

Terminal Pleistocene—Early Holocene Occupations on the Eastern Shoreline of China Lake, California

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Abstract

This paper summarizes the results of a data recovery program and geomorphological study at two Lake Mohave occupation sites on the eastern shore of China Lake, at the Naval Air Weapons Station (NAWS) outside Ridgecrest, California (Giambastiani 2008a). The sites described herein, numbers SBR-12869 and SBR-12870, were identified in 2006 and subjected to testing and data recovery excavation in 2007. They are located on the eastern edge of China Lake flanking a prominent shoreline feature that is situated at 2,180 feet elevation above mean sea level (amsl). This feature was formed by a high stand of pluvial Lake China sometime during the terminal Pleistocene or early Holocene, its exact age presently is unknown.

Introduction

The current effort is one of several recent studies in eastern California that have increased our breadth of knowledge about the terminal Pleistocene-early Holocene archaeological record of the northern Mojave Desert. Research in Death Valley (Giambastiani et al. 2005) and at China Lake (Basgall 2004, 2007; Giambastiani 2006a, 2006b, 2008a; Giambastiani et al. 2006; Rosenthal, Carpenter, and Young 2001) has improved our understanding of the settlement ranges and mobility, subsistence strategies, and technological signatures of Lake Mohave times (ca. 11000–7500 BP). Results of these studies are remarkably similar

to those obtained from other parts of the Mojave Desert, lending support to the idea that early human groups in eastern California had an adaptive system that was pervasive across the desert region.

Ultimately, this research provides insight to the nature and timing of Lake Mohave adaptations in the China Lake basin, in eastern California, and beyond. Few stemmed point sites in the Mojave Desert have yielded an artifact assemblage as large and varied as that from SBR-12869, and there is much to be learned from this site regarding the adaptive strategies of some of the earliest occupants in the region. This short treatise cannot do justice to all of the valuable data obtained from subject sites, but it does cover the highlights of what was clearly a major habitation area during Lake Mohave times.

Lake Mohave Archaeology

Named for a group of sites found along the shores of pluvial Lake Mohave (Silver and Soda Lake playas) near Baker, California (Campbell et al. 1937), the Lake Mohave complex was noted by early researchers to contain a range of large stemmed points, flaked stone crescents, steep-sided and formalized unifaces, and various core-cobble tools.

Related assemblages were recognized throughout southern California, referred to as the “Playa” complex (Rogers 1939, 1966), “San Dieguito” complex (Warren 1967, Warren and True 1961), or simply “Lake Mohave” (Wallace 1962). In the eastern Sierra, long-standing claims for Lake Mohave sites on the shores of Owens Lake have yet to be substantiated (Antevs 1952, Campbell 1949) but there is good evidence of such remains in early studies at Coso Junction (Borden 1971), Little Lake (Harrington 1957), Panamint Valley (Davis 1970, Davis, Brott, and Weide 1969), Death Valley (Hunt 1960), and China Lake (Davis 1978). As in other parts of the Great Basin (e.g. Bedwell 1970), repeated discoveries of stemmed point sites alongside extinct lakes convinced early researchers that Lake Mohave adaptations were lacustrine-based, even lacking any obvious technological links between artifacts and lakeshore resources.

More contemporary studies of Lake Mohave sites have occurred mainly in the central and western Mojave Desert, at the Fort Irwin National Training Center (Basgall 1993, 2000; Basgall and Hall 1993; Hall 1993; Jenkins 1991; Warren 1991), Edwards Air Force Base (Basgall and Overly 2004, Giambastiani et al. 2006), and the Marine Corps facility at Twentynine Palms (Basgall 2005, Obermayr and Zeanah 1998). The identification of sites in a variety of settings away from lakeshores has dispelled the myth of a lacustrine focus, with new studies working toward a better understanding of settlement systems, lithic technologies, and tool-stone procurement strategies during Lake Mohave times.

Lake Mohave Adaptations

While there have been claims that Lake Mohave and other Western Stemmed point complexes in the Great Basin date as early as 12000 BP (Bryan 1979, 1980; Warren and Crabtree 1986), it is generally

accepted that such manifestations are not much older than about 11000–10000 BP (Basgall 1993, 2000; Beck and Jones 1997; Jones and Beck 1999; Madsen 2007) and may have persisted until about 7500 BP (Basgall 2000).

In short, what we know of Lake Mohave adaptations is that human populations were low, residential mobility was high, and settlement systems involved long-distance shifts in accordance with seasonal resource abundance (Basgall 1993, Grayson 1993, Jones and Beck 1999, Warren 1984, Willig and Aikens 1988). Across the Great Basin, Western Stemmed people were generalized foragers, exploiting both animal and plant resources in a variety of habitats. Dietary fauna were mostly small mammals, especially lagomorphs, but with a wide range of others as well (Basgall and Hall 1993; Douglas, Jenkins, and Warren 1988; Hockett 2007). Plants may have been primarily marshland taxa (Madsen 2007), but in the Mojave Desert the use of dryland seeds is also implied by the limited but regular presence of ground stone tools. Mojavean sites show the primary use of fine-grained volcanic stones in the production of flaked stone tools (e.g., obsidian, basalt, rhyolite), but with a preference for cryptocrystallines in making certain kinds of implements.

The Paleohydrology of Lake China

During the late Pleistocene (ca. 50000-10000 BP) the Owens River drainage system contained seven interconnected lakes that extended hundreds of linear miles across eastern California, from Mono Lake (pluvial Lake Russell) to Death Valley (pluvial Lake Manly). China Lake (pluvial Lake China) was the fourth in succession, fed by drainage from Owens Lake when it reached a depth of 200 feet. China Lake occupies a shallow basin, and when filled to a depth of only 33 feet, or an elevation of 2,180 feet, it then emptied into the much deeper

Searles Lake basin. When Searles Lake filled to a depth of 564 feet, it constituted a mega-lake that spanned both the China Lake and Searles Lake basins (pluvial Lake Searles). Dates for the last Pleistocene high stand of Lake Searles are in debate, but consensus places the event no earlier than about 13000 years ago (Benson et al. 1990; Dorn et al. 1990; Smith 1976, 1979, 1984; Smith and Street-Perrott 1983).

Contemporary studies by Rosenthal, Carpenter, and Young (2001) and Basgall (2007) have laid the groundwork for a reconstruction of the past hydrology at pluvial Lake China. Based on the Owens Lake (Benson and Bischoff 1993) and Searles Lake (Benson et al. 1990) records, Rosenthal, Carpenter, and Young (2001) have argued that pluvial Lake China saw a dramatic recession between 14000 and 13000 BP. They also believe it may have reached overflow capacity twice since the final high stand of Lake Searles, once between 12700 and 11700 BP and again during the Younger-Dryas event (ca. 10900–10500 BP). Just prior to the Younger-Dryas event, however, there may have been a major regression between 11300 and 11000 BP at the time of an inferred “Clovis Drought” (Haynes 1991; Warren 2000). The lake finally receded after the Younger-Dryas pluvial, remaining low or dry throughout the Holocene (Benson et al. 1990). Rosenthal, Carpenter, and Young (2001:70-71) also claim that the 2,185-foot shoreline at China Lake (represented by the 2,180-foot terrace at SBR-12869 and SBR-12870) dates to the Younger-Dryas episode, contrasting previous opinions that the final Lake Searles high stand created the shoreline feature around 13000 years ago. Drawing from work by Bacon et al. (2006) at Owens Lake, Basgall (2007) suggests the last time Owens Lake exceeded its outflow sill level (and thus contributed water to Lake China) was around 12800 BP, and that it never came close to overflowing afterward. He also states “This makes the inferred overflow events at

11700–12700 BP and 10000–10900 BP (Younger-Dryas) extremely unlikely” (Basgall 2007:149) and that any transgressions at Lake China or Searles Lake after ca. 12800 BP probably created lower lake stands than suggested by Rosenthal, Carpenter, and Young (2001).

The Study Sites

Site SBR-12869 is located right on the eastern shoreline of China Lake (Fig. 1). It is essentially a surface deposit, artifacts spread widely across a 350-meter long, north-south axis and covering a partially vegetated, alkali lakebed margin that is mantled in places with thin aeolian sediments. The main body of the site lies at 2,170 feet elevation and spans a shallow, nearly imperceptible embayment that is adjacent to but just below the 2,180-foot shoreline terrace. At the far south end of the site, still some distance from the contiguous lakebed, is a series of shallow “playettes” that are rimmed by low dunes. Many of these small basins contain residual artifact assemblages that accumulated as surrounding dunes have developed. For the most part, spatial artifact distributions at SBR-12869 are homogenous and show no real variation between different artifact types (Fig. 1). While it is possible that minor shifts in the selection of camp location could be partly responsible for the elongate distribution of artifacts at SBR-12869, we suspect this is due mainly to natural processes, artifact-bearing surfaces having been repeatedly deflated and rebuilt over several millennia during periods of lake fluctuation. In fact, the north-south alignment of the site deposit probably reflects a southward “drag” of surface artifacts created by numerous episodes of lake recession.

SBR-12870 is situated atop the 2,180-foot shoreline terrace and overlooks SBR-12869. The terrace surface is composed of loose, shallow sand and is covered with moderately dense scrub vegetation. The



Fig. 1. SBR-12869 and SBR-12870 with plots for selected tool types at SBR-12869.

site is fairly small (75 by 50 meter) and contained a sparse deposit of flaked and ground stone artifacts spread about in no particular concentration. Only two artifacts of note were found, a Lake Mohave point and a millingstone, though a sample of obsidian flakes for sourcing and hydration analysis was also recovered. Landscapes in the immediate vicin-

ity of both sites are toolstone-poor. A mile or so to the southeast, however, are a variety of alluvial cobble deposits extending from the southern Argus Range all the way down to the edge of the China Lake playa. Large quantities of good quality felsite and other fine-grained volcanic stones are available in cobble form along the shoreline. These lithics

are suited to flaked stone production and for use as ground and battered stone tools, judging by their abundance in site assemblages.

The SBR-12869 Assemblage

Recovery efforts at SBR-12869 yielded a massive collection of materials that includes 139 stemmed projectile points, five crescents, 184 bifaces, 77 biface blanks and “uniface-Bs,” 156 formed flake tools, several drills, graters, and perforators, 28 cores and core tools, two millings, nearly a dozen battered stones, more than 6,000 pieces of debitage, and a handful of other items. Unfortunately, the long-term effects of sandblasting have compromised the surfaces of almost every artifact. Even those recovered from shallow depths show enough erosion to indicate they have not been buried very long. Damage is most extensive on obsidian items, many having been reduced to smooth, rounded outlines that lack details of percussion scarring.

Projectile Points

A collection of 65 Lake Mohave points includes mostly obsidian (n=49) but also rhyolite, basalt, and felsite specimens. Complete length measurements range from 32.3 to 46.2 millimeters (mean 37.6 millimeters) and full stem lengths vary between 15.5 and 28.6 millimeters (mean 20.9 millimeters). Rhyolite forms tend to be largest, obsidian points being relatively short, narrow, and thin (Fig. 2). Many finished Lake Mohave points were imported to the site and discarded in the course of re-tooling, while others were broken and rejected during production. Silver Lake points (Fig. 3) are also mostly obsidian, all of them with more pronounced shoulders than Lake Mohave forms, either convex-rounded or squarish bases, and short stems. A few show evidence of reworking but most were broken and discarded in the course of manufacturing. Another 55 Great Basin stemmed series points remain unclassified to temporal type due to fragmentation and weathering, but their basic sizes and morphology indicate that most are broken Lake Mohave points. Sandblasting has removed any traces of use-wear

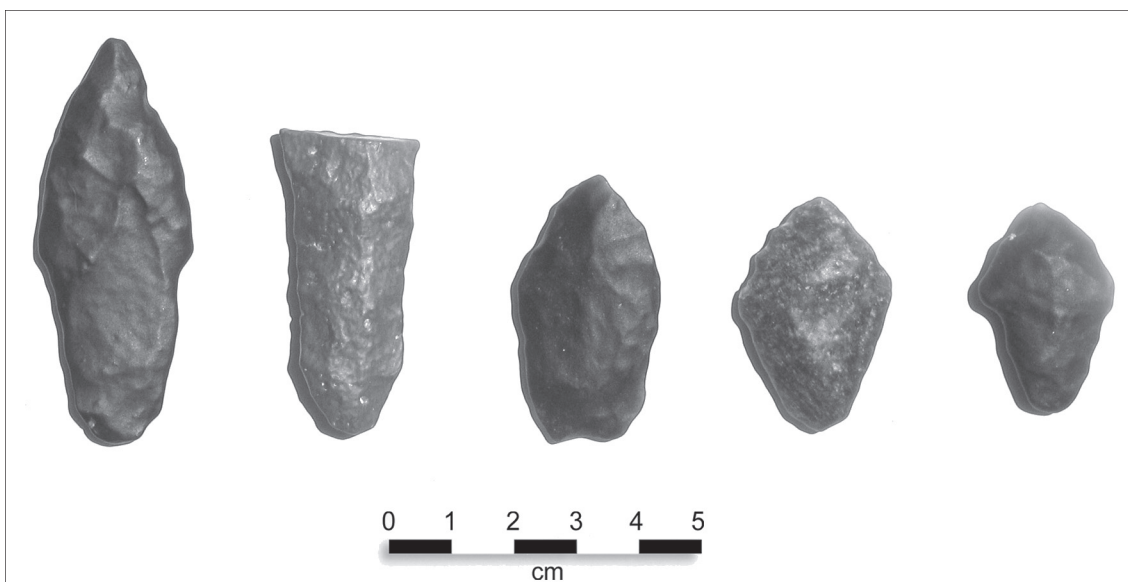


Fig. 2. Lake Mohave projectile points from SBR-12869 and SBR-12870.

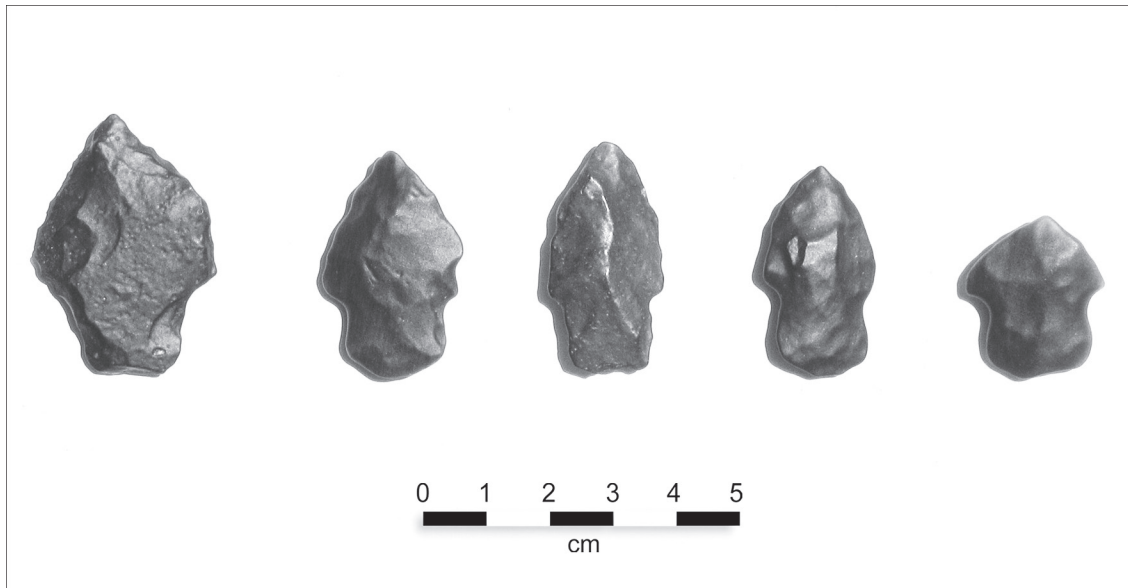


Fig. 3. Silver Lake projectile points from SBR-12869.

we might anticipate on the blades or stems of these artifacts.

Crescents

Five flaked stone crescents were recovered, all of them cryptocrystalline except one of obsidian.

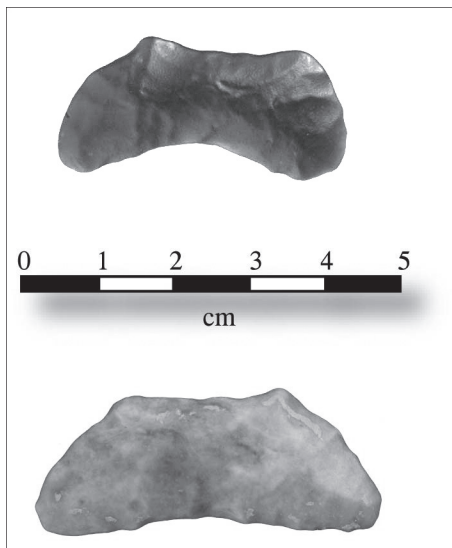


Fig. 4. Crescents from SBR-12869.

Full metrics range between 38.2 and 47.7 millimeters in length, 18-20.9 millimeters in width, and 5-8.3 millimeters in thickness. All specimens are classified as “biconcave lunate” (Rogers 1966), “butterfly” (Tadlock 1966, Type III), or “bow-tie” subtypes, having one convex lateral margin with a flat or slightly concave back and an opposing, fully concave margin. Two specimens are particularly well-shaped, one of obsidian and one of cryptocrystalline (Fig. 4), but none show any evidence of edge grinding (Hutchinson 1988) or hafting (Amick 1999, Hattori 1982) due to the effects of erosional damage.

Bifaces, Biface Blanks, and “Uniface-Bs”

Bifaces from SBR-12869 are by-products of stemmed point manufacturing, most being obsidian and consisting mainly of small, early-stage reduction forms. There is little evidence of reworking in the biface sample, and good quantities of margin and medial fragments are demonstrative of breakage during production. Biface blanks and uniface-

Bs reflect the use of local felsite and basalt. Often referred to as “bifacial cores,” biface blanks are common to cobble quarry sites across the Mojave Desert (Bamforth 1992; Binning et al. 1986; Flenniken, Williams, and Rasie 2001; Giambastiani 2004, 2006; Lerch and Yohe 1996) and represent the first step in the production of shaped bifacial preforms. Various “uniface-Bs,” as described by Gilreath and Hildebrandt (1997) at the Coso Volcanic Field, are unifacially worked blanks that belong to a bifacial reduction trajectory. At SBR-12869 they are of comparable size to bifacial blanks (larger than standard bifaces) and are considered part of the same production line. Whether a biface blank or uniface-B was made from a particular cobble depended on the size and shape of the parent mass or the flake blanks detached from it.

Formed Flake Tools

The collection of formed flake tools from SBR-12869 constitutes the most varied and interesting of all artifact classes in the assemblage. Drawing from Rogers (1939, 1966) but following Basgall (2007), these tools include “plano-convex,” “keeled,” “end-modified,” and “side-modified” forms. The most

distinctive is the plano-convex type (aka “turtle-backs,” “discoidals,” or “domed scrapers”), specimens being circular in outline, having flat ventral surfaces and rounded dorsal ones, and often retaining some portion of the original flake platform (Fig. 5). This kind of tool is common in Lake Mohave assemblages (Basgall 1993, 2000; Warren 1984) and shows basic similarities to hafted woodworking adzes in arid Australia (Gould 1977, 1980; Hiscock 1988; Hiscock and Veth 1991). Cryptocrystalline stone is dominant among all formed flake tools. This may be a “hallmark” of Lake Mohave (and Pinto) sites, demonstrated repeatedly at Fort Irwin (Basgall 1993, 2000; Basgall and Hall 1993), China Lake (Davis 1978; Basgall 2004, 2007), and other places where such lithics are not locally abundant. Paralleling inferences by Goodyear (1979), the occupants of SBR-12869 preferred cryptocrystallines in making formed flake tools, all but ignoring large quantities of nearby felsite.

Core Tools

Whereas cores from SBR-12869 are highly variable in morphology and were produced by several different reduction strategies, core tools are more



Fig. 5. Plano-convex formed flake tools from SBR-12869.

consistent in form. Most of them are large, well-flaked unifacial forms (Fig. 6) similar to Amsden's (1937:Plate 27) "keeled scrapers," Rogers' (1939) "scraper planes," and various "horse hoof cores" found throughout the Australian deserts (McCarthy 1976, Mulvaney 1969, Mulvaney and Kamminga 1999). Shaped margins on core tools are heavily edge-flaked and/or battered, and some tools show hints of former grinding facets on their flat ventral faces. These implements probably served in heavy-duty planing, chopping, or smoothing tasks involving materials like wood or bone (Basgall 1993, Giambastiani 2008b).

Debitage

A sample of more than 2,500 flakes was analyzed for technological attributes. Basic size breakdowns show a rarity of small flakes and an abundance of medium-size flakes, large flakes being common only among felsite debris. Shares of diagnostic flake types mirror these patterns; most materials have good quantities of late-stage reduction debris while felsite has a much larger fraction of cortical waste. Technological profiles for obsidian, cryptocrystal-

line, basalt, and rhyolite are indicative of imported lithics brought to the site in pre-decorticated form (as shaped and finished tools). The felsite profile is typical of a local toolstone that was minimally reduced (if at all) prior to arrival at SBR-12869.

Assemblage Summary

In many ways, the flaked stone assemblage recovered from SBR-12869 is similar to those from Lake Mohave sites in Nelson Basin (Basgall 1993). It constitutes a mix of late-stage reduction debris generated by the discard and manufacture of stemmed points (the latter from imported obsidian bifaces and flake blanks) and early-stage workshop debris produced by the manufacture of large bifacial blanks (including uniface-Bs), cores, and core tools (mainly from raw, locally procured felsite); at Nelson Basin, local basalt supported the bulk of biface production rather than felsite. Formed flake tools make up a large part of the SBR-12869 tool assemblage, being second in number only to bifaces, and are made primarily with cryptocrystal-line materials but also with felsite. Nelson Basin assemblages show a nearly identical pattern (Basgall



Fig. 6. Unifacial core tool from SBR-12869.

1993:312), again substituting basalt for felsite. The great number of tools recovered from SBR-12869, added to those still remaining, implies the site represents an accumulation of many short-term occupations at the same location. The sheer quantity of flaking debris shows that stoneworking was paramount during most, if not all, episodes of site use.

Dating the Occupations

At present, both SBR-12869 and SBR-12870 are dated strictly by the inferred ages of Lake Mohave and Silver Lake points and crescents and by a small group of obsidian hydration data. The outcome of geomorphological trenching has provided fuel for speculation about site ages, but samples for thermoluminescence dating that would help anchor a chronology for past lake fluctuations are under analysis and their results not yet available. For certain, a clear understanding of past lake hydrology will be

paramount in determining if the study sites reflect late Pleistocene or early Holocene occupations.

Obsidian Sourcing and Hydration

A sample of 126 obsidian artifacts from SBR-12869 and SBR-12870 returned usable X-ray fluorescence (XRF) sourcing data (Table 1). Traced artifacts derive mainly from the Coso Volcanic Field (86 percent) and the West Sugarloaf subsurface, specifically (49 percent of the total). The Coso Volcanic Field is the nearest obsidian source in the region, situated 20–25 miles to the north. Eight other, distant obsidians are represented in the remaining sample. Most hail from the Inyo-Mono Region north of the study area: Fish Lake Valley, Nevada (~145 miles); Casa Diablo (Lookout Mountain and Sawmill Ridge subsources, ~140 miles); Fish Springs (~80 miles); and Saline Range (Queen Impostor subsurface, ~45 miles). The others are located in western Nevada,

Table 1. Obsidian XRF results by artifact type.

	Lake Mohave	Silver Lake	Unclassified Stemmed	Crescent	Biface	Flake	Total
Coso Volcanic Field							
Joshua Ridge	1	1	1	1		18	22
Sugarloaf Mountain	6	2	1			4	13
West Cactus Peak	3	1	1			1	6
West Sugarloaf	29	2	3			28	62
Undifferentiated			1		1	3	5
Fish Lake Valley		1					1
Casa Diablo							
Lookout Mountain		1					1
Sawmill Ridge	1						1
Undifferentiated		1					1
Fish Springs	1						1
Saline Range	1						1
Obsidian Butte, NV		1					1
Split Ridge, NV			1				1
Montezuma Range, NV			1				1
Unknown	4	1	1			3	9
Total	46	11	10	1	1	57	126

one in the Montezuma Range west of Goldfield (~125 miles) and two in the vicinity of Pahute Mesa, Obsidian Butte (~115 miles) and Split Ridge (also known as Oak Spring Butte, ~150 miles). The presence of “exotic” obsidians is not unexpected in early Holocene point assemblages (Basgall 1988, 1989; Giambastiani 2004; Giambastiani et al. 2005; Johnson and Haarklau 2005) and speaks to the use of extensive settlement ranges by Lake Mohave populations.

More importantly perhaps, 19 artifacts traced to the Coso Volcanic Field were amenable to obsidian hydration analysis. Because of artifact erosion, we could not select a sample of projectile points or other artifacts that would provide a better temporal data set. In the interest of obtaining some form of

artifact dating, we were also forced to use a slightly unconventional hydration technique. Basically, any and all artifacts were selected that displayed prominent step-fractures on tool faces, such terminations often harboring sheltered fracture planes that remain unweathered by sandblasting. This is a fairly new technique, but as our data indicate it is one that shows great promise.

Resulting hydration data for SBR-12869 and SBR-12870 are presented in Table 2. Mean rim values show a range between 12.1 and 19.9 microns. However, excluding the 19.9 micron value (Chauvenet’s criterion [$S(d/\Phi) = 3.34$]) the means vary only from 12.1 to 16.5 microns and their range for SBR-12870 is even smaller, between 15.1–16.5 microns.

Table 2. Summary Obsidian Hydration Data.

Site	Artifact Type	XRF Source	Hydration Mean (microns)	Standard Deviation (microns)	Coefficient of Variation	
SBR-12869	Flake	Coso – Joshua Ridge	15.5	0.06	0.4%	
	Flake	Coso – Joshua Ridge	12.1	0.10	0.8%	
	Flake	Coso – Sugarloaf Mt.	16.1	0.07	0.4%	
	Flake	Coso – West Sugarloaf	16.0	0.08	0.5%	
	Flake	Coso – West Sugarloaf	16.0	0.05	0.3%	
	Flake	Coso – West Sugarloaf	15.9	0.09	0.6%	
	Flake	Coso – West Sugarloaf	15.1	0.06	0.4%	
	Flake	Coso – West Sugarloaf	15.0	0.11	0.7%	
	Flake	Coso – West Sugarloaf	14.9	0.08	0.5%	
	Flake	Coso – West Sugarloaf	14.1	0.07	0.5%	
	Flake	Coso – West Sugarloaf	13.5	0.04	0.3%	
	SBR-12870	Flake	Coso – Joshua Ridge	16.5	0.04	0.2%
		Flake	Coso – Joshua Ridge	16.1	0.12	0.7%
Flake		Coso – Joshua Ridge	15.5	0.05	0.3%	
Flake		Coso – Joshua Ridge	15.4	0.08	0.5%	
Flake		Coso – Joshua Ridge	15.2	0.04	0.3%	
Flake		Coso – Joshua Ridge	15.1	0.09	0.6%	
Flake		Coso – Joshua Ridge	15.0	0.09	0.6%	
Flake		Coso – West Sugarloaf	19.9	0.06	0.3%	
Summary Data (excluding outlier 19.9)			15.2	1.06	6.9%	

Caution is merited in interpreting these data, given the nature of the hydration rims measured, but if we accept that readings depict episodes of manufacture and not post-depositional breakage it is possible to roughly estimate the ages of subject sites. In translating Coso obsidian hydration measurements to calendrical ages, we have typically assumed that the various Coso sub-sources do not hydrate at significantly different rates (Eerikens and Rosenthal 2004, Gilreath and Hildebrandt 1997, but see Fredrickson et al. 2006) and, with corrections made for differences in effective temperature, have applied two hydration rate formulae to the data (Basgall 1990; King 2000). As Basgall (1990, 1993, 1995, 2007) has often stressed, however, his rate was designed with a late Holocene data set and is inaccurate at greater time depth. The same is evident with King's (2000) rate, and attempts to use either one in converting Coso rim values to ages have yielded unsatisfactory results when dealing with assemblages that pre-date the middle Holocene (Basgall 1990; Basgall and Overly 2004; Giambastiani and Basgall 2000; King 2000; Rosenthal, Carpenter, and Young 2001).

For this reason, Gilreath and Hildebrandt (1997), Rosenthal, Carpenter, and Young (2001), and Basgall (2007:109) have defined sets of micron ranges for Coso obsidian to represent general time periods rather than calculating artifact-specific age estimates. Based strictly on data from China Lake, Basgall (2007) has offered the following correspondence between micron ranges and accepted temporal intervals: Marana period, 700–150 BP (<4.2 microns); Haiwee period, 1400–700 BP (5.6–4.2 microns); Newberry period, 3200–1400 BP (8.7–5.6 microns); middle Holocene, 7000–3200 BP (11.4–8.7 microns); early Holocene, 10000–7000 BP (14.2–11.4 microns); late Pleistocene, pre-10000 BP (>14.2 microns). Current hydration data fall strictly within the two earliest micron ranges, most in the late Pleistocene range (n=16) and the rest in

the early Holocene range (n=3). At the very least, measurements on artifacts from SBR-12869 and SBR-12870 appear to reflect terminal Pleistocene/early Holocene ages.

Obviously, there are certain caveats to be taken when considering the impact of these data. The sample is small and derives from only two sites; results were obtained from a single analyst using a non-standard technique; and the measure used to estimate age may be cruder than the direct application of hydration rates. Still, the consistency of the data is intriguing, and even if grossly accurate they imply that Lake Mohave occupations at SBR-12869 and SBR-12870 were made prior to and/or during the Younger-Dryas event (ca. 11,000 to 10,500 BP). If prior, site occupations would correlate with the "Clovis Drought" (Haynes 1991, Warren 2000) and might have been commensurate with a period of decreased lake levels in the China Lake basin. Either way the data are suggestive of a greater age for Lake Mohave assemblages than is normally conceived.

Geomorphological Trenching

Two backhoe trenches were excavated at SBR-12869 and SBR-12870 in an attempt to discern the relative ages of site deposits and the relationships of the sites to the shoreline terrace. One was dug into the surface of the playa at SBR-12869 (Trench 3) and the other cut into the face of the shoreline terrace just below the main body of SBR-12870 (Trench 2). At SBR-12869, Trench 3 exposed layers of lacustrine sand laid down during Holocene high stands and episodes of aeolian redeposition as China Lake receded toward the south. Attributes of certain strata, and of the overall profile, reflect the reworking of sediments by aeolian and lacustrine processes in a nearshore or onshore environment and are consistent with the presence of low energy, shallow water conditions normally found in such

contexts. Ultimately, the stratigraphic sequence in Trench 3 shows that the cultural deposit at SBR-12869 rests atop sediments that were continually reworked during the Holocene. They imply that Holocene transgressions of China Lake reached no higher than the north end of the site, but that recessional events could still have been responsible for transporting artifacts considerable distances to the south.

In Trench 2, exposed stratigraphy shows several units of massive fine to coarse sand and pebbly sand, with distinct, localized areas of planar and cross-bedded sand (Fig. 7). Two well-defined beach ridges are evident but there is no evidence of long-term, stabilized surfaces or strongly developed soils. The beach ridges, designated Unit 4 and Unit 2, probably represent constructional beaches formed during fluctuations in levels of China Lake.

The upper ridge, Unit 4, has attributes that imply it was formed during a decline in lake level, one that followed a rapid rise to a higher stand with a shoreline farther north of the current terrace margin. The lower one, Unit 2, has well expressed graded bedding and represents the depositional crest of a 25 to 30 centimeter-high beach ridge.

Overall, the stratigraphic sequences associated with the beach ridges in Trench 2 are suggestive of a relatively quick but punctuated lake level rise, perhaps to an elevation above 2,180 feet, followed by a rapid decline and southward regression of the lake. Lacking dates for any of the key strata, the origins and ages of the beach ridges cannot yet be explained. The sequence in Trench 2 does, however, fit the picture of the Younger-Dryas episode, as described by Rosenthal, Carpenter, and Young (2001). During this brief interval, Lake China may have at-

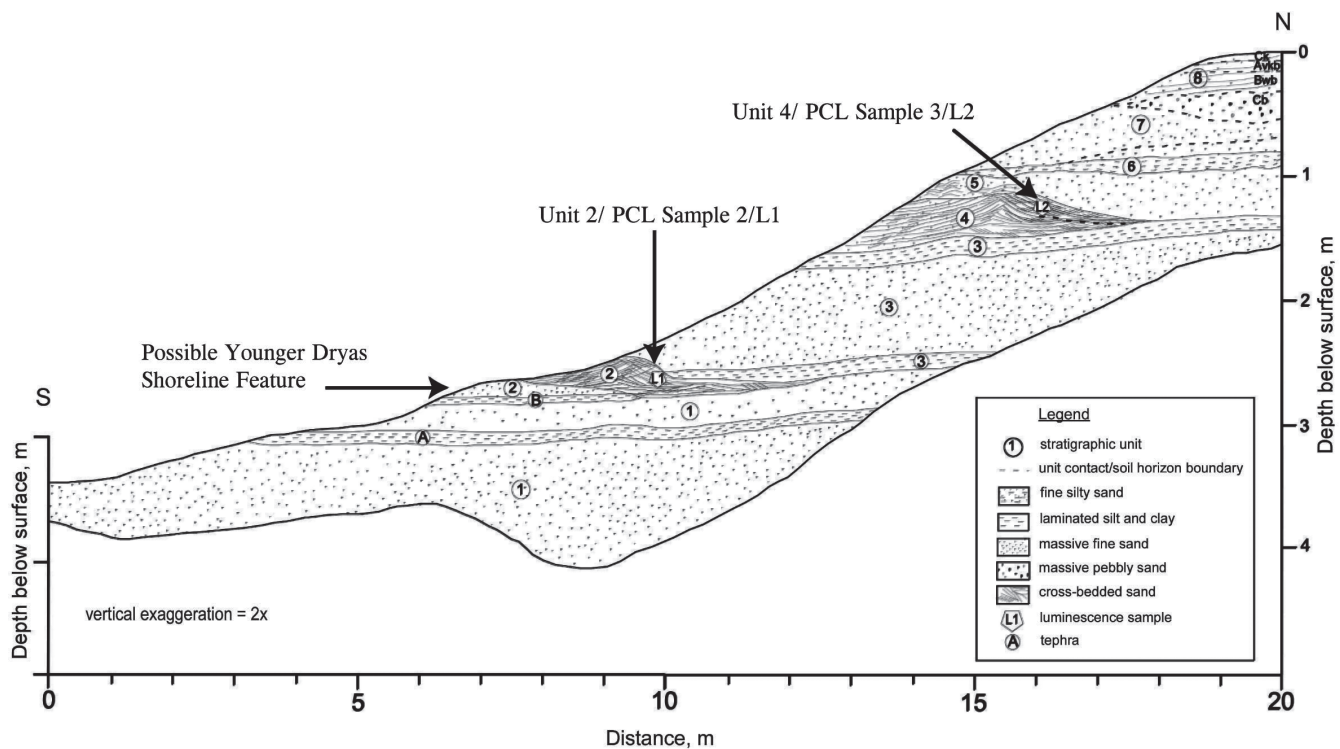


Fig. 7. Trench 2 stratigraphic profile.

tained a stable outflow level of 2,180 feet and contributed water to a rising Lake Searles. The rapid decline of the lake thereafter may have occurred in stages, leaving beach ridges at the elevations of Unit 4 (~ 2,175 feet) and Unit 2 (~ 2,172 feet) as it regressed southward. Rosenthal, Carpenter, and Young (2001) have also argued that Lake China may have reached overflow capacity twice since its final Pleistocene high stand, once between 12700 and 11700 BP and again during the Younger-Dryas event. The two beach ridges could correlate to periods of stalled recession following these high stands. Somewhat less likely, both beaches could have formed during Holocene infilling events. If so, they would represent previously undocumented high stands of China Lake, possibly correlating with mid-Holocene transgressions of Searles Lake (Ramirez de Bryson 2004) and other lakes in eastern California and the Mojave Desert (Bacon et al. 2006; Benson et al. 1990; Enzel et al. 1992; Kuehn 2002; Stine 1990, 1991). Age estimates obtained by thermoluminescence analysis (currently in process) will help generate a basic chronology for the lacustrine events portrayed in the stratigraphic profiles of Trenches 2 and 3.

The Nature, Timing, and Environmental Context of Lake Mohave Adaptations

Although data from most single-site studies have a limited reach, results of our work have archaeological implications that extend far beyond the boundaries of SBR-12869. It is good, and somewhat convenient, that patterns in assemblage composition, manufacturing, and lithic procurement are closely paralleled at other Lake Mohave sites across the desert. In this sense they are suggestive of pan-regional adaptive trends during the Lake Mohave period and imply a cultural continuity that persisted throughout the southwestern Great Basin at least until the end of the early Holocene. Typical artifacts, particularly both long- and short-stemmed

points, crescents, bifaces and biface blanks, formed flake tools, and core tools, are present at SBR-12869 in comparable portions to those seen in Lake Mohave assemblages from Little Lake (Harrington 1957), Death Valley (Hunt 1960), Panamint Valley (Davis 1970), and Fort Irwin (Basgall 1993, Basgall and Hall 1993, Hall 1993). The wide variety of tools and debris at this site is consistent with its use as a residential base where both specialized activities and rudimentary tasks were undertaken.

Technological signatures at SBR-12869 reflect two basic modes of lithic use. One involved the use of imported obsidian and cryptocrystalline, centering on the (late-stage and final) production of stemmed points and on the manufacture and use of various formed flake tools. The other involved local felsite and other igneous stones, and focused on the production of bifacial and unifacial blanks for export and of core tools for on-site use. The regularity of these patterns, as reflected by consistencies in tool morphology and material profiles across the site, also supports the premise that SBR-12869 was a repeatedly used place. Forager groups using the site brought in lithic materials from quite distance sources to the north and east, as expected of a settlement system based on high mobility and wide-ranging movements. That early populations used SBR-12869 on a frequent basis speaks to the importance of this location in a seasonal or annual subsistence round.

In fact, the high degree of settlement centralization implied by the repeated use of SBR-12869 is characteristic of Lake Mohave adaptations and may be related to the predictability of certain subsistence resources and/or raw materials at select locations (Basgall 2000). Rosenthal, Carpenter, and Young (2001) have discussed the potential for the presence of marshland habitats along the shore of Lake China during late Pleistocene-early Holocene times, and SBR-12869 (with its shallow embayment and other

attributes) appears to be a good candidate to have supported such habitats in the ancient past. This is consistent with the premise that late Pleistocene/early Holocene populations were tethered to mesic habitats as part of a broad-spectrum, “limnosedimentary” foraging strategy that favored the use of marshland environments (Madsen 2007). Not as “fixed” as implied by tenets of the Western Pluvial Lakes Tradition, (Bedwell 1973), this subsistence strategy also involved the use of habitats outside marshlands, particularly in seasons when resources in other locations provided better returns or where certain materials (like toolstone) were not available in lakeside contexts. This line of thought returns us again to ponder the ages of site SBR-12869 and SBR-12870, with particular respect to the Clovis Drought and Younger-Dryas episodes. If the sites were occupied during the Clovis Drought, supposedly arid conditions may not have supported any marshes in their vicinity. On the other hand, the Younger-Dryas pluvial may have improved local wetland habitats, both attracting and allowing for the regular and frequent settlement of the area. The differences between sites SBR-12869 and SBR-12870, both in terms of landscape situation and character, could also reflect occupations during very different environmental conditions. Groups may have used SBR-12869 repeatedly over an extended period of mesic climate, when a substantial wetland was present, while the encampment at SBR-12870 might represent a single occupation during a time when local habitats were less productive.

The considerations put forth in this paper have value for interpretations of local and regional settlement strategies and can help us in understanding land-use variability during Lake Mohave times across the desert region. Current research in other parts of the China Lake basin (Basgall 2004, 2007; Rosenthal, Carpenter, and Young 2001) has already gone far in modeling past land-use patterns, but the present (and future) study at SBR-12869 has even

greater potential to improve our understanding of Lake Mohave adaptations, their paleoenvironmental context, and the time frame in which they occurred. The results of geomorphological dating should also be of significance to the study of earlier and later cultural adaptations at China Lake, providing hard data as to the age of various strata in the 2,180-foot shoreline terrace.

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