ware neck sherd (6-1-20) which suggests a recurved form for the vessel, typical of an olla or jar. Both surfaces of the sherd are wind-scoured, which has exposed the non-plastics.

ASA also recovered two Parker Buff rim sherds; both are too small to estimate original vessel diameter accurately, so they are not included in Table 6, but available data are included here for each rim. Specimen 4-3-22 (Figure 1) was recovered from ASA unit SC3. It has a direct rim and a flat lip measuring 5.5 mm thick. There is no observable change in the wall shape or thickness for the entire 18 mm below the rim. Two small indentations were created on the exterior wall when it was still plastic. The larger indentation is 8 mm below the rim and ca. 4.5 mm wide; the other is 11 mm below the rim, slightly below and left of the first, and is smaller (ca. 3 mm) and different in shape. Neither is round, nor were they necessarily made by the same implement. They may not have been intentionally created, yet none of the other sherds have similar marks. The second Parker Buff rim (4-8-2; Figure 1) was found in ASA unit SC8. The lip is rounded flat, 8 mm wide, and quickly decreases to 5.5 mm just 18 mm below the rim, at the slight neck restriction. Faint horizontal wiping marks are visible on the exterior near the rim; otherwise the surface is smoothed, with occasional vugs and rough areas.

9.4.2 Vessel Wall Thickness

Vessel wall thickness was measured for 107 sherds with intact surfaces. The measurements were rounded to the nearest mm (Table 7).

Table 20. Sherd Wall Thickness.

Th. (mm)	# of sherds
3	8
4	19
5	41
6	21
7	11
8	3
9	1
10	1
11	-
12	1
13	1

Three-quarters (75%) of the sherds measured between 4-6 mm thick, with 5 mm accounting for thirty-eight percent of the total. The 13 mm sherd was identified as a fragment of a rounded vessel base due to the thick wall, pronounced wall curvature, and the pattern of carbon on the exterior surface; the 10 mm example is the basal end of a shallow bowl rim sherd. The 3 mm sherds were all found in the ASA collection, from SC3, TP1A and TP1B, and all are buff.

9.4.3 Residue

Of the 107 intact sherds, over half (59 sherds, 55% of total) had some degree of carbon deposit on one or more surfaces (Table 8). Fire-clouds were recorded separately from carbon deposits. Nearly one-third of the assemblage (31, 29%) had extensive carbon, mostly on the exterior. Nearly 10 percent had carbon on both surfaces. We cannot state with certainty whether the carbon was deposited through use of the vessel on or near a fire, or was the result of post-deposition activities; clearly, many of the ceramic vessels found at Lovejoy Springs were likely used for culinary purposes.

Table 21. Location of Carbon Deposits on Sherd Surfaces.

	Exterior	Interior	Both Surfaces
Carbon	20	1	10
Carbon trace	13	2	3

Carbonate deposits, often thought to result from using ceramics to hold/transport water or to boil liquids, were found on six sherds (6%); two sherds had salts on the exterior surface, two on the interior, and one had salts on both surfaces. Considering that one of the foremost features of CA-LAN-192 is the presence of potable water, this number is surprisingly low.

Two sherds from ASA unit SC1 had manganese nodules deposited on broken edges: specimen 4-1-15, the Colorado Red bowl, and 4-1-17, a Colorado Red-on-buff sherd.

The growth of manganese dendrites on ceramics, similar to its growth on rock (desert varnish), has been viewed as a sign of antiquity; the more nodules, the greater the passage of time. Recent work by O'Grady (2005) reports that manganese dioxide dendrites on ceramics may form in as few as 40 years, depending on the porosity of the ceramic substrate, the amount of manganese in the buried substrate, environment, or in painted decorations, and the presence of a standing liquid. Additional research on the formation of desert varnish must be completed to fully explain the formation process.

Interestingly, both specimens with manganese nodules are on Colorado Red sherds and not on any other buff or brown type. This may indicate that this particular sedimentary clay fosters manganese dioxide formation; that a manganese-rich mineral was used to color the clay slip or the painted decoration; that these sherds were exposed for some period of time in a different environment and transported to Lovejoy Springs with the manganese nodules already formed; or some combination of these factors.

9.4.4 Decorative Techniques

Surface treatments and decorative techniques include burnishing, painted designs, and incising. Burnished red slipped surfaces are found on a Colorado Red bowl, jar, and ground disk. There are one red-on-buff and two red-on-brown painted linear designs typical of the Colorado River area, and one example of a Hohokam-like red-on-buff design. One shoulder sherd has a faintly incised chain motif typical of Southern California Brown vessels. A series of small incised tick marks are found on the lip of a Topoc buff rim, while a Parker buff rim exterior has a possible punctate design (Figure 2).

Specimen 4-1-16 has a distinctively Hohokam design typical of Santa Cruz Red-on-buff (Figure 2:a). If it had been found in the Tucson/Phoenix basins, it would undoubtedly have been typed such and dated to A.D. 850-950/975. Miksa examined the sherd with a hand lens and thought that the inclusions (crushed angular grains of gabbro diorite) were atypical of the Tucson Basin, though might derive further west along the Santa Cruz River. The temper is similar to that attributed to Gila Bend Red on buff; Waters also reports Gila Bend sherds with Santa Cruz designs (Waters 1982). This sherd is probably from a jar, since only the exterior is decorated (see Heckman et al. 2000:Figure 52c for a similar vessel pattern).

Specimen 4-1-17 (Figure 2:b) is very similar in appearance – it too has an orangey cast and a red-on-buff design; however, it has crushed angular clear quartz as well as grains with intertwined quartz/feldspar/hornblende, and appears to fall with the type description for Parker Red-on-buff, which Waters dates to A.D. 1000 onward.

Two additional sherds (4-2-47 and 4-2-48, ASA Unit SC2; Figure 2:c & d), both from the same vessel though they do not conjoin, have broad red lines that are somewhat obscured by a faint deposit of carbon on the exterior surface. They fit Rogers' description of Cronese Brown in that they appear to be brown upon first glance, but the paste is pinkish. Rogers reported finding only one example with a "crude red line."

A small Parker buff rimsherd (4-3-22) has two indentations on the exterior that may be part of a punctate design (Figure 2:e). A Topoc buff rim (6-1-10) has small incised tick marks running down the center of the rounded flat lip, parallel to the interior and exterior walls (Figure 2:f). A Southern California Brown sherd (4-3-8) with rough surfaces and crushed quartz/feldspar/hornblende (but without the pink burning clay) may have an incised design on the exterior surface. Alternatively, this may be particularly deep mop marks (incisions left from wiping and smoothing the wet clay surface with a plant fiber “mop”); however, the clay texture is very grainy (it does not have a floated smooth surface), and resists incising (Figure 2:g).

9.5 WORKED SHERD DISKS

Ceramic disks are reported from sites throughout the Great Basin, Southwest, and southern California and are attributed a variety of functions. Some served as lids for storage vessels; these often exhibit residues of pitch or wax around the edges where they were sealed into the mouth of an olla. Central perforations (usually drilled into an existing sherd, rather than formed when the clay was wet) may have enabled a hide or plant fiber strap to be inserted, knotted on one side to secure it, then used as a handle to lift the lid out of the olla. Other perforated sherds are identified as spindle whorls, particularly in Southwestern sites where woven textiles were common. They may also have been used as game markers, toys, or ornaments. No functional evidence is apparent on any of the Lovejoy disks.

Five sherds were reshaped into disks by edge grinding (Figure 3). None of these sherds was broken during analysis to reveal a fresh face of the paste, so paste observations were restricted to surface observations. Three of the five disks were centrally-perforated using a stone drill; one was drilled conically from the interior of the original sherd, the other two were drilled biconically. The disks are similar to the wide range of sizes, both perforated and unperforated, reported for Tahquitz Canyon (Schaefer 1995:Figures IX.12 and IX.13). None corresponds in diameter to the vessel rims in the Lovejoy collections.

Specimen 7-1-11 (Figure 3:a), a disk surface collected by Wubben in 1920, is nearly half of an estimated 3.0 cm disk created from a California Desert Intermediate Ware sherd. The central perforation was drilled from the interior surface only, and is ca. 4 mm in diameter. The exterior surface was smoothed, though non-plastics are visible through the light carbon deposit. Non-plastics are much more visible on the interior surface, which is much rougher than the exterior and has copious vugs from non-plastics that popped out when this surface was ground down to the current 5 mm thickness. Non-plastics comprise more than 75% of the clay body and are primarily quartz. No fresh break was made on this tool, so it is impossible to determine macroscopically whether the sub-rounded shape of the quartz and feldspar is due to the grinding during manufacture of the disk, or to the original state of the non-plastics. One small chip flaked off the interior edge, perhaps through use of the disk. There are four ground facies – flat areas on the otherwise curved edge of the disk (Figure 3:a).

Specimen 4-3-24 is approximately one-fifth of the second perforated disk, made from a sherd of Colorado Red pottery (Figure 3:b). It had an estimated diameter of 4.0 cm, and was biconically-drilled with an opening estimated at 4.5 mm. The exterior surface has a smooth burnished red slip; the interior is rough and may have been purposely ground so that the interior surface slants to meet the exterior at the narrow 2.5 mm thick edge. Vugs remain where the non-plastics were popped out during the grinding.

The third perforated disk 4-7-2 (Figure 3:c), represented by half of the disk, had an original diameter estimated at 2.6 cm and it is 5 mm thick at the ground edge. It was biconically drilled with a 3 mm diameter central hole. There are four ground facies on the edge. This disk differs from all others in that it has two grooves cut across the exterior edge, one perpendicular to the edge, the other oblique. Both grooves are cut into the interior surface of the sherd as well as the edge; only the oblique groove extends to the exterior surface as well, having been cut deeper. These cuts were made after the sherd was ground into a disk-shape and are probably the result of rubbing that edge against a sharp string or edge of something. This sherd is also identified as California Desert Intermediate Ware, based on the abundant (75%) rounded quartz inclusions (again no new fresh break was made on the disk). Both this and the disk 7-1-11 are similar in size and paste; finely ground clay and non-plastics consisting of sub-angular to sub-rounded quartz and feldspar fired in a reduced atmosphere.

One unperforated disk 4-15-3 (Figure 3:d) is represented by two sherds that conjoin to form approximately half of a disk 4.2 cm in diameter, with an average thickness of 4 mm. The disk has been ground on the rounded edge, yet also exhibits chips all along the interior surface of the original sherd, and two ground facies on the edge. It is nearly perfectly rounded which leads one to believe that the chips are use wear rather than chipping to create the circular perform. The exterior surface is burnished but not slipped; the interior is smoothed but uneven and does not appear to have been ground.

The other unperforated disk, 4-9-5 (Figure 3:e) is a slightly elongated round form, complete except for a fragment missing on one edge. It appears to be a disk preform that has not been ground smooth on the edges (only two small facies are smoothly ground on opposing edges). It has a diameter of 3.2 – 3.3 cm, and edge thickness of 4.5 – 5.0 mm, and faint wiping impressions on both sides, but in opposite directions, perhaps a result of the wiping of the original vessel. The interior surface has a consistent carbon deposit; the exterior has a firing cloud, typical of Tizon Brown Ware. The sub-angular granitic non-plastics are also consistent with that type.

9.6 WORKED SHERD TOOLS

Two sherds were reshaped by grinding the edges into amorphous-shapes with multiple facies that could be used as scraping or grinding tools. The two examples are dissimilar in outline. Specimen 4-3-23 (Figure xxx:f) is approximately half of a roughly elliptical sherd ground on the edge in four distinct facies, one of which also exhibits grinding on the interior perpendicular to the edge. Both surfaces have random scratch marks and tiny mica flecks visible; one surface has faint red traces that may be paint. It has been

identified as a California Desert Intermediate Ware due to the finely ground paste and abundant sub-angular/sub-rounded quartz and feldspar exposed on the old break.

Specimen 4-8-1 (Figure 3:g) was originally cataloged as a rimsherd, but the angle of the “rim” is not correctly aligned and this may be a neck or shoulder fragment that has been reshaped to use as a grinding tool. Three sides are broken; one edge has been partially rounded by rubbing it back and forth perpendicular to the edge. That same edge also exhibits tiny chips, especially on each end of the “rounded” portion. The interior surface is a crackled orange color with non-plastics visible and faint anvil marks; the exterior was more smoothed in the original vessel though it too has uneven areas. A hairline crack begins at the rounded edge and runs diagonally across the interior surface, suggesting the sherd was stressed by some force, possibly when used as an edge scraper.

9.7 PETROGRAPHIC ANALYSIS

Dr. Beth Miksa performed a petrographic analysis of selected sherds and assigned each sherd to one of three compositional groups using a point count technique perfected for ceramics from the Tucson basin (Miksa and Heidke 2001). Table 5 compares the results of Miksa’s petrographic analysis to the author’s initial macroscopic descriptions. Seven of the ten petrographic samples were selected from sherds identified as brown, micaceous brown, or brown/grey types intermediate between brown and buff; the remaining three sherds were considered to be “buff”, but were also problematical. .

Interestingly, the three compositional groups identified by the point count analysis do not clearly follow the typological distinctions made during the macroscopic analysis. For example, SC1-1-19 was identified macroscopically as buff ware. Miksa noted that it contained the widest range of rocks as well as grog (ground potsherd), which signified a different manufacturing technique than was observed in the remaining nine sherds; nonetheless, its mineral content placed it clearly within Group 1. The “intermediate” and grey sherds also fit in Group 1. In contrast, Group 2 includes a granitic brown as well as a sherd identified as a Topoc buff ware and a Parker buff stucco sherd.

Ideally, the point counts of rocks observed in the sherd thin sections would be compared to sand and rock samples collected from local petrofacies (distinct rock groupings) to identify potential raw material sources. Although we did not have any clay or rock samples from the Lovejoy Springs site, nor from the surrounding area, to compare to the sherds, Miksa felt that the materials for all ten sherds were consistent with a granitic source, likely quartz monzonite. The published literature shows ample sources of quartz monzonite in the western Mojave Desert in an area that begins 50 miles west of Lovejoy Buttes, extends 45 miles to the northwest, 50 miles to the north and northeast, 30 miles to the east, and 10 miles to the south, according to published geological (Miksa 2006).

Miksa concludes:

The source(s) cannot be in any of the mountain ranges with common metamorphic, sedimentary, or volcanic rocks. The sherds may be made from

a sandy silty clay, or from a somewhat mafic silty clay to which granitic sand has been added. Sample TEU2-29-4 is a compositional outlier; even so, the textural features of its quartz and feldspar are much like the others. The remaining samples fall into two slightly different but related compositional groups. Sample SC1-1-19 is compositionally similar to the other samples but exhibits grog and other characteristics that suggest a different or modified manufacturing technology.”

TABLE 22. Sherds Submitted for Petrographic Analysis.

SAMPLE PROVENIENCE	MACRO IDENTIFICATION	PETROGRAPHIC GROUP	PETROGRAPHIC NOTES
4-SC1-1-19	Buff?	1	Widest range of rock, grog, less silt, sand; different manufacture
4-SC1-1-22	Brown	1	
4-SC1-1-24	Brown	1	Increased mafic minerals
4-SC2-2-29	Brown – intermediate?	1	
4-SC2-2-37	Cronese - residual, grainy, burnished high spots	1	Increased mafic minerals
5-31-2	Grey, residual, grainy	1	
4-SC1-1-18	Parker Stucco	2	K feldspar more abundant than plagioclase
4-SC2-2-38	Topoc (pinkish, fine, clayey)	2	K feldspar more abundant than plagioclase
4-SC3-3-18	Tizon/So Cal Brown	2	K feldspar more abundant than plagioclase
11-TEU2-29-4	? Brown micaceous	3	Most abundant plagioclase; Increased mafic minerals, volcanics; extremely silty

9.8 CHRONOLOGICAL IMPLICATIONS

The plain buff and brown ceramics associated with this area remain poorly-dated and lack clear typological distinctions. Although the general cultural schema of Patayan I, II, and III (Rogers’ Yuman I, II, III) has been confirmed in various locales, few direct

radiocarbon dates from deposits on the ceramics have been added to the published literature. Cross-dating with intrusive Hohokam sherds has similarly been difficult, although significant gains have been made in narrowing the absolute dating for Hohokam ceramics in the Phoenix and Tucson basins. As more radiocarbon dates have been obtained from plain sherds, there has been some blurring of the formerly rigid divisions between rim/lip forms previously used to distinguish the three developmental periods (Bayman and Ryan 1988). In short, additional data are required to address each of these issues.

The buff ceramics from Lovejoy Springs span the entire Lower Colorado Buff Ware sequence from Patayan I – III (A.D. 700 to the Historic Period). Patayan I is represented by the three Colorado Red sherds (2 rims and 1 disk), as well as direct rims with rounded lips (Waters 1982a:Fig. 7.1). None of the rim sherds has a marked recurve, a form reputed to begin in Patayan II, but PII/PIII types (Parker Buff, Colorado Red-on-buff, Cronese Brown) are also present in the assemblage. According to Waters, stucco exterior treatments are restricted to Patayan II and III (A.D. 1000 onward); conversely, Schroeder (1958) dates Parker Stucco as early as “pre A.D. 200? to at least 1840”.

The Santa Cruz/Gila Bend Red-on-buff sherd dates no earlier than A.D. 850 in the Phoenix/Gila basins. It is impossible to say when it was brought to the site, nor whether it was an intact vessel or a curated sherd.

No brown wares from the Owens Valley or the Great Basin were detected in the ceramic sample. Both of these wares were manufactured using the coil-and-scrape technique to shape the pots and have distinctive wiped surfaces. Recent studies of Owens Valley Brown Ware suggest ceramics may have been present in the valley as early as A.D. 1300, with widespread local manufacture at the individual or family level ca. A.D. 1450 (Eerkins 2003:20).

Sherds identified as Southern California Brown Ware due to their surface treatment and paste characteristics also have anvil marks on some interiors, as do several of the Parker buff sherds. Southern California Brown Ware has been found in the Transverse Ranges as early as A.D. 600-799, in coastal southern California villages ca. A.D. 1000, and widespread throughout San Diego County ca. A.D. 1450 (Griset 1996).

The only ceramics in proximity to a radiocarbon assay at Lovejoy Springs is a Southern California Brown cooking jar, fragments which were found principally from 40-50 cm below surface in TEU 1; only three tiny sherds were found below 80 cm. A charcoal sample (#212904) taken from Feature 1a from 100-110 cm (20 cm below the deepest tiny fragments of the cooking jar) produced a calibrated range of A.D. 1450-1650, suggesting that the cooking jar was deposited after that time.

None of the California Desert Intermediate sherds had anvil marks, though they also were extremely small in size compared to the other sherds (perhaps more friable?).

Unfortunately there is no vertical or horizontal stratigraphy that can date the ceramics in this collection. All dates are based on cross-dating with sherds found in other areas, and in some cases, are themselves cross-dated by decorated Anasazi or Hohokam sherds.

Clearly, buff sherds were brought to Lovejoy much earlier than pottery was being manufactured to the north and northeast; the dating of the California Desert Intermediate and the Tizon/Southern California Brown remain open questions awaiting further data.

9.9 INFERENCES DRAWN FROM THE CERAMIC ASSEMBLAGE

We are fortunate in having the ceramic sample from all of the known excavations and surface collections from the Lovejoy Springs site; if only the most recent excavations had constituted the ceramic sample, one would have thought that the ceramics consisted solely of locally-made brown ware. In fact, Lower Colorado Buff, Tizon/Southern California Brown, an intermediate brown/buff ware herein called California Desert Intermediate, and one Hohokam Red-on-buff example are included in the ceramic sample, indicating that many exotic ceramics were brought to the site through the centuries. All of the non-brown ceramics were surface-collected from the site between 1920 and 1968. The earlier samples also contained worked sherds including perforated and unperforated disks, as well as amorphous-shaped sherds used as scraping tools.

The ceramics from Lovejoy Springs are evidence of long distance exchange networks, and may also document the movement of Mohave traders reported ethnographically (Kroeber 1925:612; Davis 1961). We cannot say with certainty who brought the many different types of pottery to the site, whether they were transported by their makers, by intermediary traders, or collected by Antelope Valley residents during visits to surrounding areas. Some were also made from local clays.

Clearly, Lovejoy Springs was an important watering hole and campsite, and was likely visited by people traveling west from the Lower Colorado region through the Mojave Valley and back again, and also by people and/or goods coming north from the San Bernardino Mountains down into Antelope Valley. The ceramics also confirm a lack of trade or movement northward to the Panamint/Owens Valley region.

Because we were able to look at ceramics collected over the past 80 years from Lovejoy Springs, we were able to confirm our suspicion that this water hole attracted people who were passing through or using areas of the Mojave Desert over the past thousand years. In all probability, even more diverse ceramic types may have been deposited at Lovejoy Springs but were removed by visitors over the past 125 years. Given the paucity of exotic sherds, many of which were single representatives of vessels, some of these sherds may have been exotics that were surface-collected elsewhere by native peoples and brought to Lovejoy Springs.

The diversity of ceramics likely reflects the diversity of people who visited or resided in the area. In addition to the historically-recorded east-west Mohave trading corridor between the Colorado River and the Pacific Coast, ceramics and possibly people from

other areas came to the Mojave region. For example, the single specimen of Hohokam Buff Ware probably derives from the Phoenix/Tucson basins. Malcolm Rogers's surveys of the Mojave Sink convinced him that early turquoise miners brought Southwestern ceramics with them (Deadman's Gray and Lino Gray and their decorated varieties) in the early 9th century, and that Mojave desert residents traded Pacific shell for Prescott Gray ware:

During these pre-ceramic times, all the Prescott Gray Ware types were traded for and are now found surficially associated to some extent with the first importations of early Yuman types from the Lower Colorado focus (Rogers 1945a:175)

Rogers identified two ceramic types produced in the Mojave Sink: Cronese Brown and a rare variant Crucero Brown. The petrographic evidence from sherds found at Lovejoy Springs confirms "Margaret's Principle" (Lyneis 1988c) that the brown wares in the central Mojave were locally produced. The thin-sectioned California Desert Intermediate sherds seem to derive from clay sources found in a region that potentially extends from 50 miles west of Lovejoy Buttes, northwest 45 miles, north and northeastward 50 miles, 30 miles to the east, and 10 miles to the south. Further petrographic examination of clays and non-plastics from this area may refine the ceramic materials procurement zone considerably.

Unfortunately, we lack any associated or direct dating for these sherds. Rogers concluded that "settled occupation" of the Mojave River region ceased around A.D. 1400, as dated by the presence of Jeddito Black-on-yellow sherds on Mojave Sink sites, though he states:

It is probable that small parties from the Colorado River continued to visit it occasionally for some time, but the increasing aridity and the expanding Shoshonean and southern Paiute bands soon after made the Colorado valley a more favorable and a decidedly more hospitable habitat (1945a:176)

Schroeder postulated an even earlier abandonment of the area beginning ca. A.D. 1150 (1952:56), while Sutton (n.d.) suggested that the Antelope Valley was abandoned in the Late Prehistoric Period (A.D. 1250-1750) due to the drying climate, and only sparsely populated during the Protohistoric (reviewed in Earle 2005:9-10).

Drover's excavations in the Cronese Basin (1979) and Jenkins's comparisons of ceramics from Afton Canyon on the lower Mojave River with those from Fort Irwin (1989) provide ample evidence that the area was not abandoned, that ceramics were deposited throughout the eastern Mojave; and that the ceramic assemblages are amalgamations of buff, brown, gray, and other wares that don't quite fit existing typologies. Joint use of the area historically by several ceramic-producing groups (Desert Serrano, Mohave, and after 1840 by the Chemehuevi-Southern Paiute) attest to multiple potential sources for ceramics found in the Mojave region (Earle 2005, 2006).

The Lovejoy ceramics reflect the multiple sources of ceramics, but do not provide any direct dating that would address the question of whether the site was abandoned for any period of time, nor who occupied it at any given time. The PII/III Lower Colorado Buff Ware traits and types at the site span the full length of the combined periods (A.D. 1000 – Historic). The Colorado Red-on-buff sherd is a PIII type, but it is a single sherd that could have been transported by Mohave traders who continued to use the Mojave trade route in the late 19th century. The Intermediate Brown Ware that was likely made from local clays is not associated with a particular cultural group, and it is currently impossible to determine whether they were made by Serrano, Chemehuevi, or some other group.

Interestingly, there are no examples of Owens Valley Brown Ware in the Lovejoy Springs collection, suggesting that there was not extensive contact or trade beyond a certain point northward. This supports Warren's proposed boundary between Numic to the north and Patayan [Takic] to the south (Earle 2006:1). The petrographic data suggest a potential resource procurement zone for local ceramic materials that is 100 miles E-W, ca. 60 miles N-S, and centered about 20 miles north of Lovejoy Springs.

Ceramic vessels used at the site include wide- and medium-wide mouth vessels, probably ollas and deep bowls, and one small shallow serving bowl. One of the medium-wide vessels was used for cooking. Interestingly, narrow-mouth ollas suitable for transporting water or stashing food for long-term storage, are missing from the assemblage.

Sherds were recycled as tools, either as disks of unknown function, or as amorphous-shaped sherds used to grind or scrape. All of the disks are smaller than the rim diameters of the vessels, so they may have been used for other purposes than pot lids. It is also possible that we merely lack the evidence of narrow mouth vessels for which these might have been lids, because they were carried away from the site or hidden offsite in rock crevices.

If the buff rim sherds derived from whole vessels at Lovejoy, not just transported fragments of rims, someone went to considerable effort to transport large vessels from the Colorado River area to the western Mojave Desert. Rogers suggested that pottery was being traded for shell. A complete LCBW narrow-mouth olla found at a site on the Santa Barbara coast (and currently at the Santa Ynez Historical Society Museum) attests to the long-distance trade and value of these vessels.

9.10 FUTURE RESEARCH

Three areas for future research on Mojave Desert ceramics include: (1) expansion of petrographic analysis of sherds, clays, and mineral samples, (2) direct dating of carbon deposits on suitable sherds, and (3) a comparison of brownware sherds with those from known Serrano and Chemehuevi sites. Ethnographic data concerning Serrano pottery is limited to brief statements by Benedict (1924) that mountain clays were collected, dried, sifted to remove large non-plastics, aged for 24 hours, then shaped into pots for cooking and ollas for storing mesquite and piñon flour. It would be useful to compile

petrographic data on clays and sherds from throughout the Serrano area to provide a baseline for comparison with brown sherds found at the northern base of the mountains and on the floor of the Mojave River Valley.

At present, brown ware ceramics are dated by association with exotic ceramic types or other dated materials. In an area where ceramics were being transported long distances and site deposits are generally surficial, sites such as Lovejoy Springs that have subsurface midden deposits are exceedingly rare and valuable. Hopefully, intact midden yet remains at the site; any future ground disturbance should sample likely areas with these objectives in mind.

10

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: VERTEBRATE FAUNAL REMAINS

Excavations were conducted at CA-LAN-192 (Lovejoy Springs) in 1989 and 2005. The 1989 excavation was a single unit (Unit 6) conducted by Cerro Coso College; the 2005 excavation was also a single unit (Unit 1) from an Emergency Excavation conducted by Applied Earthworks (AE). One hearth feature was recovered from Unit 1. This report begins with a discussion of the methods employed in the identification and quantification of the faunal assemblage, discusses the implications of depositional context, and describes the economically significant taxa. The season of site occupation is explored followed by an examination of foraging efficiency. Site function is discussed next and the report concludes with discussion of patterns of mammalian exploitation in the Western Mohave Desert area. A brief description of the vertebrate fauna recovered from Feature 1 is presented after the main body of the report.

10.1 METHODS

Identification of the reptile, bird, and mammal specimens from Lovejoy Springs was accomplished using the comparative osteological collections maintained in the Department of Ornithology and Mammalogy at the California Academy of Sciences (CAS), San Francisco, and comparative osteological collections maintained by the author. A variety of manuals and publications aided in the identification process (Gilbert 1980; Klein and Cruz-Urbe 1984; Lawrence 1951).

Each specimen was identified to the most specific taxonomic unit possible and any ambiguity in identification was resolved by assigning the specimen to the next higher taxonomic category. The taxonomic organization and nomenclature used here follows different references for different classes or orders: for reptiles Jennings (2004), for birds California Bird Records Committee (2000), and for mammals Laudenslayer, Grenfell, and Zeiner (1991). Specimens not identifiable to the order level or higher were placed in the class category (i.e. Mammalia – mammal, Aves – bird) while specimens not identifiable to class were assigned to the indeterminate category. Where possible size determinations were made for specimens in the class category. Attributes recorded for each specimen included anatomical part, portion, side, size, age/fusion, and cultural and natural modifications such as burning, butchering, and surface weathering. Carnivore and rodent gnawing were noted when present. Each specimen was examined both macroscopically and microscopically with a hand held magnifying glass. Bone fragments that fit together to form a more complete specimen were counted as one specimen.

Quantification of faunal remains from archaeological sites may be accomplished using several methods of counting. Two methods of counting commonly used in faunal analyses are the minimum number of individuals (MNI) and the number of identified

specimens (NISP). MNI is calculated by separating the most abundant element of a taxon into right and left sides and then uses the greater number as the unit of quantification. NISP is simply a count of each individual specimen attributed to a particular taxon (Grayson 1984; Klein and Cruz-Urbe 1984). While each method presents several difficulties in analysis NISP provides a valid measure of relative abundance of the various taxa in an assemblage (Grayson 1984). Consequently NISP is used to compute the abundance of the vertebrate faunal assemblage at Lovejoy Springs.

10.2 TAXONOMIC COMPOSITION

The vertebrate faunal assemblage from CA-LAN-192 consists of 6,231 specimens. Of the 1,181 specimens identified to class level or higher mammals are by far the most abundant (N = 1174, 99.4%) followed by very small numbers of birds (N = 4, 0.3%) and reptiles (N = 3, 0.3%). Identified specimens number 489 and include one reptilian taxon, two avian taxa, and 11 mammalian taxa (Table 23).

10.3 DEPOSITIONAL CONTEXT

One important consideration regarding faunal material from archaeological sites is whether or not its presence is due to natural or cultural processes. Any inferences about subsistence practices, seasonality, intensification, site function, etc., are dependent on the distinction between the two processes. The depositional origin of faunal material from caves and rockshelters is especially difficult to ascertain, since those settings are often used by non-human carnivores and raptors, as well as by humans (Hockett 1991, 1994). In contrast, at open sites that have a distinct artifactual component such as LAN-192, the designation of faunal remains as cultural is more easily accepted.

However, many vertebrate species live in and around archaeological sites and their presence in faunal assemblages is problematic due to their intrusive nature. The distinction between culturally and naturally derived small mammals is important in this study since their depositional origin may have significant implications for understanding the nature of the mammalian exploitation practices of the prehistoric inhabitants at Lovejoy Springs.

Several studies have attempted to establish criteria to separate naturally occurring small mammal specimens from those of cultural origins (Hockett 1991, 1994; Jung 1996; Schmitt and Juell 1994; Thomas 1971). These studies attempt to establish various qualitative and quantitative criteria to help distinguish culturally derived faunas. Several of these criteria were tested by Jung (1996). She compared small mammal remains recovered from an “assemblage that is known to be exclusively cultural in origin” (Jung 1996:21) with the findings of small mammal bone accumulations from several non-human agents, including raptors and coyotes (Hockett 1991; Schmitt and Juell 1994). Jung (1996) found that many of the quantitative indicators used to identify a culturally modified assemblage may not be valid and concluded that the qualitative indicators of burning and cut marks provide the best unequivocal indicators presently available to distinguish cultural from naturally derived faunal assemblages.

Table 23. Taxonomic Composition of Faunal Remains from CA-LAN-192

Class:	Reptilia		
Family:	Viperidae		
	<i>Crotalus spp.</i>		Rattlesnake
Class:	Aves		
Order:	Strigiformes		Owls
Family:	Corvidae		
	<i>Aphelocoma californica</i>		Western scrub-jay
Class:	Mammalia		
Family:	Leporidae		Rabbits & Hares
	<i>Sylvilagus spp.</i>		Rabbits & Cottontails
	<i>Lepus californicus</i>		Black-tailed jackrabbit
Order:	Rodentia		Rodents
Family:	Geomyidae		
	<i>Thomomys bottae</i>		Botta pocket gopher
Family:	Heteromyidae		
	<i>Dipodomys heermanni</i>		Heermann's kangaroo rat
Family:	Cricetidae		
	<i>Neotoma spp.</i>		Woodrat
Family:	Canidae		
	<i>Canis spp.</i>		Coyote/dog/wolf
Order:	Artiodactyla		Even-toed ungulate
Family:	Cervidae		
	<i>Odocoileus hemionus</i>		Mule deer
	<i>cf. Odocoileus hemionus</i>		Mule deer

The conclusion of Jung (1996) that burning and cut marks provide the best unequivocal indicators presently available to distinguish cultural from naturally derived faunal assemblages provides a good starting point for assessing the depositional origin of the vertebrate assemblage recovered from LAN-192. Evidence of both burning and butchering/spiral fracturing was recorded from the vertebrate remains at Lovejoy Springs and is summarized in Table 24. Evidence of cultural modifications is present on just a few identified taxa and is focused on the three lagomorph taxa. Other than the two indeterminate rodent specimens the remaining small mammal taxa do not exhibit any evidence of cultural modification. This observation suggests that the presence of lagomorphs in the faunal assemblage at LAN-192 may be cultural in origin but the presence of the other small mammals are likely non-cultural in origin.

However, one difficulty in the use of burning as a criteria to distinguish naturally from culturally derived bone rests with the fact that not all bone refuse from cooking shows evidence of burning since meat serves as an insulator for bone during cooking. Thus, meat cooked with bone-in will not result in any sign of discoloration on the bone. Generally only the portion of the bone that protrudes from the meat will manifest color

changes commensurate with cooking. While it is reasonable to conclude that the presence of burned bone can be used as one indication of culturally derived bone, the absence of burned bone does not necessarily imply that the bone was not culturally derived.

Table 24. Culturally Modified Bone

Taxa	Total NISP	Burn	Butcher	% Modified
Reptiles				
<i>Crotalus spp.</i>	3	0	0	0
Birds				
Strigiformes	1	0	0	0
<i>Aphelocoma californica</i>	1	0	0	0
Mammals				
Leporidae	175	23	0	13.10%
<i>Sylvilagus spp.</i>	13	4	0	30.80%
<i>Lepus californicus</i>	270	79	3	30.40%
Rodentia	2	2	0	100%
<i>Thomomys bottae</i>	4	0	0	0
<i>Dipodomys heermanni</i>	11	0	0	0
<i>Neotoma spp.</i>	3	0	0	0
<i>Canis spp.</i>	3	0	0	0
Artiodactyl	1	0	0	0
<i>Odocoileus hemionus</i>	1	1	0	100%
<i>cf. Odocoileus hemionus</i>	1	0	0	0
Sub-total	489	109	3	
Aves	2	0	0	0
Mammal	396	112	1	28.50%
small	294	70	6	25.90%
Indeterminate	5050	1146	15	23%
Sub-total	5742	1328	22	
Total	6231	1437	25	

Similarly, the absence of butchering marks does not necessarily mean that bone refuse is non-cultural. Butchering does not always result in observable butchering marks on bones. The absence of cut marks may be attributed to the skill of the person butchering the carcass (Guilday et al 1962:64), or to the fact that soft tissue and/or the periosteum protect the bone surface from marks (Shipman and Rose 1983:70). It is obvious that, while the presence of burning and butchering provides the best indicators for a culturally derived faunal assemblage, the absence of either characteristic cannot be construed as evidence of a non-cultural origin.

Further support for the cultural derivation of vertebrate remains in archaeological sites, and particularly at Lovejoy Springs, may be gleaned from other sources (e.g. Bayham

1982). Bayham (1982:217) suggests that “absolute quantity is important and may be of value in distinguishing cultural bone.” He adds that species present in “trace amounts” (Bayham 1982:217) were less likely to have been utilized by man, and even if their presence in an archaeological assemblage was the result of human exploitation, their economic importance probably was negligible.

The number of taxa identified to order level or higher is small (N = 489) and some taxa are represented by small numbers of specimens (Table 24). The determination of which taxa are culturally derived and which are naturally occurring is not straightforward but for purposes of this analysis the crotalid snakes (N = 3), the two bird taxa, Strigiformes and *Aphelocoma californica* (N = 2), and the four rodent taxa, unspecified rodents (N = 2), *Thomomy bottae* (N = 4), *Dipodomys heermanni* (N = 11), and *Neotoma spp.* (N = 3) are considered naturally occurring or of minimal economic importance in the assemblage and are deleted from the discussion of the economically significant taxa at LAN-192 (total NISP deleted is 25). Although the presence of these animals may provide information about the paleoenvironment of the site area they are considered non-cultural in origin or of minimal economic significance at Lovejoy Springs; the remaining taxa (N = 464) constitute the economically significant taxa at Lovejoy Springs.

10.4 VERTEBRATE EXPLOITATION AT LAN-192

Economically significant identified taxa at LAN-192 number 464 specimens and include six mammalian taxa (Table 25). Lagomorphs dominate the economically significant taxa (N = 458, 98.7%) with carnivores and artiodactyls present in much smaller numbers (N = 3, 0.65% each).

Table 25. Economically Significant Taxa at CA-LAN-192

Taxa	NISP
Mammals	
Leporidae	175
Sylvilagus spp.	13
Lepus californicus	270
Canis spp.	3
Artiodactyl	1
Odocoileus hemionus	2
TOTAL	464

Lagomorphs are the most abundant mammalian group and number 458 specimens. Black-tailed hare (aka jackrabbit) is the most numerous lagomorph (N = 270, 59%), followed by unspecified leporids (N = 175, 38.2%), and rabbits/cottontails (N = 13, 2.8%). Forty indeterminate leporids are small animals, possibly rabbit; 15 are large leporids, possibly jackrabbit, 31 are from medium-sized leporids, and the remaining 89 leporid specimens are of indeterminate size.

Jackrabbits occupy open or semi-open country and avoid dense areas of chaparral or forested regions. This species lives throughout the state in almost all life zones, from sea level to elevations over 12,000 feet (Ingles 1965:147). Jackrabbits live in the open, in shallow depressions in tall grass where they are not easily visible and use their great speed to avoid their many predators. Grasses comprise the main component of their diet although they are also known to eat brushy plants. Jackrabbits generally breed throughout the annual cycle and their young are able to hop when only a few hours old (Burt and Grossenheider 1976 ; Orr 1942:94).

Two species of rabbit live in the site area, *Sylvilagus audubonii* (Audubon cottontail) and *S. bachmani* (Brush rabbit). Due to their overlapping range in the site area and their similar body size, only genus level identification was undertaken (also see Yang et al. 2005). Cottontail rabbits are herbivores, feeding on a wide variety of grasses, leaves, and fruits. They are commonly found in open grasslands, open grassy hillsides, edges of brushland, creek bottoms, and dry gullies where they live in burrows or shallow depressions in stands of tall grass. In contrast, brush rabbits inhabit brushy hillsides and canyons, areas of heavy chaparral cover, or other areas of dense vegetation. They avoid open areas or areas of loose brush where the cottontail is more common. Brush rabbits usually live in forms or shallow depressions located in thick brush where there are extensive runways for rapid entry or escape. Their main food consists of forbs and grasses (Burt and Grossenheider 1976; Ingles 1965; Orr 1940).

One medium-sized canid is identified at Lovejoy Springs from three specimens, all from Unit 1, 110-120 cm level. It is unknown if this canid is coyote or dog since it is extremely difficult to distinguish between the two species when only fragmentary specimens are present (see Gilbert 1980). The three canid specimens include one right anterior malar fragment, one left mid-mandible fragment with both a 4th premolar fragment and a 1st molar fragment in situ, and one anterior maxilla fragment with a canine tooth fragment and the 2nd and 3rd right incisor fragments in situ. The latter specimen is made up of four fragments that fit together and are counted as one specimen. All of the canid specimens were covered with heavy concretion.

The ubiquitous coyote occupies an extremely wide range of habitats, extending through all life zones on California. The home range of a male coyote may extend up to 16 square miles while the home range of a female is generally restricted to about four square miles (Van Gelder 1982:229). Coyotes do most of their hunting at night and their omnivorous diet includes small mammals such as rabbits, hares, ground squirrels, gophers, kangaroo rats, as well as insects, berries, and fruits (Ingles 1965; Van Gelder 1982).

Dog burials are known at the Encino Village Site (LAN-43) where 11 dog burials containing 17 individual animals plus one canid cremation were identified (Langenwalter 1986). At present it is unknown if the canid from Lovejoy Springs represents a dog burial or merely the remains of a canid that died at the site.

Artiodactyls are poorly represented at LAN-192 with only three specimens. The single indeterminate artiodactyl specimen is a tooth enamel fragment with typical artiodactyl

morphology. One mule deer specimen is identified from a complete first phalange (see Lawrence 1951) and the tentatively identified mule deer specimen is from a metatarsal shaft fragment that is highly fragmented into many pieces but that all fit together to form one element. Metatarsal shaft fragments are difficult to identify to species but, in this case, it is likely deer rather than pronghorn or other artiodactyl based on the comparison of the archaeological specimen with several other artiodactyl specimens available to this analyst.

Deer range extends throughout California, except for areas of the Central Valley and the southeastern desert. Recent studies of desert mule deer populations in the Sonoran Desert region of southeastern California (Marshal et al. 2006) point to the low density of deer populations in the study area likely due to low rainfall and the consequent lack of deer forage. Marshal et al. (2006:61) also suggest that mule deer densities may increase during the hot, dry season as the animals move toward water and thus range less widely although their numbers are still low. In general, deer are grazers and browsers. Preferred habitats include chaparral, oak woodland, areas providing woody cover, meadows, and sources of freshwater. Forbs and grasses are important food sources in the spring and acorns are consumed in abundance in the fall. Deer may be resident or migratory. In areas where winter snow cover is deep, such as the higher Sierra Nevada Mountains, deer migrate downslope to secure food. Where the climate is characterized by a long, hot, dry season, causing green succulent forage to decrease in abundance and quality, deer may engage in limited upslope migration to seek better quality food. Deer are generally solitary animals during the summer months although does and their fawns remain together. Aggregation of mixed herds occurs during the fall mating season and young are born the following spring, generally between April and mid-June (Longhurst et al. 1952; Zeiner et al. 1990).

10.5 DISCUSSION

Lovejoy Springs is located in the Western Antelope Valley in an area identified as 'high desert' with an elevation of 2,270 feet (Price et al. 2005: 2.2). It is situated in the rain shadow of the San Gabriel Mountains. Average daytime temperatures vary between a high of 98°F in summer to 56°F in the winter although night time temperatures can drop below freezing (Price et al. 2005: 2.2). Winter is the rainy season with the average rainfall ranging between five and nine inches; the summers are long and dry. Vegetation in Antelope Valley is primarily saltbrush scrub, creosote bush scrub, and Joshua tree woodland plant communities (Price et al. 2005: 2.2).

All of the mammalian taxa present at LAN-192 represent locally available terrestrial species. Price et al. (2005:2.2) list several species likely available in the site area such as a variety of small rodents and lagomorphs, skunks, kit foxes, bobcats, and mule deer, as well as pronghorn, bighorn sheep, and black bear (also see Bean 1974; Beck and Haase 1974) although only lagomorphs, canids, and mule deer were identified in the archaeofauna included in this study.

Rabbits were taken in a variety of ways. They were hunted by individual hunters or by large groups of people organized in communal rabbit hunts. They were shot with bow

and arrow, hit with throwing sticks, taken with nets, snares or traps, or even captured after brush fires (Bean 1974:59; Bean and Smith 1978:571; Harrington 1942:6). Rabbits were skinned by the men but cooked by women who were also responsible for fashioning rabbit fur blankets and clothing (Bean 1974:59; see Yoder et al. 2005). Small mammals were roasted in earth ovens or boiled and sometimes cooked whole or skinned.

Deer were run down by individual Kitanemuk Serrano hunters, taken in communal deer hunts, or by hunters hunting in relays (Harrington 1942:6). Deer hear disguises were used in hunting (Harrington 1942:8) and hunters also simulated the actions of deer to get close to them (Bean 1972:57). The bow and arrow was the most efficient weapon to hunt large game animals (Bean 1974:65). Bean (1972:58) states that slaughtered large animals were partially butchered at the kill site and carried back to the village. Marrow extraction was an important activity (Bean and Smith 1978:71)

Dogs were kept as pets where their primary function was as watchdogs (Bean 1974:64). They were also used for hunting and Harrington (1942:7) states that both dog and coyote were eaten by the Kitanemuk Serrano. Coyotes were hunted for their skins that were used in ceremonial regalia (Bean 1974:63).

In general the pattern of economically significant taxa at LAN-192 is broadly similar to that observed at other Western Mohave Desert sites. Hudson (1994) examined the vertebrate remains from six sites located along the eastern perimeter of Rogers Dry Lake in the Antelope Valley. She found that small mammals were the most important identified resource while large mammals played a minor role. Hudson (1996) also investigated the vertebrate faunal remains from nine sites located on the western side of Rogers Lake. Here Hudson also noted that there was “a fairly consistent subsistence strategy [with a] strong focus on small mammals, particularly jackrabbits” (Hudson 1996:245).

10.6 SEASONALITY AT LOVEJOY SPRINGS

Seasonality refers to the time of year when a particular event may have take place. The time of the year may be either an absolute calendric date or a sequential period, such as fall or winter (Monks 1981:178). Several techniques, using a variety of archaeological data, may be employed to determine when a particular species was taken, and thus infer the season(s) a site was occupied. The direct method to infer seasonality is the presence or absence of seasonally available species (Monks 1981:180). Indirect methods used as indicators for seasonality include physiological events such as epiphyseal fusion, tooth eruption and wear patterns, and data gathered from incremental structures such as mollusk shells and fish otoliths and scales. In addition, archaeological data such as pertinent settlement patterns, artifact functions, or burial patterns may be used to infer seasonality (Monks 1981).

At sites where animals that have definite seasonal presence and/or availability, such as Western pond turtles and migratory waterfowl, the time of the year when a site may have been occupied is more easily ascertained. The Western pond turtle is one good seasonal

indicator in areas where they reside. Pond turtles begin hibernation in the mud of streams and ponds near the end of September and do not reappear until late March or April (Stebbins 1985; Storer 1930) and thus were likely harvested from spring through summer and into the early fall. Migratory waterfowl also are good seasonal indicators since they are generally present in larger numbers in parts of California from late fall through early spring (Cogswell 1977), and were certainly exploited when present. Another seasonal indicator may be the cycle of antler growth in mule deer. Male mule deer shed their antlers shortly after the rut, usually sometime in December or January, and immediately begin new antler growth (Gerlach et al. 1994). The presence of a mule deer skull with antlers attached suggests that an animal was taken during the time of the year when antlers growth had begun but before they were shed in the winter.

The above seasonal indicators are not present in the faunal sample examined from Lovejoy Springs. Lagomorphs are very prolific and generally are available throughout the annual cycle; thus they are not particularly good seasonal indicators. Canids also are present throughout the year and also are not good seasonal indicators. And at LAN-192 the mule deer specimens described above are not present in the faunal assemblage from the site. Thus, the economically significant mammalian assemblage in this sample from Lovejoy Springs does not provide any definitive insight into the season(s) the site was occupied.

10.7 EFFECIENCY AT CA-LAN-192

Measures of foraging efficiency reflect the decisions of a predator, here the prehistoric inhabitants of CCO-767. Foraging efficiency is one measure of cultural selection, also known as selective efficiency (Bayham 1982). According to the tenets of the diet-breadth model, high-ranked prey will always be taken when encountered, while low-ranked prey will move in and out of the diet as a function of the availability of high-ranked prey. And if the rank of an animal is generally correlated with body size, that is, large animals are high-ranked, small animals are low-ranked, then the relative abundance of large and small animals in an archaeofaunal assemblage reflects one measure of selective efficiency, where efficiency is measured in terms of net energy obtained.

One method to measure foraging efficiency is derived from simple taxonomic ratios using NISP counts for taxa with distinct differences in size and energetic efficiency (Bayham and Broughton 1990; Bayham and Valente 1997; Broughton 1994a, 1994b, 1997). The resulting ratios reflect the relative dietary contribution of each taxon. The various indices range along a continuum from values of 1.0 to 0.0. Values of indices that approach 1.0 indicate high frequencies of large animals relative to smaller species, while values that approach 0.0 indicate low frequencies of large animals relative to small animals (Broughton 1994a:506).

Size differences and the concomitant differences in energetic returns exist among the various economically significant mammalian taxa at LAN-192. Drawing from the relative abundance of these different-sized mammalian groups one efficiency index, the

artiodyctyl index, represents the relative dietary contribution of the large vs. small mammals, calculated as follows:

$$\sum \text{NISP Artiodyctyls} / \sum (\text{NISP Artiodyctyls} + \text{Lagomorphs})$$

At LAN-192, the artiodyctyl index is 0.0065. This figure suggests that the mammalian procurement practices at the site were dominated by the exploitation of high-cost, low-efficiency taxa.

Several variables may affect the artiodyctyl index, including the relationship between the population density of human foragers and the natural abundance of artiodyctyls (Broughton 1994b:379). Sites adjacent to habitats with low densities of artiodyctyls will yield a lower artiodyctyl index. Likewise, sites characterized by a higher population density might display a lower artiodyctyl index due to overexploitation. Several other explanations may account for the very low artiodyctyl index at Lovejoy Springs including sampling strategies, site function, and seasonality to name a few.

At LAN-192 the lagomorph component includes both jackrabbits and cottontails/rabbits, small animals with significant size differences and energetic returns (see Simms 1984:Table 5). A second index, the lagomorph index, reflects the measure of lagomorph efficiency and includes only jackrabbit and cottontail/rabbit NISP:

$$\sum \text{NISP Jackrabbits} / \sum (\text{NISP Jackrabbits} + \text{Cottontails/Brush Rabbits})$$

The lagomorph index here is 0.95. This high number suggests that the inhabitants of the site took larger numbers of larger, more efficient jackrabbits relative to smaller, less efficient cottontails and brush rabbits.

In summary, the low artiodyctyl index suggests that the mammalian procurement practices at LAN-192 were characterized by the exploitation of high-cost, low efficiency vertebrate resources with low-cost, high efficiency resources taken in smaller numbers. However, the high lagomorph index points to the exploitation of larger, more efficient jackrabbits versus smaller, less efficient cottontails/rabbits. These conclusions must be viewed with some reservation since the sample included in this study represents only a small portion of the site.

10.8 SITE FUNCTION

Binford (1980) explains the variability in archaeological assemblages as a function of the ways people organize themselves in relation to their environment and their subsistence strategies. Foragers represent one adaptation in which consumers move to food. Here there are frequent residential moves, no food storage, and with “regular daily food-procurement strategies (Binford 1980:9). Foragers use two types of sites, the residential base and the location. The residential base is the center of subsistence activities of the group, where most processing, manufacturing, and maintenance activities take place, and from where foraging parties originate. The contents of residential sites reflect differing durations of occupation as well as different seasonal scheduling of activities, although

forager residential sites generally are occupied for only short periods of time. Locations are also occupied for short periods of time but are places where “extractive tasks are exclusively carried out” (Binford 1980:9). This results in very little material evidence although material may accumulate over time if a location is used year to year. In summary foragers “have high residential mobility, low-bulk inputs, and regular daily food-procurement strategies “ (Binford 1980:9).

Collectors, in contrast, move goods to consumers through specially organized task groups and they store food (Binford:10). They rely on logistically organized food procurement groups that go out from the residential base to secure specific resources or to gather information. These activities result in three other types of sites in addition to the residential base and location: the field camp, the station, and the cache. Field camps are temporary operational centers that are organized to procure “target resources” (Binford 1980:10). Here a task group sleeps, eats, and maintains itself away from the residential base. Sites of task groups are created relative to the specific target resource. Stations are information gathering sites while caches represent temporary storage places in the field.

The logistical strategy of collectors is defined as one in which task groups are sent out from the residential base to “procure specific resources in specific contexts” (Binford 1980:10). This strategy represents “labor accommodations to incongruent distributions of critical resources or conditions which otherwise restrict mobility” (Binford 1980:10). Task groups are generally small and consist of skilled and knowledgeable individuals; they are not searching for food on an encounter basis but are organized to procure “target resources” (Binford 1980:10). These “producer parties” procure products for larger social groups that reside in another setting away from the field camp, such as a residential base.

The results of earlier excavations at Lovejoy Springs point to its use as a residential site where a wide variety of activities took place. This is supported by the recovery of a diverse array of artifacts including large quantities of ground stone, flaked stone tools and debitage, thousands of shell and stone beads, ceramic sherds, charcoal, and large quantities of faunal remains (Price et al. 2005:4.6). In addition a mass burial of as many as nine individual was uncovered during a 1968 emergency salvage excavation (Price et al. 2005:1.4). Further, I suggest that Lovejoy Springs functioned as a residential base in a logistically organized food procurement strategy as described by Binford.

As noted above the most abundant economically significant animal at LAN-192 was jackrabbit. Examination of body part representation of jackrabbits shows that all parts of the animal were present at Lovejoy Springs (Table 26). (Isolated teeth and phalanges were also present but are not included in Table 4.) Consistent with Binford’s forager/collector model I suggest that jackrabbits represent the target resource that were taken by task groups organized specifically to exploit them from field camps and that, for the most part, entire jackrabbit carcasses were brought back to the area where the larger social group resided, here Lovejoy Springs.

Table 26. Major Jackrabbit Body Parts, CA-LAN-192

Head	Forelimb	Hindlimb
Maxilla	Scapula	Innominate
Mandible	Humerus	Femur
Auditory Bulla	Radius	Tibia
	Ulna	Tarsal
	Metacarpal	Calcaneus
		Astragalus
		Metatarsal

10.9 PATTERNS OF MAMMALIAN EXPLOITATION AT SELECTED SOUTHERN CALIFORNIA DESERT SITES

Faunal data is available from several sites located in the Western Mohave Desert (see Hudson 1994 and 1996). For purposes of this discussion faunal data from KER-526, KER-500, and KER-1189 are compared with the faunal data from LAN-192. The Kern County sites considered here are located to the east of Lovejoy Springs and were selected based on the relatively high number of faunal specimens from each site: KER-526 (14,374 specimens), KER-500 (1334 specimens), and KER-1189 (1756 specimens). In addition to the four Western Mohave Desert sites the area of comparison is extended southward to include one site in a similar environmental setting, RIV-6069 (Valente n.d.). This site is situated on an alluvial fan at the northern portion of the Lakeview Mountains just above the floor of the San Jacinto Valley. To facilitate comparison of disparate assemblages, data was aggregated by mammal size categories and includes all identified taxa by size category regardless of depositional origin.

The pattern of mammal exploitation in the Western Mohave Desert sites included here is virtually identical (Table 27). At LAN-192, KER-526, and KER-500 the relative abundance of large, medium, and small mammals is very close; at KER-1189 the relative abundance of the various size groups is still very similar but with slightly more large and medium mammals than noted at the former three sites. However, at RIV-6069, the pattern of mammal exploitation is quite different (Figure 1). Here large mammals are present in significantly higher numbers than at the Western Mohave Desert sites; medium mammals are also present in much higher numbers with a concomitant decrease in the numbers of small mammals.

The pattern of lagomorph exploitation from three Western Mohave sites, LAN-192, KER-526, and KER-500 is very similar in that jackrabbits are the most abundant lagomorph taxa by far (Table 28). However, at KER-1189 the relative abundance of jackrabbits vs. cottontails/rabbits is not as markedly different (Figure 2). Here jackrabbits are still the most abundant lagomorph but cottontails/rabbits are present in higher numbers. Although small mammal numbers are much smaller at RIV-6069 the

Table 27. Mammalian Exploitation in the Western Mojave Desert

	LAN-192	KER-526 ¹	KER-500 ²	KER-1189 ²	RIV-6069 ³
Lg.	N = 3	N = 16	N = 1	N = 16	N = 931
Mammals	(0.4%)	(0.3%)	(0.2%)	(1.9%)	(18.8%)
Med.	N = 3	N = 10	N = 3	N = 12	N = 268
Mammals	(0.4%)	(0.2%)	(0.7%)	(1.5%)	(5.4%)
Sm.	N = 772	N = 4709	N = 432	N = 787	N = 3752
Mammals	(99.2%)	(99.5%)	(99.1%)	(96.6%)	(75.8%)

¹ Hudson 1994; ² Hudson 1996; ³ Valente n.d.

lagomorph component is characterized by the higher abundance of jackrabbits relative to cottontails/rabbits. The pattern of lagomorph exploitation at RIV-6069 is more similar to the pattern of lagomorph exploitation at KER-1189 in the relative abundance of jackrabbits vs. cottontails/rabbits. The explanation for these local differences in lagomorph exploitation is unknown at present but may be the product of the environmental setting of each site, the local availability of the various lagomorph species, season of site occupation, sampling bias, etc.

Table 28. Relative Abundance of Lagomorphs at Selected Southern California Sites

	LAN-192	KER-526 ¹	KER-500 ²	KER-1189 ²	RIV-6069 ³
Jackrabbits	N = 270 (95.4%)	N = 438 (93.2%)	N = 68 (100%)	N = 49 (68.1%)	N = 410 (57.3%)
Cottontails/rabbits	N = 13 (4.6%)	N = 32 (6.8%)	N = 0	N = 23 (31.9%)	N = 305 (42.7%)

¹ Hudson 1994; ² Hudson 1996; ³ Valente n.d.

10.10 SUMMARY

The vertebrate faunal remains from Lovejoy Springs point to a heavy reliance on small mammals, namely jackrabbits with cottontails/rabbits taken in smaller numbers. Larger mammals such as canids and artiodactyls were present in very small numbers. Birds and reptiles, also present in very small numbers, were not considered economically significant.

Seasonality of site occupation cannot be determined with the faunal remains present in the assemblage. Other lines of evidence from the site may provide insight into the season(s) of occupation of Lovejoy Springs.

Efficiency, measured in terms of small vs. large animal abundances, is low. This points to the exploitation of small, less efficient mammals rather than the exploitation of large, more efficient mammals. In contrast, lagomorph efficiency is high which suggests the exploitation of higher numbers of jackrabbits versus smaller numbers of cottontails/rabbits.

Lovejoy Springs likely functioned as the residential base of a collector strategy as defined by Binford in his forager/collector continuum. Jackrabbits represent the target resource of task groups organized to procure a specific resource from a field camp with the goal of bringing that resource back to the site of a larger social group.

Comparison of the vertebrate faunal data at four Western Mohave Desert sites suggests that small mammals were exploited to a high degree at all sites. A similar pattern of small mammal exploitation is also present at RIV-6069, a site located in a desert setting to the south. In all cases large mammal exploitation was minimal. However, jackrabbits were the most important lagomorph taxa at all sites included in the comparison.

The findings noted in this report must be viewed with caution since the site has been heavily disturbed during earlier construction activities. In addition this study includes only fauna from a small portion of the site.

11

THE MATERIAL CULTURE OF LOVEJOY SPRINGS: PALEOBOTANICAL REMAINS

11.1 INTRODUCTION

As part of the archaeological investigations at CA-LAN-192, the Paleoethnobotany Laboratory, Cotsen Institute of Archaeology, University of California, Los Angeles (UCLA) conducted macrobotanical analysis of eight soil samples. The samples were collected from three hearths and two soil columns associated with discrete features (Table 29). The analysis attempted to answer the following research questions.

- What plant remains were deposited and what were their uses?
- What habitats and vegetative communities were exploited?
- Is there evidence of seasonal activities?
- Is there evidence of differential use of plant resources in different time periods?
- Is there evidence of major drought episodes in the Holocene Period?

Table 29. Analyzed Soil Samples from CA-LAN-192.

EB Number^a	Sample	Unit	Level^b	Feature	Vol. (L)	Date	Context
4163	4a	TEU 1	30-40		0.8		Column
4161	21a	TEU 1	90-100	1a	1.4	350 +- 40 BP	Hearth
4162	19a	TEU 1	130-140		1.5		Column
4188	36A-1	05-10-01	30-40		5.6		Column
4189	36B-1	05-10-01	30-40	10	3.4	520 +- 40 BP	Hearth
4190	38A-1	05-10-01	50-60		4.5		Column
4191	42A-1	05-10-01	90-100		4.5		Column
4192	30-B	05-08-01	7-10	8	2.1	1200 +- 40 BP	Hearth

^a The EB number is the accession number of the UCLA Paleoethnobotany Laboratory.

^b cmbd.

11.2 METHODS

Soil samples were agitated in a 10 gallon bucket containing water. Agitation allows light materials, such as carbonized plant remains, to float to the surface where they are decanted into chiffon netting (0.02 mm) and hung to dry (light fraction). Sediment remaining in the bucket was poured into a sieve with a 1.0 mm mesh opening. This heavy fraction was dried and saved for future analysis (all heavy fractions were examined for the presence of carbonized material).

When dry, the light fraction was sifted through a series of nested sieves (2.00, 1.00, and 0.50 mm), yielding four size fractions (>2.00 mm, 2.00-1.00 mm, 1.00-0.50 mm, and <0.50 mm) to facilitate sorting under an incident light binocular microscope (10-40x) and to permit selective removal of distinct materials from each fraction. In this analysis, carbonized wood, amorphous material, and Joshua tree remains were removed and weighed only from the >2.00 mm fraction. All other carbonized plant material from the 2.00-1.00 mm and 1.00-0.50 mm fractions was removed and counted or weighed. Only whole or identifiable seeds were pulled from the <0.50 mm fraction. Plant material generally decomposes in a relatively short period of time after deposition. Therefore, uncarbonized plant remains, which usually represent contamination by modern vegetation, are noted but not removed (Minnis 1981).

Many of the Lovejoy samples contained uncarbonized rootlets; one sample (EB 4189) contained uncarbonized seeds and one (EB 4188) contained some animal droppings. Only carbonized material was considered to be of cultural origin, but this evidence of modern contamination indicates there may be some mixing within the upper levels at the site.

The recovered carbonized plant remains were identified using comparative plant and seed collections and seed identification manuals located in the Paleoethnobotany Laboratory at UCLA. Wood charcoal specimens were fractured to give a clean transverse section and then examined under an incident light binocular microscope at 60x. Taxonomic identifications were made using comparative modern wood specimens collected from southern California. If available, 20 pieces of wood charcoal from the >2.00 mm fraction of each sample was selected. This subsample size was deemed appropriate given the diversity of taxa present (Smart and Hoffman 1988:186). In most samples, fewer than 20 fragments were large enough to be identified.

11.3 RESULTS

Eight soil samples from three excavation units were analyzed, comprising a total soil volume of 23.8 liters (L). Table 30 presents the carbonized plant material counts and weights for each sample. Because the volumes of the flotation samples varied, density values (counts/liter or grams/liter) were calculated to allow for comparison across all samples (Table 31). Sample EB 4163 was less than 1 liter; consequently the density values are higher than the absolute values. Table 32 presents absolute counts and weights of identified wood charcoal fragments > 2.00 mm. Seed densities ranged from 0.00 to 11.4 seeds/L, whereas wood charcoal densities ranged from 0.00 to 1.297 g/L.

Atriplex sp. (saltbush), *Calandrinia* sp. (red maids), *Chenopodium* sp. (goosefoot), and *Sueda* sp. (probably bush seepweed, *Sueda moquinii*) were the only identifiable taxa recovered from the flotation samples. Seeds are rarely identified to the species level because seeds within the same genus are very often morphologically similar and carbonization often distorts the specimens, obscuring diagnostic characteristics. Some seeds could not be identified to genus and, based on morphology, were placed in families. These include the *Asteraceae* (sunflower), *Brassicaceae* (mustard), *Malvaceae* (mallow),

Table 30. Carbonized Plant Material Absolute Counts and Weights (grams)

Unit	TEU 1			05-10-01				05-08-01
		1A			10			8
Feature	30-40	90-100	130-140	30-40	30-40	50-60	90-100	07-10
EB Number	4163	4161	4162	4188	4189	4190	4191	4192
TYPE								
SEEDS								
Asteraceae							1	
Asteraceae cf.				1				
<i>Atriplex</i> sp.						2		
Brassicaceae cf.				2				
<i>Calandrinia</i> sp.								
Cheno-Ams		1		9	1	3		
<i>Chenopodium</i> sp.				3		1	3	
Malvaceae		1						
Poaceae				2				
Poaceae cf.						3	1	
<i>Sueda</i> sp.				4				
Type A		2						
Type B		1						
Type C		1						
Unidentifiable seeds and frags.		10		7	1	7	4	
Seed Total ^a	0	16	0	28	2	16	9	0
PLANT PARTS^b								
Wood	0.05	0.27	0	0.09	4.41	0.18	0.55	0.01
Amorphous	0.03			0.01			0.01	
<i>Yucca brevifolia</i>					58.76			

^a Seed total includes unidentifiable seeds and fragments.

^b Weights (in grams).

Table 31. Carbonized Plant Material Densities (counts/liter or grams/liter)

Unit	TEU 1			05-10-01				05-08-01
	1A			10				8
Feature	30-40	90-100	130-140	30-40	30-40	50-60	90-100	07-10
EB Number	4163	4161	4162	4188	4189	4190	4191	4192
TYPE								
SEEDS								
Asteraceae							0.2	
Asteraceae cf.				0.2				
<i>Atriplex</i> sp.						0.4		
Brassicaceae cf.				0.4				
<i>Calandrinia</i> sp.								
Cheno-Ams		0.7		1.6	0.3	0.7		
<i>Chenopodium</i> sp.				0.5		0.2	0.7	
Malvaceae		0.7						
Poaceae				0.4				
Poaceae cf.						0.7	0.2	
<i>Sueda</i> sp.				0.7				
Type A		1.4						
Type B		0.7						
Type C		0.7						
Unidentifiable seeds and frags.		7.1		1.3	0.3	1.6	0.9	
Seed Total ^a	0	11.4	0	5.0	0.6	3.6	2.0	0
PLANT PARTS^b								
Wood	0.065	0.196	0	0.016	1.297	0.040	0.122	0.005
Amorphous	0.035			0.001			0.002	
<i>Yucca brevifolia</i>					17.282			

^a Seed density total includes unidentifiable seeds and fragments. Sum of individual densities may not equal total due to rounding.

^b Density (g/L).

and *Poaceae* (grass) families. The Cheno-Ams category includes a number of species found in the *Chenopodiaceae* and *Amaranthaceae* families, whose seeds contain a central endosperm around which the embryo curves (e.g., *Amaranthus*, *Atriplex*, and *Chenopodium*). Seeds placed in this category lack diagnostic seed coats upon which identifications to the genus or family level are made.

Several seeds were unknown and defined as types. Type A seeds were triangular to irregularly shaped, measuring 1.1 x 1.4 mm and 1.3 x 1.5 mm. Type B is a spherical seed, 1.9 mm in diameter, which is missing its seed coat; Type C is a flat oval seed with a v-shaped notch on one margin, measuring 0.8 x 1.2 mm. Seeds that were too distorted or fragmented to classify to even the family level are placed in the unidentifiable seeds category. Many of the fragments from Sample EB 4161 were from a large seed with a smooth surface, but they were too small to ascertain if they were from a legume such as mesquite.

In addition to seeds and fruits, the samples also contained *Yucca brevifolia* (Joshua tree) wood and other amorphous material. Botanical material that lacked any diagnostic characteristics and could not be positively identified to a known taxon was placed in the “Amorphous” category. Amorphous material is typically very porous, possesses minimal vessel structure, and lacks a distinctive shape. Charcoal was identified as *Asteraceae* cf. (sunflower family), *Atriplex* sp. (saltbush), *Larrea tridentata* (creosote), *Prosopis* sp. cf. (mesquite), *Yucca brevifolia* (Joshua tree), and an unidentifiable diffuse porous wood (Table 32). Some dicotyledon fragments were too small or distorted, or lacked diagnostic characteristics for identification.

11.4 DISCUSSION

Macrobotanical analysis provided evidence of a small range of plant activities conducted at the site. Seed and wood charcoal densities are low to moderate compared to other archaeological sites in nearby northeast Los Angeles County (e.g., Martin and Popper 1997, 2000; Popper 2005). Five of the eight samples contained seeds exhibiting a moderate diversity of plant taxa. A total of 14 plant taxa (identified to family, more specifically, or as a type) were recovered. All of the identified taxa were locally available and have been recovered from other prehistoric archaeological sites in southern California. The following discussion of the identified remains draws on habitat, seasonality, and use data provided in several sources (Barrows 1900; Bean and Saubel 1972; Ebeling 1986; Hickman 1993; Mead 1972; Munz 1974; Sawyer et al. 1995; Strike 1994; and Zigmund 1981). These sources use contemporary and ethnographic data, which may not necessarily apply to the prehistoric inhabitants of CA-LAN-192 or be relevant to the plant communities that existed within the vicinity of the site area.

The samples contain different assemblages of plants, but show that plant collecting was focused mainly on the nearby desert scrub environment. Given the significant time and effort required in collecting firewood, one would expect that the site inhabitants preferred easily available local sources. Saltbush (recovered in six samples) and creosote (recovered in five samples) were the most common firewood sources, and were available

for the site inhabitants to exploit for other uses. Creosote wood ignites easily and burns hot, which made it a preferred fuel. In addition, the Kawaiisu used boiled creosote leaves as a medicine. Saltbush prefers disturbed and alkaline or saline soils. The foliage, as the common name suggests, has a high sodium content. The Kawaiisu used the wood of saltbush to make arrow shafts. Other southern California groups used the roots and leaves (which contain *saponin*) or the ash of the whole plant to make soap. The Cahuilla and Luiseño also acquired saltbush seeds for food.

Creosote and saltbush grow in association with Joshua tree, seepweed, Asteraceae (sunflower family), and mesquite plants. Joshua tree grows on desert flats and slopes. Numerous southern California groups used pit hearths to process yucca for food. Joshua tree flower heads contain abundant sugar, and were gathered in spring for roasting in pits. Later in the year, the seeds were gathered and ground into flour for making mush. Joshua tree leaf fibers were an important source for cordage, mats, and baskets, and it seems likely that dead plants would also be used as a fuel.

Seepweed grows in the desert, particularly in alkaline and saline places. Both the toasted and ground seeds and boiled leaves were food sources, and the leaves also produced a dye for basket material. Mesquite provided excellent fuel and wood for tools. In addition, the blossoms and pods were an important food source in the desert. Although specific desert plants grow more commonly in some areas than others, all of the above can grow in the same area. Consequently we cannot isolate distinct areas of resource exploitation from these remains.

Another group of plants recovered from the samples grow in both open and disturbed habitats. Goosefoot prefers sandy or gravelly soils or mesic habitats, depending on the species. Its growth may have been encouraged around habitation sites. The Cahuilla ate young shoots and leaves as greens in the spring and summer, and the seeds when they ripened in the summer. They also parched and ground the seeds into flour. Red maids are a common desert plant, growing on sandy to silty soil. There are no references to the use of this particular species, although some southern California groups ate the tender leaves of other species of red maids in the spring, and the seeds were parched and ground for *pinole* in the late spring and early summer. The mustard, grass, and mallow family seeds could represent taxa that grew in the desert, on the disturbed soils of the site, or around the site environs.

The relatively small assemblage of plant parts recovered from the site might be attributed to the contexts of the deposits, preservation conditions, and the amounts and types of plant use by the site inhabitants. Low seed and charcoal densities are often associated with midden deposits that represent secondary deposition (the debris from cleaning out hearths and living areas) or the natural dispersal of plant refuse after site abandonment. These remains become mixed with other garbage and fill, thus reducing their concentration and likelihood of preservation.

The midden column samples from CA-LAN-192 generally follow this pattern, with low seed and charcoal densities, and in one case, no plant remains. Low seed densities could

indicate that small seed processing was not a significant activity at the site, was conducted in other areas of the site, or was not preserved. But given the low densities of seeds from the unspecific column sample contexts, it is possible that many of the seeds represent accidental inclusions. Some seeds may have blown into hearths or, in the case of the Cheno-Ams, may have been saltbush seeds attached to branches used as firewood. If we could identify the seeds more specifically to ascertain that they could not have grown in the natural environment around the site, or on the disturbed soils of the site, we would be able to argue that they were brought in on purpose, presumably for food.

Two of the three hearth samples contrast nicely with the column samples. These hearths contained significantly higher charcoal densities and in one case higher seed densities. These remains represent the debris of fires and plant processing in the pits and/or secondary refuse that was protected in the pits from post-depositional disturbances such as trampling and mixing. While Feature 8 was cleaned out, leaving almost no charcoal, and Feature 10 contained abundant charcoal from Joshua tree and saltbush, Feature 1A contained a moderate amount of creosote charcoal and a variety of seeds. The Joshua tree remains come from dense parts of the plant, not the flower heads, so it is uncertain whether this indicates use of the plant for fuel or some other purpose. But the distribution of fuel types in the features suggests that firewood selection was not random. Instead, it seems to indicate that firewood was selected for its unique properties depending on the type of fire required. Feature 1A contained exclusively creosote, Feature 10 a mix of Joshua tree and saltbush, and Feature 8 exclusively saltbush.

In sum, the plant remains provide evidence primarily of fuel use by the site inhabitants. Saltbush and creosote were the favored firewood, easily available around the site, but possibly preferred for different tasks. Joshua tree remains point to their use as a fuel, and potentially as a food. Small seeds are poorly represented at this site, either reflecting poor preservation or the subsistence activities at the site. It is unclear whether the few seeds recovered represent small seed processing or accidental inclusions. But there is no evidence of acorn or berry use at the site.

The discussion above shows that native California groups used some of the recovered taxa for food, medicinal, and utilitarian purposes. Although we have no archaeobotanical evidence of these uses at this site, we know that the plants were available. In early spring the inhabitants could have gathered a variety of greens, mesquite blossoms, and Joshua tree flower heads, followed by seeds of goosefoot, saltbush, grasses, and green mesquite pods in late spring or summer, and dried mesquite in the fall and winter. But the use of mesquite at the site is equivocal given the presence of only one tentatively identified fragment of charcoal.

Similarly, the local environment contained other plant resources that probably were used by the site inhabitants (e.g., leafy greens, medicines, and basketry material). Unless these were exposed to fire and charred, but not completely burned, and protected from mechanical degradation in a pit or midden deposit, they would not be preserved.

Lovejoy Springs appears to have been occupied over a lengthy time period for at least 5000 years or more, but the plant remains come from the most recent portion of this occupation. The one early flotation sample contained almost no plant material, precluding any discussion of changes in the environment or plant use over time. Thus, this analysis probably records only a portion of the plant use activity by the inhabitants of the Lovejoy site and most likely applies rather exclusively to the late prehistoric occupation of the site.

Table 32. Wood Charcoal Absolute Counts and Weights (g)

Unit	TEU 1						05-10-01						05-08-01			
Feature	1A-0-10						10						8			
Level	30-40		90-100		130-140		30-40		30-40		50-60		90-100		07-10	
EB Number	4163		4161		4162		4188		4189		4190		4191		4192	
TYPE	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.	Ct.	Wt.
Asteraceae cf.							1	<0.01					3	0.13		
<i>Atriplex</i> sp.	3	0.01					6	0.05	16	0.66	3	0.03	8	0.12	3	0.01
Dicotyledon											3	0.02	2	0.05		
<i>Larrea tridentata</i>			15	0.21			3	0.03	2	0.01	2	0.01	2	0.01		
<i>Prosopis</i> sp. cf.									2	0.01						
<i>Yucca brevifolia</i>	6	0.04														
Total identified	9	0.05	15	0.21	0	0	10	0.08	20	0.68	8	0.06	15	0.31	3	0.01
Total charcoal		0.05		0.27		0		0.09		4.41		0.18		0.55		0.01

SUMMARY OF HUMAN REMAINS FROM CA-LAN-192

12,1 INITIAL RECOVERY AND DESCRIPTION OF REMAINS

In March of 1968 construction began on a spillway system for the artificial lake constructed near Lovejoy Springs by the Lake Los Angeles Development Corporation. During these ground disturbing operations, several “Indian graves” were encountered. Dr. Charles Rozaire, then Curator of Archaeology at the Los Angeles County Museum of Natural History, was called to excavate four individual burials. However, some of these skeletal remains were vandalized before they could be adequately documented and recovered. Subsequent earthmoving operations disturbed additional skeletal remains, which were excavated by the Archaeological Survey, a research unit of University of California, Los Angeles (UCLA) department of Anthropology under the direction of James Toney (Toney 1968:1).

During this salvage excavation a mass burial consisting of a minimum of five individuals was excavated. Toney (1968:8) initially described five individuals by assigning an alpha designation to each. Toney’s field drawing and description of the individuals provide provenience and context information for the mass burial. In particular, the drawing shows the direct association of an Olivella shell bead necklace and “shroud” with Individual A, the association of an obsidian projectile point in the chest cavity of Individual E, as well as an inverted milling slab covered in red ocher in the abdominal and pelvic region of Individual E. Nelson’s original description for each individual provides additional contextual and placement information and is reproduced below:

Individual A: A child between ages 6 to 8 years was tightly flexed on the left side, with the head oriented to the west. The arms were placed outside the legs and the hands were crossed near the ankles. Around the neck was a double loop necklace of Olivella [*sic*] saddle beads. Under the right arm and folded up and over the pubic area was a shroud made of 10 strands 50 cm long of spire lopped Olivella [*sic*] beads.

Individual B: To the north and parallel to the child an adult (sex undetermined) was placed on the back with the lower legs flexed under the thighs and with the head oriented to the east and the hands crossed over the pubic area.

Individual C: Adult (sex undetermined) with the head oriented to the north was placed with the pelvic region over the lower jaw of Individual A. The hands were crossed over the pubic area. Lower legs were flexed with the legs pointing northeast over the pubic area of the child, such that the right leg was under the left femur and the trunk over the femurs of Individual B.

Individual D: Adult (sex undetermined) with head oriented to the north with the torso over the torso of Individual B and parallel to individual C. The right elbow as over the feet of Individual A and the lower legs flexed in the same manner and direction of Individual C.

Individual E: Adult (sex undetermined) with the head oriented to the east was placed on the back in a slight curve with lower legs flexed to the northeast over the pubic area of Individual A, such that the right leg was under the left femur and the left foot crossed over the right forearm of Individual D. An eccentric projectile point (Specimen 534-13) was placed under the chest cavity on the right (north) side. Above and on the right lower quadrant of the torso of Individual E and extending over the head shroud (see Individual A) was an inverted milling slab of dense granitic material covered on one edge with red ochre (Toney 1968:8-9).

Although Toney indicates that the crania of all but Individual A were disturbed and fragmented by backhoe activity, his descriptions of the placement and articulation of the five individuals of the mass burial suggest that they were encountered in their primary context. Toney's description of the skeletal remains, however, remained limited to the field observations, and further specialized osteological analyses of the remains were not conducted at that time.

12.2 SUBSEQUENT ANALYSIS

In 1990, Andrew Nelson of UCLA's Department of Anthropology analyzed the collection of skeletal material excavated by the Archaeological Survey. The collection, as encountered by Nelson consisted of commingled remains in a series of poorly labeled bags. As a result, a portion of Nelson's analysis consisted of sorting individuals out of the collection based on size, age, sex, weathering, and color indicators.

As would be expected, Nelson's assessment of the remains yielded slightly different results from the original field observations. In particular, Nelson's analysis yielded a total minimum number of nine individuals represented in the collection rather than five, as previously reported. In addition to the five individuals identified by Toney, Nelson identified the remains of one additional adult, and isolated bones and unassociated fragments that did not belong to any of the previously identified individuals and, therefore, represented a minimum of three additional individuals (Nelson 1990:cover page). Nelson believes that the additional adult burial (B1) was probably excavated as one of the "individual burials" noted on Toney's sketch field map and does not represent an additional individual from the mass grave. This was based not only on the alphanumeric designation that deviated from the alpha designation from the mass grave, but also on morphological observations of the skeletal material that indicated a different level of preservation and probable post-depositional environment. Therefore, the mass grave contained no less than eight individuals.

Nelson's osteological analysis encompassed a series of morphological observations as well as osteometric data whenever preservation and completeness of the skeletal material allowed. The summarized results of his study per individual are as follows:

Individual 1: This individual consisted of the incomplete and fragmentary remains of a young adult female ranging in age between 18 and 23 years. The sex of this individual was based on the presence of a wide sciatic notch and preauricular sulcus on the pelvis. The young age of the individual was based on the presence of a visible epiphyseal line of the recently fused iliac epiphysis. Fusion of this epiphysis generally occurs between the ages of 17 and 23. Her probable stature, based on long bone measurements, ranged between 150-155 cm. The individual exhibited a high degree of dental attrition, alveolar absorption, and abscesses for an individual of such young age. This individual was probably either Individual C or E excavated from the mass grave, but it was impossible to distinguish between the two.

Individual 2: This individual consisted of the fragmentary remains of the juvenile burial (Burial A) in the mass grave associated with the thousands of Olivella beads. Although Toney estimated these remains to be from a juvenile between the ages of 6 to 8 years, Nelson's analysis indicated the remains to be instead from an infant between the ages of 6 – 18 months. Nelson's age assessment was based on the examination of crown and root formation of a nearly complete set of dentition, and the presence of unfused vertebral arches which generally begin fusing during the first year. Nelson notes that this is the same age of another infant burial that was also accompanied by several thousand Olivella beads from CA-LAN-488, a Kitanemuk site reported by Robinson.

Individual 3: The remains of an adult female, probably initially designated as individual B from the mass grave. There were no data available to determine the age of the individual to a more specific age range. The sex of this individual was based on the presence of a wide sciatic notch and preauricular sulcus on the pelvis. Based on osteometric data obtained from this individual her stature ranged from 163 – 172 cm. Similar to Individual 1, Individual 3 exhibited a high degree of alveolar resorption and abscesses.

Individual 4: This individual represents the remains of an adult male (middle to old age) with an approximate stature of 173 cm. The sex of this individual was based on the presence of a narrow sciatic notch and absence of a preauricular sulcus on the pelvis. This individual probably represents Individual D excavated by Toney.

Individual 5: Little information is recorded about this individual. Due to the commingled and fragmentary nature of the remains, the identification is based on an isolated femoral head that could only be identified as adult (based on epiphyseal fusion) and probably male (based on size). Nelson indicated that this individual (like Individual 1) was probably either Individual E or C identified by Toney during excavation.

In addition to the individuals from the mass grave, Nelson also examined a single individual, believed to have been excavated as an isolated grave and represented by the designation B1. The description of this individual is as follows:

Individual B1: This individual is represented by the remains of a young adult between the ages of 16-20 years. The age estimate is based on the eruption of only one third molar, and incomplete or recently completed epiphyseal fusion, particularly of the calcaneus and distal tibia. Nelson indicates that the size of the individual is suggestive of a female, but there are no other indicators of sex to support this assertion. The dental patterns represented in this individual differ from those seen in the individuals of the mass burial. In particular, this individual shows evidence of dental enamel hypoplasia and a malalignment of its maxillary dental arcade. Dental attrition in this individual, however, is very slight.

Additional Remains: Besides the skeletal remains that were designated as individuals in the collection, Nelson identified additional isolated or unassociated fragments that represented three unnumbered individuals. One of the unnumbered individuals was indicated by a single juvenile tibia head that was too large to belong to Individual 2. The presence of five right adult femoral head suggest that at least one additional unnumbered adult is represented in the mass burial. Finally, a significant portion of an infant skeleton (also not belonging to Individual 2) was also extracted from the commingled remains (Nelson 1990:3).

When Nelson inventoried the commingled remains from the mass grave he identified five right femoral heads from adults. Toney had only noticed four adults and one juvenile in the mass grave. The presence of an additional adult femoral head raises the minimum number of individuals to 6 (then there are the other infant remains and the juvenile tibia head that doesn't belong to Individual 2 that brings the count to 8).

12.3 GENERAL OBSERVATIONS AND CONCLUSIONS

Nelson offered several general observations for the collection. In particular, he noted that the remains from the mass burial appear to have been exposed to the elements “some time after they were defleshed” based on the friable nature of the bones and exfoliation of the inner table of the cranial fragments (Nelson 1990:3). It is possible, however, that the friable nature of the bones and the exfoliation noted by Nelson could have been the result of exposure to direct sunlight during the initial disturbance and excavation process. It is unclear from the previous reports how long the remains were left exposed following their discovery by backhoe, or how long the excavation process took. Photographs of the excavation in progress, however, show that the burials were indeed excavated in direct sunlight, and this level of exposure could very well cause the damage noted by Nelson.

Nelson also noted that there was some indication that the bones from the mass burial had been burned. None of the bones, however, were calcined and this was based strictly on black staining on some surfaces and some degree of warping (Nelson 1990:3). This

observation was not, however, confirmed and it should be noted that other events besides exposure to fire can cause discoloration or warping.

The individuals represented in the collection were generally gracile, with lightly developed muscle attachments. The individuals are of medium stature ranging from less than 4 feet 9 inches (Individual B1) to 5 feet 8 inches (Individual 4) (Nelson 1990:4-5). The individuals appeared to be in good health. There was no evidence of infectious or neoplastic disease. However, the dental attrition on the individuals from the mass grave was extreme. The worn teeth showed evidence of dark brown to black staining that Nelson suggest may have been due to preservation conditions, tobacco use, or pulp necrosis (Nelson 1990:8).

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13 SOILS AND STRATIGRAPHY

13.1 THE NATURAL LANDSCAPE

CA-LAN-192 is differentially preserved across a complex landscape whose contours have been altered by historic and modern development. Geoarchaeological investigations at the site were intended primarily to define cultural and natural stratigraphic sequences, identify intact archaeological deposits suitable for further investigation, and correlate sedimentary units across the extensive site area. The analysis also provided data on soil genesis, site formation processes, and paleoenvironments.



Figure 34 Principal landforms of the project area. San Gabriel Mountains in background, unnamed granitic butte in midground, alluvial piedmont in foreground (traversed by Avenue P on the right).

CA-LAN-192 is set in a gap between the Lovejoy Buttes, a series of Mesozoic granitic hills rising above the toe of the alluvial piedmont north of the San Gabriel Mountains. Figure 34 illustrates the principal landforms of the project area. Sediments at and

surrounding the site consist of poorly sorted gravel and sand deposits, mudflows, colluvium, and infilled channels derived from mass wasting, erosion, and debris flows caused by catastrophic flood events. Numerous gullies entrench the middle and upper portions of the piedmont and are responsible for the majority of deposition on the lower slopes. Shifts in water flow may result in large stable areas of piedmont where wind-blown sands are deposited, or, contrastingly, this process may cause deflation leaving a surface layer of rocks and gravel (Waters 1992).

CA-LAN-192 lies at the toe of the alluvial piedmont, where depositional energy is much lower than on the middle and upper portions and the environment is much less dynamic. Further, the buttes act as a dike in the piedmont, slowing the northward movement of materials and periodically damming waters to form intermittent playas. Regional geological maps (Campbell and Oakeshott 1967; Rogers 1967) show the area as Quaternary lake deposits, concurring with this interpretation. Outwash and debris flows from the Lovejoy Buttes mix with the fine sediments along the margins of the gap between buttes. While disturbance has altered surface landform relations nearly everywhere in the project area, buried intact horizons were observed in each trench profile.

Native soils in the immediate site area are classified in the Cajon Series, particularly Cajon loamy fine sands (CcD2) and Cajon loamy sands (CaC). The Cajon soils, generally located on lower slopes within and adjacent to the site, are formed in granitic alluvial fans with slopes between 2 and 9 percent (CaC) and 9 and 15 percent (CcD2). Hummocks of wind-deposited sand 3–4 feet high are common in these areas and may cover as much as 80 percent of the surface. Sheetwash and debris flows are common in areas between aeolian materials, occurring as thin layers of granitic gravel. Granitic outcrops are frequently associated with the Cajon Series and depth to bedrock is between 4 and 5 feet.

Other soil types in the CA-LAN-192 vicinity, but not found at the site, consist of both Rosamond and Hesperia (in very small quantities) fine sandy loams. Rosamond Series soils, located on the eastern and southern sides of the site, generally form low on alluvial fans with slopes under 2 percent. Typically, the upper strata are light brownish gray fine sandy loams with platy structure. Lower strata are pale brown silty clay loams to pale brown sandy clay loams with angular block structures and soft irregular lime masses.

13.2 GEOARCHAEOLOGICAL INVESTIGATION

To determine the extent (if at all) of intact cultural deposits at CA-LAN-192 and to document previous mechanical disturbance, backhoe test trenches were excavated across the project APE at 50-foot parallel intervals, except for Trench 6 which was excavated perpendicular to Trench 5. The 11 trenches were excavated to a depth of 1.0–1.5 meters and measured between 40 and 230 feet long. A minimum of one 1-meter-wide profile was drawn from each trench using United States Department of Agricultural (USDA) methods, and a sample (approximately 0.075 square meters) of each identified sedimentary stratum within each trench was screened through 1/8-inch mesh to search for

artifacts. All mechanical excavations were conducted under the direction of the field supervisor and observed by the Native American representative.

Two distinct areas of sedimentation occur in the project vicinity and generally correspond to mapped soil units (Soil Conservation Service 1969). Previous archaeological work conducted at Stephen Sorensen Park (Price et al. 2005) confirmed these units and identified Rosamond Series sediments near the baseball/softball diamond and soccer field. Soils include loamy and clayey alkaline sediments with well-developed moderate to strong structure. More active deposition was identified north of the original park location near the basketball courts where Cajon Series stream channels, a surface aeolian component, and granitic outcrops overlie a decomposing granite base horizon. The primary difference between the Cajon and Rosamond soils is the amount of fines present within the matrix, which is largely conditioned by the degree of slope upon which they occur. It was, therefore, expected that the Cajon soils would become more “intact” as one moved north of the existing park (into the current project area) and onto the steeper slope coming down from Lovejoy Buttes. This expectation was tempered, though, with the realization that historical disturbance to the project area had likely obscured much of the original landform.

Four representative soil profiles from Trenches 1, 4, 8, and 10) all contain elements consistent with the environmental and geological conditions associated with a Cajon Series soil and also demonstrate the mechanical disturbance in this part of the site. The profile from Trench 10 best illustrates this interplay, exhibiting three distinct soil units—a layer of recently deposited slope wash, the remnants of an intact Cajon soil, and bedrock. The upper stratum (Soil Unit I) is a 20-centimeter-thick layer of yellowish brown medium fine sand, well-sorted, with subangular to subrounded grains and 10 percent pebble gravels (0.5–1.5 centimeters). This modern slope wash overlies an approximately 85–90-centimeter-thick remnant of an intact Cajon soil (Soil Unit II). Soil Unit II is a pale brown silty medium sand that exhibits the remnants of some root action (all less than 0.5 centimeters). The sharp boundary between Soil Units I and II, the presence of the root remnants, and the lack of a developed A horizon all indicate that the upper portion of the soil has been mechanically removed. The deepest unit in the profile (Soil Unit III) is a horizontal layer of consolidated and continuous granitic bedrock occurring 96–108 centimeters below surface.

The profiles observed in Trenches 1, 4, and 8 are representative of various processes that have impacted the project area, but are all variations of the same basic structure described for Trench 10.

The two deepest units in Trench 1 correspond to the intact Cajon soil (Soil Units II) and bedrock (Soil Unit III) noted for Trench 10. Dissimilarly however, Soil Unit II is overlain by two episodes of fill and slope wash. The uppermost layer of disturbance (Soil Unit Ia) consists of a 28–48 centimeter layer of redeposited fill comprised of yellowish brown poorly sorted silty sand with 20–30 percent gravel. This covers an older layer (Soil Unit Ib) of well-compacted and poorly sorted brown silty sand containing 10 percent gravel fill. These two layers of disturbance allude to a sequence in which the upper portion of

Soil Unit II was mechanically truncated and then subject to a subsequent fill episode. This initial fill—Soil Unit Ib—was itself then truncated and subject to a more recent fill episode, namely Soil Unit Ia.

The Trench 4 profile exhibits a presumed intact profile underlying modern fill. The deepest three strata (Soil Units V–VII) consist of weathered, decomposing, and consolidated granite bedrock respectively. Immediately covering the bedrock, Soil Unit IV is an intact Cajon soil that was subsequently covered by an intrusive alluvial deposit, Soil Unit III, consisting of well-sorted and loosely compacted medium fine sand with 10 percent pea gravels. The sharp transition and undulating contact between Soil Units III and IV strongly suggest that the area was subject to a rapid influx of material onto a stable surface. These sediments are overlain by a shallow 5–10 centimeter layer of silty coarse sand (Soil Unit II) and a thick layer of disturbed fill (Soil Unit I) associated with the construction of Avenue P.

The profile from Trench 8 illustrates a truncated intact soil that is overlain by modern slope wash. Interestingly, the removed material, which had previously overlain Soil Unit II, was redeposited elsewhere as Soil Unit I and consists solely of a thin layer of alluvium washing down from the steeper terrain of Lovejoy Buttes.

13.3 CONCLUSIONS

Æ’s geoarchaeological findings are consistent with the history of the Lovejoy Springs area. The steep incline of the APE exhibits mechanical disturbances overlying substantial erosion activity and decomposing bedrock. This profile is expected given the amount of documented construction in the area and the steep slope up to Lovejoy Buttes to the west. Although buried and intact native soils were observed throughout the project area, the upper portions of these horizons had all been mechanically disturbed and no evidence of prehistoric occupation was found.

Further, no evidence of the Rosamond Series soils was found during the investigation. Importantly, the Rosamond soils have been previously identified in correlation with cultural deposits at CA-LAN-192 (Price et al. 2005). Intact midden deposit was encountered near the southwestern corner of the soccer field during Æ’s investigations for the second phase of construction at the park. EXU 106 exhibited an upper midden deposit (Soil Units 1 and 2) extending for 30–40 centimeters (Price et al. 2005:Figure 4-3). It transitioned into an intact Rosamond Series soil that reached at least 2 meters in depth. No associated A horizon was observed with the midden, suggesting that the upper portion of the cultural deposit may have been removed. Alternatively, horizonation may be delayed in this area because of environmental factors in the arid setting or because of other factors on this fringe of the midden.

As a result of the current and previous geoarchaeological investigations at CA-LAN-192, an intrasite pattern emerges with respect to the two major soil series identified in the vicinity of the project area. While prehistoric occupation occurred across the landscape, intensive occupation (i.e. midden development) appears to be associated with the mapped

locations of the Rosamond soils. As the major defining difference between Rosamond and Cajon soils is the difference in slope, it is not surprising that the flatter and, by extension, more stable landscapes were more intensively occupied than the steeper surrounding slopes.

13.4 INTEGRITY

The integrity of the portions of CA-LAN-192 within the current project APE has been compromised by various episodes of construction, grading, and filling, some of which may date back nearly a century (Padon and Love 2004:4). These activities have substantially altered the original landscape of the site, obscured intrasite spatial patterning, and removed large portions of the cultural assemblage. Documented activity at Lovejoy Springs includes the construction of an irrigation reservoir in the early twentieth century, the creation of Lake Los Angeles in 1968 (which included constructing the lake's earthen dam and Avenue P using midden soil), excavation of the large drainage canal north of Avenue P, the subsequent removal of the lake's shoreline and dam in 1992, and the construction of the current park in 1995–1996. At that time, the remaining midden deposits were capped with clean fill.

Photographs of construction at the site during the 1980s reveal that mass grading was again conducted across the lower or northeastern portion of CA-LAN-192 where the soccer field and baseball diamond are located. Access roads, sewer and septic systems, subterranean sprinkler lines, and other utilities also have been installed within the boundaries of the site. Specific to the current project area, Padon and Love (2004:5) report that in 1992, “the northwest edge of the artificial lake was removed by heavy equipment and spread over the bottom of the now-dry lake bed.”

The geoarchaeological study implemented by Æ shows that the tested portions of the project APE lack stratigraphic integrity because of erosional processes and the massive earthmoving that has occurred there. Cultural strata, if at one time present, have been removed in many areas; in some cases these have been relocated to other parts of the site. In some areas cultural and noncultural strata are mixed, and imported fill has been added.

IMPLICATIONS OF SITE CHRONOLOGY AND CONTENT FOR A REVISED TAXONOMY OF THE WESTERN MOJAVE DESERT

The archaeological site at Lovejoy Springs has become familiar to local researchers because of its extent, complexity, and substantial ground stone assemblage. The most well-known and notable element of the site, however, is a ritualized mortuary feature containing the remains of as many as nine individuals decorated with more than 3,000 *Olivella* beads. The burial feature was exposed in 1968 during massive excavations for the artificial Lake Los Angeles, and was removed by a team of archaeologists from UCLA led by Jim Toney. Chester King (2002) examined the beads and observed that the collection has a narrow range of types dating exclusively from his Early Middle Period, around A.D. 1 to A.D. 200. The dating of the beads is consistent with an uncalibrated radiocarbon age of 2720 ± 70 years on bone from the burials (Love 1993). Because this mortuary feature is so well known, many have assumed that the Lovejoy Springs site dates principally from this time and its primary cultural association is with the Gypsum Pattern.

In this section we present information on site chronology garnered from multiple data sets collected from Lovejoy Springs by different researchers over a period of 80 years. Multiple lines of evidence including 6 radiocarbon dates, 80 obsidian hydration rim measurements, and typological analysis of more than 350 beads, 32 projectile points, 116 ceramic fragments, and more than 800 pieces of ground stone indicate quite clearly that there are at least four, if not five or more periods of occupation spanning at least the past 3,000-4,000 years. We examine cultural assemblages associated with each period of occupation, and discuss the implications for the cultural history of the region. Existing taxonomies make it difficult to compare the dating and content of these assemblages with other sites in the region. We suggest that a new taxonomic framework for the Western Mojave is needed to resolve inconsistencies and contradictions in existing schema.

14.1 BEADS

As noted, King identified two principal bead types—dorsal ground saucers and oblique spire ground—associated with the burials, observing that these two types are often found together in early Middle Period contexts (King 2002: 2). However, examination of the non-burial associated bead assemblage from the site, collected over a period 80 years from five different episodes of work, revealed a much broader range of bead types and chronology than did the grave lots examined by King (2002). The non-burial associated bead and ornament assemblage includes 363 specimens made not only from *Olivella biplicata* but also from at least seven other shell species. The specimens can be separated into 27 distinct types whose use spanned more than 3,000 years from the late Early Period to the Mission Period.

When considering just the non-burial associated diagnostic *Olivella* bead specimens it can be seen that a substantially greater number of bead types mark Late Period occupation of the site (Table 33). The two bead types used almost exclusively in the large mortuary feature, listed at the bottom of Table 34, are two of only three types that mark Middle Period (i.e. terminal mid Holocene) occupation. Conversely, there are fourteen bead types marking Late Period occupation and three that are transitional between the two.

Table 34 indicates that roughly equal numbers of beads derive from Middle and Late period contexts, suggesting that the intensity of occupation at Lovejoy Springs was at least as great during the Late Period as it was during the time of cemetery use during the early Middle Period.

Importantly, the assemblage also contains several beads indicating that use of the site continued well into the Mission Period. Four *Olivella* ground disc (type H1a) and six wall disc (type J) beads have straight-sided, narrow perforations indicating they were drilled with an iron needle. King (1990b:4) suggested that the regular use of iron needles as bead drills occurred between A.D. 1776 to 1791. Two glass beads with relatively wide diameters suggest site use may have extended into the late Mission Period (post A.D. 1800) as well.

14.2 PROJECTILE POINTS

Thirty-two projectile points from both surface collection and subsurface excavations were complete enough to allow classification and provide examples of several types commonly found throughout the Desert West (Table 35). These projectile points suggest that the Lovejoy site was initially occupied during the Middle Holocene Period, and site occupation appears to have continued through the end of the Late Holocene. The assemblage includes points assignable to the Pinto (2), Elko (2), Gypsum (1), Humboldt Basal-notched (1), Saratoga Springs (3), Rose Spring (5), Cottonwood (17), and Desert Side-notched (1) series. One relatively complete specimen—a large lanceolate, concave base, dart point—did not allow categorization according to standard typologies. Additionally three fragmentary arrow points were not complete enough to be assigned to a particular series.

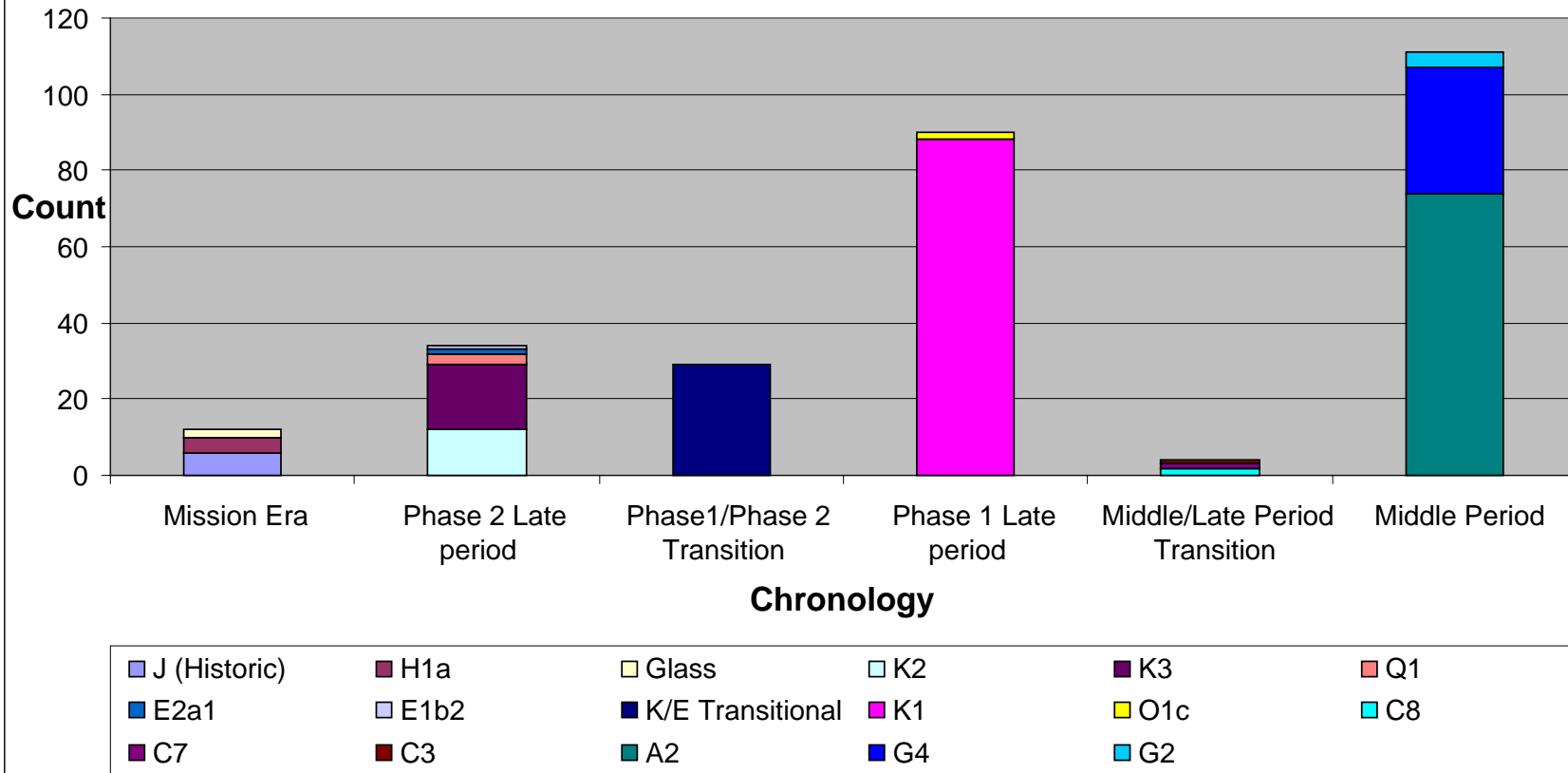
All the work at Lovejoy Springs has produced only one Desert side-notched point, while Cottonwood Series points are the most common type with 16 specimens. Most archaeologists agree that both types post-date A.D. 1200, though there is some suggestion that Cottonwood points may have appeared earlier.

Five Rose Spring points and three larger, triangular points classified in the Saratoga Spring series appear to date from ca. A.D. 500 to 1200; as such, they are associated with the transition from dart to bow and arrow use. There is growing evidence that the Rose Spring series may have appeared several centuries earlier than initially posited; they are now thought to have been introduced in eastern California as early as A.D. 200-300 (Sutton in press; Yohe 1992).

**Table 33. Temporal Placement of Diagnostic *Olivella* Shell Beads
(following chronologies of Bennyhoff and Hughes (1987) and King (1990a))**

Type	#	Mission Era	Late Period		Middle Period	Early Period
			Phase 2	Phase 1		
Semi-Ground Disc (H1b)	1	<----->				
Ground Disc (H1a)	4	<----->				
Barrel (B3)	4	<----->				
Spire (B5)	1	<----->				
Wall Disc (J)	7	<----->				
Normal round thin lipped (E1a1)	3	<----->				
Full Lipped (E2a1)	1	<----->				
Bushing (K2)	12	<----->				
Cylinder (K3)	17	<----->				
Tube (Q1)	3	<----->				
Oval Thin Lipped (E1b2)	1		<----->			
E/K Transition	29		<----->			
Cupped (K1)	88			<----->		
Drilled Whole (O1)	2			<----->		
Punched Whole (O2)	1			<----->	<----->	
Drilled Spire Lopped (A3)	1			<----->		<----->
End Ground (B2)	27			<----->		<----->
Capped (B4)	6			<----->		<----->
Split Oval (C3)	1			<----->		
Split Amorphous (C7)	1			<----->		
Split Rough (C8)	2			<----->		
Normal Saucer (G2)	4				<----->	
Ground Saucer (G4)	33				<----->	
Oblique Spire Lopped (A2)	74				<----->	

Table 34. Relative Frequencies of Diagnostic Bead Types at CA-LAN-192



Two points have been classified as Elko corner-notched, while two other large contracting stem specimens are classified in the Gypsum series. These styles are thought to be contemporaneous, marking an initial Late Holocene component dating between 2000 B.C. and A.D. 500.

Table 35. Frequency Distribution of Lovejoy Points by Period

Projectile Points	Measured OH Samples	Obsidian Hydration Range	Estimated Years B.P.	Sequence
16 Cottonwood 1 Desert side-notched	3.2, 3.4, 4.0	<3.3	< 650	Terminal Late Holocene
5 Rose Spring 3 Saratoga Spring	3.8, 3.8 3.9	3.3-4.4	650-1,500	Intermediate Late Holocene
2 Elko corner-notched 2 Gypsum 1 Humboldt	5.5, 5.5	4.4-6.8	1,500-4,000	Initial Late Holocene
2 Pinto	7.8	6.8-14.4	4,000-7,000	Middle Holocene
		14.4-19.0	7,000-13,500	Early Holocene/ Late Pleistocene

One other fragment of a Humboldt Basal-notched biface was recovered from the Lovejoy site and may be contemporaneous with the Elko and Gypsum points. This fragmentary example represents the “ear” from a larger obsidian biface. However, the specimen has been reworked into a style conformable to the Cottonwood Series; it may have been scavenged from an older site, or from the Initial Late Holocene component at the Lovejoy site itself, and re-used.

The two remaining classifiable points, one corner-notched and one side-notched, might be classified as Elko points except that they are more robust and considerably thicker than the other Elko points. We have tentatively identified these members of the Pinto series, a classification supported by a hydration rim of 7.8 microns on one of the specimens, suggesting an age of 4800 years and a terminal mid-Holocene affiliation.

14.3 CERAMICS

The ceramic sample from Lovejoy comprises 116 items: 107 fragments of utilitarian vessels; seven sherds reworked into other tool forms; and two baked or unbaked clay specimens. Only eight vessel rims were recovered, compared to 99 body sherds.

The ceramics reflect a broad range of buff and brown wares, both decorated and undecorated, as might be expected given the site’s location midway between the Colorado River and the Pacific

Coast on a recognized and well-used trade corridor. Sherds from four well-defined ceramic wares are present: Lower Colorado Buff, Hohokam Red-on-buff, Southern California Brown (also referred to as Tizon Brown), and an intermediate brown/buff ware which Suzanne Griset has termed California Desert Intermediate (Table 36).

TABLE 36. Distribution of Ceramics by Ware, Type, and Age.

Ceramic Ware	Number of Specimens	Dating
SOUTHERN CALIFORNIA BROWN (TIZON BROWN)	58	A.D. 600- historic
CALIFORNIA DESERT INTERMEDIATE	14	uncertain
Cronese Red-on-brown	2	
LOWER COLORADO BUFF	3	A.D. 700 - historic
Colorado Beige	2	PI A.D. 700-1000
Colorado Red	3	PI A.D. 700-1000
Colorado Red-on-buff	1	PII/III A.D. 1000-hist
Parker Buff	15	PII/III A.D. 1000-historic
Parker Stucco	4	PII/III A.D. 1000-historic
Pyramid Gray	1	PII A.D. 900-1150
Topoc Buff	8	PII A.D. 900-1150
Topoc Red-on-buff	1	PII A.D. 900-1150
Tumco Buff	1	PII A.D. 1200-1400
HOHOKAM BUFF		
Santa Cruz/Gila Bend Red-on-buff	1	A.D. 850-975
Total	114	

Unfortunately there is no vertical or horizontal stratigraphy that can date the ceramics at Lovejoy, and no directly associated radiocarbon dates. The only ceramics in proximity to a radiocarbon assay at Lovejoy is a Southern California Brownware cooking jar, fragments of which were distributed principally between 40-50 cm below surface in TEU 1, with only 3 tiny sherds found below to 80 cm. A charcoal sample from Feature 1a (100-110 cm bs, 20 cm below the deepest tiny fragments of the cooking jar) produced a calibrated range of A.D. 1450-1650, suggesting that the cooking jar was deposited after that time.

All ceramic dates are therefore based on cross-dating with sherds found in other areas, and in some cases, are themselves cross-dated by decorated Anasazi or Hohokam sherds.

Typologically, the buff ceramics span the entire Lower Colorado Buff Ware ceramic period, from Patayan I – III (A.D. 700 to the Historic Period). Patayan I is represented by the three Colorado Red sherds (2 rims and 1 disk), as well as direct rims with rounded lips (Waters 1982a:Fig. 7.1). None of the rimsherds has a marked recurve, a form reputed to begin in Patayan II, but PII/PIII types (Parker Buff, Colorado Red-on-buff, Cronese Brown) are also present in the assemblage. According to Waters, stucco exterior treatments are restricted to Patayan II and III (A.D. 1000 onward).

The Santa Cruz/Gila Bend Red-on-buff sherd dates no earlier than A.D. 850 in the Phoenix/Gila basins. It is impossible to say when it was brought to the site, nor whether it was an intact vessel or a curated sherd.

No brown wares from the Owens Valley or the Great Basin were detected in the ceramic sample. Both of these wares were manufactured using the coil-and-scrape technique to shape the pots and have distinctive wiped surfaces. Eerkins' recent studies of Owens Valley Brown Ware suggest ceramics may have been present in the valley as early as A.D. 1300, with widespread local manufacture at the individual or family level ca. A.D. 1450 (Eerkins 2003:20).

Griset has identified undecorated brownware sherds from Lovejoy Springs as Southern California Brownware due to their surface treatment, paste characteristics, and anvil marks on some interiors. Southern California Brown Ware has been found in the Transverse Ranges as early as A.D. 600-799, in coastal southern California villages ca. A.D. 1000, and widespread throughout San Diego County by A.D. 1450 (Griset 1996).

Clearly, buff sherds were brought to Lovejoy much earlier than pottery was being manufactured to the north and northeast; the dating of the California Desert Intermediate and the Tizon/Southern California Brown remain open questions awaiting further data.

14.4 XRF AND OBSIDIAN HYDRATION

Eighty obsidian artifacts from the Lovejoy Springs site were submitted to Craig Skinner at the Northwest Research Obsidian Studies Laboratory for X-ray fluorescence analysis and obsidian hydration rim measurement. Of the 80 specimens in the obsidian sample, 36 were too small for trace element analysis. Seven geochemical groups, five of which were correlated with the Coso Volcanic Field, were identified among the 44 remaining specimens (Figure 35). Forty of those 44 specimens (91%) originated in the Coso Volcanic Field, and one each came from the Queen and Casa Diablo sources. The two remaining specimens originally were attributed to unknown sources; one of these subsequently was matched with the Los Vidrios source in northwestern Sonora, Mexico. The locations of the site and the obsidian sources are shown in Figure 36. Analytical results are presented in Table 37.

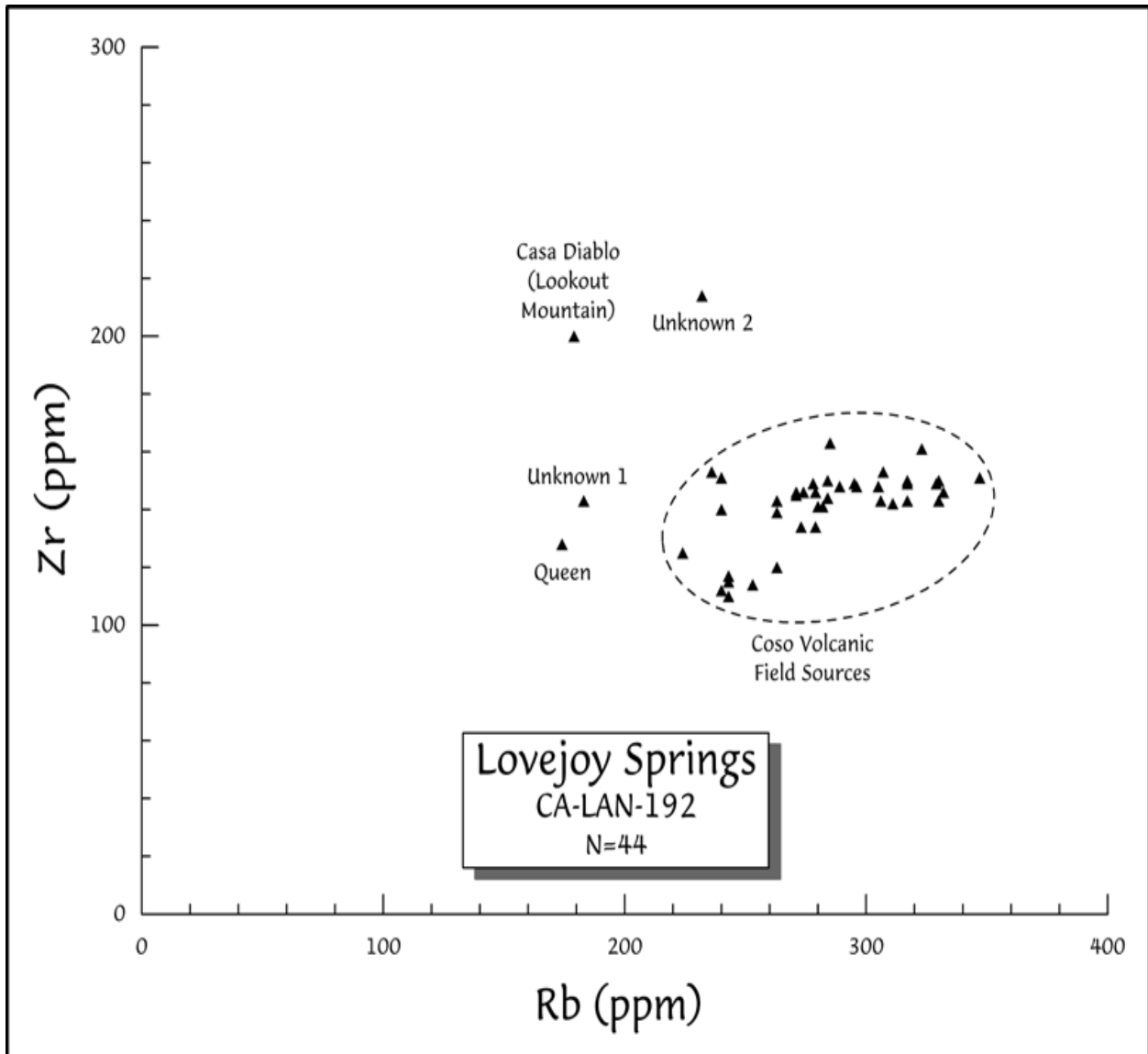


Figure 35. Scatterplot of rubidium (Rb) plotted versus zirconium (Zr) for all analyzed specimens.



Figure 36. Location of CA-LAN-192 and the sources of the characterized artifacts.

Table 37. Summary of results of XRF trace element studies.

Obsidian Source	Number	Percentage
Casa Diablo (Lookout Mountain)	1	2.3
Coso (Sugarloaf Mountain)	4	9.1
Coso (West Sugarloaf)	19	43.2
Coso (undifferentiated)	17	38.6
Queen	1	2.3
Unknown 1	1	2.3
Unknown 2	1	2.3

The obsidian hydration measurements yielded readings that range from 1.2 to 13.3 microns and fall within four definable clusters (Figure 37). A cluster of 20 specimens has rim widths ranging from 10-13.3 microns. Unfortunately, all of these specimens are flakes—no formed tools yielded rim measurements in this range.

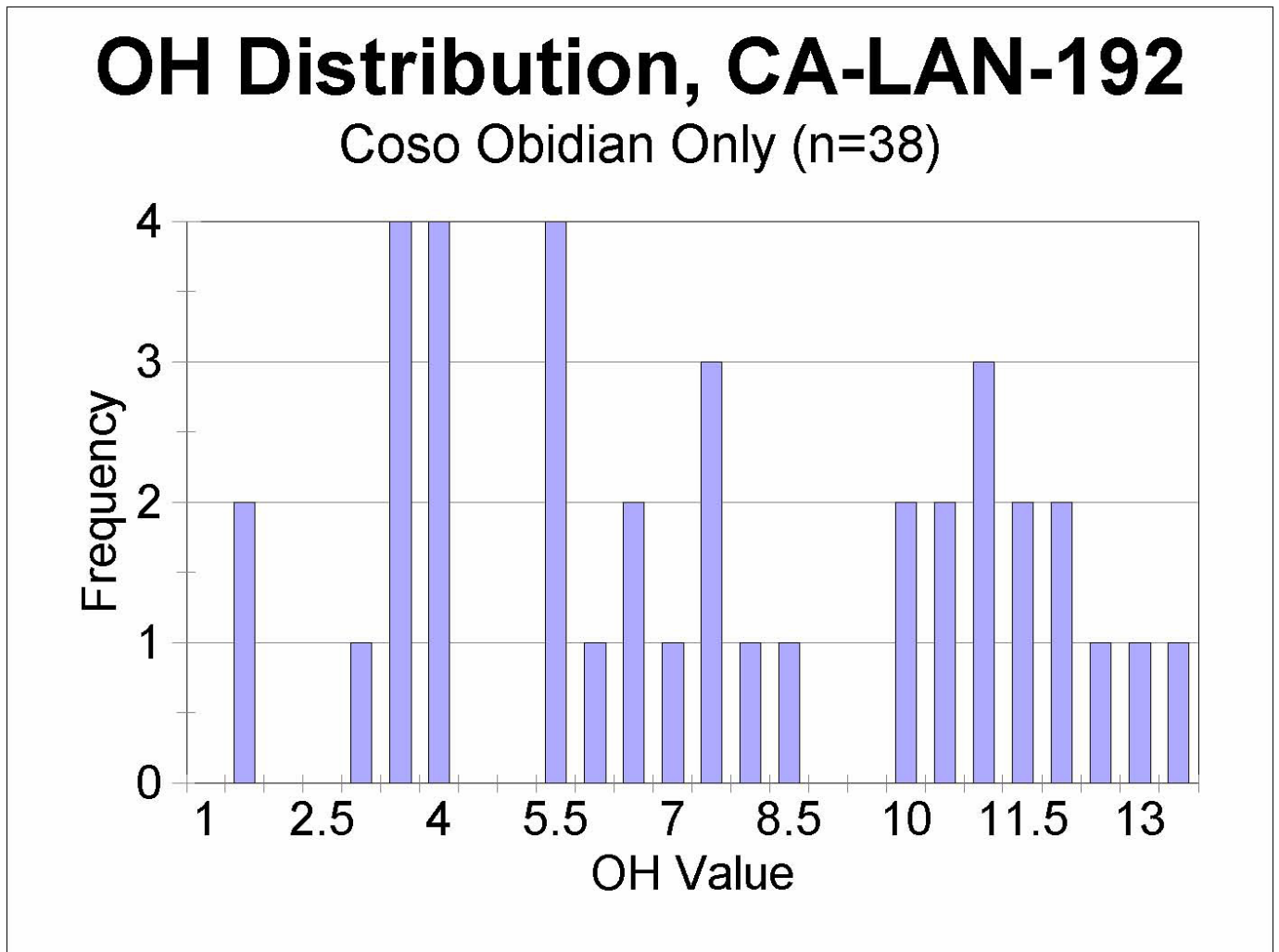


Figure 37. Distribution of Obsidian Hydration Rim Thickness

The second cluster includes 38 specimens ranging from 5.1 to 8.8 microns, and includes the one obsidian Pinto point at 7.8 microns and two Elko corner notched points at 5.5 microns each. One of these Elko points is an eccentric variety found with the multiple interments.

Fourteen obsidian specimens cluster between 2.6 and 4.6 microns. This cluster includes three Cottonwood points at 3.2, 2.4, and 4.0 microns, two Saratoga Springs examples, each at 3.8 microns, and one Rose Spring specimen at 3.9 microns.

The final, most recent cluster includes just two specimens ranging from 1.2-1.5 microns, with no formed tools.

Table 38. Summary of results of obsidian hydration analysis.

Obsidian Source	Rim measurements (microns)	Total
Casa Diablo (Lookout Mountain)	NA	0
Coso (Sugarloaf Mountain)	1.2, 1.4 3.4 5.4 6.5 3.0, 3.2, 3.5, 3.5, 3.8, 3.8, 3.9 4.0	5
Coso (West Sugarloaf)	5.1, 5.5, 5.3, 5.5, 5.5 6.2 7.2, 7.2, 7.8 9.7 10.0, 10.4, 10.6 5.8 6.3, 6.6 7.3, 7.3, 7.5	21
Coso Volcanic Field	8.1 10.2, 10.7, 10.9 11.3, 11.3, 11.8 12.0, 12.2, 12.7 13.3	17
Queen	1.6 2.6 3.2 4.1, 4.5, 4.6 5.1, 5.2, 5.3	1
Source Not Determined	6.0, 6.0, 6.2, 6.7, 6.8, 6.8, 6.9 7.0, 7.2, 7.2, 7.5, 7.5, 7.5, 7.8, 7.9, 7.9 8.0, 8.0, 8.5, 8.5, 8.6, 8.8 10.8 11.0, 11.1, 11.6 12.2, 12.5	36
Unknown 1	1.3 3.6	2
Unknown 2	4.0	1
Total		83

Table 39. Clusters of Obsidian Hydration Rim Thicknesses

Sequence	Lovejoy Hydration Values (in microns)	Time Span (Years B.P.)	Age (yrs B.P.) calculated using Basgall (1990) Rate	Age (yrs B.P.) calculated using Pearson Rate
Terminal Holocene	1.2-1.5		48-81	186-244
	hiatus			
	2.5-4.6		265-1090	469-1104
Initial Late Holocene	Hiatus			
	5.1-8.8		1385-4911	1288-3036
Middle Holocene	hiatus			
	9.7-13.3		6156-12,803	3565-6085

14.5 RADIOCARBON DATING

Six radiocarbon dates are available to place the Lovejoy Springs site in an absolute chronological framework (Table 40). As with the other chronological data sets, the absolute dates span a broad range from the terminal mid-Holocene to the protohistoric period. Three of the dates, taken on charcoal from excavated hearths, post-date A.D. 750 and span the late prehistoric occupation of the site. Two uncalibrated dates, one on bone and one on charcoal but both associated with the mortuary complex, place that feature in the early centuries of the late Holocene, around 500 B.C. At 1630 B.C., the sixth and most ancient date, taken on an *Olivella* spire-lopped bead, places that component firmly into the Middle Holocene.

14.6 SUMMARY AND INTERPRETATIONS

The Lovejoy Springs site is very large and highly variable both horizontally and vertically; unfortunately, none of the documented explorations of the site have revealed a complete stratigraphic sequence. By combining multiple data sets, however, we have constructed the following sequence of site occupation.

Intensive occupation from at least middle Gypsum time is indicated by two radiocarbon dates of 2400 and 2700 BP associated with a large mortuary feature containing multiple individuals and thousands of beads--principally type G4 dorsal ground *Olivella* saucers, which Chester King placed in his Middle Period Phases 1 and 2, and Type A2a oblique spire ground *Olivella*, also found typically in early Middle Period contexts. The mortuary feature also contained an Elko point with a hydration rim of 5.5 microns on Coso obsidian. The Gypsum component, which conventional wisdom holds as the primary occupation, has hydration rims ranging from 5.5-8.5 microns.

Table 40. Radiocarbon Data from CA-LAN-192

Lab No.	Provenience	Material Type	Sample Size (g) ^a	Processing Method	Radiocarbon Years (B.P.) ^b	Calibrated Intercept	Calibrated Range (2 sigma)	^{12/13} C Ratio	Reservoir Correction Value
Beta 212904	2005 emergency excavation TEU 1; Feature 1a, 10-20 cm (100-110 cmbd)	charcoal	1.1	AMS	350±40	A.D. 1510 A.D. 1600 A.D. 1620	A.D. 1450-1650	-20.9	--
Beta 215484	2005 AE monitoring Unit 05-10-01 Feature 10, 40 cmbd	charcoal	4.89	AMS	520±40	A.D. 1420	A.D. 1320-1340 A.D. 1390-1440	-16.3	--
Beta 215192	2005 AE monitoring Unit 05-08-01 Feature 8, 119 cm	charcoal	1.41	AMS	1200±40	A.D. 810 A.D. 840 A.D. 860	A.D. 710-910 A.D. 920-960	-12.6	--
WSU 4099	1990 Bruce Love Monitoring Feature 1 (Hearth)	soil	circa 95 cmbs	Standard	2420±120				—
WSU 4098	1968 UCLA Burial	bone	—	Standard	2720±70				—
Beta 217029	2005 emergency excavation TEU 1, 120-130 cmbs	<i>Olivella</i> shell bead (Type A1- simple spire lopped)	.4	AMS	3900±40	1630 B.C.	1740-1510 B.C.	+1.5	225±35

a - Sample size before pretreatment by Beta Analytic, Inc.

b - Radiocarbon years are adjusted for C13/C14.

c - cmbs = centimeters below surface.

Although we have only 2 Pinto points, the hydration data indicate a robust pre-Gypsum component (or components) with multiple rims in excess of 10 microns. We have one radiocarbon date of 3900 B.P. which may date the upper limit of that component.

At the late prehistoric end of the sequence, we have a well-defined Rose Spring/Saratoga Spring component with hydration rims ranging from 2.5-5 microns and a radiocarbon date of 1200 BP. The southwestern ceramic wares also originated during this period. An even later prehistoric/protohistoric component features Desert Brownware ceramics and a radiocarbon date of 350 BP; glass and needle-drilled Olivella beads bring us into historical times. We also know that native people were living at the site into the 1870s.

It is rather remarkable, given the amount of scientific attention and excavation that the Lovejoy site has drawn, that the entire projectile point inventory is limited to just 32 typable specimens. One can only assume, given the enormous collection of other artifacts - predominantly milling equipment and shell beads - that the procurement of large game was a rather minor component and of limited importance with respect to other cultural activities conducted at the site. It is tempting to suggest that hunting increased in importance during the last 700-800 years of site occupation, given the dominance of Cottonwood points in the collection. However, this may be a result of sampling bias since virtually all of the projectile points in the collection came from the earliest surface collections made by amateurs between the 1920s and 1950s.

However, there is still much to be learned from this relatively small collection of points. Claude Warren (1984:423-424, 426) first observed that Desert Side-notched points become less frequent as one moves south from the Owens Valley and out of the Numic heartland into the Mojave Desert. Mark Sutton (1988) subsequently corroborated that observation. More recently, Mike Delacorte (1995) argued that Desert side-notched points may be distinctive marker artifacts of Numic groups, and their age and distribution tracks Numic population movement out from a homeland in the Owens Valley less than a thousand years ago. This pattern of infrequent occurrence of Desert Side-notched projectiles in the historic territories of Tatic-speaking Uto-aztec groups is strongly supported in the current sample, with only one Desert Side-notched point and 16 Cottonwood specimens in the assemblage.

Our ceramic data corroborates the evidence for a significant late prehistoric ethnic boundary somewhere to the north of Lovejoy Springs, and suggests that differences in ceramic wares may also serve as a regional ethnic marker. No brownwares from the Owens Valley or the Great Basin were detected in the Lovejoy ceramic sample. Eerkins' recent studies of Owens Valley Brown Ware suggest ceramics may have been present in the valley as early as A.D. 1300, with widespread local manufacture at the individual or family level by A.D. 1450 (Eerkins 2003:20). Conversely, Southern California Brownware is common at Lovejoy, and also is found in the Transverse Ranges as early as A.D. 600-799, in coastal southern California villages ca. A.D. 1000, and widespread throughout San Diego County by A.D. 1450 (Griset 1996).

Both of these wares were manufactured using the coil-and-scrape technique to shape the pots and have distinctive wiped surfaces. We suggest that the Utoaztecan ancestors of the Takic and Numic people brought ceramic technology with them to the Mojave Desert from the Southwest or northern Mexico shortly after A.D. 500. When the two linguistic groups diverged their ceramic traditions evolved separately to become two distinct wares, perhaps based on differences in materials available in the different territories rather than differences in technology of manufacture.

One of the favorite pastimes of archaeologists attempting to assign dates to their sites is to assign absolute dates to obsidian hydration rim widths. To assist in this endeavor, several rate conversion formulae have been proposed over the years to translate rim widths to absolute dates. However, we are now become aware of the shortcomings and challenges of attaching a specific date to a hydration measurement (cf. Gilreath 2000). Rather than converting hydration measurements to ages and dates using a specific equation, some researchers now chose to identify ranges of rim widths corresponding to the cultural divisions or chronological periods recognized in the local eastern California prehistoric sequence. One such hydration-linked cultural sequence developed for the Owens Valley is shown below, with a proposed Lovejoy modification to account for the difference in Effective Hydration Temperature between the Owens and Antelope valleys. One obvious shortcoming of this sequence is that the “hinge points” between cultural components do not match the actual hydration ranges identified at Lovejoy based on 74 rim measurements. Thus, it becomes apparent that additional work is needed to link specific ranges of hydration rim widths with regional cultural complexes and to place these complexes in absolute time.

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