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Constructing a Regional Historical Context for Terminal Pleistocene/Early Holocene Archaeology of the North-Central Mojave Desert

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Constructing a Regional Historical Context for Terminal Pleistocene/ Early Holocene Archaeology of the North-Central Mojave Desert

Step 1: Paleoenvironmental Landscape Reconstruction

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ABSTRACT

The well-known early archaeology at Naval Air Weapons Station (NAWS) China Lake in east-central California currently lacks strong historical context, making stewardship, determinations of eligibility for the National Register of Historic Places, and management of these cultural resources, as required by Section 110 of the National Historic Preservation Act, a difficult task for all federal agencies. This is in part because the earliest sites are difficult to accurately date within the Terminal Pleistocene or Early Holocene (15,000 to 8,000 years ago). They are also thinly spread over vast tracts of land, leaving the regional context for understanding their significance equally thin and poorly understood.

This study, funded by the Department of Defense Legacy Resource Management Program (Project 07-349, Cooperative Agreement Contract Number W912DY-07-02-0042 [W31RYO72277563]) takes a regional, multi-agency approach to build a strong and comprehensive context by partnering NAWS China Lake with contiguous and nearby federal land-managing agencies in the Mojave Desert, including the Fort Irwin National Training Center (NTC), the National Park Service (Death Valley National Park and Mojave National Preserve), and the Bureau of Land Management (BLM). The project is multi-disciplinary, using a global perspective and paleoenvironmental context. The results are designed to substantially aid National Register determinations of eligibility by identifying current data gaps and systemizing data collection. As such, it will facilitate developing and tailoring future research designs for early site management. By examining sites associated with the earliest occupations in the region, the project will also aid Native Americans, inclusive of designated Tribal Historic Preservation Officers at Mojave Desert Tribes, in understanding their cultural history.

This report presents Step 1 of the study—a paleoenvironmental landscape reconstruction of the Terminal Pleistocene/Early Holocene in the north-central Mojave Desert. Specifically, the investigations focused on the ancient hydrology and geomorphology of the China Lake Basin area, which was once part of the extensive Owens River pluvial lake system that extended from Mono Basin to Death Valley. Situated fully on NAWS China Lake, the basin has the highest concentrations of Terminal Pleistocene/Early Holocene archaeology in the Mojave Desert. As such, it is the ideal setting to investigate the timing and nature of early human settlement in the Mojave Desert and assess how world-wide climatic changes associated with the Pleistocene/Holocene transition impacted early prehistory in western North America.

The extent that ancient lakes and wetland habitats were critical to the earliest occupants of the Mojave Desert remains uncertain and much debated. This is largely because the pluvial history of Lake China remains poorly understood, inferred mainly from lacustrine records obtained from nearby contexts such as Owens and Searles lakes. The current study gathered new, independent geological data directly from the China Lake Basin environs to reconstruct the Terminal Pleistocene and Early Holocene paleoenvironment. This included previously undocumented geologic stratigraphic records of the Pleistocene/Holocene transition in local washes emanating from the adjacent Sierra Nevada, inflow records along the Owens River channel leading to China Lake, within the China Lake Basin itself, and at the China Lake overflow channel.

Step 1 of the project—reconstructing the paleoenvironment during the Pleistocene/Holocene transition (15,000-8000 cal BP)—was an unqualified success and provides a firm foundation for creating a strong historical context for the early archaeological sites in this region (which will be carried out in Step 2 of the project). This new paleoenvironmental reconstruction provides a strong and compelling three-stage geomorphic and hydrological transition between 15,000 and 8,000 years that documents the demise of pluvial conditions and the deterioration in effective moisture. Pleistocene pluvial lake levels declined and China Lake and Searles lake basins became hydrologically separated by ~13,400 cal BP. China Lake, however, persisted until just after 13,000 cal BP. Subsequently, localized wetland habitats flourished as high groundwater levels and spring discharge continued to deliver surface flows to local washes and the China Lake Basin area. These wetland habitats largely disappeared by ~9000 cal BP as groundwater levels dropped, and alluvial fan deposition increased. This newly developed hydrological record from the NAWS China Lake area facilitates better understanding of the greater Mojave Desert and southwestern Great Basin, indicating that region-wide climatic shifts from the Terminal Pleistocene through the Early Holocene were responsible for these patterns. The timing of these changes coincides well with

evidence from Greenland ice cores, demonstrating that geomorphic changes in the Mojave Desert during the Pleistocene/Holocene transition represent threshold responses to world-wide climate change.

As such, these results provide a firm foundation for conducting Step 2 and successfully completing the overall project objectives. This entails creating a strong historical context for understanding the archaeology of the Terminal Pleistocene and Early Holocene. This will strengthen stewardship, provide a consistent and rigorous basis for determinations of eligibility for the National Register of Historic Places, and greatly assist in the management of these cultural resources, as required by Section 110 of the National Historic Preservation Act.

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A number of individuals provided important support and assistance in making the project a success. Without the hard work and persistence of Michael Baskerville (Cultural Resources Manager, NAWS China Lake) and Kish LaPierre (Cultural Resources staff, NAWS China Lake) this project would not have been possible. They were instrumental in obtaining environmental and Explosive Ordnance Disposal (EOD) clearance to explore the installation's geomorphology and to conduct paleoenvironmental coring on the installation. We also greatly appreciate Rod Snodgrass at EOD for providing us with safe passage to various locations on the installation. Russell Kaldenberg (prior Cultural Resources Manager, NAWS China Lake) played an important role in ensuring the project proposal was well-supported. Robert Couch (Applied Research Associates) graciously provided copies of core logs as well as other information regarding cores he had obtain previously in the China Lake Basin. We also appreciate and thank US Geological Survey geologist, Angela Jayko, for sharing field notes and radiocarbon dates from the Rose Valley area.

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1. INTRODUCTION

This multi disciplinary project is designed to provide a new historical context for the poorly understood Terminal Pleistocene/Early Holocene archaeology in the Mojave Desert of east-central California. The project is funded by the Department of Defense (DoD) Legacy Resource Management Program (Project 07-349, Cooperative Agreement Contract No. W912DY-07-02-0042[W31RYO72277563]). The study was administered by the US Department of the Army Corps of Engineers, Engineering and Support Center; managed by the DoD Legacy Resource Management Program; and carried out by Far Western Anthropological Research Group. The aim of the Legacy Resource Management Program is to provide resources for protecting, enhancing, and conserving natural and cultural resources on DoD lands through stewardship, leadership, and partnership.

This study takes a regional multi-agency approach that partners NAWS China Lake with contiguous and nearby federal land-managing agencies, including the Fort Irwin National Training Center (NTC), Death Valley National Park, the Mojave National Preserve, and the Bureau of Land Management (BLM), along with Native American Tribes (Figure 1). The results will have direct military benefits by aiding stewardship, determinations of eligibility for the National Register of Historic Places, and management of these early sites throughout the arid west.

The project consists of two main components: 1) a paleoenvironmental reconstruction of the dynamic ancient landscape during the Terminal Pleistocene and Early Holocene (15,000 to 8,000 years ago); and 2) construction of a GIS-derived diachronic model of early settlement in paleoenvironmental context (based in large part on re-analysis of existing archaeological material using new dating methods). Owing to the scale of the project, funding was only provided for Step 1: reconstructing Mojave Desert pluvial lake histories and hydrological regimes at the end of the Ice Age. A subsequent proposal will be submitted for funding Step 2 of the project.

This report presents the results of Step 1 of the project and consists of six chapters. Chapter 2 summarizes the overall project goals and design, while Chapter 3 provides a brief environmental and cultural background for the study area. Chapter 4 presents the approach, fieldwork, and laboratory results for the paleoenvironmental investigations. In Chapter 5, these results are placed in broader contexts and a Terminal Pleistocene/ Early Holocene paleoenvironmental reconstruction is presented. The report concludes in Chapter 6 with a brief discussion of the approach that will be taken in Step 2 of the study.

Figure 1. Regional Map Showing the Project's Main Federal Land-Managing Agencies in Relationship to the Mojave Desert and Great Basin.

2. OVERALL PROJECT GOALS AND DESIGN

The Mojave Desert and the Great Basin have perhaps the most extensive archaeological records for early human occupation in North America. This record is largely comprised of small surface scatters of archaeological material, typically represented by distinctive early flaked stone artifacts often referred to as characteristic of the Clovis and Paleo-Indian archaeological complexes. This early occupation began near the end of the last Ice Age, a period of time referred to as the Terminal Pleistocene/ Early Holocene (between 15,000 and 8,000 years ago). NAWS China Lake has long been recognized as having one of the largest concentrations of early prehistoric cultural material (e.g., Davis and Palaqui 1978), even exceeding the impressive archaeological assemblage associated with the margins of Pleistocene Lake Mojave in the Mojave National Preserve (e.g., Campbell and Campbell 1937). At NAWS China Lake, these archaeological sites are concentrated in the low-lying China Lake Basin. Yet throughout the west, the regional context for understanding the significance of these resources remains poorly developed and not well understood. This makes National Register evaluations, stewardship, and management of the earliest sites challenging and often unsystematic.

This study takes a regional perspective toward building a strong historical context for understanding Terminal Pleistocene/ Early Holocene archaeology of the Mojave Desert (Figure 2). This broad-based approach encompasses 5,000 square miles, and includes the jurisdiction of numerous federal land-managing agencies (including the Fort Irwin NTC, the BLM, Death Valley National Park, and the Mojave National Preserve). Such a broad-scale approach is appropriate because early inhabitants of the arid west were mobile hunter-gatherers who may have traversed across large tracts of land each year. Thus, a small-scale study would only encompass a limited piece of extensive settlement systems, and makes it difficult to appreciate the full range of early human/land interplay.

In addition, these small, mobile bands of hunters-gatherers typically focused on infrequent (sporadic) but very rich environmental settings within the desert. As the last Ice Age ended, substantial global climatic changes took place, including unprecedented warming and cooling events that significantly impacted rainfall patterns, the landscape, and its flora and fauna. Indeed the climate changed and fluctuated on an amplitude and with a frequency that nature has not approached since. Desert lakes, a distinctive aspect of the Pleistocene pluvial ecosystem, dried up during this period of dramatic climatic change. Probably the most prominent Pleistocene pluvial system was the series of linked lakes that began with Owens River flowing into Owens Lake on the east side of the Sierra Nevada, which then overflowed into Lake China (on NAWS China Lake), then into Lake Searles (partially on NAWS China Lake), then into Lake Panamint, and finally continued to its terminus at Lake Manly (in Death Valley National Park). Given that the ancient (paleo-) environment of the region was very different than today, it is necessary to gather data to reconstruct its precise character. This broad regional perspective will allow us to identify productive environmental settings at different points in time at the end of the Ice Age.

The earliest archaeology in the west (especially well-represented at NAWS China Lake and Fort Irwin NTC) can only be understood in a broad regional context that takes into account a rapidly changing paleoenvironment. Therefore, this project takes a multi-disciplinary, global perspective toward reconstructing hydrological regimes and pluvial lake histories at the end of the Ice Age (Step 1), and the nature and spatial distribution of the Terminal Pleistocene/Early Holocene archaeological record within this regional ecological context (Step 2). The project also capitalizes on recent insights into the global climate, such as from the Greenland ice cores, and employs innovative and new methods and analytical tools to comprehensively examine large-scale archaeological patterns.

This report concerns Step 1 of the project, developing a paleoenvironmental reconstruction for the region. Surprisingly, the pluvial history of ancient China Lake has never been rigorously studied, despite its rich early archaeological record. The approach we have taken has been to gather new independent data from geological localities on the ancient hydrology of China Lake Basin (including inflow sources, the basin itself, and its output/overflow history). With these results, the history of the region's ancient lakes and the timing of pluvial conditions can be reconstructed. This model can then be compared and contrasted with existing reconstructions

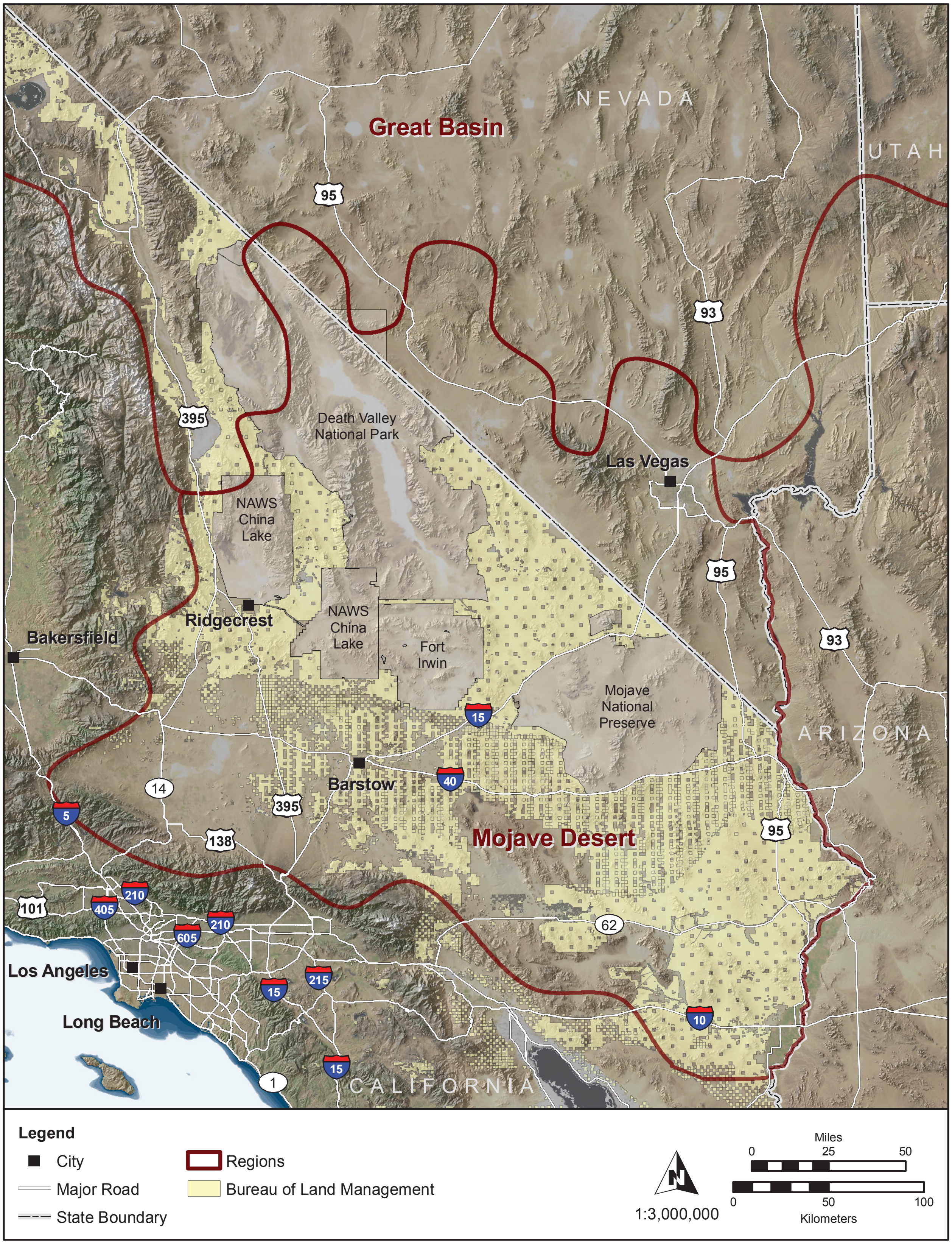


Figure 2. Map of Mojave Desert Showing the Project's Main Federal Land-Managing Agencies.

of the pluvial history of the Mojave River system, which terminated at Pleistocene Lake Mojave (in the Mojave National Preserve). These results will provide new insight on how dramatic global climatic changes at the end of Pleistocene impacted paleoenvironments in the Mojave Desert and the timing and scale of these changes.

The paleoenvironmental baseline will then provide a foundation for subsequent Step 2, which will include analysis of pollen from alluvial cutbanks, cores, and packrat middens to refine reconstructions of ancient plant communities in the region; re-analysis of Terminal Pleistocene/ Early Holocene archaeological materials; and the synthetic integration of paleoenvironmental and archaeological results through GIS spatial modeling.

Completion of Step 2 will result in a new and appropriate historical context for the Terminal Pleistocene/Early Holocene archaeology of the Mojave Desert. The final product will aid in National Register eligibility determinations by identifying current data gaps, and greatly assist in the development and tailoring of research designs for future Section 106 and Section 110 efforts at Early sites. This will, in turn, facilitate management decisions for desert land managers, assist SHPOs and THPOs (such as the Big Pine Paiute and Shoshone Timbisha tribes), and greatly benefit the military mission of both NAWS China Lake and Fort Irwin NTC, as well as at nearby Marine Corps Air Ground Combat Center (MCAGCC) 29 Palms.

The project is scaled to the regional level, and puts NAWS China Lake at the lead in a multi-agency consortium that includes contiguous and nearby federal land-managing agencies. The use of a multi-disciplinary, global perspective and employment of innovate laboratory techniques allows NAWS China Lake to take a leadership role in managing early archaeology in the Mojave Desert. The final product will fill some existing data gaps, provide clarity on remaining information needs, and summarize current knowledge concerning Terminal Pleistocene/ Early Holocene sites. As a result, the funding will aid Early site NRHP eligibility determinations; and assist land managers throughout the arid west, western states' SHPOs, and Mojave Desert THPOs in addressing future National Historic Preservation Act Sections 106 and 110 needs.

3. REGIONAL NATURAL AND CULTURAL CONTEXT

This chapter provides a brief contextual overview that sets the stage for our investigation of Terminal Pleistocene and Early Holocene human adaptations. Initially, the modern setting is summarized; then prior paleoenvironmental reconstructions are discussed. Finally, the archaeological record is reviewed with special emphasis on normative perspectives and lacunae in our understanding of regional adaptive trends.

MODERN SETTING

Mojave Desert

The study area falls within the Mojave Desert, and the four main federal land-holding agencies involved in the project are well-distributed across this region (see Figure 2). The Mojave Desert extends east from the Sierra Nevada, Tehachapi, San Bernardino, and San Gabriel mountains to the Colorado River, and south from Death Valley to near the northern edge of the Salton Trough. As such, it falls mainly within California, with the northeastern portion extending into southernmost Nevada.

The Mojave Desert is part of the greater southern Basin and Range physiographic province, and is generally considered a subdivision of the larger Great Basin within intermountain western North America. The Basin and Range province is characterized by multiple, roughly parallel, fault-block, and volcanic mountain ranges separated by broad valleys. Within this province, the Mojave Desert is a transition between the high, cold desert-steppe of the Great Basin to the north, and the low, hot, Colorado and Sonoran deserts to the south and southeast. In general, the region is typified by large alluvial fans emanating from steep mountain ranges and playas in valley bottoms.

The Mojave Desert climate is characterized by very low rainfall, high temperatures, extreme intra-daily variation in temperature, and periodic high winds (Thompson 1929:69). In contrast to the Great Basin farther north, the Mojave is considered a hot desert, with maximum winter temperatures averaging about 15 °C (60 °F) and summer temperatures averaging between about 35 and 39 °C (96 and 102 °F).

Rainfall is sporadic, and any single locality can go years without measurable precipitation (Major 1977). Rainfall in the region includes winter (October through April) precipitation from storms eastward from the Pacific, and summer rainfall (May through September) driven by Sonoran monsoonal storms originating to the south (Bryson 1957). The months with the most precipitation include November through February and July through August. The majority of annual rainfall, however, occurs in winter, between December and March. This is unlike the Colorado Desert to the south, where as much as half of annual precipitation derives from summer monsoons. Surface water is rare, save for the occasional spring or rare pools left after winter storms and summer monsoons.

The greater Mojave Desert biome is composed of a mosaic of different plants adapted to xeric desert conditions (Barbour and Major 1988). Though generally lacking diversity, it includes species commonly found in both the Great Basin and the Sonoran Desert. Elevation, temperature, sediments, geology, slope, and other factors result in different vegetation communities within the greater Mojave Desert biome. Creosote-dominated vegetation communities, however, are the most pervasive in the region.

Northwest Mojave Desert

This project is focused on the China Lake Basin within NAWS China Lake in the northwestern portion of the Mojave Desert. The basin falls within Indian Wells Valley, an enclosed hydrological sink extending a maximum of 55 miles north-south and 30 miles east-west (Figure 3). Rose Valley and the China Lake Basin, both of which are referred to frequently in this report, are subsets of Indian Wells Valley. The valley is a down-dropped, bedrock basin, in-filled with as much as 6,200 feet of lacustrine and alluvial sediments. Elevations range from 2,150 feet above mean sea level (amsl) on the China Lake playa to about 3,000 feet amsl at the top of the alluvial piedmont rimming the valley. Reaching elevations above 8,000 feet, the Sierra Nevada Mountain Range

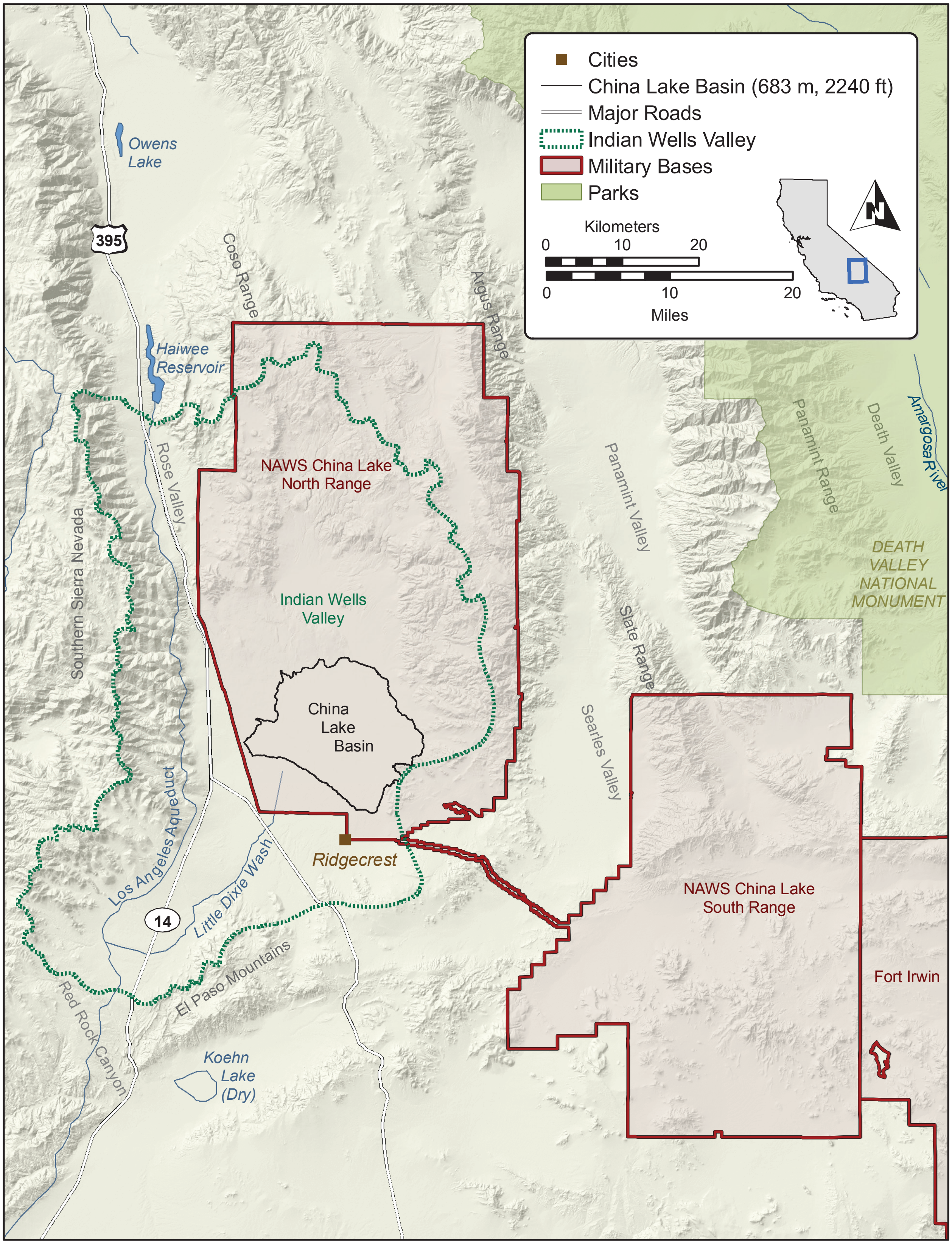


Figure 3. Map of Indian Wells Valley and China Lake Basin Environs.

lies immediately to the west, while the Coso Range lies to the north, and the Argus Range to the east. The El Paso Mountains and Black Hills separate Indian Wells Valley from Fremont Valley to the south, the latter separated from the Antelope Valley farther southwest by the Rand Mountains, Rosamond Hills, and Bissel Hills. Each of the basins in the northwestern Mojave is distinguished by a valley-bottom playa. These include the playas at China Lake and Airport Lake in Indian Wells Valley, Koehn Lake in Fremont Valley, and Rogers, Buckhorn, and Rosamond lakes in Antelope Valley.

Aridity in the northwestern Mojave Desert is mainly a product of its southern latitude and position east of the Sierra Nevada and Peninsular ranges. Due to the north-south orientation of these mountain ranges, prevailing westerly winds are cooled as they rise to overcome the mountain crests, causing them to release heavy moisture. This results in high amounts of rain and snow on the windward, west-facing slopes of the Sierra and Peninsular ranges, but creates a rain shadow on the eastern side.

Typically, between 3.0 and 6.5 inches of rain fall occurs each year in Indian Wells Valley (as measured at NAWS China Lake's Weather Station). Higher elevations surrounding the valley receive light snowfall from November through April, generally dissipating within a few days. Springs and small seeps provide the primary surface water in the valley, but during rare periods of intense rain, the playa of China Lake Basin holds up to several inches of water. Any number of ephemeral drainages originating in the Sierra Nevada, Argus ranges, and ranges to the south deliver surface flows to China Lake Basin, although, these too are rare. In fact, not a single perennial stream currently exists within Indian Wells Valley.

The hot, arid China Lake Basin and Indian Wells Valley fall within the Mojave Creosote bush scrub formation (Küchler 1976). This desert scrub vegetation includes extensive tracts of Creosote Bush Scrub, Saltbush Scrub, and Alkali Sink plant communities, the latter associated with the dry lake-bed playas. Creosote bush (*Larrea tridentata*) tends to form large homogenous tracts, frequently with its principle associate burrobush (*Ambrosia dumosa*), in the coarse, well-drained soils on the valley bottoms, alluvial piedmonts, and surrounding slopes to an elevation of around 3,500 feet amsl (Holland and Keil 1990; Silverman 1996). Saltbush Scrub communities occur primarily on the low-lying desert plains adjacent to the ancient lake-bed playa and are primarily composed of members of the goosefoot family (Chenopodiaceae). Allscale (*Atriplex polycarpa*) is the most common species in Indian Wells Valley, forming uniform tracts along the edges of China Lake playa. Alkali Sink Scrub occurs in the highly saline zone surrounding the playa and is transitional between the Saltbush Scrub community and the barren salt flats of the former lake bed. Common species within the Alkali Sink community include desert holly (*Atriplex hymenelytra*), allscale, and saltgrass (*Distichlis spicata*).

A variety of species of passerine and raptorial birds, joined periodically by migratory waterfowl drawn by the few perennial springs and infrequent playa lakes, occur in the region. Small mammals are also common in the valley including ground squirrels (*Spermophilus* spp.), pocket mice (*Prognathus* spp.), woodrats (*Neotoma* spp.), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*). Coyote (*Canis latrans*), desert kit fox (*Vulpes macrotis*), badger (*Taxidea taxus*), ringtail cat (*Bassariscus astutus*), bobcat (*Lynx rufus*), and mountain lion (*Felis concolor*) are the principle carnivores. Mule deer (*Odocoileus hemionus*) and desert bighorn sheep (*Ovis canadensis nelsoni*) are also known to occupy higher elevations in this region.

PALEOENVIRONMENT

Paleoclimate in Global Perspective

Environmental conditions in the past were different than they are today. During the Late Pleistocene and Early Holocene, the climate was generally cooler and periodically much wetter. Recent high-resolution proxy climate data from annually layered ice cores, particularly in Greenland and Antarctica, have refined our understanding of how changes in climate affected the globe during the Late Pleistocene and Early Holocene (Alley 2000; Alley et al. 2003; Charles 1998). A tight chronology of events at less than the decade level of resolution are now available that chart the magnitude and timing of climatic events (Grachev and Severinghaus 2005; Severinghaus and Brook 1999; Severinghaus et al. 1998; Steffensen et al. 2008; Taylor et al. 1997). These developments in global paleoclimate reconstruction provide an opportunity to more tightly link varied lines of paleoenvironmental evidence (including lake cores, site pollen, geoarchaeology, and archaeological information), reconcile contradictory aspects of earlier reconstructions, and more accurately assess the role of climate change in prehistoric occupation trends during this time frame. Results are briefly summarized below. All dates throughout this report are referred to in calibrated years before present, rather than radiocarbon years, unless otherwise noted. Calibrated ages are a more accurate reflection of the true timing and length of past events, and allow correlation with high resolution paleoclimate records developed from annualized phenomena (e.g., varve counts, growth increments) and radiocarbon dates developed from different kinds of carbonate fractions (e.g., wood, tufa, mollusk shell).

Global climatic changes were both rapid and extreme during the Late Pleistocene and Early Holocene (Severinghaus and Brook 1999; Severinghaus et al. 1998; Grachev and Severinghaus 2005; Steffensen et al. 2008). At the height of the last glacial maximum, 22,000 cal BP, it was much colder and drier than today (at least five to seven °C). During this period of climatic change and fluctuation, there were two remarkable events when temperature increased rapidly and dramatically. The first event occurred about 14,600 ± 300 cal BP, marking the start of the Bølling climatic regime (Severinghaus et al. 1998), and the second took place 11,570 ± 10 cal BP at the onset of the Preboreal era (Severinghaus and Brook 1999). During both events, mean annual temperature increased globally, and in Greenland where the most detailed information has been obtained, it increased 9 ± 3 °C (16 ± 5 °F). Each of these climate events occurred within one or two decades, in other words, less than one generation (Severinghaus and Brook 1999; Severinghaus et al. 1998). This global warming trend, ultimately marking the end of the last Ice Age, was slowed and partly reversed during a cooler interval between 12,900 and 11,570 cal BP termed the Younger Dryas. It should also be noted that the transition to the Younger Dryas took place over a 100-year period, considerably slower than the Bølling and Preboreal rapid warming events (Severinghaus et al. 1998; Severinghaus and Brook 1999; Taylor et al. 1997).

The implications of these high amplitude global events on local environmental sequences and human adaptations have yet to be fully realized as it takes time to re-examine existing information and gather new data. Overall, the northward retreat of ice sheets at the end of the Pleistocene in the northern hemisphere led to a northward shift in the jet stream and a change in the distribution of storm systems. However, the impact of these rapid warming events and the intervening Younger Dryas cold interval on global circulation patterns, rainfall, and vegetation is increasingly the subject of research in a variety of settings world-wide, including the Great Basin (e.g., Madsen 1999). There are also emerging indications that the nature and scale of paleoenvironmental changes may have varied greatly between regions within North America (e.g., Meltzer and Holliday 2010).

The causal factors underlying these rapid changes in global climate (both the two rapid warming events and the somewhat slower cooling reversal) remain obscure. Recently, there has been much speculation regarding the causes of the Younger Dryas cooling episode. Probably the most controversial interpretation is that this cooling event was precipitated by an extraterrestrial impact (such as a comet or meteorite) and directly brought about the demise of the Pleistocene megafauna (e.g., Firestone et al. 2007). In North America, 34 species of Rancholabrean megafauna went extinct, including ten species that were larger than a ton in average weight. Notable species were Pleistocene horse, camel mammoth, mastodon, dire wolf, American lion, sloth, and tapir. This ET theory has been met with enthusiasm (Kennet et al. 2008), cautious interest (Haynes 2008; Faith and Surovell 2009), and skepticism (Gill et al. 2009; Surovell et al. 2009). Most notably, there have been questions raised regarding whether there is indeed evidence of a large extraterrestrial impact event and whether a number of these species had already gone extinct prior to the Younger Dryas.

Mojave Desert Paleovegetation

Late Pleistocene and Early Holocene proxy paleoclimatic and paleoenvironmental records (especially geomorphic, pollen, and packrat midden analyses) provide a dynamic diachronic picture of Mojave Desert paleoenvironments (Drover 1979; Enzel et al. 1992, 2003; Enzel and Wells 1997; Koehler and Anderson 1998; Koehler et al. 2005; Tchakerian and Lancaster 2002; Spaulding 1990; Wells and Anderson 1998; Wells et al. 1989; Wells et al. 2003; West et al. 2007).

During the Late Pleistocene (between about 25,000 and 12,000 years ago) semiarid-to-arid conditions also prevailed in the northwestern Mojave Desert due to the rainshadow of the Sierra Nevada. Much cooler temperatures than today, however, made effective precipitation much higher. As a result, Pinyon-juniper woodland was widespread at elevations between about 1,000 and 1,800 meters (3,280 and 5,900 feet); and Juniper woodland was dominant below 3,000 feet (Spaulding 1990; Minnich 2007). In Death Valley, Utah Juniper and Whipple yucca (*Yucca whipplei*) thrived in an area today dominated by Mojave Desert scrub (Wells and Woodcock 1985).

Koehler et al. (2005) notes that the rare occurrence of pinyon north of latitude 36° N (immediately north of the China Lake Basin) during the Late Pleistocene is characteristic of a paleoecotone that bisected the northern Mojave at this time. North of this latitude, Juniper-steppe with an understory of cold-adapted shrubs is characteristic of relatively cold winter temperatures, whereas the common occurrence of pinyon and Whipple yucca, and the rare presence of steppe shrubs south of 36° N, is consistent with milder winters.

Recently, Gill et al. (2009) has argued that Terminal Pleistocene megafauna extinctions had a profound effect on ancient vegetation patterns. In addition, Gill et al. (2009) assert that the demise of these "keystone megaherbivores" began well prior to the Younger Dryas. In eastern North America, their extinction led to a rise in hardwood forest and ultimately more extensive forest fires. Although the precise implications for the Mojave Desert are uncertain, undoubtedly rapid vegetation changes and novel plant associations lacking modern analogs characterized the Terminal Pleistocene.

At the end of the Pleistocene, vegetation began to shift toward modern geographic patterns (Koehler and Anderson 1998; Koehler et al. 2005; Wigand and Rhode 2002). Initially, the distribution of pinyon pine greatly decreased, and desert thermophiles migrated northward. By about 11,650 years ago (the start of the Holocene) climate warmed enough to classify the region as a hot desert, and that much of the region was dominated by species typical of the modern upland Mojave Desert community (<1,300 meters). These included juniper, wolfberry, cliffrose, and desert almond. Though Middle Holocene (starting around 8,000 years ago) climates are now seen as substantially more variable than Antevs' (1948) initial conception of a warm, dry Altithermal, it appears that the Holocene warming and drying trend continued during this period. This helped foster the evolution of modern, xerically adapted vegetation communities.

Mojave Desert Paleolandscape

Clearly, climate, hydrology, and vegetation were significantly different before about 15,000 years ago, during the Late Pleistocene than after. Runoff from surrounding mountains was of an order of magnitude greater than today, and greater effective moisture allowed lakes to retain substantial amounts of water. At times during the Late Pleistocene, large lakes were widespread in the Great Basin. Within the Mojave Desert, the most extensive was the Owens River system (Figure 4). At its maximum, this was a 450-kilometer-long network of interconnected lakes and rivers that originated at Lake Russell in Mono Basin, flowed into Owens Lake on the east side of the Sierra Nevada, which then overflowed into Lake China (on NAWS China Lake), then into Lake Searles (partially on NAWS China Lake), then into Lake Panamint, and finally continued to its terminus at Lake Manly in Death Valley National Park (Benson et al. 1990, 1996, 1997, 1998; Gale 1914; Garrett 1991; Grayson 1993; Smith 2010).

The Mojave River drainage also carried regular, if not perennial, flows during the Late Pleistocene, forming a series of associated lakes (Enzel et al. 1989; Tchakerian and Lancaster 2002; Wells et al. 2003). This long river has its origins in the San Bernardino Mountains in the Transverse range along the southern edge of the Mojave Desert. During this pluvial period associated with higher precipitation and major flood events, a series of Pleistocene lakes were formed at the lower reaches of this system. These included, starting upstream, Lake Manix, Cronese Lake, and Lake Mojave. Lake Mojave encompassed modern playas of Soda Lake and Silver Lake, of which the former lies within the Mojave National Preserve.

During the Pleistocene, the Owens River system drained almost the entire eastern Sierra front, from Mono Lake to China Lake, and extended well into the Mojave Desert through Searles Valley and Panamint Valley before ending in Death Valley (Figure 5). When Owens Lake reached its outlet at an elevation of about 1,145 meters (3,756 feet), it overflowed to Rose Valley which, in turn, overflowed into Indian Wells Valley and

Figure 4. Map of Mojave Desert showing Pleistocene Lakes, including those associated with Owens River and Mojave River Systems.

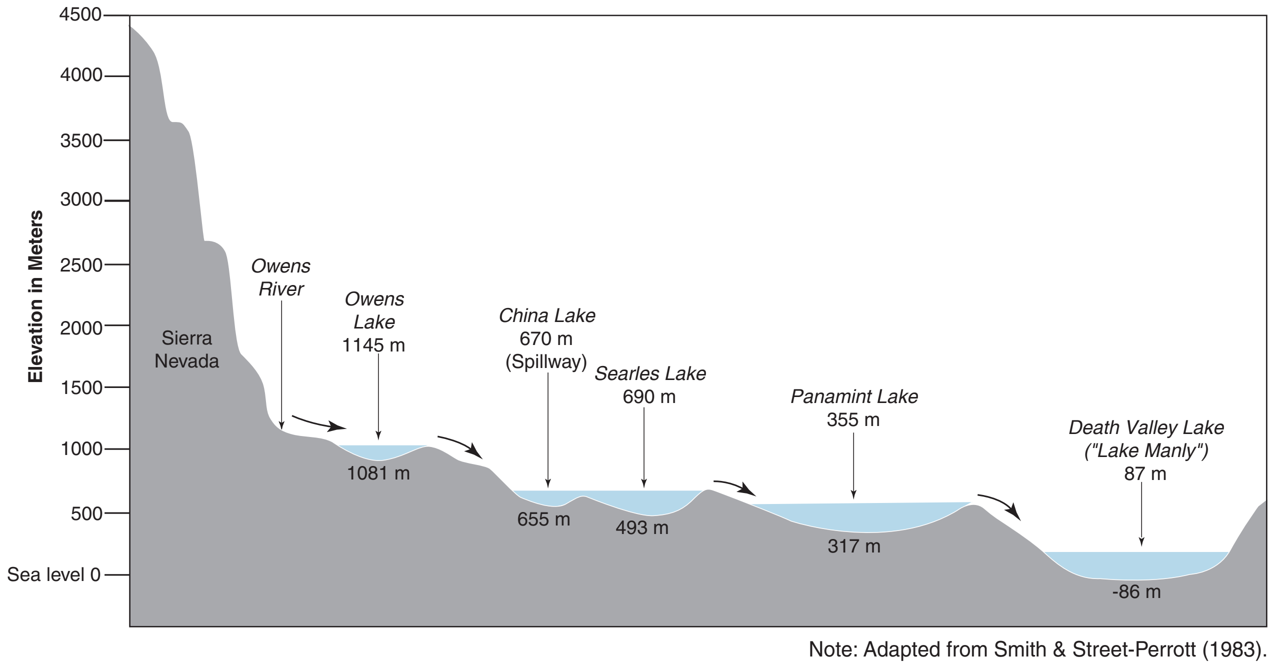


Figure 5. Pleistocene Pluvial Lake Connections Along the Owens River Drainage System.

China Lake. China Lake would in turn overflow into Searles Valley when it reached an elevation of between about 665 and 670 meters (2,180 and 2,200 feet) or approximately ten to 16 meters (53 to 33 feet) in depth (Benson et al. 1990; Gale 1914; Rosenthal et al. 2001; Smith and Street-Perrott 1983; Warren 2008). Searles Lake then had to fill to a depth of approximately 172 meters (564 feet) before it coalesced with the waters of China Lake to form pluvial Lake Searles. This lake rose until it reached its sill with Panamint Valley where it would have been almost 200 meters deep (656 feet), maintaining a surface elevation of 690 meters (2,264 feet). By the Late Pleistocene, however, the paleo-Owens River only connected the intermediate basins of Owens, China, Searles, and Panamint lakes (Smith and Street-Perrott 1983); today the river terminates at the nearly dry lakebed of Owens Lake.

As the hydrologic "gatekeeper," the Owens River system, and Owens Lake in particular, has been most extensively studied via a series of lake cores (Benson 2004; Benson et al. 1996; Benson et al. 1997; Phillips 2008; Phillips et al. 1996) and descriptive and chronological analysis of littoral environments and neotectonics (Bacon et al. 2006; Orme and Orme 2008). Several studies have also focused on stratigraphy of Lake Searles, providing reconstructions of this pluvial lake's history (Ramírez de Bryson 2004; Smith 1979, 2010; Smith and Street-Perrott 1983; Benson et al. 1990).

Based on these studies, two contrasting models now exist for the Owens River system. One reconstruction has its origins at Lake Searles and is consistent with prevalent lake-level reconstructions elsewhere in the Great Basin (Madsen 1999). This model tends to correlate high lake levels with cold intervals (such as the Younger Dryas). In contrast, a newer model proposed by Benson et al. (1997), drawing on recent Owens Lake coring, aims to link the results with global climate patterns (see also Benson et al. 2003). They argue that Late Pleistocene cold intervals were dry and, hence, lake levels were lower, while warm intervals were wet with correspondingly high lake levels. There is also considerable difference of opinion regarding when precisely, if at all, Owens Lake and China Lake may have overflowed during the Terminal Pleistocene/Early Holocene (Benson et al. 1997; Bacon et al. 2006; Smith 2010). Surprisingly, no comprehensive study of pluvial Lake China has been undertaken. As such, reconstruction of Terminal Pleistocene/ Early Holocene environmental conditions and lake level timings in the China Lake Basin have had to rely on conflicting proxy data from the immediately upstream basin (Owens) and the immediately downstream basin (Searles) (e.g., Basgall 2007; Byrd 2007; Giambastiani 2008; Rosenthal et al. 2001; Warren 2009).

ARCHAEOLOGICAL CONTEXT

Western North America

For many years, the Paleoindian culture referred to as Clovis was considered to reflect the first human group to enter and populate the New World (e.g., Haynes 1969; Jelinek 1992). These big game hunters were thought to have crossed the Berring land bridge bringing with them a blade-based tool kit (with strong affinities to the Upper Paleolithic of the Old World) that included distinctive Clovis spear points (large concave-base lanceolate points with a long thinning flake at the base, referred to as fluting) (Collins 1999; Haynes 2002). Traveling through an opening in the ice sheets, it is thought that these ancient people "blitzkrieged" through the Americas around 13,500 to 12,800 cal BP, possibly decimating the last of the Pleistocene megafauna.

Clovis sites are best documented in the southwest and the Great Plains (Haynes 2002). The distinctive Clovis adaptive strategy then gave way to the Folsom culture (dated between about 12,900 and 11,900 cal BP), also represented by wide-ranging, mobile hunters and gatherers who periodically exploited large game (especially bison) and retained the fluting technology, albeit on smaller and thinner projectile points (Fiedel 1992). By the start of the Early Holocene, at least in the Great Plains, Folsom was replaced by the Plano culture (postdating around 11,900 cal BP) that had more varied point forms, all of which were unfluted and typically had rectangular bases.

The Clovis-first perspective has fallen out of favor in recent years owing in part to newly documented sites in South America that appear to predate Clovis (Madsen 2004), and recent results from Texas on an archaeological assemblage (referred to as the Buttermilk Creek Complex) that stratigraphically underlies and predates a Clovis occupation horizon (Waters et al. 2011). Currently there is considerable agreement that humans entered the New World via multiple migrations using both coastal and inland routes (Erlandson et al. 2007a). Most scholars view this as a post-glacial maximum process (after 21,000 cal BP), although some have argued for pre-glacial maximum incursions as well (Madsen 2004). In short, the Clovis-first paradigm has given way to a multifaceted perspective on entry into the New World. Conventional thinking now embraces the likelihood that some groups entered in pre-Clovis times, and that other populations with different technologies and adaptive strategies than Clovis may have occupied North America during the Terminal Pleistocene.

These new perspectives have spurred archaeologist to explore fresh ideas for the initial occupation in western North America. For example, Erlandson and others (2007b) have elaborated on the coastal migration route model. They refer to it as "the Kelp highway," that entailed travel by boat, exploiting this corridor's highly productive marine resources. This route to South America, of course, may have entailed landings by paleocoastal hunter-gatherers along California's ancient shoreline, which would have been situated westward of the modern shoreline, and in most places is now inundated. A single date of about 13,200 to 12,900 cal BP on skeletal remains from Arlington Springs (CA-SRI-173) on the northern Channel Islands off the southern California coast, has lent credence to this perspective (Johnson et al. 2002).

Despite the demise of the Clovis-first paradigm, new research continues to enhance our understanding of the Clovis complex. Waters and Stafford (2007) recently conducted a new high-precision dating program, and their results indicate that the Clovis complex persisted for a much shorter time span than previously estimated—perhaps only 300 years (from around 13,000 to 12,700 cal BP—11,050 to 10,800 radiocarbon years before present [RCYBP]). If correct, this implies that either Clovis populations or Clovis technology rapidly spread across an extensive portion of North America. This short chronology, however, has not been fully accepted (Beck and Jones 2010; Haynes et al. 2007).

It has long been recognized that classic Clovis sites have not been documented in California (e.g., Moratto 1984). Indeed, with the exception of human skeletal remains from the Arlington Springs site, no stratified site in California has been dated to the Clovis time frame (13,500 to 12,800 cal BP). Fluted points are also infrequently encountered in California, generally as isolated surface finds (Dillon 2002; Rondeau et al. 2007). The two most prominent concentrations of fluted points occur near Tulare Lake in the southern San Joaquin Valley and in China Lake Basin (Davis and Panlaqui 1978; Hopkins 1991). Moreover, scholars have recently stressed that labeling all fluted points in California as Clovis is inappropriate since these projectiles rarely fall within the morphological or metric range of fluted points well-documented at actual Clovis sites in the Southwest and the Great Plains (e.g., Byrd 2006; Dillon 2002; Rondeau 2006; Rondeau et al. 2007). Instead, California fluted points are typically smaller and thinner, and it has been suggested that they should be referred to under the more general rubric of "fluted" or "concave-base" points; a tacit recognition that they may well post-date the age of Clovis (Basgall 1998).

The recent proposition (Firestone et al. 2007) that the Younger Dryas cooling episode and the demise of the North America Racholabrean megafauna was caused by an extraterrestrial impact has drawn considerable archaeological interest. Haynes (2008) has recently concurred that a major perturbation took place at the start of the Younger Dryas cold interval, circa 12,900 cal BP. The start of the Younger Dryas is marked by the widespread appearance of a black, organic-rich layer, and Clovis sites and Pleistocene megafauna (except the bison) stratigraphically underlie these "black mats." As such, Haynes (2008) cautiously revives Martin's (1967) notion that Clovis populations may have contributed to or caused the demise of Pleistocene megafauna.

Other scholars have gone so far as to suggest that this extraterrestrial event at the start of the Younger Dryas (around 12,900 cal BP) caused a major human population disruption in California. Kennett et al. (2008) assert that this event led to large-scale wildfires and the extinction of pigmy mammoths on the northern Channel Islands. Both Jones (2008) and Kennett et al. (2008) also argue that early human occupation (contemporaneous with Clovis) was then disrupted for 600 to 800 years, after which (around 12,200 cal BP) a "large-scale colonization" took place. Supporting evidence for both early occupation episodes is limited to two dates from two sites (i.e., one date from each time segment). This "disruption" hypothesis is not, however, supported by evidence from other parts of western North America (Beck and Jones 2010; Meltzer and Holliday 2010). For example, Meltzer and Holliday (2010), drawing on an extensive database of dated sites in the Great Plains and southwest, document a continuous sequence of occupation that begins well prior to the Younger Dryas and continues through the end of the Pleistocene. Indeed, the bulk of Pleistocene sites in this area date to the Younger Dryas.

Great Basin and the Intermountain West

The demise of the Clovis-first model has led Great Basin scholars to reassess the nature of Terminal Pleistocene occupation (e.g., Beck and Jones 1997), and the relationship between pluvial lakes and early occupation trends (Adams et al. 2008; Pinson 2008). Recently, Beck and Jones (2010) have argued that the earliest intermountain west sites (those in the Great Basin and on the Columbian Plateau) were not represented by Clovis complex assemblages with their characteristic blade technology and fluted points. In fact, no Clovis assemblage sites have been dated or documented. Instead, stemmed point assemblages represent the earliest occupation episodes. They muster a total of 29 radiocarbon dates from 11 localities with stemmed points including 17% that date to the Bølling-Allerød (contemporaneous with the Clovis complex) and 83% which date to the Younger Dryas (most of which fall within the early part). As such, "Western Stemmed" point assemblages originated in the Terminal Pleistocene and are considered to be nearly as early, if not contemporaneous, with the Clovis complex of the Great Plains and the southwest.

Besides having different forms of projectile points, these Western Stemmed assemblages are also differentiated from Clovis complex assemblages by having: 1) flake rather than blade blanks for projectile points; 2) side struck rather than end struck flake blanks for bifaces; 3) points typically made from fine-grained volcanics rather than chert; and 4) have an additional tool type—crescents (typically bifacially retouched, often with one steep-side)—considered to be a marker of littoral adaptations (Beck and Jones 2010:97-100). Similar to California, fluted points are typically found in surface contexts in this region and based on statistical analysis are significantly smaller than fluted points from Clovis sites (Beck and Jones 2010:Table 4). As such, Beck and Jones (2010) argue that intermountain west fluted points most likely post-date the Clovis complex and are contemporaneous with Folsom occupation in the Great Plains. This is consistent with the earliest dates from Clovis sites which they argue occur in the southern Great Plains (Texas); a subsequent northwest migration accounts for later dates in the northern Great Plains (Colorado).

Beck and Jones (2010:81) further suggest that "…initial colonization of the intermountain region most likely involved groups moving inland from the Pacific coast carrying a non-Clovis technology, which was already in place by the time Clovis technology arrived." Although evidence of Terminal Pleistocene stemmed points is lacking near the coast, they suggest that a likely migration route for coastal groups was up the Columbia River onto the plateau and then into the Great Basin.

Mojave Desert

The flurry of new perspectives on the Terminal Pleistocene record in surrounding regions has yet to significantly impact long-held views on the Mojave Desert archaeological record. A brief review is provided below.

Possible Early Assemblages

Periodically, assertions have been made that humans occupied the Mojave Desert as early as 40,000 years ago, and these claims generally focus on sites with heavily weathered surface material that lack the formal shaping characteristic of finished tools (see Moratto 1984:29-73 for a detailed review). These "pre-projectile point" sites have often been referred to as the Malpais complex, and the absence of diagnostic tools and dating evidence has led most archaeologists to discount assertions of very early occupation episodes (Sutton et al. 2007).

Most scholars believe that the earliest occupation in the Mojave Desert began considerably later, in the Terminal Pleistocene (e.g., Moratto 1984). There are, however, no sites with radiocarbon assays on cultural material that date to the Pleistocene. Infrequent fluted and non-fluted concave-base points are considered to fall within this time frame (Basgall 1988; Basgall and Hall 1991; Byrd 2006, 2007; Rondeau et al. 2007; Sutton et al. 2007:234; Warren and Phagan 1988). These are most often recovered in isolated or mixed contexts, with the most extensive documented in China Lake Basin (Basgall 2004, 2005, 2007; Byrd 2006, 2007; Davis and Panlaqui 1978; Rondeau et al. 2007). There is also considerable difference of opinion whether or not fluted lanceolate points should be referred to as Clovis points and therefore representative of the Clovis complex (which is tightly dated to between 13,500 and 12,800 cal BP), or instead subsumed within the Great Basin Concave Base point series (Basgall 1995; Byrd 2006; Sutton et al. 2007; Warren 2008). The loose and inconsistent use of the term Clovis in the Mojave Desert, at times being used to refer to all fluted points and to possible post-Clovis complex time segments of the Pleistocene (between 12,800 and 11,600 cal BP), has hindered advances in understanding the early record.

Overall, little is known about Terminal Pleistocene human occupation in the Mojave Desert; the nature of land-use, subsistence, and the organization of technology remains poorly defined, as do basic temporal parameters. While it is widely assumed that fluted and unfluted concave-base points in the Mojave Desert date to the Terminal Pleistocene, this has never been demonstrated radiometrically or chronostratigraphically. Recent obsidian hydration efforts provide a basis for constructing a relative time sequence, but hydration-age conversions remain poorly resolved, particularly for the earliest time periods (e.g., Basgall 1991; Rosenthal 2010). These efforts do indicate that fluted and unfluted concave-base points most likely predate stemmed points in the Mojave Desert (e.g., Basgall 1988; Gilreath and Hildebrandt 1997; Gold et al. 2007; Meyer et al. 2010:Table 12; Rosenthal 2010). They also provide a basis for linking site assemblages with similar obsidian hydration profiles (but lacking diagnostic points) to a relative time sequence of projectile points (e.g., Byrd 2006, 2007).

Lake Mojave Assemblages

Lake Mojave Assemblages represent the earliest well-recognized and spatially extensive archaeological occupation horizon in the Mojave Desert. The Lake Mojave Period is named in reference to the pioneering work of Elizabeth Campbell (Campbell et al. 1937) along the margins of Pleistocene Lake Mojave, whose southern portion lies within the Mojave National Preserve. Lake Mojave archaeological assemblages include stemmed Lake Mojave and Silver Lake projectile points, crescents, pressure-flaked bifaces, flake-based tools, and percussion-flaked cores (Basgall and Hall 1992, 1994a, 1994b; Basgall 1991, 1993; Basgall et al. 1988; Byrd 2006, 2007; Byrd and Berg 2007; Eerkens et al. 2007; Sutton et al. 2007; Warren 1967, 1984, 1986). Flaked stone technology focused on using non-obsidian fine-grained volcanics and metavolcanics and ground stone is also now recognized as an integral aspect of the artifact assemblages (Basgall 1993; Basgall et al. 1988; Basgall and Hall 1994b; McGuire and Hall 1988). Sites are especially well-documented on Fort Irwin and NAWS China Lake as well as near Lake Mojave.

Warren and his colleagues have argued that Lake Mojave Period settlements were mainly concentrated along lake shores, and produced artifact assemblages reflecting heavy emphasis on hunting with only a minor indication of plant processing (Warren 1967, 1984, 1986; Warren and Crabtree 1986; Warren et al. 1984; Warren and Schneider 2003). Subsequent research by Basgall and Hall (1992) in contrast, has documented Lake Mojave sites in a wider range of habitats with artifact and faunal assemblages indicative of a more generalized adaptation (Basgall 1993; Basgall et al. 1988).

Lake Mojave assemblages are generally believed to date to the Early Holocene (11,600 to 8000 cal BP), and possibly slightly earlier. However, only a handful of radiocarbon dates on cultural material have been obtained, all of which fall in the Early Holocene (Basgall 1993:Table 3.1). Thus, no Lake Mojave sites have produced evidence for Pleistocene-age occupation contemporaneous with early Western Stemmed point sites elsewhere in the Great Basin and on the Columbia plateau (Beck and Jones 2010).

The subsequent Pinto Period, defined by the presence of Pinto points with characteristic shoulders and bifurcated bases (Basgall and Hall 1992; Harrington 1957; Vaughan and Warren 1987), has traditionally been considered to date to the Middle Holocene (circa 8000 to 4400 cal BP). However, recent dating results on shell beads from six sites dominated by Pinto points all produced Early Holocene-age dates (Fitzgerald et al. 2005). Moreover, most of the results (seven of 11 samples) predate 9000 cal BP, raising questions regarding earlier estimates for the time span of both the Pinto and Lake Mojave periods (Basgall and Hall 1994a, 2000; Fitzgerald et al. 2005; Schroth 1994).

Spatial analyses and obsidian hydration readings suggest that Western Stemmed Tradition points are temporally later than concave-base points in the Mojave Desert (Basgall 1993:47; Basgall and Hall 1991; Meyer et al. 2009:Table 17; Rosenthal et al. 2001; Rosenthal 2010). Such is not the case for Pinto points; they co-occur with stemmed points at many sites and their obsidian hydration readings overlap significantly with those of stemmed points (Rosenthal 2010).

In short, strong evidence for the timing of the origins and end of the Lake Mojave Period is lacking. It is conceivable that it has its origins in the Terminal Pleistocene and its demise prior to the end of the Early Holocene. Moreover, it is possible that other assemblages may have overlapped temporally with Lake Mojave Period assemblages.

Evidence from the China Lake Basin Environs

As discussed, few localities in the Mojave Desert evince substantial human occupation during the Terminal Pleistocene, when colonizing populations are thought to have first settled most of North America and extinct megafauna still roamed the landscape. China Lake Basin, however, appears to be a major exception to this trend. Although radiometric and chronostratigraphic evidence is lacking, the Pluvial Lake China area harbors a number of small, discrete surface assemblages which have produced either diagnostic tools or potentially early obsidian hydration readings, hinting at persistent human occupation during the Terminal Pleistocene.

Distinguished mainly by fluted and basally thinned concave-base projectile points and Coso obsidian hydration readings averaging greater than about 15.0 microns, at least 14 separate surface sites or site loci in the basin may date to the Terminal Pleistocene (e.g., Basgall 2004; Byrd 2006:Table 12; Byrd 2007:Table 17). China Lake Basin also contains numerous localities where the fossil remains of large herbivores, including elephantidae, bison, camelids, and equous have been found (Fortsch 1978). These remains are often spatially convergent with the earliest archaeological residues (e.g., Basgall 2005; Davis and Panlaqui 1978). Currently, the surficial context of these finds makes behavioral associations between extinct megafauna and early human hunters, unconvincing (c.f., Basgall 2005:5-2; Davis and Panlaqui 1978; Moratto 1984:70).

China Lake Basin and the broader Indian Wells Valley also harbor extensive evidence for Lake Mojave assemblages (Basgall 2004, 2005; Byrd 2006, 2007; Rosenthal et al. 2001). These surface sites are represented mainly by Coso obsidian hydration readings, averaging between about 15.0 and 11.0 microns, and tool assemblages including large projectile points of the Western Stemmed Tradition (e.g., Silver Lake and Lake Mojave forms), domed unifacial "scrapers" or cores, chipped-stone crescents, and various other bifacial and minimally modified tools. These assemblages are found widely in the basin. In contrast, post-Lake Mojave Period occupation is rare in China Lake Basin (Basgall 2005:108-109; Rosenthal et al. 2001:74).

Why this comparatively small basin harbors such a high concentration of Terminal Pleistocene/Early Holocene archaeological sites, and numerous other larger and better-studied basins in the Mojave Desert do not, is an important problem; the answer to which may lead to a better understanding of the earliest human adaptations in western North America. Undoubtedly, the answer will be greatly aided by gaining a better handle on local paleoenvironmental conditions.

While aspects of the paleoenvironment have been reasonably well studied in adjoining lowlands such as Owens Valley, we know little about the local environment in China Lake Basin during the Terminal Pleistocene/ Early Holocene. Lake histories remain poorly resolved and continue to be the subject of much speculation (e.g., Basgall 2004, 2005; Byrd 2006, 2007; Giambastiani 2008; Rosenthal et al. 2001; Warren 2008). Furthermore, little is known about other types of environments that may have existed in the larger Indian Wells Valley during the transition from the Pleistocene to the Holocene. Archeologists have suggested that lake-side marshes, spring seeps, wet meadows, and other riparian settings were likely present in the valley bottom (e.g., Basgall 2004; Davis and Panlaqui 1978; Rosenthal et al. 2001; Warren 2008), but little direct evidence of these types of mesic habitats has been forthcoming. Understanding the environment in China Lake Basin and Indian Wells Valley during this period is critical for identifying the types of plant and animal foods that may have attracted early foraging groups; determining where in the basin those resources are likely to have existed; and distinguishing how climate changes at the end of the Pleistocene may have influenced human economic and technological developments during the Holocene.

4. FIELD INVESTIGATIONS AND NEW DATA ON THE TERMINAL PLEISTOCENE/EARLY HOLOCENE

This chapter consists of three main sections. First, we briefly outline the research approach taken to gain new insight into the Terminal Pleistocene/Early Holocene transition in the north-central Mojave Desert. Then we summarize the nature of our field investigations and the analytical methods that were employed. Finally, we present the results of our field investigations, highlighting the salient aspects of the new geomorphic records that were documented during this study. This substantive section is divided into three main parts structured to facilitate new insight into the paleoenvironmental history of the China Lake Basin: the inflow records, the lake basin records, and the overflow records.

RESEARCH APPROACH

Despite considerable research on the hydrological and paleoenvironmental records of Owens Lake and Searles Lake, the fluvial history of these interconnected basins during the Pleistocene/ Holocene transition is still a subject of significant disagreement (c.f., Bacon et al. 2006; Benson et al. 1990; Orme and Orme 2008; Smith 2010). This has, in part, fueled debate about the nature of early human occupation in this region and the extent to which lacustrine and/or some other types of mesic environments were the focus of early subsistence economies in the Mojave Desert (c.f., Basgall 1993; Basgall and Hall 1994; Byrd 2006, 2007; Rosenthal et al. 2001; Sutton et al. 2007; Warren 1967, 1984, 1986, 2008). The lack of consensus regarding the Owens and Searles records has resulted in conflicting interpretations about the timing of lacustrine high stands at China Lake and the antiquity of early human occupation in the basin, much of which lies well below the lake's outflow sill (i.e., below maximum lake level; e.g., Rosenthal et al. 2001; Warren 2009).

Because Indian Wells Valley (inclusive of Rose Valley and the China Lake Basin) is the main hydrological link between Owens Valley and Searles Valley, paleohydrologic and geomorphologic records from this area provide the most direct means of resolving discrepancies in the interpretation of the hydrologic record of the lower Owens River system and the nature and timing of early human occupation in this region. As a result, a main goal of the current effort was to generate new primary data on the paleohydrology and landscape history of Indian Wells Valley during the period between 15,000 and 8000 cal BP. This was done through a program of focused field and laboratory work combined with a literature search and broad synthesis of existing information from Indian Wells Valley/China Lake Basin and the wider Mojave Desert.

FIELD INVESTIGATION METHODS AND ANALYTICAL STUDIES

To better understand the fluvial history of China Lake and the lower Owens River system, field work focused on identifying geomorphic records related to the timing of water inflow, water outflow, and lake level fluctuations within China Lake Basin. At various times in the past, China Lake Basin and the larger Indian Wells Valley received surface water inflow from two primary sources: the Owens River through Rose Valley; and local washes and streams, particularly those with large watersheds draining the eastern Sierra Nevada (St.-Amand 1986). To assess the contribution of these drainages during the Terminal Pleistocene and Early Holocene, we examined natural and mechanical exposures along the Owens River system in Rose Valley, and all major washes entering Indian Wells Valley from the eastern Sierra Nevada and El Paso Mountains. No substantial drainages enter China Lake Basin from the White Hills and Coso Range to the north or the Argus Range to the east.

Fieldwork included several facets. Initially, wide-ranging field inspection of the inflow, lacustrine basin, and overflow areas was conducted to better understand surface manifestations of the geomorphic record and to identify localities for detailed study and sampling. Then 15 inflow alluvial sample localities were subjected to detailed investigations (Table 1; Figure 6). These included six in Rose Valley (northwest of China Lake Basin), seven in the southwest portion of Indian Wells Valley (one in Indian Wells Canyon and six along Little Dixie Wash), and one locality immediately southwest of the valley in Dixie Wash. Then coring took place at seven localities near the margins of China Lake Basin. Finally, surface samples were collected in two locations in the general overflow area. These efforts, along with analytical methods, are summarized below. It should be noted that the sample locations that were studied during these field investigations are entirely comprised of geological field localities—none were archaeological sites.

Table 1. Summary of Field Investigations by Geological Sample Locality.

SETTING	LOCALITY	UTM EAST [a]	UTM NORTH [a]	LOCALITY TYPE	NUMBER OF C-14 DATES	NUMBER OF INVERTEBRATE SAMPLES (PRESENT) [b]
Rose Valley, Inflow	Rose Valley flat	417934	3984967	Alluvial section	1	-
Rose Valley, Inflow	Cinder flat	418765	3981771	Alluvial section	1	-
Rose Valley, Inflow	Dead Chevy	415058	3984307	Alluvial section	1	-
Rose Valley, Inflow	Lava end	416269	3985690	Alluvial section	3	2 (0)
Rose Valley, Inflow	North Pit	415295	3991136	Alluvial section	2	1 (1)
Rose Valley, Inflow	South Pit	416035	3990462	Alluvial section	2	2 (0)
Indian Wells Canyon, Inflow	-	418471	3948131	Alluvial section	3	-
Little Dixie Wash, Inflow	Locus 1	422956	3935635	Alluvial section	2	2 (1)
Little Dixie Wash, Inflow	Locus 3	422592	3935262	Alluvial section	5	5 (1)
Little Dixie Wash, Inflow	Locus 4	421761	3935245	Alluvial section	3	3 (0)
Little Dixie Wash, Inflow	Locus 5	420471	3934298	Alluvial section	2	-
Dove Springs Wash	Locus 5771	408904	3918620	Alluvial section	2	3 (2)
China Lake Basin	Core 9	434038	3955277	Core	2	2 (0)
China Lake Basin	Couch et al.(2004) Core SB01	423635	3961800	Core	3	2 (0)
China Lake Basin	Couch et al. (2004) Core SB05	437475	3944908	Core	1	4 (4)
China Lake Basin	China Lake tufa knoll	445330	3950497	Surface	1	-
Overflow Area	Salt Wells Valley, outlet beach	447540	3949962	Surface	1	1 (1)

Notes: [a] NAD 83 Zone 11; [b] One additional sample was obtained from Little Dixie Wash locality 2. It contained ostracodes identical to those from localities 1 and 5. Nine other samples from Couch et al. (2004) cores TTIWV-SB08, -SB10, and -SB28, and one sample from Core 8 retrieved during the current study, were also analyzed for micro-invertebrates. These samples remain undated and are of little analytical utility (see Appendix D).

Inflow Record Sampling

In Rose Valley we documented and sampled alluvial strata at six separate geological localities in the central and southern part of the valley trough. Five of the sample loci were located near the main valley axis where evidence of the former Owens River channel is still visible (North and South Borrow Pits, Lava End, Rose Valley Flat, and Cinder Flat). The sixth locality was an isolated playa in the southwest part of the valley (Dead Chevy Flat).

Most of the stream channels draining the eastern Sierra Nevada and El Paso Mountains into the Indian Wells Valley were found to lack exposed deposits of appropriate age. We were, however, able to identify and sample nine localities that had small isolated alluvial terraces dating to the Terminal Pleistocene/Early Holocene. These sample localities were situated within three separate drainages emanating from the eastern slope of the Sierra. These include Indian Wells Canyon (1 locality) and Little Dixie Wash (seven localities), which drain into Indian Wells Valley/ China Lake Basin, and Dove Springs Wash (one locality), which drains southeast through Red Rocks Canyon into Koehn Lake Basin (Figure 6).

Lake Level and Outflow Record Sampling

As part of our evaluation of the inflow and outflow history of China Lake Basin, we combined an examination of lake shore features visible on the surface with a coring program in the central and northwest parts of Indian Wells Valley. Lake features such as beach deposits, barrier ridges, strand lines, wave-cut platforms, and calcareous tufa formations occur throughout China Lake Basin, offering direct evidence of the existence of former lake stands at different elevations (Couch et al. 2004; Davis 1975; Davis and Panlaqui 1978; Gale 1915; Kunkel and Chase 1969; Lee 1913; Moyle 1963; St.-Amand 1986). In an effort to determine the age and altitude of

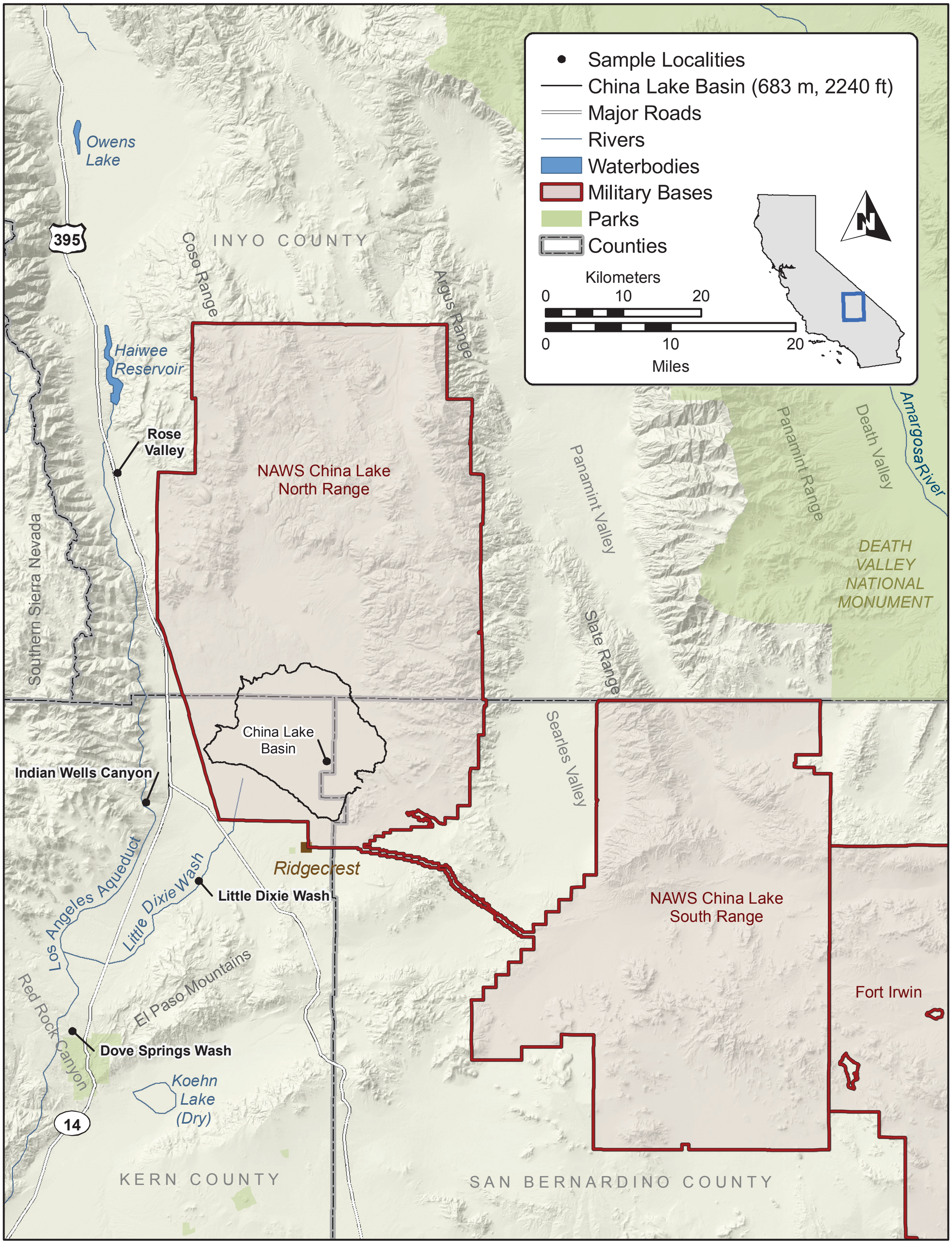


Figure 6. Landscape Features and Geological Sample Locations in the China Lake Environs.

particular lake stands, we examined and documented several such features in portions of the NAWS China Lake. Examination and documentation of these lake-related features also focused on upper Salt Wells Valley and Poison Canyon which forms the hydrological conduit between China Lake and Searles Basin. This examination was focused in the Main Magazines and Ordnance T & E areas within NAWS China Lake and down-stream localities in Poison Canyon. At two geological localities, samples were collected and dated.

As part of the coring effort, we sampled seven geological locations in China Lake Basin and along the former Owens River fan in Indian Wells Valley. Sediments were recovered in cores from depths between about two and 13 meters (~6 and 45 feet) below ground surface using a 4-inch diameter hollow-stem auger. Five cores (3 through 7) on the Owens River fan were found to contain stratified alluvial deposits of terrestrial origin, but lacked datable material and evidence of lacustrine deposition (note: access precluded drilling at locations originally designated as cores 1 and 2). The two cores (Core 8 and 9) recovered along the margins of China Lake Basin recorded a sequence of terrestrial and lacustrine deposits. Of these, further study focused on Core 9 because it contained the most detailed and unambiguous record of lake and distal fan deposition.

Alluvial and lacustrine deposits previously recovered in select cores from Indian Wells Valley/China Lake Basin (Couch 2003) were also examined and five stratigraphic samples from two of these earlier cores (SB-1 and SB-5) were radiocarbon dated, and several samples were subjected to ostracode analysis. These samples, however, are excluded from further consideration because the results proved stratigraphically inconsistent and largely irrelevant (too old) for the current study.

Soil and Strata Designations and Descriptions

Stratigraphic units (strata) recorded in cores and cut-bank exposures were identified on the basis of physical composition, superposition, relative soil development, and/or textural transitions (i.e., upward-fining sequences) characteristic of discrete depositional cycles. Each exposed stratum was assigned a Roman numeral (I, II, III, etc.) beginning with the oldest or lowermost stratum and ending with the youngest or uppermost stratum. Buried soils (also called paleosols), representing formerly stable ground surfaces, were identified on the basis of color, structure, horizon development, bioturbation, lateral continuity, and the nature of the upper contact with the overlying deposit, as described by Birkeland et al. (1991), Holliday (1990), Retallack (1988), and Waters (1992), among others. Detailed descriptions of sample localities are provided in Appendix A.

Master horizons describe in-place weathering characteristics and are designated by upper-case letters (A, B, C), and are preceded by Arabic numerals (2, 3, etc.) when the horizon is associated with a different stratum (i.e., 2Cu); number 1 is understood but not shown. Combinations of these numbers and letters indicate the important characteristics of each major stratum and soil horizon; they are consistent with those outlined by Birkeland et al. (1991), Schoeneberger et al. (1998), and the United States Department of Agriculture Soil Survey Staff (1998).

Radiocarbon Dating and Regional Database Compilation

For this study, geological samples were submitted for radiometric analysis to Beta Analytic Inc. (BETA) in Miami, Florida, or the National Ocean Sciences Accelerator Mass Spectrometry Facility (NOSAMS) at the Woods Hole Oceanographic Institution in Massachusetts. All radiocarbon dates reported here (unless otherwise indicated) were calibrated to calendar (solar) years before present (cal BP) according to Stuiver and Reimer (1993) using the CALIB version 6.01 program and intcal04.14c dataset (Reimer et al. 2004) to compensate for secular variations in the cosmic output of radiocarbon over time; by convention, zero years before present (0 BP) equals 1950 AD. The radiocarbon-dating methods and laboratory sample sheets are provided in Appendix B along with the results.

To compensate for regional reservoir effects of old or dead carbon, following the findings of Lin et al. (1998), a correction factor of 330 years was subtracted from all conventional dates obtained on carbonate materials (i.e., tufa, oolites, CaCo3) and freshwater bivalve shells. All dates were then calibrated using the terrestrial dataset for the northern hemisphere. No correction factor was applied to dates on ostracodes or freshwater gastropod samples (e.g., Pigati 2002; Pigati et al. 2004). Individual dates are identified by their original lab number and reported as the calculated median probability intercept, while error ranges are reported at the 2-sigma (95%) confidence interval.

A total of 36 new dates were obtained for this study on geological samples of algal tufa (carbonate), freshwater gastropod shell, organic sediment (peat, soil), and plant remains (roots, pine needle). Dating results and additional information about the new samples are reported in the following sections and presented in Table 2 and summarized in Figure 7.

A regional database of 576 radiocarbon dates from more than 163 separate localities in the Mojave Desert and immediately adjacent regions (e.g., the Owens Valley) was also compiled from published and unpublished sources. The database (Appendix C) includes information on location, elevation, provenience, and stratigraphic context; obtained whenever possible from the primary sources.

In all, we compiled 224 dates (36.6%) from 69 localities in the Indian Wells Valley/China Lake Basin and adjoining areas (Dove Springs Wash, Rose Valley, Searles Valley), and 388 dates from 97 other localities in the Mojave Desert. About three-quarters of the total sample (n=469 or 76.6%) date to between 17,000 and 7000 cal BP, and are relevant for the current study of the Terminal Pleistocene/ Early Holocene transition.

Micro-Invertebrate Sampling and Analysis

A total of 38 geological sediment samples from China Lake Basin (n=20), Dove Springs Wash (n=3), Little Dixie Wash (n=12), and Rose Valley (n=3) were analyzed for micro-invertebrates and mollusks by Dr. Manuel R. Palacios-Fest (Appendix D). Only 11 of the samples contained ostracodes or mollusk shells. In addition, 24 valves of the ostracode species *Ilyocypris bradyi* from two localities (Dove Springs Wash and North Borrow Pit) were used to conduct stable isotope (δ13C and δ18O) analysis at the Environmental Isotope Laboratory of the University of Arizona. A complete description of methods and results of the micro-invertebrate and mollusk analyses are presented in Appendix D.

PROJECT RESULTS

This discussion is divided into three parts. First, inflow records are presented, organized by drainage. Then Lake Level records are considered. Finally, the China Lake overflow records are discussed. The location and extent of detailed maps for each sample locality are presented in Figure 8.

Inflow Records

This section includes a discussion of the Rose Valley geological localities followed by consideration of those localities situated further to the southwest that drain the eastern Sierra Nevada (Indian Wells Canyon, Little Dixie Wash, and Dixie Wash). This is followed by a synthesis of the inflow history during the Terminal Pleistocene and Early Holocene.

Rose Valley Locality

As the main conduit for water flow between Owens and China lakes, geomorphic evidence from Rose Valley is critical for understanding the fluvial history of these adjacent lake basins. Rose Valley ranges in elevation from about 1,067 meters (~3,500 feet) amsl at its northern end, about 78 meters (~256 feet) below the Owens Lake outflow sill, to about 1,036 meters (~3,400 feet) amsl at its southern end, and about 1,200 meters (~3,937 feet) above the China Lake outflow sill. The valley's long axis trends from northwest to southeast and is relatively small; about 18.5 kilometers (11.5 miles) in length and ten kilometers (~6.2 miles) in width. It is bounded on the west by faults along the base of the eastern Sierra Front Range (dominantly granitic rocks), and on the east by faults at the base of the Coso Range and Darwin Hills (dominantly volcanic rocks). Outcrops of Pliocene rhyodacite occur at the northern end of the valley, and Pleistocene basalt flows (e.g., Little Lake and Red Hill) outcrop at its southern end (Duffield and Bacon 1981; Duffield and Smith 1978; Jayko 2009).

Table 2. Radiocarbon Sample Dating Results for this Study Listed by Lab Number.

County, Locality, Locus	Context and Description	Material Dated	Mean Depth cm	14C CRY BP	±	12C/13C	Lower 2-Sigma	Cal BP (Med. Prob.)	Upper 2-Sigma	Laboratory No.
KER, Indian Wells Canyon	Profile IK-01, 2Ab buried fan/terrace	Soil (SOM)	270	8790	40	nr	9627	9811	9939	Beta-237061
KER, China Lake, Core SB01	Bore Hole TTIWV-SB01	Organic sediment	5258	16250	80	-25.5	19215	19416	19583	Beta-249418
KER, China Lake, Core SB01	Bore Hole TTIWV-SB01	Soil (SOM)	6371	12160	70	-27.4	13788	14008	14224	Beta-249419
KER, China Lake, Core SB05	Bore Hole TTIWV-SB05	Organic sediment	3079	180	40	-22.8	131	176	230	Beta-259414
KER, China Lake, Core SB05	Bore Hole TTIWV-SB05	Plant (parts)	3201	>Mod.	na	-22.4				Beta-259415
KER, China Lake, Core SB05	Bore Hole TTIWV-SB05	Plant (pine needle)	5700	>Mod.	na	-21.9				Beta-259416
INY, Rose Valley flat	Auger 2, Rose Valley Flat	Organic sediment	15	7320	80	-23.7	7994	8129	8323	Beta-260150
INY, Rose Valley, Cinder flat	Auger 4, Cinder Flat	Organic sediment	70	9180	100	-22.8	10184	10369	10588	Beta-260151
INY, Rose Valley, Lava end	Column Sample, Lava End; 2Ab horizon below Cartago soil	Organic sediment	60	4440	80	-23.0	4867	5074	5295	Beta-260152
INY, Rose Valley, Lava end	Column Sample, Lava End; black mat below Cartago soil	Organic (black mat)	165	9410	100	-24.5	10372	10656	10887	Beta-260153
INY, Rose Valley, Lava end	Column Sample, Lava End; black mat below Cartago soil	Organic (black mat)	180	8120	100	-23.1	8703	9065	9321	Beta-260154
INY, Rose Valley, Lava end	Lava End Rose Valley Flat; 2Ab horizon below Cartago soil	Organic sediment	50	6770	100	-22.2	7458	7627	7797	Beta-260155
INY, Rose Valley, Chevy flat	Auger 7, Dead Chevy Flat, 2Ab	Soil (SOM)	90	9720	100	-24.1	10742	11097	11289	Beta-260156
KER, Indian Wells Canyon	Profile IK-01, 3Ab soil near base of cutbank	Soil (SOM)	300	9750	50	-24.5	11088	11190	11250	Beta-272225
KER, Indian Wells, Little Dixie	Locality 1, cutbank along west side of wash, 2Ab	Shell (gastropod)	175	10000	60	-11.6	11262	11486	11722	Beta-272226
KER, Indian Wells, Little Dixie	Locality 1, cutbank along west side of wash, 2Ab	Soil (SOM)	198	9610	50	-25.3	10766	10944	11167	Beta-272227
KER, Indian Wells, Little Dixie	Locality 1, cutbank along west side of wash, 3Ab	Soil (SOM)	270	10120	60	-25.6	11590	11746	11988	Beta-272228
KER, China Lake, Core 9	Core 9, 6Cg, pale olive silty clay, distal fan, slough, or playa above coarse beach deposit	Organic sediment	427	9690	50	-26.3	11067	11123	11225	Beta-280679
KER, China Lake, Core 9	Core 9, 11Cg, olive gray near-shore sand below coarse beach deposit	Organic sediment	1064	14610	50	-24.6	17501	17780	18026	Beta-280680
KER, Indian Wells, Little Dixie	Local 4, Auger 1, T-3(?) terrace, 3Ab horizon	Soil (SOM)	155	9930	40	-25.2	11235	11324	11410	Beta-280681
KER, Indian Wells, Little Dixie	Local 4, Auger 1, T-3(?) terrace, 7Ab horizon	Soil (SOM)	268	10450	40	-25.5	12202	12387	12549	Beta-280682
SBR, China Lake, tufa knoll	Algal tufa on granitic knoll W of lake outlet	Carbonate (tufa)	1	11440	50	4.6	12773	13000	13138	Beta-280683
INY, Rose Valley, north pit	RV-NCTP-3Cu Strat. II, within coarse channel facies	Organic sediment	255	8790	40	-25.0	9627	9811	9939	Beta-280684
INY, Rose Valley, south pit	RV-SCTP-4Ob Strat. II, lower playa, east side	Organic sediment	470	11560	50	-25.9	13276	13395	13567	Beta-280685

Table 2. Radiocarbon Sample Dating Results for this Study Listed by Lab Number *continued*.

County, Locality, Locus	Context and Description	Material Dated	Mean Depth cm	14C CRY BP	±	12C/13C	Lower 2-Sigma	Cal BP (Med. Prob.)	Upper 2-Sigma	Laboratory No.
SBR, Searles, Salt Wells Valley	Beach sand, marl, *Anodonta* and snail shells on wave-cut bedrock platform	Shell (gastropod)	1	11550	50	-8.0	13267	13387	13537	Beta-280686
KER, Indian Wells, Little Dixie	Local 4, Auger 1, T-3(?) terrace, 5Ab horizon	Soil (SOM)	210	10510	50	-25.6	12375	12473	12610	Beta-280734
KER, Indian Wells Canyon	Profile IK-01, 6Ob, thin peaty layer near base	Organic sediment	373	10240	50	-24.8	11758	11984	12142	Beta-280735
KER, Dove Springs Wash	DSW-L#5771-5Ab Strat. X (IX in field)	Soil (SOM)	107	4230	40	-23.4	4685	4753	4861	Beta-280993
KER, Indian Wells, Little Dixie	Fan Local 5, left bank, 3Ab, flaketool in 3Cu	Soil (SOM)	233	6990	40	-23.2	7718	7827	7882	Beta-281207
KER, Indian Wells, Little Dixie	Fan Local 5, left bank, 4Ab, below flaketool	Soil (SOM)	285	6340	40	-23.2	7168	7273	7331	Beta-281208
KER, Dove Springs Wash	DSW-L#5771-5Ab Strat. X	Plant (roots)	107	>Mod.	na	-21.3				OS-79559
KER, Dove Springs Wash	DSW-L#5771-13Ab Strat. I, basal unit	Soil (SOM)	440	10300	60	-25.4	11953	12102	12393	OS-79560
KER, Indian Wells, Little Dixie	LDW-L#2-2Ab Strat. II, east bank	Plant (roots)	35	>Mod.	na	-20.4				OS-79561
KER, Indian Wells, Little Dixie	LDW-L#2-3ABkb Strat. I, east bank	Plant (roots)	55	>Mod.	na	-26.2				OS-79562
KER, Indian Wells, Little Dixie	LDW-L#3-4Ab Strat. IV, with snails, west bank	Soil (SOM)	263	10000	55	-24.9	11263	11482	11717	OS-79563
KER, Indian Wells, Little Dixie	LDW-L#3-6Ab Strat. II, west bank	Soil (SOM)	320	10100	55	-25.5	11399	11697	11844	OS-79564
KER, Indian Wells, Little Dixie	LDW-L#3-7Ab Strat. I, basal unit, west bank	Soil (SOM)	350	10500	60	-25.7	12369	12454	12598	OS-79565
INY, Rose Valley, north pit	RV-NCTP-3Cu Strat. II, channel facies, north	Plant (roots)	255	>Mod.	na	-13.1				OS-79566
INY, Rose Valley, south pit	RV-SCTP-4Ob Strat. II, lower playa, east side	Plant (roots)	470	>Mod.	na	-12.7				OS-79567
INY, Rose Valley, north pit	RV-NCTP-2Ab Strat. III, north wall	Soil (SOM)	75	985	45	-22.0	788	883	971	OS-79583
KER, Indian Wells, Little Dixie	LDW-L#3-3Ab Strat. V, with snails, west bank	Soil (SOM)	203	9440	95	-25.2	10479	10703	11099	OS-79584
KER, Indian Wells, Little Dixie	LDW-L#3-5Ab Strat. III, weak soil, west bank	Soil (SOM)	298	10100	110	-25.1	11271	11688	12058	OS-79585
KER, Dove Springs Wash	DSW-L#5771-8Ab Strat. VI, with snails	Plant (roots)	223	>Mod.	na	-24.5				OS-79586
INY, Rose Valley, south pit	RV-SCTP-3Ab Strat. III, upper playa, east side	Soil (SOM)	210	9980	55	-24.1	11250	11447	11645	OS-79587

Notes: Samples Beta-259414, -259415, -259416, 249418 and -249419 were obtained from cores previously reported by Couch (2004) and were stored at the core repository at UC Bakersfield when accessed for the current project. We assume based on the modern dates, that Samples Beta-259414, -259415, -259416 were contaminated with recent organics at some point following collection. Samples OS-79559, -79561, -79562, -79566, -79567, -79586 are modern root fractions. A miscommunication with the radiocarbon laboratory resulted in analysis of these modern contaminants, rather than the organic sediment (SOM) fraction intended.

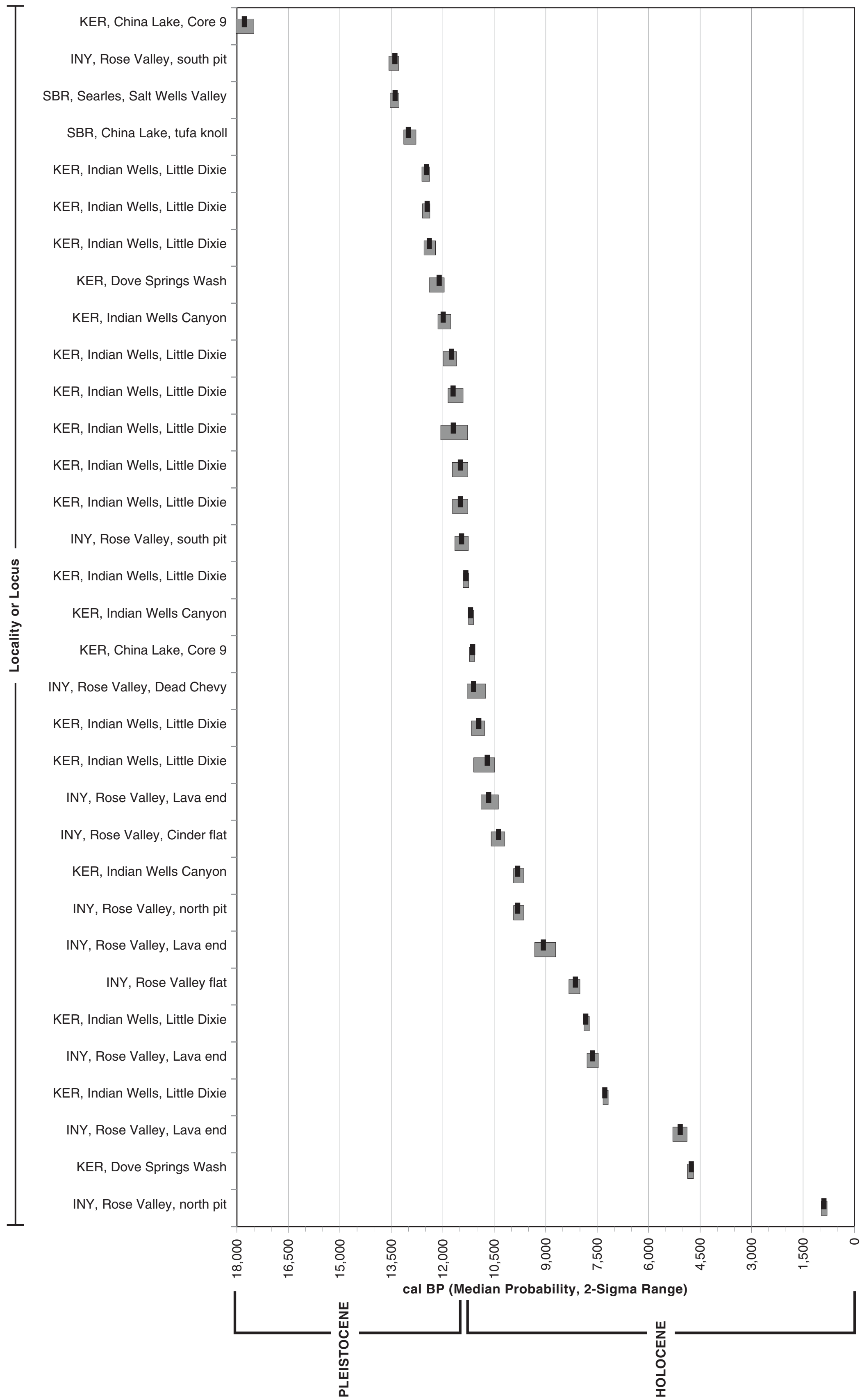


Figure 7. Distribution of Radiocarbon Dates from this Study.

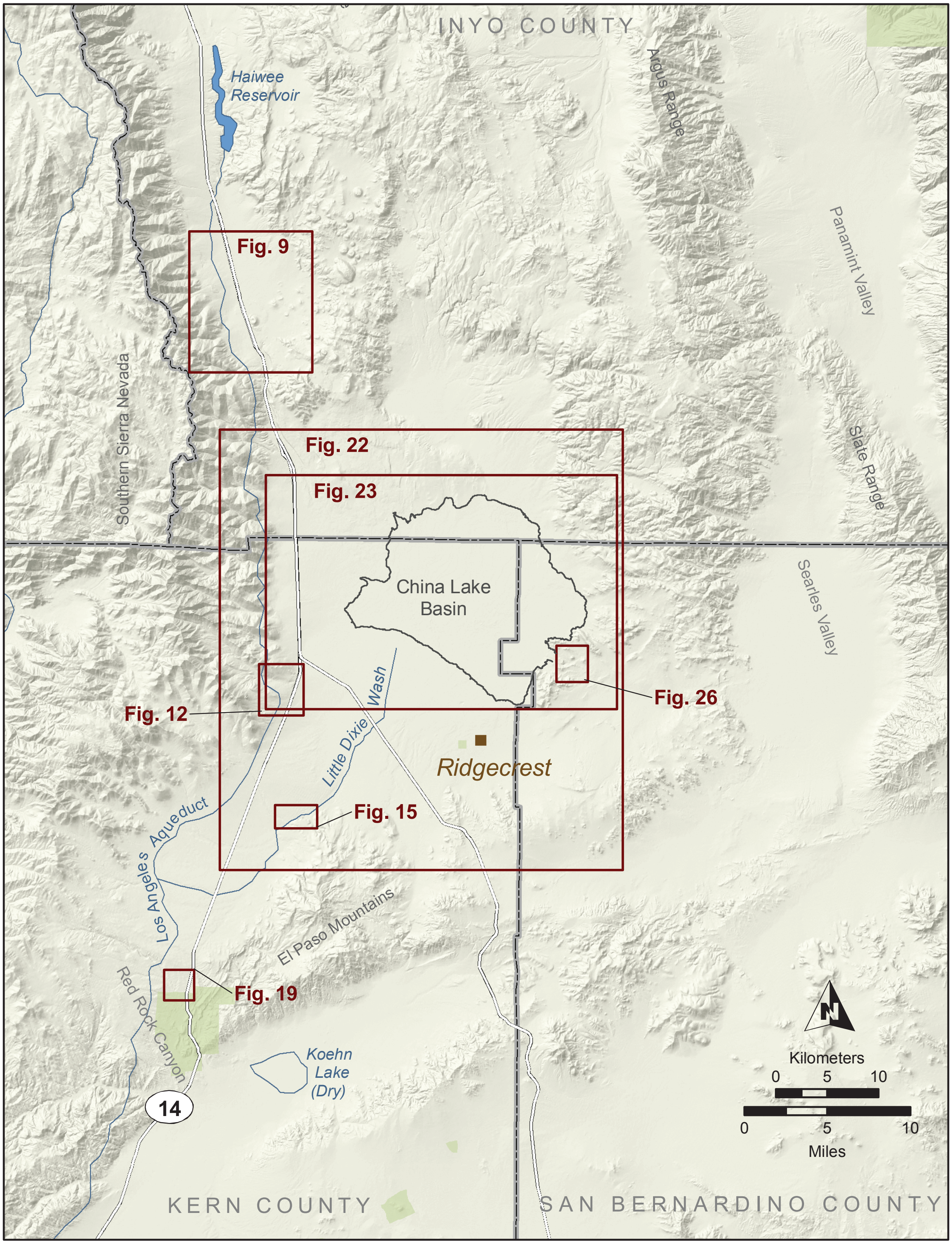


Figure 8. Index Map Showing Location and Extent of Detailed Maps for Geological Sample Localities.

A complex series of Pleistocene- and Holocene-age alluvial fans coalesce around the valley margins to form sloping aprons along its eastern and western sides. Recent alluvial deposits are more localized and largely restricted to the lowest-lying portions of the valley floor (Jayko 2009). All six geological localities reported below occur within these recent deposits and are inset below higher and older fan remnants originating at the base of the eastern Sierra (Figure 9). Distinctive natural features within the valley include a relatively young volcanic cinder cone (Red Hill), a paleo-waterfall carved into basalt by the Owens River channel (Fossil Falls), and a spring-fed body of water known as Little Lake, all located in the southern part of the valley. Paleoenvironmental records indicate a meadow, salt grass marsh, and shallow ponds existed at Little Lake between about 5800 and 3200 cal BP, suggesting the water table was nearly 13 meters lower then than at present (Mehringer and Sheppard 1978:165).

Borrow Pit Loci

The north and south borrow pits are situated near the center of Rose Valley about 1.25 kilometers (~0.78 miles) and 0.4 kilometers (0.25 miles) due north of Gill Station/Coso Road, and roughly 1.1 kilometers (0.7 miles) and 1.6 kilometers (1.0 mile) due east of State Route 395, both respectively (Figure 9). The pits lie about 0.8 kilometers (0.5 miles) apart within the relatively flat valley-axis alluvial unit of Jayko (2009). Both pits have irregularly cut sloping-side walls that expose alluvial deposits from a few meters to several meters below the original ground surface (Figure 10). Each was excavated by Caltrans in the 1960s to extract sand and gravel deposited by the lower Owens River and alluvial fans emanating from the eastern Sierra.

South Borrow Pit

In the south pit, a six-meter-thick, vertically stratified sequence of channel, floodplain, lacustrine/paludal, and eolian deposits is exposed along the eastern side. The basal stratum (Stratum I-5Cu) consists of coarse sand that grades downward into rounded to subrounded gravel and cobbles with sorting and bedding that clearly represent the bed load of a formerly active stream or river channel (Figure 11). This stratum is overlain by a thin layer of dark organic-rich silt (Stratum II-4Ob, or black mat 1) that marks a transition from high-energy to low-energy depositional conditions. A radiocarbon date from Stratum II (11,560 ± 50 BP, or 13,395 cal BP, Beta-280685) indicates this transition occurred during the Terminal Pleistocene.

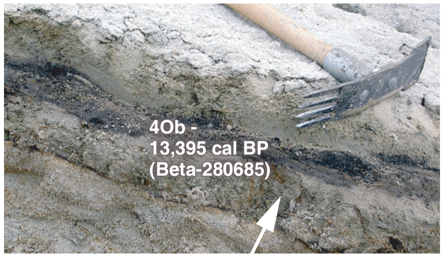
Above these strata lies a relatively thick deposit of light-colored silt loam (Stratum III-3Cu) with a very prominent dark organic-rich horizon in the upper 0.5 meters (Stratum IV-3AOb, or black mat 2; Figure 11). The uniform fine-grained texture, light lower and dark upper horizons, and presence of mesic-adapted snails indicate this stratum was deposited in a shallow lake or wetland setting, as noted by Jayko (personal communication August 2010). A sample of the 3OAb horizon of Stratum III submitted for this study yielded a radiocarbon date of 9980 ± 55 BP, or 11,447 cal BP (OS-79587), and a nearly identical date of 10,000 ± 40 BP, or 11,473 cal BP (WW-4519) was obtained by Jayko (personal communication August 2010) on a second sample from the same horizon. This evidence confirms the presence of lacustrine/paludal (marsh) environments in Rose Valley during the transition from the Terminal Pleistocene to Early Holocene.

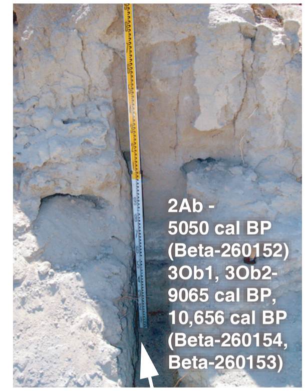
The prominent upper black mat is abruptly overlain by a fining-upward deposit of loam and loamy sand of mixed alluvial and eolian origins in which a weakly developed soil has formed (Stratum V-2Ab/2Cu). Overlying this is a deposit (Stratum VI) of pale brown coarse sand that contains a poorly sorted mixture of gravel and cobbles whose origin can be attributed to a combination of alluvial and eolian processes within the valley axis (Figure 11).

North Borrow Pit

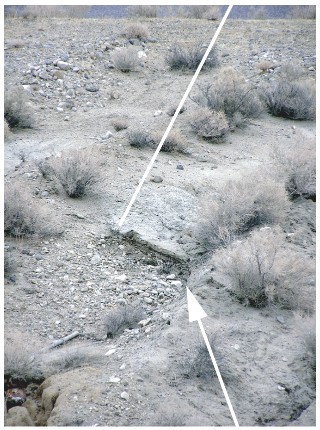
The north pit contains a sequence of vertically stratified channel, floodplain, and eolian deposits that were exposed in a five-meter-thick section on the pit's northeastern side. Here, the basal stratum (Stratum I-4Cu4) consists of coarse sand with weakly sorted and poorly bedded subangular to well-rounded gravel and cobbles that appear to be an alluvial fan deposit (Figure 11). This stratum is overlain by a relatively thin layer of

Figure 9. Rose Valley Landscape Features and Sample Loci.

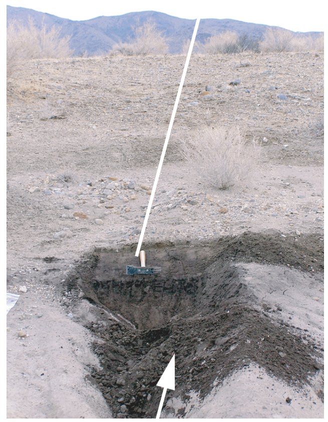




Middle Holocene Alluvial Fan Deposits Overlying Early Holocene Black Mats in Pauludal Deposit at Lava End Locus



Channel Deposit Below Black Mat (4Ob) in South Borrow Pit



Black Mat (3AOb) in Paludal Deposit, South Borrow Pit

Organic Silt (3Cu) in Alluvial Fan Deposit, North Borrow Pit

Lava End Sample Location Rose Valley, Inyo County, View to South

Overview of South Borrow Pit Locus to Northeast

Overview of North Borrow Pit Locus to Northwest

Lava End Sample Location Rose Valley, Inyo County, View to Northeast

Figure 10. Rose Valley Alluvial Landforms and Stratigraphy.

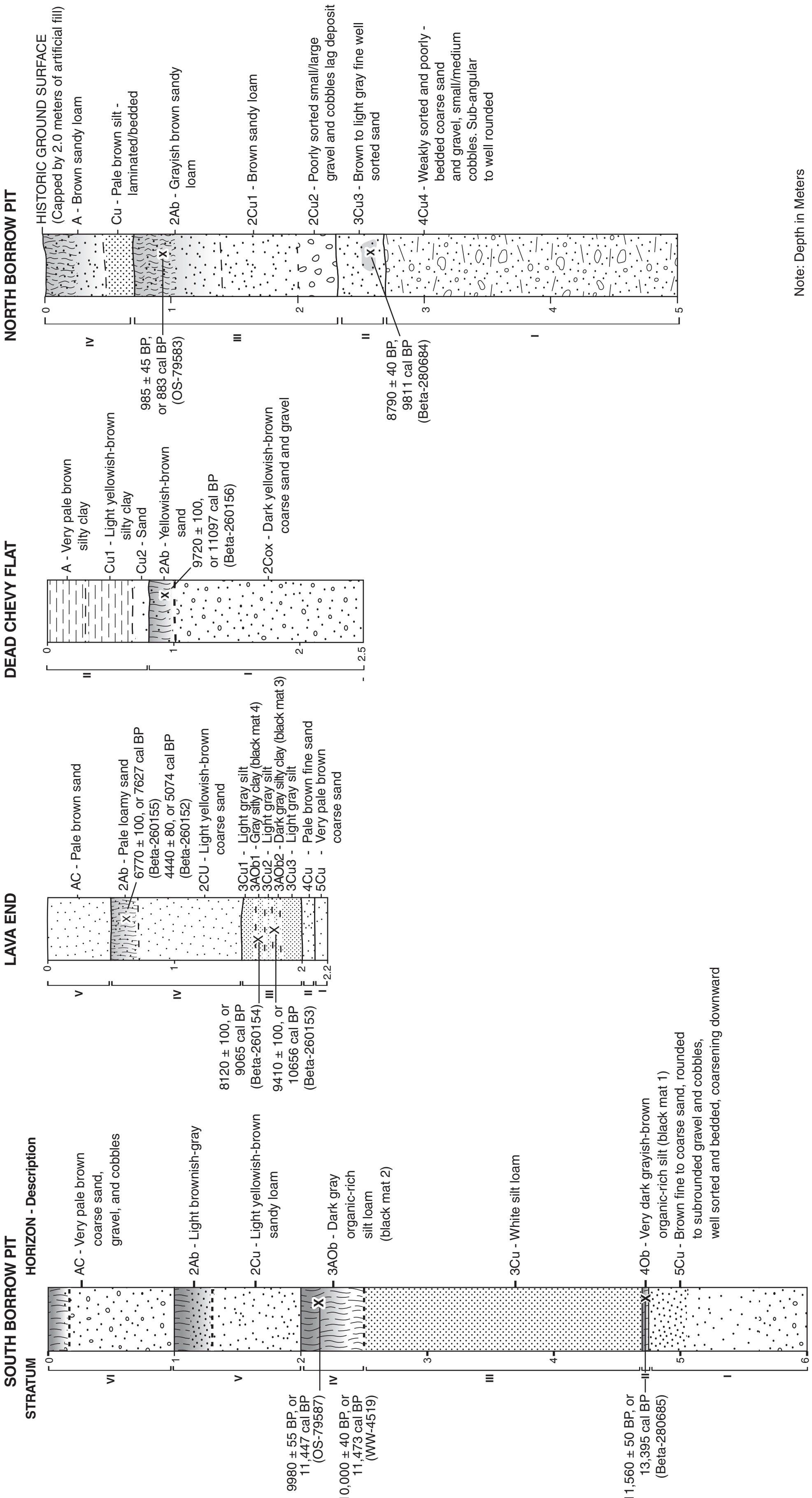


Figure 11. Alluvial Stratigraphy of Selected Rose Valley Loci.

fine, well-sorted sand containing a dark organic silt lens that pinches out to the west (Stratum II-3Cu3), marking a transition from high-energy to lower-energy depositional conditions. A date from the silt lens of 8790 ± 40 BP, or 9811 cal BP (Beta-280684) indicates that this transition occurred during the Early Holocene.

Three species of micro-invertebrates (two ostracodes and one mollusk) occurred in the 3Cu Horizon (see Appendix D, Table 5). The ostracodes *Ilyocypris bradyi* and *Fabaeformiscandona acuminata* suggest a dilute, spring source. *F. acuminata's* salinity tolerance is below 1,000 milligrams L-1 total dissolved solids (TDS) (Forester et al. 2005) implying that the sample location is close to the water source (see Appendix C, Table 4). Two mollusk specimens of *Tryonia* sp. were also identified in the sample (see Appendix C, Table 7). The genus *Tryonia* is known to prefer low-to-moderate salinity (1,000-2,000 milligrams L-1 TDS; Sharpe 2002, 2003; Appendix D, Table 6).

Five valves of *I. bradyi* were analyzed for carbon and oxygen isotopes. As discussed in the Results section of Appendix D, the δ18O value obtained from the 3Cu samples are the most positive obtained from the China Lake region suggesting either arid conditions prevailed during the Early Holocene or rainfall was more seasonal (e.g., monsoons; Appendix D, Table 8).

The sand lens is abruptly overlain by an erosional lag deposit of poorly sorted small-to-large gravel and cobbles (Stratum III-2Cu2) that fines-upward into a sandy loam in which a weakly developed soil has formed (Stratum III-2Ab/2Cu1). The mixed nature of Stratum III likely reflects the influences of both alluvial and eolian processes. A date of 985 ± 45 BP or 883 cal BP (OS-79583) from the 2Ab horizon provides a minimum age for Stratum III, and a maximum age for the deposit of alluvial silt and sandy loam that overlies it (Stratum IV-A/Cu). Finally, this section is overlain by about 2.0 meters of artificial fill derived from the borrow activities (see Figure 11).

Neighboring Geological Localities—Dead Chevy Flat, Cinder Flat, Rose Valley Flat, and Lava End

Other Early Holocene dates were obtained from buried soils and organic black mats identified in small surface playas elsewhere in the valley. At Dead Chevy Flat to the southwest of the borrow pits (see Figure 9), a buried soil (2Ab) that formed on a fan deposit of coarse sand and gravel (Stratum I-2Cox) provided a date of 9720 ± 100 BP, or 11,097 cal BP (Beta-260156). This buried soil was overlain by light-colored, fine-grained playa deposits (Stratum II in Figure 11).

In the valley axis at the Lava End locality (see Figure 9), a six-stratum sequence was identified in which coarse and fine sand (Stratum I-6Cu and Stratum II-5Ab) is overlain by two vertically stratified organic black mats (Stratum III-3AOb1 and 3AOb2), both formed in silty clay (see Figure 11). The lower 3Ob2 mat is dated at 9410 ± 100 BP, or 10,656 cal BP (Beta-260153), and the upper 3Ob1 mat dates to 8120 ± 100, or 9065 cal BP (Beta-260154). Overlying black mat 4 is a fining-upward deposit of coarse-sand to loamy sand that contains some internal sorting and bedding, consistent with an alluvial origin (Stratum IV-2Ab/2Cu). A weakly developed soil that formed in the upper part of Stratum V yielded radiocarbon dates of 6770 ± 100, or 7627cal BP (Beta-260155) and 4440 ± 100, or 5074 cal BP (Beta-260152), indicating it is Early-to-Middle Holocene in age. Above this lies a moderately indurated, pale brown sand deposit that is probably eolian in origin (see Figure 11).

Dates similar to those from black mat 3 and 4 at Lava End were obtained at nearby Cinder Flat and Rose Valley Flat. Thin, organic-rich buried soils (2Ab Horizons) at these localities yielded dates of 9180 ± 100, or 10,369 cal BP (Beta-260151) and 7994 ± 80, or 8129 cal BP (Beta-260150), respectively (see Figure 9; not depicted in Figure 11 or elsewhere).

Eastern Sierra Drainages

Indian Wells Canyon

Situated on the western side of Indian Wells Valley, this geological locality occurs in the lower part of Indian Wells Canyon about 8.5 kilometers (~5.3 miles) west-northwest of the town of Inyokern, and about 2.9 kilometers (~1.8 miles) west of State Route 14 along Indian Wells Canyon Road; about 100 meters due south of the gravel road (Figure 12). The exposed section lies along the canyon's south side where a north-flowing wash meets the east-west oriented canyon bottom at an elevation of about 1,000 meters (3,280 feet) amsl; roughly 340 meters (1,115 feet) above the floor of China Lake Basin. At this point, the wash is deeply incised through an isolated alluvial terrace that is set against the surrounding granitic bedrock. Incision during the late Holocene has removed a 20-meter-long segment of the terrace, exposing a five meter vertical sequence of 11 alluvial strata along the eastern side of the wash. These strata rest upon steep granitic hill slopes (Stratum I) that are weathered and truncated by erosion (Figure 13).

The basal alluvial stratum (Stratum I-9Cox) is an erosional lag deposit consisting of coarse granitic sand and small subangular-to-subrounded gravel with iron-oxide mottling throughout (Figure 14). This is overlain by a very thin organic mat of dark grayish-brown sandy clay loam (Stratum II-8Ob) that marks a transition from erosional to depositional conditions. This lower mat is covered by a deposit of very fine well-sorted sand that is either alluvial or eolian in origin, or both (Stratum III-7Cu1/7Cu2). Above this is a poorly sorted and bedded channel deposit composed of oxidized sand and gravel (Stratum IV-6Cox) that fines upward into sandy loam containing another thin organic mat at the top (Stratum IV-6Ob). A date of 10,240 ± 50 BP, or 11,984 cal BP (Beta-280753) obtained on this mat confirms it is Terminal Pleistocene in age. This upper mat is buried by a deposit of fine oxidized sand that is massive and probably eolian in origin (Stratum V-5Cox). Capping this stratum is a 20-centimeter thick layer of dark grayish-brown loamy sand that contains a very weakly developed soil (Stratum VI-4Ab).

A deposit of oxidized alluvial sand overlies Stratum VII, which fines upward into loamy sand containing a moderately developed soil (Stratum VII-3Ab/3Cox). A date of 9750 ± 50 BP, or 11,190 cal BP (Beta-272225) obtained on the 3Ab horizon indicates it is Early Holocene in age, and that underlying strata (VI and VII) mark the transition from the Terminal Pleistocene to the Early Holocene.

This soil is buried by a deposit of poorly sorted and well-bedded alluvial sand that grades into grayish-brown loamy sand. It is distinguished by a moderately developed soil that contains some flaked stone debitage of Coso obsidian (Stratum VIII-2Ab/2Cu). A sample of the 2Ab Horizon yielded a date 8790 ± 40 BP, or 9811 cal BP (Beta-237061) demonstrating that it is also Early Holocene-age. This former land surface is covered by about 80 centimeters of brown loamy sand that lacks any obvious soil development (Stratum IX-AC), suggesting it was probably deposited during the Late Holocene (<4000 cal BP).

Little Dixie Wash

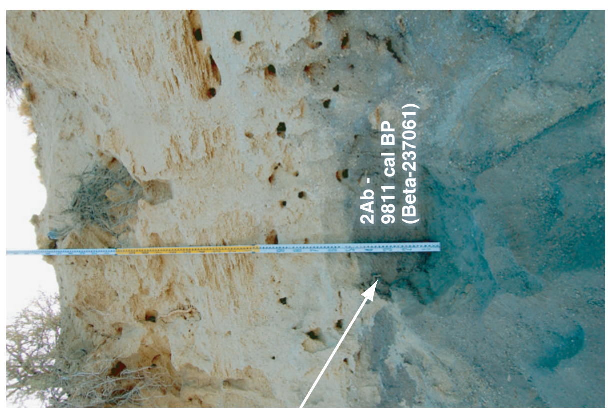
Little Dixie Wash is the largest of the three drainages exiting the eastern Sierra Nevada, where alluvial records from the Terminal Pleistocene/Early Holocene are stored. This geological locality is situated in the southwestern part of Indian Wells Valley about 11 kilometers (~6.8 miles) southwest of the town of Inyokern, and about 6.3 kilometers (~3.9 miles) southeast of the intersection of State Route 14 with State Route 178 (Freeman Junction); more than eight kilometers (five miles) east of the Sierra Nevada Front range (Figure 15). The wash drains from southwest to northeast directly into China Lake Basin and is the main internal drainage for that part of Indian Wells Valley. The portion of the wash examined for this study ranges in elevation from about 860 to 830 meters (2,821 to 2,723 feet) amsl, which is more than 160 meters (~525 feet) above the basin floor, and about one-half the elevation of the Indian Wells Canyon locality. The wash channels runoff from Freeman Canyon, Cow Heaven Canyon, Sage Canyon, Peak Horse Canyon, and Bird Spring Canyon.

The medial portion of Little Dixie Wash contains alluvial terraces that are inset several meters or more below the surface of a broad and highly dissected alluvial fan that emanates from Freeman Canyon to the west (Figure 16). Immediately to the east, a basalt flow—part of the El Paso Mountains—rises more than 95 meters (~315 feet) above the channel (Figure 15). In this section of the wash, the channel is incised through the inset alluvial terrace (T2 terrace) for 2.8 kilometers (~1.75 mile), creating a series of natural bank exposures about one to three meters above the channel bottom. Four sections containing stratified alluvial deposits exposed in the inset terrace were sampled on the western bank of the wash (Localities 1, 3, 4, 5; Figure 15). In addition, two isolated deposits of exceptionally large cobbles were identified within this segment, each forming a ridge on either side of the wash.

Figure 12. Indian Wells Canyon Inset Terrace and Sample Locus.

Indian Wells Canyon Sample Locus and Indian Wells Valley in Distance (east)

Strata Exposed in Incised and Inset Alluvial Fan Terrace to Southeast



Radiocarbon-Dated Strata within Alluvial Fan Terrace

Figure 13. Indian Wells Canyon Sample Locus.

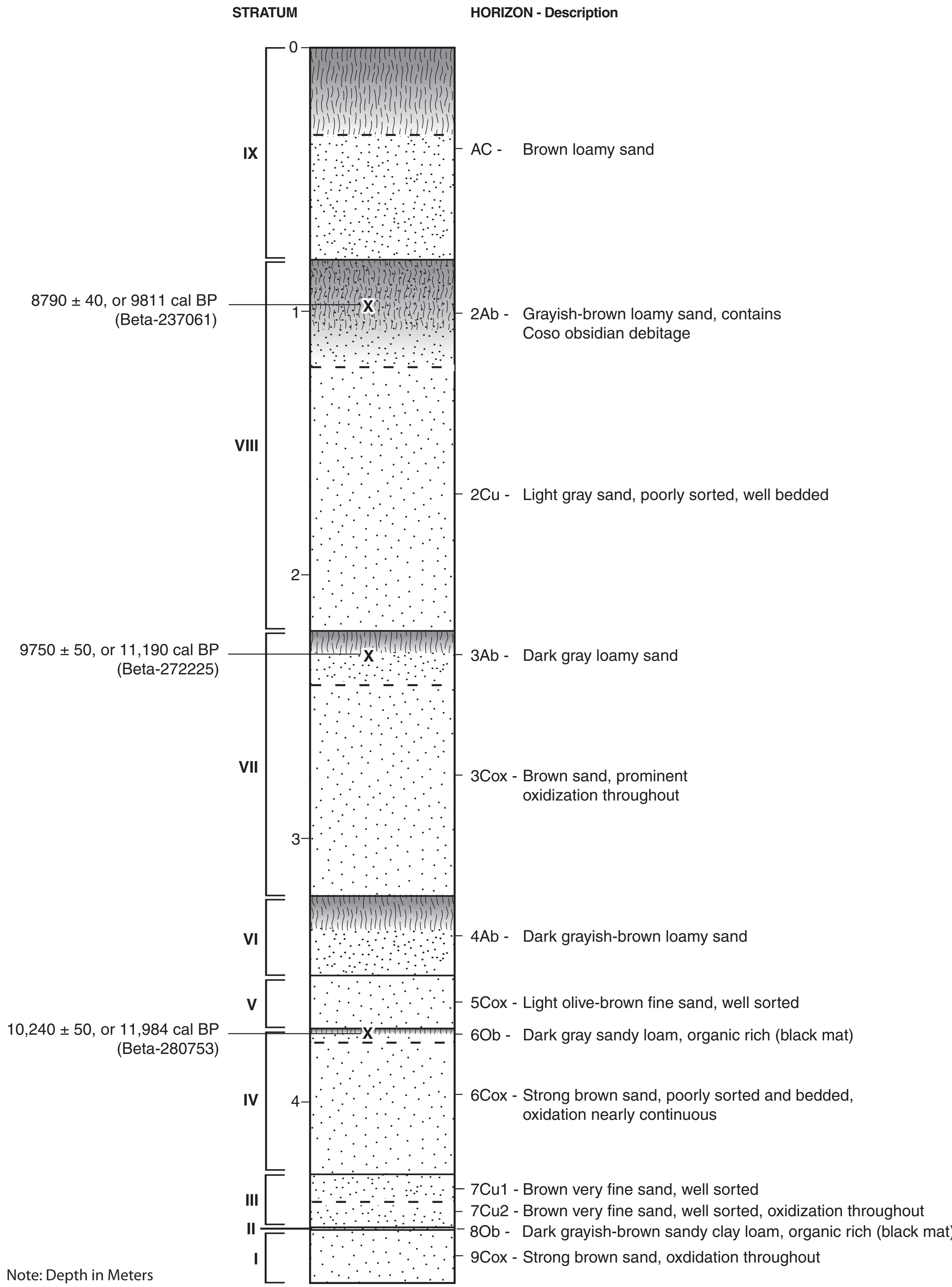


Figure 14. Indian Wells Canyon Terrace Alluvial Stratigraphy.

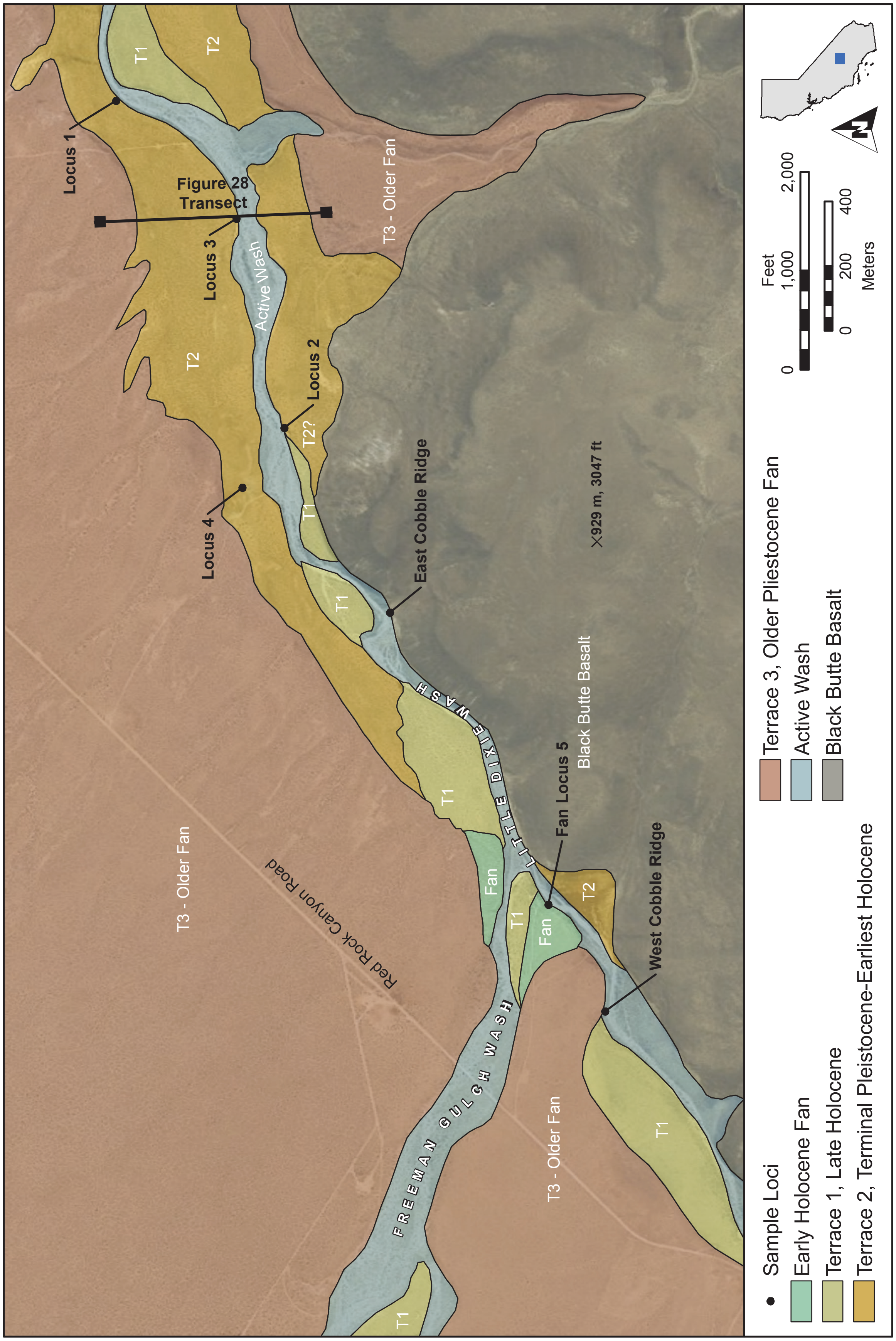
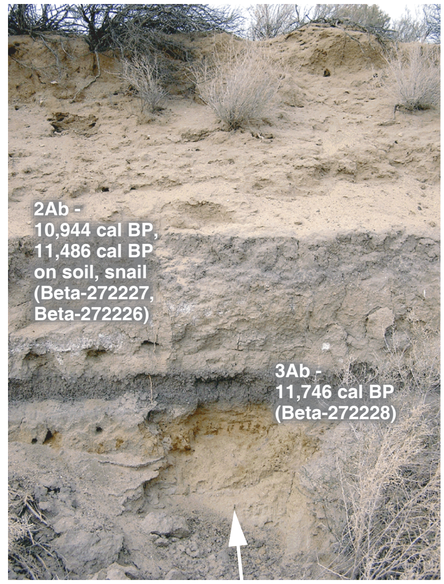
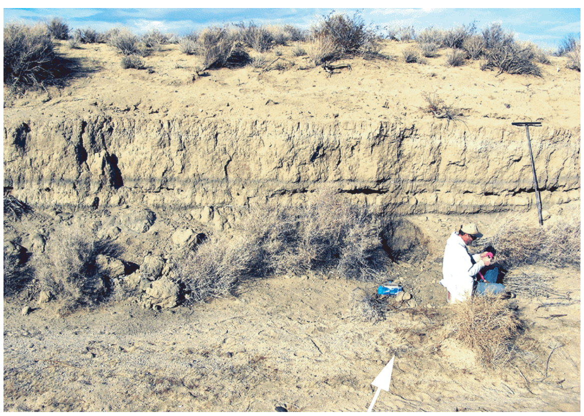


Figure 15. Little Dixie Wash Landscape Features and Sample Loci.

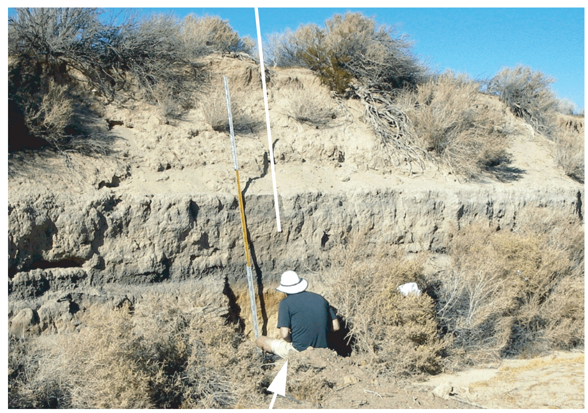
Radiocarbon-Dated Black Mats and
Paludal Deposits at Locus 3 (2-m tape for scale)



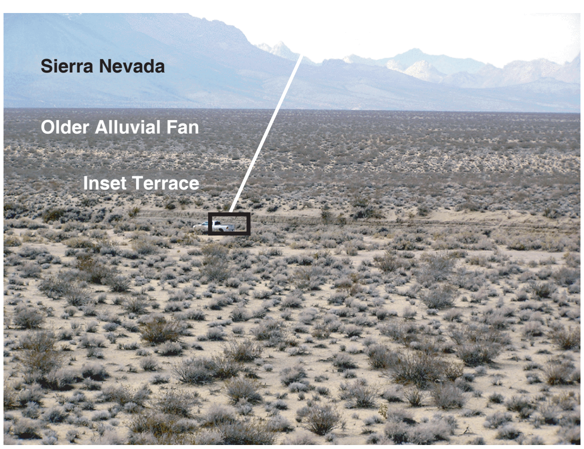
Radiocarbon-Dated Black Mat (3Ab) and
Paludal Deposit (2Ab) at Locus 1



Stratigraphic Section Exposed at Locus 3



Stratigraphic Section Exposed at Locus 1



Overview of Inset Alluvial Terrace at Locus 3 to the West

Overview of Inset Alluvial Terrace at Locus 1 to the North

Figure 16. Little Dixie Wash Alluvial Terrace and Strata.

Alluvial Terrace Stratigraphy (Loci 1-4)

The basal stratum (Stratum I-7Ab/7Cu) is an alluvial deposit consisting of fine sand and small rounded-to-subrounded gravel that gradually fines upward into grayish-brown silty clay, displaying moderate soil development (Figure 17). This stratum was exposed at the base of the Locus 3 cutbank, and was identified in an auger boring at Locus 4 (see Figure 15). The 7Ab horizon proved to be Terminal Pleistocene in age as verified by nearly identical dates of 10,500 ± 60 BP or 12,454 cal BP (OS-79565) from Locus 3, and 10,450 ± 40 BP or 12,387 cal BP (OS-79565) from Locus 4.

Overlying this stratum is a silty clay alluvial deposit that displays a light brownish-gray lower portion and a gray upper portion (Stratum II-6Cu and 6Ab, respectively), with a few small iron-oxide mottles present in both horizons. The 6Ab horizon represents a moderately developed soil that produced a Terminal Pleistocene date of 10,100 ± 55 BP or 11,697 cal BP (OS-79564), which corresponds to a date of 10,160 ± 60 BP or 11,746 cal BP (Beta-272228) on the 3Ab horizon at Locus 1 (Figure 17). At Locus 3 this stratum is capped by an alluvial deposit of light brownish-gray silt loam with common iron-oxide mottles that fines upward into grayish-brown silty clay with fewer mottles and weak soil development (Stratum III-5Cox and 5Ab, respectively). A sample of the 5Ab horizon produced a date of 10,100 ± 110 BP or 11,688 cal BP (OS-79585), nearly identical to the age of the underlying 6Ab horizon.

Lying above Stratum III is alluvial sediment deposited in a paludal environment (see Appendix D). This deposit consists of a light brownish-gray silty loam that fines upward into grayish-brown silty clay, on which is formed a weakly developed soil containing small gastropod shells (Stratum IV-4Cu and 4Ab, respectively). This stratum is Early Holocene in age based on a date of 10,000 ± 50 BP or 11,482 cal BP (OS-79563) on the 4Ab horizon, corresponding closely with dates of 10,000 ± 60 BP or 11,486 cal BP (Beta-272226) and 9610 ± 50 BP or 10,944 cal BP (Beta-272227) from the 2Ab horizon at Locus 1 (see Figure 16 and Figure 17). At Locality 3, Stratum IV is covered by another deposit of alluvial and paludal sediment composed of light yellowish-brown loamy sand that fines upward into light grayish-brown silty clay (Stratum V-3Cu and 3Ab, respectively). The upper portion of this stratum displays a weakly developed soil containing small gastropod shells. A date of 9440 ± 95 BP or 10,703 cal BP (OS-79584) from the 3Ab horizon verifies that this deposit was formed during the Early Holocene.

Stratum V is overlain by a light gray silty clay loam alluvial deposit with a moderately developed ped structure and some powdery calcium carbonate coatings (Stratum VI-2Bwb). Immediately above this fine-grained stratum is a thick deposit of coarse sand and small-to-large gravel formed by the complex interplay of alluvial fan and eolian processes (Stratum VII-A/Cu).

Micro-Invertebrates

Two loci within Little Dixie Wash were sampled and analyzed for micro-invertebrates (LDW-Locus #3 and LDW Locality #4). Ostracodes and mollusks were only identified at LDW-Locus #3 (see Appendix D, Table 3). Three dilute-water, spring-related ostracode species were identified in the 4Ab Horizon of Locality 4, including *Fabaeformiscandona acuminata*, *Eucypris meadensis*, and *Cypridopsis okeechobei*. This assemblage suggests water salinity did not exceed 1,000 milligrams L-1 TDS (Forester et al. 2005). In addition, four aquatic gastropods occurred in the same horizon: *Pseudosuccinea columella*, *Helisoma (Carinifex) newberryi*, *Gyraulus parvus*, and *Fossaria parva* (see Appendix D, Figure 2c). All four species tolerate a wide range of salinity and can occur in a variety of environments from swamps to streams (Sharpe 2002, 2003; see Appendix D, Table 6).

Alluvial Fan Stratigraphy (Locus 5)

As the southernmost (upstream) geological locality along the wash, a vertical sequence of six alluvial strata was documented south of the present confluence of Freeman Gulch and Little Dixie Wash at Locus 5 (see Figure 15). This sequence is part of an alluvial fan that is inset within the gulch below much older deposits of the Freeman Fan (Figure 18). Attention to this locus was sparked by the discovery of a chert-formed flake-tool

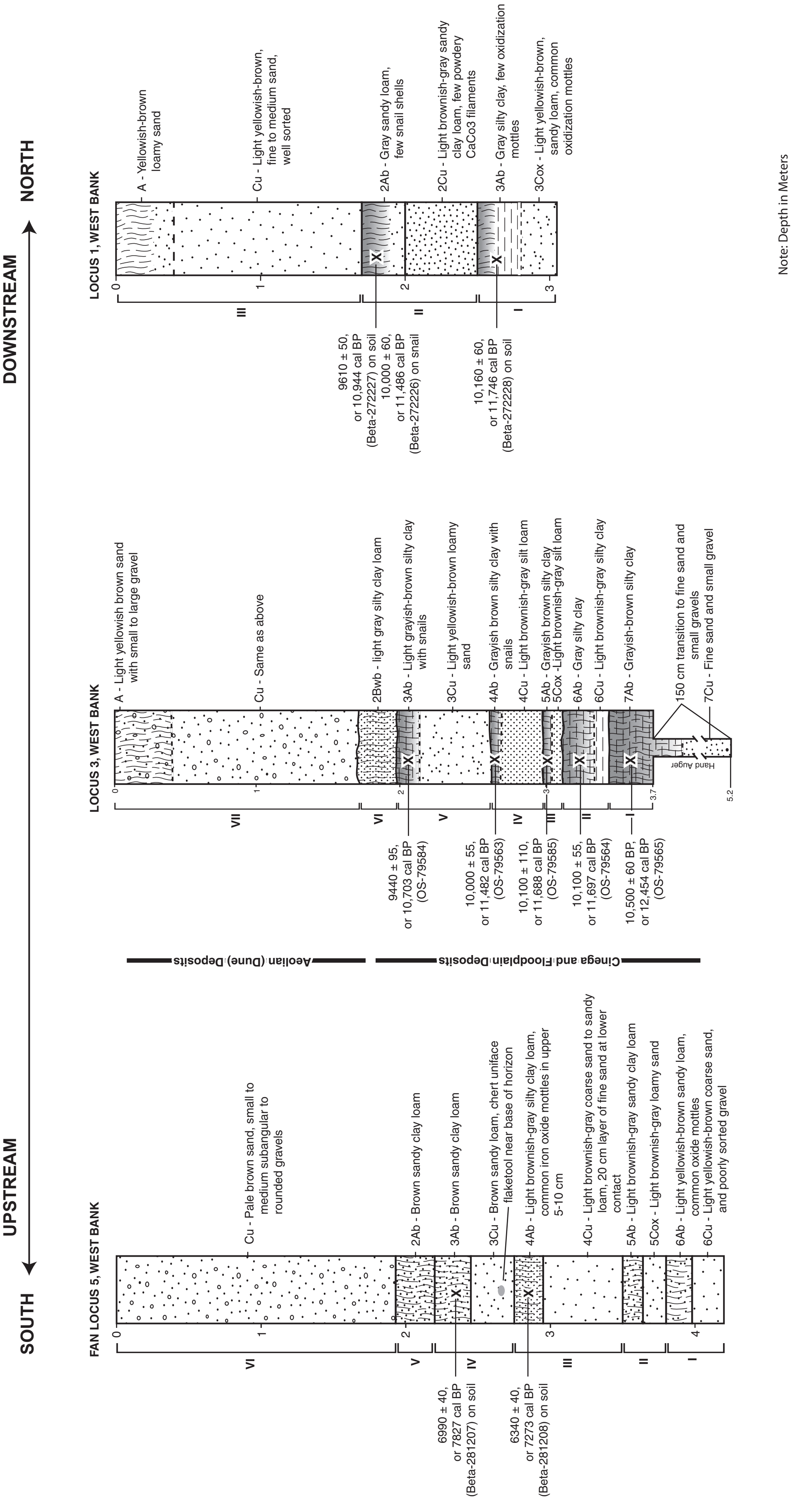
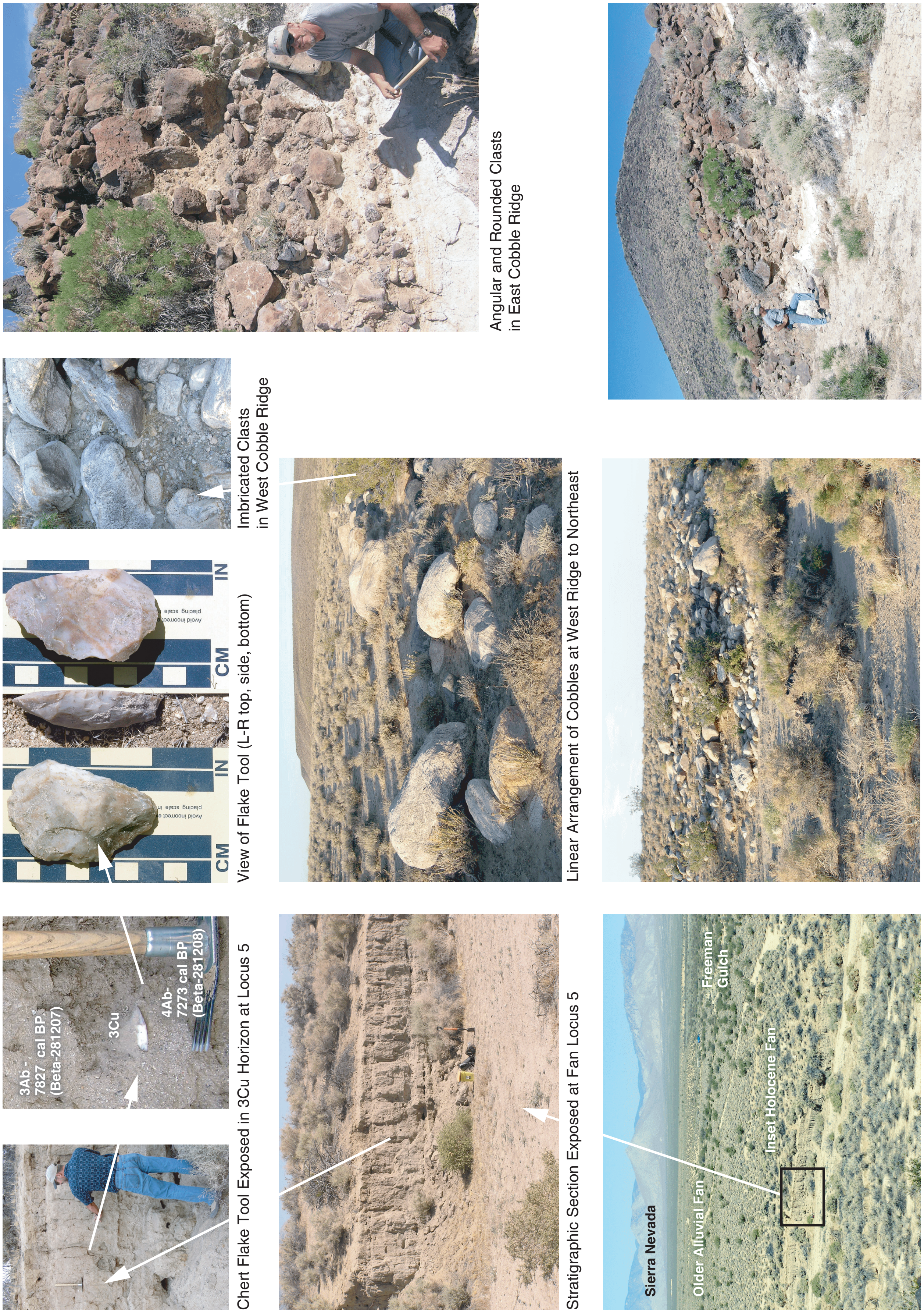


Figure 17. Alluvial Stratigraphy of Selected Little Dixie Wash Loci.



Chert Flake Tool Exposed in 3Cu Horizon at Locus 5

View of Flake Tool (L-R top, side, bottom)

Imbricated Clasts in West Cobble Ridge

Angular and Rounded Clasts in East Cobble Ridge

Stratigraphic Section Exposed at Fan Locus 5

Linear Arrangement of Cobbles at West Ridge to Northeast

Overview of Inset Holocene Fan at Locus 5 to Southwest

Overview of West Cobble Ridge to Northwest

Overview of East Cobble Ridge to Northeast

Figure 18. Little Dixie Wash Alluvial Fan and Cobble Ridge Loci.

protruding from the cut-bank within the wash (see Figure 17); the only in situ prehistoric tool identified during this study. Since similar artifacts are typically associated with Terminal Pleistocene/ Early Holocene cultural assemblages in the Mojave Desert (e.g., Basgall 1993), an effort was made to bracket the artifact's age by obtaining radiocarbon dates from overlying and underlying deposits.

The lower four strata (Stratum I-IV) at Locus 5 consist of coarse sand that fine upward into sandy loam (Stratum I), sandy clay loam (Stratum II and IV), or silty clay loam (Stratum III), each with weakly developed soils formed in the stratum's upper portion (see Figure 17). The presence of a few small angular to subrounded gravel in Stratum I, II, and IV, and the small-to-medium angular to subrounded gravel in Stratum III are typical of an alluvial fan deposit. Iron-oxide mottles also occur in the Ab horizons of Stratum I and III, and the lower part of Stratum II (5Cox horizon).

The artifact was found about five centimeters above the contact of Stratum III and IV within the lower 3Cu horizon of Stratum IV at a depth of about 2.7 meters below ground surface (see Figure 17 and Figure 18). A radiocarbon date of 6340 ± 40 BP or 7223 cal BP (Beta-280208) was derived from the 4Ab horizon of Stratum III underlying the artifact, and the overlying 3Ab horizon of Stratum IV gave a slightly older date of 6990 ± 40 BP or 7827 cal BP (Beta-280208), indicating that some older carbon was probably reworked or redeposited into Stratum IV. Despite the age reversal, this artifact was probably deposited sometime between about 7,800 and 7,200 years ago, or roughly, at the end of the Early Holocene.

Overlying the lower four strata is an alluvial fan deposit of sandy clay loam displaying a weakly developed soil (Stratum V-2Ab; presumably Middle Holocene), capped by a coarse sand with small to medium subangular to rounded gravel formed by alluvial and eolian processes (Stratum VI-Cu; Middle or Late Holocene?). The latter stratum lacks evidence of soil development (see Figure 17). No black mats, organic-rich soils, mesic-adapted snails, or paludal-like deposits occur within the alluvial fan sequence exposed at Locus 5.

Cobble Ridge Loci

Two isolated deposits of small boulders and large cobbles were also identified along the edges of the wash, each forming a distinctive ridge or berm (see Figure 18). The most downstream of these was identified on the eastern side of the wash about 585 meters (1,919 feet) southwest of Locus 4 at an elevation of about 850 meters (2,790 feet). The other is evident on the western side of the wash about 370 meters (1,214 feet) southwest of Locus 5 at an elevation of about 864 meters (2,836 feet); approximately 1.4 kilometers (~0.87 miles) upstream from the eastern cobble ridge (see Figure 15).

The eastern (downstream) ridge is well exposed in a 1.5- to 3.0-meter vertical section that parallels the wash over a distance of about 20 meters. The long axis of the ridge is oriented from the southwest to the northeast and slopes in the same general direction (see Figure 18). The deposit overlies truncated volcanic bedrock and is dominated by large angular-to-subangular basalt cobbles (30 to 90 centimeters in diameter) that are smaller toward the bottom of the deposit (i.e., coarsens upwards). The lower portion contains a small percentage of granitic gravel and small cobbles that are generally rounded-to-well-rounded (see Figure 18). The gravel, cobbles, and boulders lie clast-to-clast with very little fine-grained matrix present.

The western (upstream) ridge parallels the wash over a distance of more than 55 meters (>180 feet), standing about 1.5 to 2.5 meters above the base of the wash (see Figure 18). The long axis of the ridge is oriented from the northwest to southeast and slopes slightly in that same direction. Only partially exposed in profile, the deposit overlies truncated granitic bedrock and is dominated by large rounded-to-subrounded granitic cobbles (40 to 100 centimeters in diameter) that are imbricated and mainly clast-to-clast, with granitic sand and gravel filling the interstices (see Figure 18).

As the formation of similar boulder/cobble ridges normally results from high-energy flood events, the presence of these deposits suggest the amount of runoff, rate of stream flow, and erosive power within Little Dixie Wash was exponentially greater on one or more occasions. These event-related deposits are probably related to initial down-cutting and erosion of the older fan deposits, prior to emplacement of the Terminal Pleistocene/Early Holocene inset terrace.

Dove Springs Wash

The Dove Springs Wash geological locality lies about 5.1 kilometers (~3.1 miles) northwest of the intersection of State Route 14 and the entrance to Red Rocks State Park, and 1.8 kilometers (1.1 miles) due west of State Route 14; about 3.6 kilometers (~2.2 miles) southwest of Little Dixie Wash (Figure 19). At an elevation of about 908 meters (2,980 feet) amsl, the exposed section in Dove Springs Wash occupies a central position along the drainage between the headwaters at about 1,830 meters (~6,000 feet) amsl and the basin of Koehn (dry) Lake, where it terminates at about 576 meters (1,890 feet) amsl; approximately 12.8 kilometers (~8 miles) to the southeast (Figure 19). A series of discontinuous alluvial terraces lie inset along the wash several meters or more below the surrounding landscape of highly eroded and deeply dissected Miocene- to Pleistocene-age alluvial and volcanic deposits (Miller and Amoroso 2007). The exposed sections correspond to the Latest Pleistocene and Holocene young alluvial fan deposits mapped (Qyw4) by Miller and Amoroso (2007).

The Dove Springs Wash geological locality consists of a 200-meter (~656-foot) long cutbank extending along the north side of the wash in which a sequence of 13 alluvial strata is exposed in a 4-meter-high (~13.1-foot) vertical section (Figure 20). These correspond to the dark bands of "lignitic sand" described by paleontologist David Whistler from the San Bernardino County Museum (Whistler 1990, 1994). A date of 12,642 cal BP (Beta-18449) from a conifer branch collected in a soil near the base of the wash (Whistler locality 5775) indicated that Terminal Pleistocene, and possibly Early Holocene, deposits were present at this location. The occurrence of a single chalcedony flake from the dated stratum identified by Whistler (1994) may provide evidence for human use of this locality during the Terminal Pleistocene.

Alluvial Stratigraphy

The basal stratum, which was only partially exposed at this locus, is an alluvial deposit consisting of sandy loam and a few (~10%) small rounded-to-subrounded gravels (Stratum I-13Ab) displaying a moderately developed, very dark gray soil (Figure 21). Organics from this soil yielded a Terminal Pleistocene date of 10,300 ± 60 BP, or 12,102 cal BP (OS-79560). The 2-sigma confidence interval from this date does not overlap with the date of 12,642 cal BP reported by Whistler (1994) from the basal deposit. Thus, it is not clear if both dates are from the same stratum, as Whistler's (1994) sample originated from an exposure several hundred meters downstream. In the exposure examined for the current study, the deepest soil is buried by an alluvial deposit composed of pale red volcanic sand and gravel (Stratum II-12Cu), which fines upward into sandy loam. A moderately developed, very dark, grayish-brown soil formed in the upper portion of this stratum (Stratum II-12Ab).

Above this lies a fine alluvial sand with a few iron-oxide mottles that grades upward into silty clay displaying a weakly developed grayish-brown soil (Stratum III-11Cox and 11Ab, respectively). This is overlain by a silty clay with a few iron-oxide mottles in the lower portion and a moderately developed dark gray soil in the upper part (Stratum IV-10Cox and 10Ab, respectively). Capping the soil is a thin deposit of coarse sand that grades abruptly into loamy sand with a very weakly developed grayish-brown soil (Stratum V-9Cu and 9Ab, respectively), probably marking a very short period of surface exposure (Figure 21).

Overlying this is a paludal deposit of fine-to-loamy sand with a very weakly developed grayish-brown soil near the upper contact (Stratum VI-8Cu and 8Ab, respectively). Freshwater snail shells, like those identified at Little Dixie Wash, were present throughout this stratum (Figure 21). Covering Stratum VI are two relatively thick alluvial strata composed of fine-to-coarse sand with weakly developed, light-colored soils at the top of each (Stratum VII-7Ab/7Cu and Stratum VIII-6Ab/6Cu, respectively), representing episodes of increased stream flow and channel aggradation.

These units underlie another paludal deposit of coarse sand that fines upward into sandy clay loam with a moderately developed dark grayish-brown soil, containing saline-tolerant ostracodes and a few very small freshwater snail shells (Stratum IX-5Cu and 5Ab, respectively; see Appendix D). A date of 4230 ± 40 BP or 4753 cal BP (Beta-280993) was derived on organic sediment from the 5Ab horizon, indicating a Middle Holocene-age for this paludal environment.

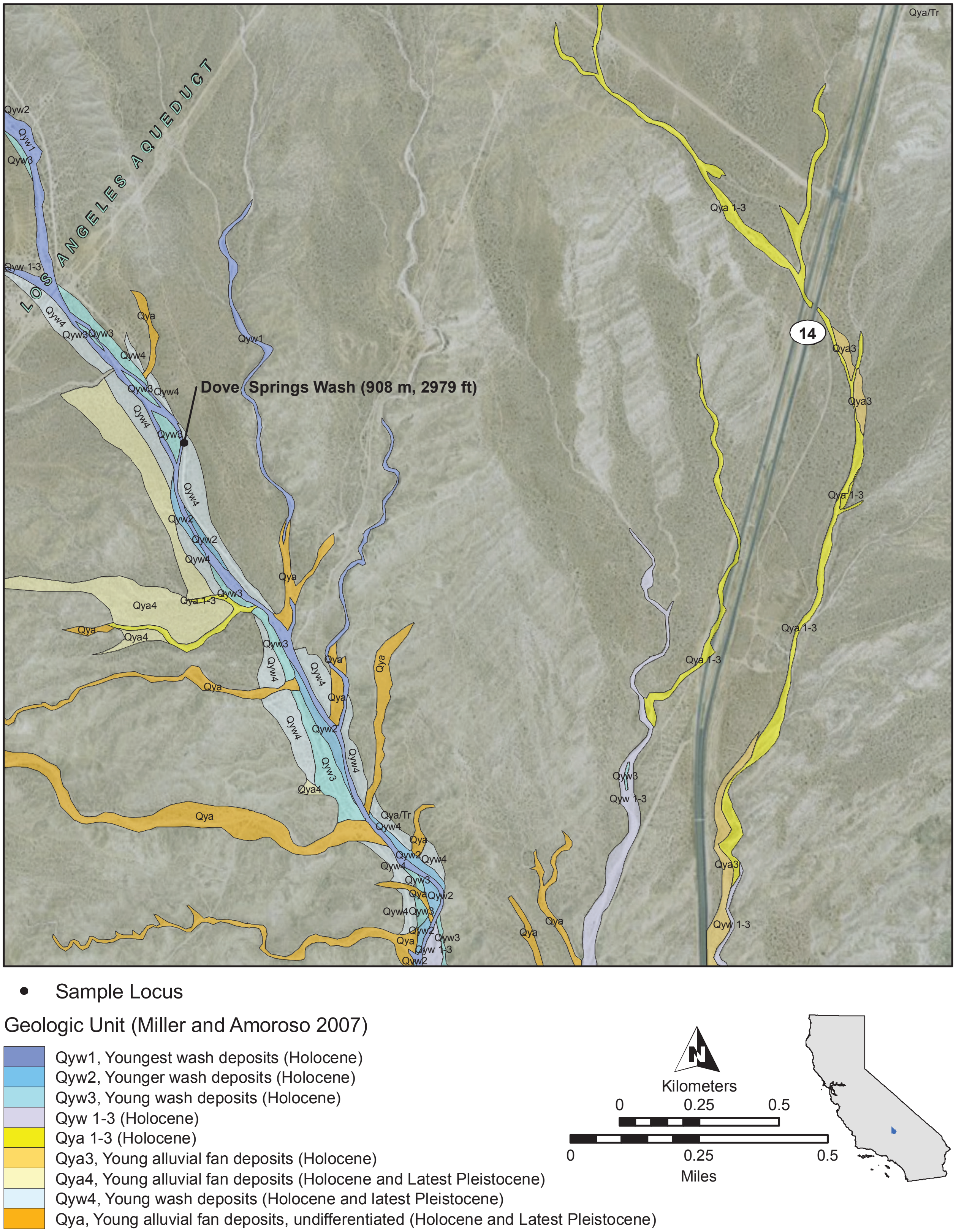
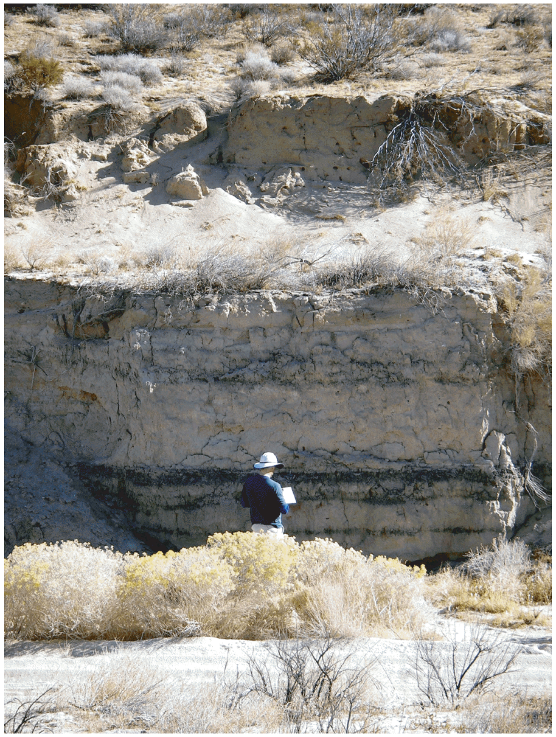


Figure 19. Sample Locus and Terminal Pleistocene and Holocene Deposits along Dove Springs Wash.



Overview of Dove Springs Sample Locus to Northeast

Overview of Dove Springs Sample Locus to Southeast

Black Mats and Paludal Deposits at Sample Locus

Freshwater Snail Shell Exposed in Cut Bank

Black Mats and Paludal Deposits Exposed Downstream

Figure 20. Dove Springs Wash Sample Locus and Alluvial Strata.

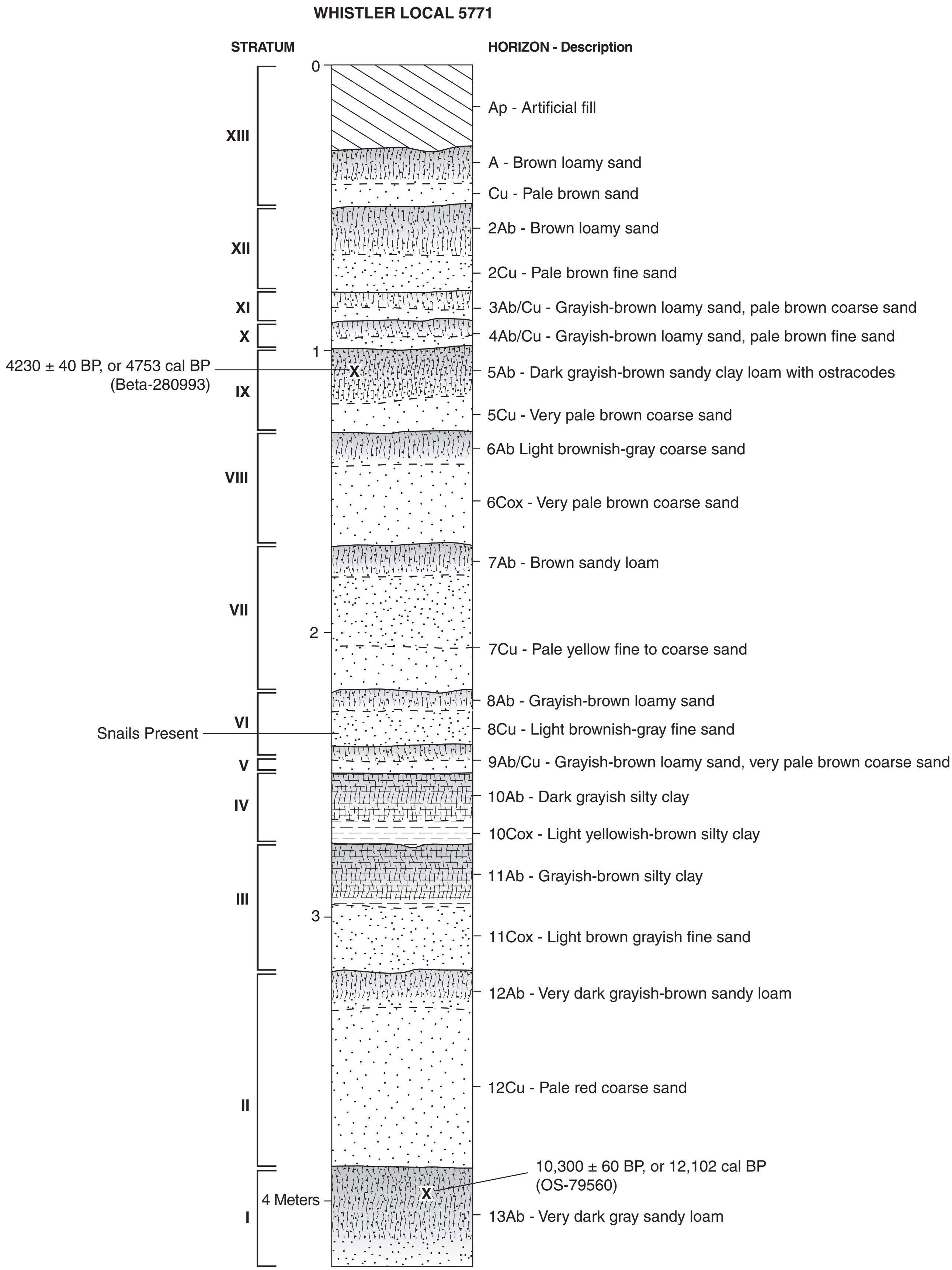


Figure 21. Dove Springs Wash Alluvial Stratigraphy.

Above Stratum IX are three additional alluvial strata (Stratum X, XI, and XII), each consisting of coarse-to-fine sand and loamy sand with relatively thin, weakly developed soils, ranging from brown to dark grayish-brown in color (see Figure 21). At the present surface of the sampled exposure is an artificial fill deposit from a dirt access road constructed along the northeastern side of the wash.

Micro-Invertebrates

Samples from three isolated horizons were analyzed for micro-invertebrates, including the 5Ab, 8Ab, and 13Ab Horizons. The latter sample was found not to contain micro- or macro-invertebrates. The 5Ab Horizon contained an abundant ostracode record (dry mass of 2.6 specimens per gram of sediment). Four species were identified including *Eucypris meadensis* (the most abundant), *Ilyocypris bradyi*, *Fabaeformiscandona acuminata*, and *Cypridopsis vidua* (see Appendix D, Figure 2b). *Eucypris meadensis* is a dilute-water, spring-related species and *Ilyocypris bradyi* is a spring- and stream-related species (see Appendix D, Table 4). Dominance of *Eucypris meadensis* indicates salinity did not exceed 1,000 milligrams L-1 TDS (Forester et al. 2005).

Ten valves of *I. bradyi*, in two batches of five shells each, were analyzed for carbon and oxygen isotopes. As discussed in the Results section of Appendix D, it is inferred that these values indicate low evaporation during deposition of the 5Ab horizon. The stable isotope signature is consistent with the dilute-water inference from micro-invertebrates.

Two ostracode and three mollusk species were identified from the older 8Ab Horizon including *I. bradyi* and *E. meadensis* accompanied by the gastropods *Physa virgata* and *Tryonia* sp. and the clam *Pisidium casertanum*. Dilute waters hosted this faunal association. Salinity did not exceed 2,000 milligrams L-1 TDS, the maximum tolerance for *Tryonia* sp., but more likely was close to 1,000 milligrams L-1 TDS, the maximum tolerance for *E. meadensis* (Forester et al. 2005; Sharpe 2002, 2003).

The stable isotope analysis of ten valves of *I. bradyi* from the 8Ab Horizon yielded δ13C and δ18O values similar to those from the 5Ab Horizon. Like the latter horizon, it is inferred that the δ18O values in Horizon 8Ab reflect low rates of evaporation (Appendix D, Table 8). The stable isotope signature is consistent with the dilute-water inference from micro-invertebrates.

Summary of Terminal Pleistocene/Early Holocene Inflow Conditions

Alluvial strata preserved in Rose Valley, Indian Wells Valley, and Dove Springs Wash provide a record of successive landscape changes and related surface flows from the Terminal Pleistocene to Early Holocene. The record begins prior to the formation of the lower black mat in the South Borrow Pit in Rose Valley, around 13,400 cal BP. This mat lay upon coarse-grained sand, gravel, and cobble deposits that were sorted and bedded within an active channel, under high-energy fluvial conditions not recorded in later-dating deposits exposed in this section. We interpret these fluvial deposits as bed-load of the former Owens River channel, suggesting significant water flow shortly before 13,500 to 13,600 years ago, based on the upper 2-sigma range of the associated radiocarbon date.

In contrast, basal deposits from eastern Sierra Nevada drainages were consistently found to date between about 12,600 and 12,000 cal BP, and thus post-date the interval of high-energy bed-load and channel activity in Rose Valley. Further, all of the Terminal Pleistocene/ Early Holocene alluvial deposits identified in drainages emanating from the Sierra Nevada represent discontinuous terraces set within older fans. An absence of earlier alluvial terrace deposits in these drainages implies that erosional processes (i.e., channel incision and lateral migration) prevailed prior to 12,600 cal BP, precluding deposition and storage of sediment. High-energy cobble ridges (not dated) bordering the channel of Little Dixie Wash may be further evidence of this erosive interval.

When the lower Owens River and Sierra drainage records are viewed together, it appears that surface runoff and stream flows were generally greater between about 13,600 and 12,600 cal BP, with high-energy flows and erosive conditions persisting no later than about 12,600 to 12,400 cal BP in most of the studied drainages. A shift in the depositional regimen occurred toward the end of the Pleistocene (between roughly 12,600 and 11,500 cal BP), allowing fine-grained sands, silts, and clays to accumulate in large and small drainages alike. This interval is marked by multiple short depositional pulses, each separated by intervening periods of landform stability and soil formation. The lowest alluvial strata at Dove Springs Wash, Little Dixie Wash, and Indian Wells Canyon, record an initial episode of deposition between about 12,600 and 12,300 cal BP, followed by a more stable period between about 12,300 and 12,000 cal BP. This cycle was followed by another depositional pulse centered between about 12,000 and 11,800 cal BP, and a stable period at the end of the Pleistocene between about 11,800 and 11,500 cal BP. This latter interval corresponds to the formation of organic-rich horizons (i.e., soil, peat, and black mats) and habitats supporting freshwater snails.

These same general conditions persisted well into the Early Holocene. After another pulse of deposition around 11,200 cal BP, organic-rich horizons and mesic habitats supporting freshwater snails once again appeared between about 10,900 and 10,400 cal BP in Rose Valley and Little Dixie Wash. This suggests that effective moisture during the first millennia of the Holocene was at least as high as the last millennium of the Pleistocene. Yet, despite persistent wet conditions, the fine-grained nature and sequential pulsing of deposition in the local drainages imply only periodic, low-energy surface flows in the lower Owens River system and eastern Sierra drainages. This, in turn, indicates there were likely no significant or sustained sources of inflow into China Lake during the Terminal Pleistocene/ Early Holocene transition.

China Lake Basin Lake Level Records

Indian Wells Valley is a topographic basin bounded by the Sierra Nevada on the west, the Argus Range on the east, the Coso Range on the north, and the El Paso Mountains and Rademacher Hills on the south (see Figure 8). The basin is structurally controlled by a series of mostly active faults including the Sierra Nevada Frontal Fault to the west, the Airport Lake and Argus Range faults to the east, the Little Lake Fault to the north-northwest, and the Inyokern Fault to the south (Figure 22; Roquemore 1981; Zbur 1963). The valley floor lies between 792 and 656 meters (2,600 and 2,154 feet) amsl, and is covered mainly by a series of broad coalescing Pleistocene-age pediments and Holocene-age alluvial fans that generally slope from west to east and from south to north across the valley. Outcrops of Pliocene-age lacustrine deposits (White Hills) have been uplifted and faulted along the valley's northern side, separating China Lake Basin from the internally fed basin of Airport Lake. On the northwestern side of the valley, the White Hills are partly overlain by Pleistocene basalt flows (e.g., Little Lake) that form prominent flat-topped ridges adjacent to the former channel of the lower Owens River (Duffield and Bacon 1981; Duffield and Smith 1978; St.-Amand and Roquemore 1979; Zbur 1963).

Today, Indian Wells Valley has no perennial streams (Kunkel and Chase 1969; Moyle 1963; St.-Amand 1986). China Lake Basin is distinguished by a dry playa that lies along the southeastern side of Indian Wells Valley; it represents the lowest point on the valley floor (655 meters or 2,154 feet amsl). China Lake Basin is the primary depocenter for water and sediment transported by the lower Owens River system through Rose Valley. When water filled the basin in the past, it then overflowed southeast through a narrow canyon in the Argus Range and into Salt Wells Valley and Poison Canyon until reaching the Searles Valley basin; a drop of about 176 meters (~577 feet) overall.

The present elevation of the sill or topographic divide between China Lake and Searles basins is about 670.5 meters (2,200 feet) amsl according to USGS digital elevation model data. Others have variously placed it at 667.5 meters (2,190 feet) amsl (Dutcher and Moyle 1973; Kunkel and Chase 1969; Smith 1979), 668.7 meters (2,194 feet) amsl (Lee 1913), and 665 meters (2,181 feet) amsl (Smith and Street-Perrott 1983); a difference of 5.5 meters (18 feet). With such discrepancies, it is interesting to note that a well hole placed within the basin's outlet identified about 12.5 meters (41 feet) or more of "windblown sand" immediately overlying bedrock, with "no water-laid material" reported (Kunkel and Chase 1969:31). This means the bedrock sill lies at an elevation of about 658.4 meters (2,160 feet) amsl, or only about 1.8 meters (~6 feet) above the south playa low point. This suggests that overflow and lake levels were partly controlled by a "soft sill" of windblown sand and/or a beach barrier ridge that was likely breached and rebuilt more than once by lake transgressions and regressions.

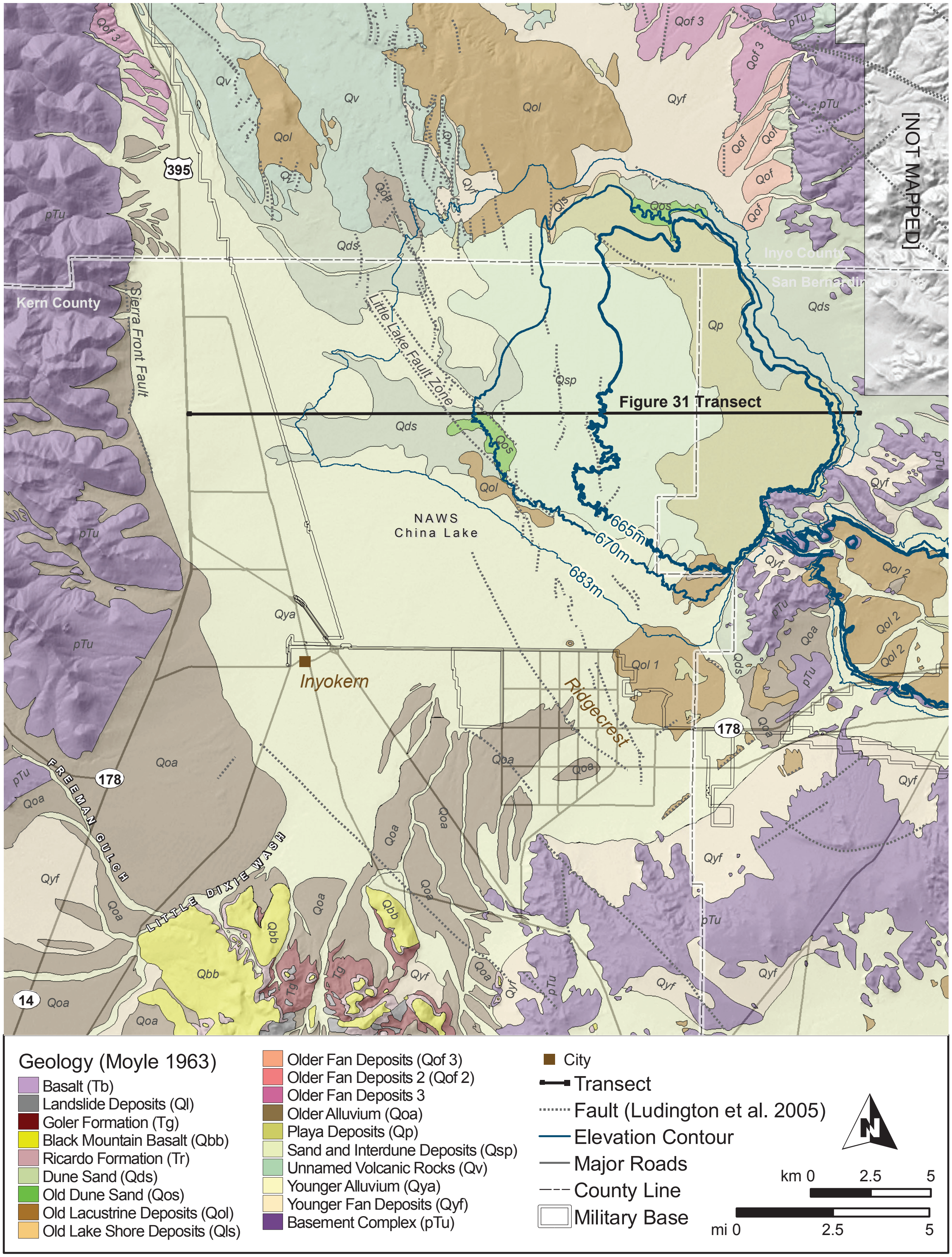


Figure 22. Geologic Deposits and Former Lake Contours in Indian Wells Valley.

Lake Core Stratigraphy (Core 9)

Situated within the NAWS China Lake Charley Range, Core 9 was placed about 6.8 kilometers (4.2 miles) northwest of Armitage Airfield (Figure 23). This is about 3.4 kilometers (2.1 miles) northwest of the Range Access Road and Snort Access Road intersection, and about 55 meters (180 feet) west of Range Access Road (UTM zone 11, 434038E, 3955277N, WGS 84). The core was positioned west of the present China Lake playa in the dune and inter-dune playa zone (Figure 24) at an elevation of about 669.6 meters (2,197 feet) amsl, which is just below the modern sill level, and within the area defined as Stake 19 for archaeological purposes by Emma Lou Davis (Davis 1975; Davis and Panlaqui 1978).

Core 9 contained a vertically stratified sequence of lacustrine and terrestrial deposits that extended about 10.7 meters (35 feet) in depth below the surface of a small inter-dune playa (Figure 24). The lower six meters (~20 feet) of the core contain lacustrine sediments that record a transition from higher/deeper to lower/shallower lake levels. At the base of this sequence is a stratum of greenish-gray (gleyed) sandy clay loam, likely deposited subaqueously in a relatively deep lake (Stratum I-12Cg). Above this is an olive-gray (gleyed) deposit of coarse sand that fines upward into very fine sand (Stratum II-11Cg). This deposit formed in a shallower lake, signaling an overall lowering of water levels (Figure 25). A date of 14,160 ± 50 BP, or 17,780 cal BP (Beta-280680) obtained on organics from this stratum indicates the deposit is Late Pleistocene in age.

Stratum II is overlain by a gray-to-olive-gray (gleyed) deposit that coarsens upwards from very fine sand to sandy loam (Stratum III-10Cg1 and 10Cg2); again formed in a lacustrine setting. These facies are capped by a 60-centimeter thick deposit of moderately sorted and bedded coarse sand and small-to-medium, subangular-to-rounded gravel (Figure 25), which formed along the shore of a former lake (Stratum IV-9Cu). The top of the beach deposit lies 7.6 meters below surface at an elevation of about 662.2 meters (2,172 feet) amsl. Above this is a layer of light gray sandy loam which appears to be lacustrine sand, weakly cemented by gypsum (Stratum V-8C). The sand underlies another layer of light gray sand that contain a few moderately sorted and bedded, small-to-medium, subangular-to-rounded gravel, and a few thin layers of black sand (Stratum VI-7C). The Stratum VI sands may have accumulated near shore—perhaps related to a prograding Owens River delta—but in deeper water than the coarse sand lenses associated with Stratum IV. Lacustrine sediments in Core 9 terminate at an elevation of about 665.3 meters (2,181 feet) amsl and do not appear to contain carbonates as no effervescence was observed when exposed to a ten percent solution of hydrochloric acid.

Capping the lacustrine sequence is a 4.5-meter (~15-foot) thick sequence of terrestrial alluvial and eolian deposits (Figure 25). The base of this sequence is initiated by a pale olive (gleyed) silty clay alluvial deposit with subangular blocky structure and a few hard nodules of calcium carbonate (CaCo3) near the top (Stratum VII-6Cg). The gleying and fine-grained texture suggests a slough or playa setting for this stratum. Organics obtained from the 6Cg horizon yielded an Early Holocene date of 9690 ± 50 BP, or 11,123 cal BP (Beta-280679).

Above is another slough or playa deposit of white sandy clay loam with weak soil development that is infused with calcium carbonate (CaCo3), which effervesces violently when exposed to hydrochloric acid (Stratum VIII-5Akb). This soil is buried by light olive-grey silty-clay displaying weak soil development and containing a few hard calcium carbonate (CaCo3) nodules that effervesce strongly when exposed to hydrochloric acid (Stratum IX-4Akb); again formed within a slough or playa.

The slough and playa deposits are overlain by a deposit of pale yellow medium-to-coarse sand that fines upward into light olive-brown silt with weak soil development formed by a combination of alluvial and eolian processes (Stratum X-3Cu and 3Ab, respectively). The soil is covered by a layer of strongly effervescent pale yellow sand of eolian origin (Stratum XI-2Cu; interval between 1.52 and 2.13 meters not recovered) that fines up into light yellowish-brown silt. This deposit displays weak soil development and contains soft calcium carbonate (CaCo3) nodules that are also strongly effervescent (Stratum XI-2Akb). The sequence is completed by very pale brown loamy sand that grades into very pale brown silt (Stratum XII-Cu and A, respectively), both strongly effervescent. This stratum forms the present inter-dune playa surface (Figure 24 and Figure 25).

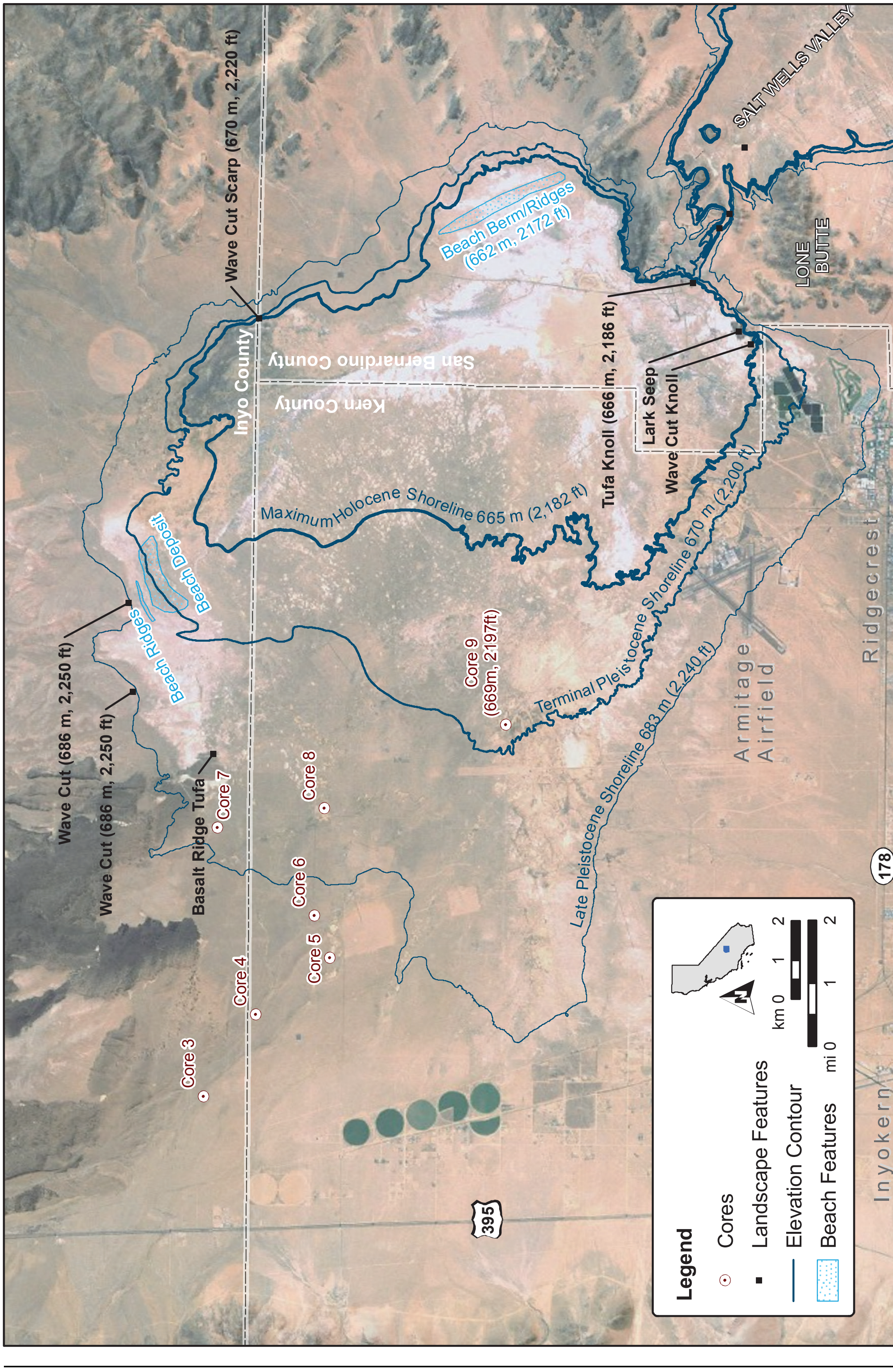
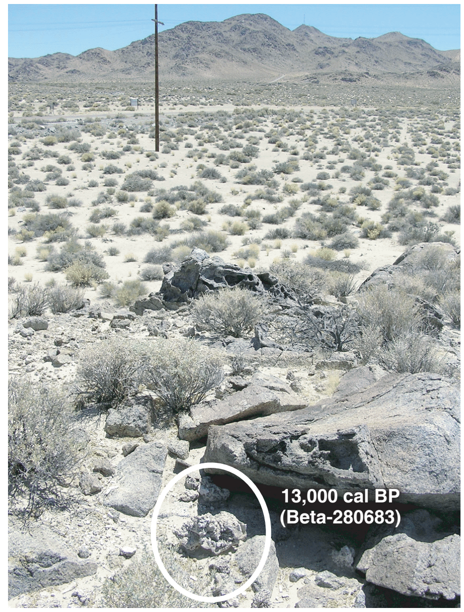


Figure 23. Prominent Lake Features and Former Shorelines in China Lake Basin.

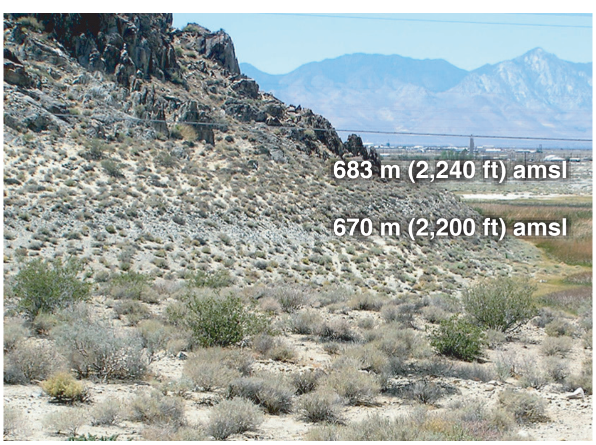
Sorted, Bedded Beach Sand and Gravel, ~8 to 9 m, Core 9 (Strata IV)



Algal Tufa Exposed on Granitic Bedrock Knoll to Southeast

Dune and Interdune Playas in Core 9 Area to Southwest

Honeycomb Formations on Bedrock Knoll to Northwest



Two Proiminent Shorelines on Knoll Near Outlet to Southwest

China Lake Playa from Bedrock (Tufa) Knoll to Northwest

Figure 24. Landforms and Deposits in the China Lake Basin.

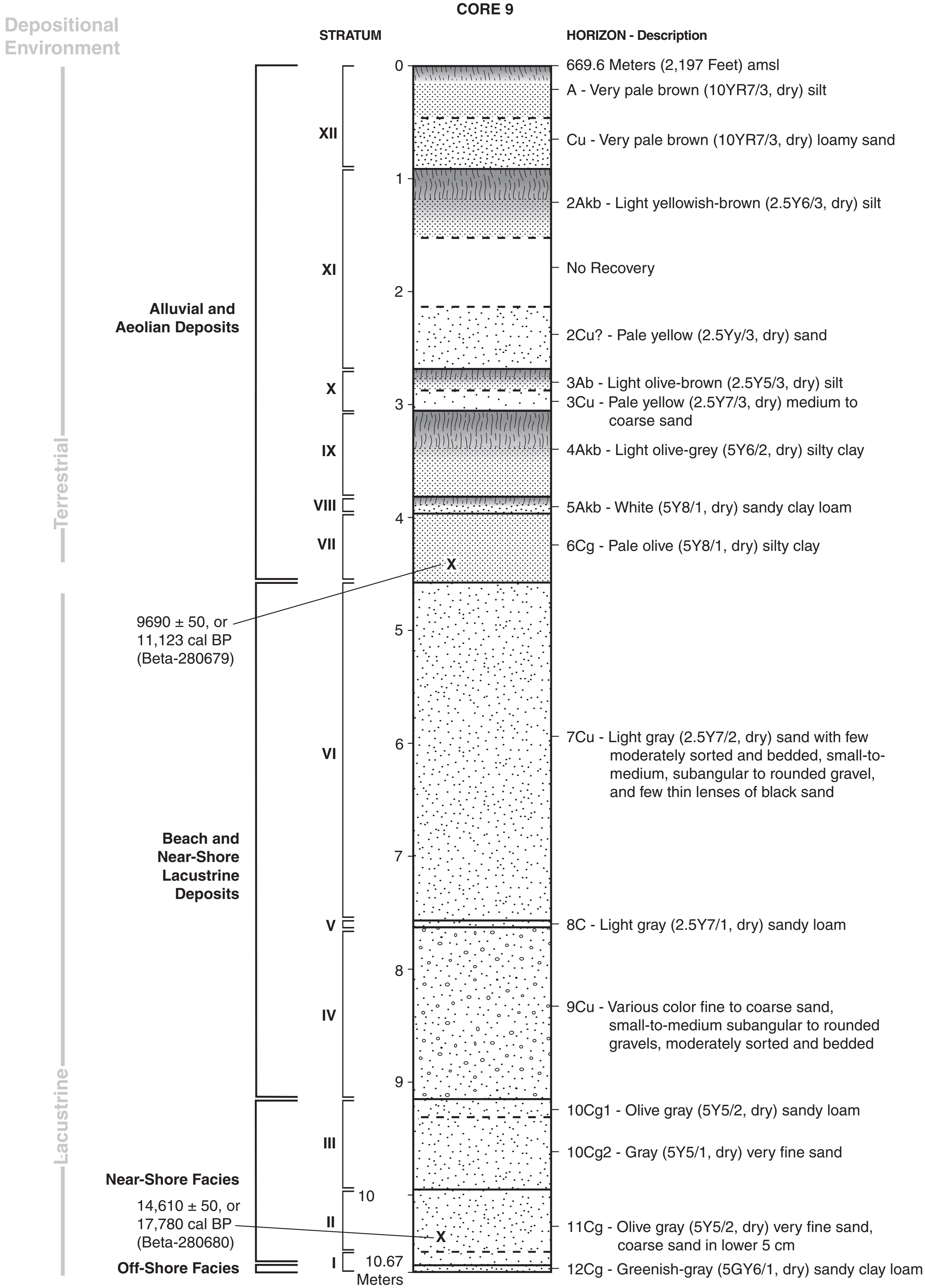


Figure 25. Alluvial Stratigraphy of Core 9 from the China Lake Basin.

Beach, Shoreline, and Lake Features

At least two and possibly three wave-cut strand lines can be seen encircling a steep bedrock knoll on China Lake Basin's southeast side. The knoll and strand lines are similar to, or the same as, those pictured by Lee (1913:405). The knoll lies immediately south of Lark Seep, northwest of the intersection of Water and Knox Roads, and reaches a maximum elevation of about 700 meters (2,300 feet) amsl (see Figure 23). The highest strand line forms a subtle notch that surrounds the top of the knoll at about 695 meters (2,280 feet) amsl. Lower down the knoll is a conspicuous strand line at about 683 meters (2,240 feet) that coincides with the presence of a light-colored deposit of sediment and the absence of bedrock surface outcrops. The most prominent and recent looking of the three strand lines is a narrow terrace of beach sand and gravel at an altitude of about 670 meters (2,200 feet) amsl near the base of the bedrock knoll (see Figure 24). The elevations of all three features correspond with those of other suspected shoreline features previously reported in Searles and China Lake Basins (Davis 1975; Davis and Panlaqui 1978; Kunkel and Chase 1969; Moyle 1963; Smith 1979; St.-Amand 1986), while the lowest wave-cut strand line lies at the same elevation as the modern outflow sill.

A little more than 1.7 kilometers (1 mile) northeast of this knoll is a smaller bedrock knoll, located northwest of the intersection of Knox and Magazine roads, and about 400 meters (1,314 feet) northwest of the basin sill and outlet channel (see Figure 23). An examination of the knoll top revealed that calcareous algal tufa deposits were attached to the bedrock at an elevation of about 665.5 meters (2,183 feet) amsl, and that lakeshore wave-action had created extensive honeycomb patterns within the bedrock (see Figure 24). Tufa of this type forms when lime-secreting algae colonize zones where sunlight regularly penetrates below the surface of a lake (Scholl 1960). The tufa produced a date of 11,440 ± 50 BP, or 13,000 cal BP (Beta-280680; reservoir correction applied). As this locality lies about five meters below the modern outlet, the associated date suggests a lake stood below the sill level during the Terminal Pleistocene.

At Basalt Ridge on the basin's northern side (see Figure 23), tufa deposits occur near the ridge top at about 680.9 meters (~2,234 feet) amsl and are discontinuous and consist of conglomerates that contain numerous basalt gravel and cobbles. The elevation of these deposits correlates with the intermediate strand line (683 meters amsl) identified on the bedrock knoll near the basin's outlet. Davis (1978) obtained dates of 15,650 cal BP and 13,710 cal BP (UCLA-1911A, UCLA-1911B,) on tufa from this general location, suggesting that a coalesced lake existed above the China Lake Basin outflow sill as recently as 13,700 cal BP.

Lake Level History

Basal lacustrine deposits from Core 9 indicate that a relatively deep lake existed in that location before about 18,000 cal BP during the last glacial maximum. Given the depth below surface of these fine-grained lacustrine deposits (660.8 meters amsl; Stratum II and III), the associated high stand, probably correlated with the 683- or 695-foot shorelines evident at the outlet knoll. The appearance of near-shore beach deposits in Core 9 after 17,780 cal BP indicates that the lake began to contract around that time. Dates on *Anodonta* shell of 14,390 ± 70, or 17,504 cal BP (Beta-220692) and 13,130 ± 80, or 15,939 cal BP (Beta-220691) from the basin's eastern side confirm the presence of a lake, at least periodically, from about 17,500 to 16,000 cal BP (Byrd 2007). Basalt Ridge tufa deposits suggest the lake attained a level of as much as 680.9 meters (~2,234 feet) amsl by 15,650 cal BP and again by 13,710 cal BP. If these dates are correct, they likely correlate with lacustrine deposits of Stratum VI, in Core 9, representing a higher stand following deposition of the lower beach deposits sometime after 17,780 cal BP (i.e., Stratum IV).

Lake levels dropped to at least the 670-meter (2,200 feet) sill level by 13,000 cal BP, as marked by the formation of algal tufa of this age on bedrock near the outlet at an elevation of about 666 meters (~2,186 feet) amsl. By the Early Holocene, the lake had dropped well below the 665-meter level based on a date of 11,123 cal BP from the basal alluvial/eolian sequence (beginning at 665.3 meters amsl) above the lacustrine sands in Core 9. The age of this capping deposit suggests the underlying fine-grained lacustrine sediments date older than 11,123 cal BP. However, since the upper lake deposits remain undated, the lacustrine record could be substantially older than the age of the capping deposit. As no evidence was found in Core 9 to indicate that the lake ever again rose to the 665-meter level, China Lake seems not to have reached its outflow sill after about 13,000 cal BP.

China Lake Outflow Records

Except for a few rounded bedrock knolls (e.g., Lone Butte), the narrow canyon forming China Lake's outlet consists of steep and rugged bedrock slopes. The canyon floor is partially filled with dune sand and alluvial sediments, and does not have a continuous channel or dominant wash exposed at the surface.

Two prominent wave-cut strand lines encircle bedrock knolls in the canyon (Figure 26). The highest of these lies at about 683 meters (2,240 feet) amsl, or the same elevation as the laterally extensive shoreline found in China Lake Basin (Figure 27). A prominent beach ridge is associated with this shoreline on the northern side of Lone Butte where it extends northward over a distance of about 190 meters (~623 feet) to an elevation of about 659 meters (~2,163 feet) amsl. Composed mainly of gravel and cobbles, the ridge measures about 46 meters (~150 feet) across at its widest point, and is elevated some four to five meters (13 to 16 feet) above the surrounding land surface (Figure 27).

A less conspicuous shoreline feature is situated at about 654 meters (2,147 feet) amsl. This shoreline is associated with a smaller barrier-type beach ridge on the northern side of Lone Butte, extending in a northeast direction for about 127 meters (~417 feet; Figure 26). Measuring about 16 meters (~50 feet) across at its widest point, this ridge consists mainly of gravel, and is elevated at least one to two meters (2.9-5.8 feet) above the surrounding land surface (Figure 27). Given its elevation below the sill of China Lake Basin, the lower shoreline and beach ridge appear to represent a recessional stand of Lake Searles.

Another beach deposit was identified at a slightly lower elevation of 652 meters (2,140 feet) amsl on a wave-cut bedrock platform perched above the canyon floor about 1.6 kilometers (~1 mile) west-southwest of Lone Butte (UTM Zone 11, 447540E, 3949962N, WGS 84; Figure 26). This deposit consists of lacustrine marl overlain by beach sand that contains freshwater snail (*Helisoma Carinifex newberryi*) and mollusk (*Anodonta* sp.) shells (Figure 27). A date of 11,550 ± 50 BP or 13,387 cal BP (Beta-280686) from one of the snail shells establishes the age of the beach as Terminal Pleistocene.

Salt Wells Valley and Poison Canyon

As the connecting link between China Lake and Searles Lake basins, Salt Well Valley and Poison Canyon contain outcrops of lacustrine and shoreline deposits that lie below the 670-meter (2,200-foot) sill level of China Lake. Smith (2009) has mapped the age and extent of these deposits, and various studies have obtained radiocarbon dates on shells, lacustrine marl, carbonates, and rock varnish from the area (Benson et al. 1990; Couch 2003; Dorn et al. 1990; Garcia et al. 1993; Hildebrandt and Darcangelo 2006; Kaldenberg 2006; Lin et al. 1998; Ramirez de Bryson 2004; Smith 2009). Radiocarbon dates from these deposits record sustained stands of Lake Searles that are proxy evidence for outflow from China Lake Basin (Smith 2009).

Nine *Anodonta* shells from this area yielded dates ranging between 16,645 and 13,556 cal BP (Beta-211389, Beta-211387), with an overall mean age of 14,400 cal BP (Hildebrandt and Darcangelo 2006; Kaldenberg 2006). These samples were recovered between elevations of about 640 and 587 meters (2,100 and 1,926 feet) amsl (average of 625 meter, 2,050 feet), with most or all derived from surface or reworked contexts. Eleven dates on marl and carbonate from Salt Wells Valley and Poison Canyon range between about 15,800 and 12,347 cal BP, resulting in a mean of 13,717 cal BP (Couch 2003; Lin et al. 1998; Ramirez de Bryson 2004). All but one of these samples is from elevations of 590 to 575 meters (1,936-1,886 feet) amsl, or about 581 meters (1,906 feet) amsl, on average.

Shell samples from Salt Wells Valley and Poison Canyon are generally older and regularly found about 44 meters (144 feet) higher in elevation than the marl and carbonate samples. This relationship is consistent with shells occurring in shallow near-shore positions, and marl and carbonates forming in deeper off-shore positions of the lake. The age and elevation of these samples suggest a large and/or deep lake was established in the canyon more than 16,000 years ago and based on the youngest shells dates, may have persisted at relatively high levels up to at least 13,500 years ago. The size/depth of the lake appears to have declined substantially after about 13,300 cal BP, as younger dates have only been obtained from one sample of marl and one sample of carbonate at low elevations within the canyon. This data implies that water levels had dropped below the China Lake sill and created two separate lake basins after about 13,300 years ago.

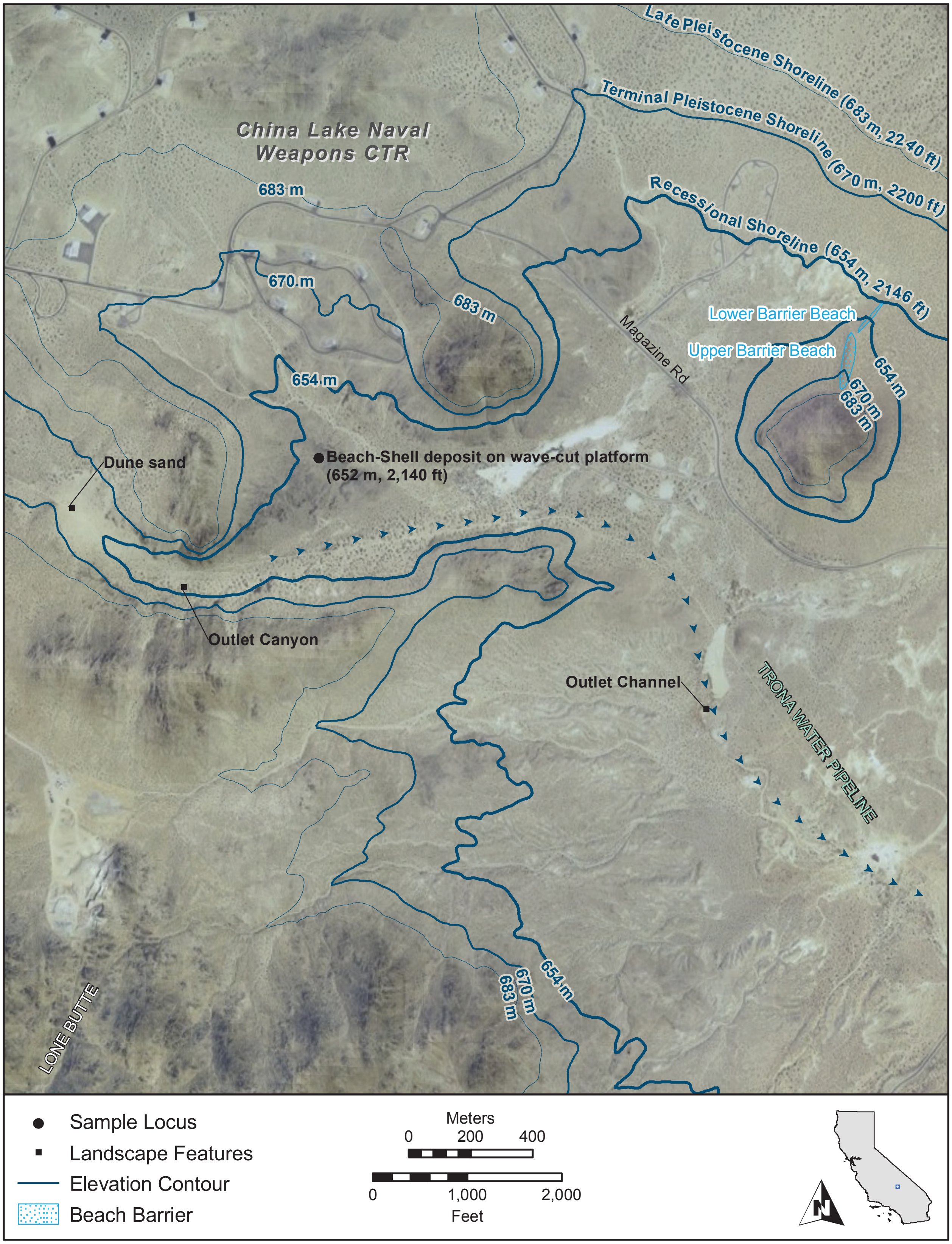
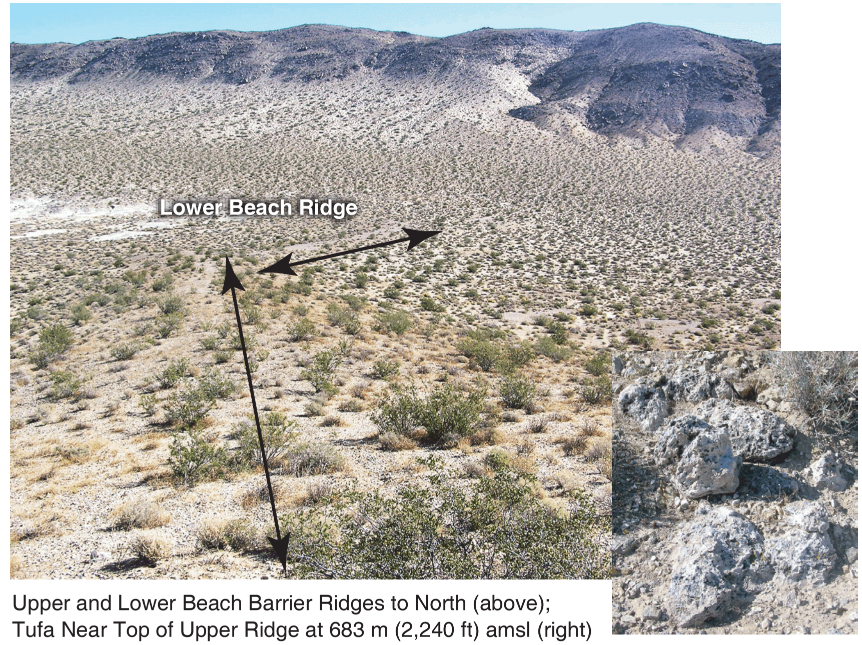


Figure 26. Landscape Features and Sample Locus in Salt Wells Valley-China Lake Outlet.

Marl, Shells, and Beach Sand on Wave-Cut Bedrock Platform at 654 m (2,147 ft) amsl to Northeast (above); Date of 13,387 cal BP (Beta-280686) on Small Snail (far right) 13,387 cal BP (Beta-280686)



Upper and Lower Beach Barrier Ridges to North (above); Tufa Near Top of Upper Ridge at 683 m (2,240 ft) amsl (right)

Two Prominent Shorelines on Bedrock Knoll to Northwest

Prominent Shorelines on Hillsides of Salt Wells Valley to East toward Searles

Figure 27. Landforms and Lake Features in Salt Wells Valley-China Lake Outlet.

China Lake's Outlet History

Stratigraphic and radiocarbon evidence show there was a large and deep lake within Salt Wells Valley and Poison Canyon more than 15,000 years ago. This lake probably stabilized at or around 683 meters (2,240 feet) amsl (China and Searles coalesced), as marked by extensive shoreline features at that altitude. The lake likely maintained itself at relatively high levels until about 13,500 cal BP, after which the number of radiocarbon-dated shells in Salt Wells Valley declines. Searles Lake dropped rapidly between about 13,500 and 13,400 cal BP, until it temporarily stabilized at about 654 meters (2,147 feet) amsl, some 16 meters (52.4 feet) below the sill of China Lake. Evidence of this recessional stand includes an extensive shoreline, a barrier beach ridge, wave-cut bedrock platform, and beach deposit with shells dating to about 13,390 cal BP (Beta-280686), all of which occur within three meters (9.8 feet) or less of the 654-meter (2,147-foot) shoreline. The near absence of marl and carbonate deposits and freshwater shells dating less than 13,300 cal BP suggest that Searles Lake fell rapidly after this time and has not since returned to Salt Wells Valley or upper Poison Canyon. The history of lake level and landscape changes is discussed further in Chapter 5.

5. PALEOHYDROLOGY AND LANDSCAPE HISTORY IN THE NORTHWESTERN MOJAVE DESERT DURING THE PLEISTOCENE/HOLOCENE TRANSITION

The current study documents a three-part geomorphic and hydrological transition, reflecting deterioration of effective moisture conditions around the time of the Pleistocene/Holocene transition in the northwestern Mojave Desert. This sequence is marked first by the decline in lake levels and hydrological separation between the lake basins of China Lake and Searles. Following this interval, groundwater continued to be delivered to these valleys in pulses, supporting localized wetland habitats in medial channel positions and around spring seeps. After 10,000 cal BP, groundwater levels dropped, formerly wet locations dried, and a widespread re-activation of alluvial fan deposition occurred across the northwestern Mojave Desert.

HYDROLOGICAL HISTORY OF LOWER OWENS RIVER AND LOCAL DRAINAGES

Between about 18,000 and 13,500 cal BP, China Lake Basin received substantial and often sustained inflows from the lower Owens River and other local drainages, resulting in high lake stands. Deposition of deep-water lacustrine sediments (Core 9), freshwater *Anodonta* shells, tufa deposits, and related shoreline features, offer compelling proof of high water levels in China Lake and Searles basins during this time period (details provided in next section). Surface flows from Owens River are confirmed by coarse-grained channel deposits (i.e., cobbles and gravels) along the river in Rose Valley, dating just prior to 13,400 cal BP. In the South Borrow Pit, fine-grained silt and an organic-rich black mat rest immediately above Owens River channel deposits and indicate that active water flow slowed or stopped and the depositional regime changed sometime around 13,400 cal BP (Figure 29). It remains possible that the lower Owens River continued to flow after this time, as the active channel could have shifted away from the sample locality. However, stratigraphic records from several other locations in Rose Valley dating to the Early Holocene and later reveal only coarse alluvial fan or fine-grained distal fan/playa deposits in axial positions once occupied by the lower Owens River.

Comparatively high surface water flows prior to 13,000 cal BP in the Indian Wells Valley region is also supported by the terrace sequence and stratigraphic records preserved in local washes. No later than 12,600 cal BP, alluvial deposits began to accumulate as discrete and discontinuous inset terraces in the medial and lower reaches of the largest drainage systems, including Little Dixie and Dove Springs washes. These deposits now form the first terrace (T2) above the active channels and fill erosional voids carved into older and higher distal fan deposits (Figure 28). The position of these terraces suggests that the dominant fluvial process prior to about 12,600 cal BP was lateral channel migration and erosion. The absence of older terrace deposits in these inset positions indicates that local run-off may have been substantially higher before this time. By 12,600 cal BP, the competency of these drainages had declined and they were no longer capable of evacuating even fine-grained sediments.

Between about 12,600 and 10,500 cal BP, water discharge into some local washes appears to have been regular, but episodic, reflected by similar sequences of stratified sands, silts and organic-rich horizons preserved as inset terraces at Little Dixie Wash, Dove Springs Wash, and Indian Wells Canyon. Groundwater and/or effective moisture conditions supported mesic habitats colonized by freshwater gastropod and ostracode species, formation of soils and organic-rich layers (black mats), and the episodic deposition of paludal (spring or marsh) sediments. At least three cycles of deposition are recorded during the Terminal Pleistocene/Early Holocene (Figure 29). The first two depositional pulses occurred between 12,600 and 12,300 cal BP, and between 12,000 and 11,800 cal BP. The latter interval coincides with the appearance of freshwater mollusks and formation of organic-rich horizons in Little Dixie Wash. In the South Borrow Pit in Rose Valley, deposition of more than two meters of fine silt loam is recorded along the lower Owens River channel after 13,400 cal BP, but before 11,400 cal BP, when an organic rich mat developed. At this same time, formation of spring mats dated between 11,540 and 11,270 cal BP is evident at the Basalt Ridge locality in China Lake Basin (Basgall 2004) and an organic mat developed in Indian Wells Canyon, dated to about 11,200 cal BP. The Early Holocene brought a repeat of this

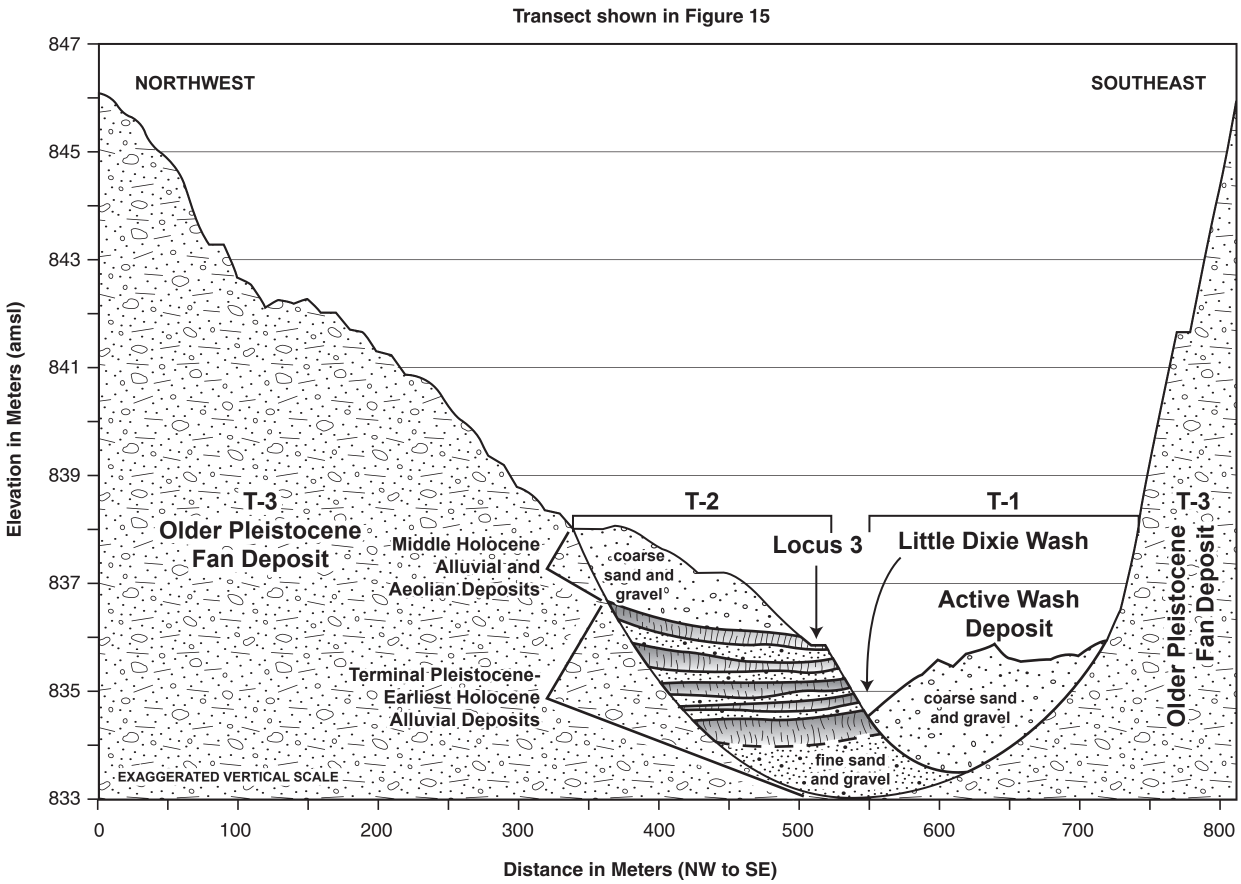


Figure 28. Elevational Cross Section of Little Dixie Wash Showing Inset Position of Terminal Pleistocene/Earliest Holocene Terrace.

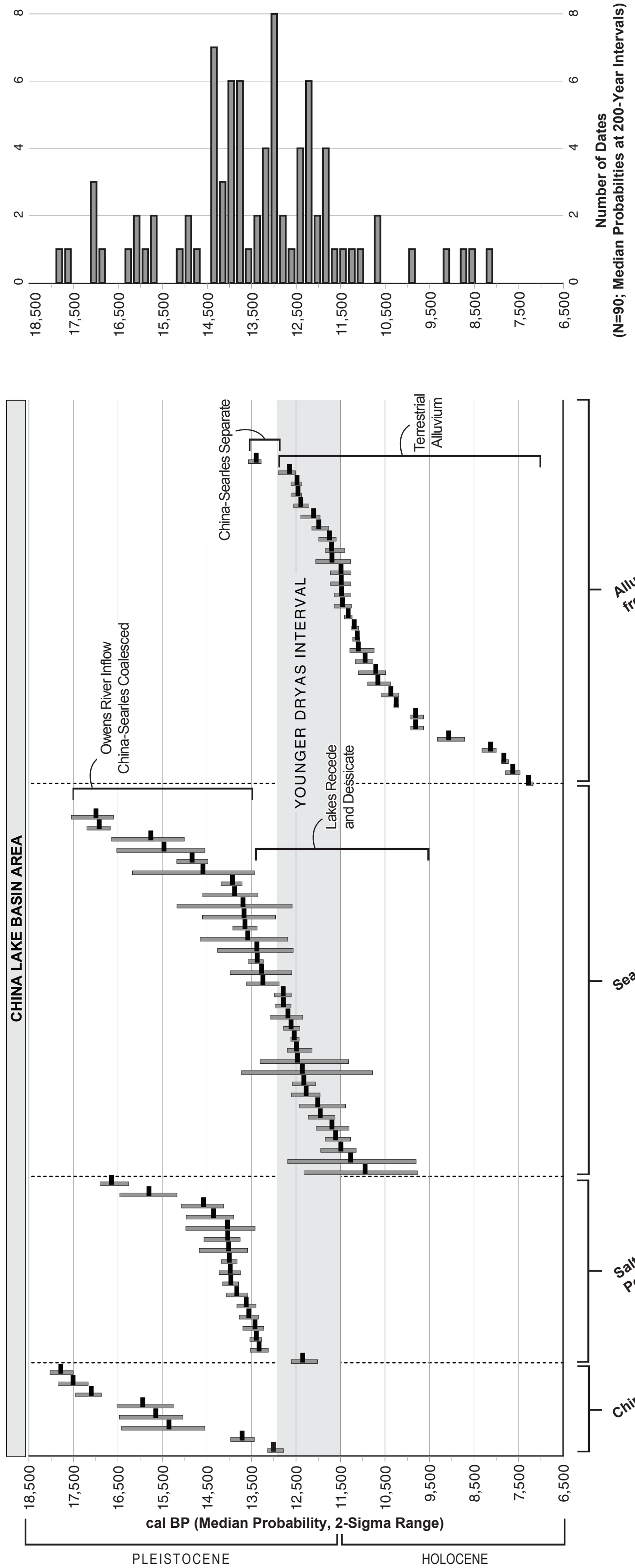


Figure 29. Radiocarbon Record of Lake Level and Landscape Changes in the China Lake Basin Area.

pattern as a depositional pulse after about 11,200 cal BP was again followed by the emergence of habitats supporting freshwater mollusks and the development of organic-rich horizons by about 10,700 cal BP in Little Dixie Wash. Deposition of fine-grained, clay-rich silts dated between 10,600 and 9065 cal BP at the Lava End locality in Rose Valley also reflect comparatively high ground-water flows into the Early Holocene.

Physical evidence of surface water at this time, however, is not widespread but largely limited to specific drainage segments where hydrologic conditions permitted the formation of braided channel systems (cienegas) and near-level inset alluvial terraces composed of only very fine-grained sands, silts, and clays. Much of the water in these settings was likely supplied by local springs and other groundwater sources fed and recharged in part, by non-local sources at higher elevations in the Sierra, such as the upper South Kern River; an important source of ground water in southern Indian Wells Valley (Guler and Tyne 2004, 2006; Ostdick 1997). These conditions began around the on-set of the Younger Dryas, but continued well into the Early Holocene.

After about 10,500 cal BP, the number of groundwater-related deposits declined substantially, presumably due to warmer and drier conditions characteristic of the Middle and Late Holocene in the northwestern Mojave Desert. However, a brief period of moist conditions during the Middle Holocene is recorded at Dove Springs Wash, where ostracode-rich, fine-grain paludal deposits (Stratum X-5Ab) date to 4753 cal BP (Beta-280993); the only such example post-dating 10,400 cal BP identified during this study.

LAKE LEVEL HISTORY

China Lake Basin appears to have received substantial input from the lower Owens River and other local washes, up to about 13,400 cal BP. A prominent wave-cut shoreline and related features at an elevation of about 683 meters (2,240 feet) amsl in China Lake Basin, and lacustrine deposits in Salt Wells Valley, Poison Canyon, and the larger Searles Lake Basin dated between about 16,000 and 15,000 cal BP (Figure 30), indicate that waters from China and Searles basins merged to form a relatively stable and sustained lake (Figure 31). We estimate the Terminal Pleistocene lake to have covered an area roughly 272 square kilometers and include a water volume of about 3.8 million cubic meters. Bivalve shells in upper Salt Wells Valley dated between 14,035 and about 13,955 cal BP occur below the 670-meter elevation (although the precise context and elevation of these dated shells remains unknown; Kaldenberg 2006), suggesting declining waterlevels and separation of the two lake basins. By 13,700 cal BP, a coalesced lake reformed and stabilized well above the modern China Lake sill (670.6 meters, 2,200 feet) at an elevation of no less than 681 meters (2,234 feet) amsl, based on a dated tufa sample from the Basalt Ridge in China Lake Basin (Davis and Panlaqui 1978).

Lake levels appear to have fallen at least 11 meters (36.1 feet) to the elevation of the China Lake Basin outflow sill (670.6 meters; 2,200 feet amsl), between about 13,700 and 13,400 cal BP and China and Searles lakes separated (Figure 30). Evidence for this rapid decline comes from a date of 13,390 cal BP on freshwater *Helisoma* sp. shell associated with a beach deposit in upper Salt Wells Valley, at an elevation of 654 meters (2,147 feet) amsl, and a date of 13,000 cal BP from algal tufa situated just below the outflow sill in China Lake Basin, at an elevation of 666 meters (2,186 feet) amsl. The decline in depth recorded for China and Searles lakes correlates almost precisely with evidence from the lower Owens River channel indicating that high-energy surface flows stopped by 13,400 cal BP. The separate lakes stabilized long enough to form a prominent set of shoreline features at the sill elevation in China Lake Basin (670.6 meters; 2,200 feet amsl) and in upper Salt Wells Valley at an elevation of about 654 meters (2,147 feet) amsl (see Figure 27). We estimate this lake stand to have covered an area roughly 160 square kilometers with a water volume of 1.03 million cubic meters—about 75% less volume and 60% less area than the coalesced high stand.

China Lake receded below the 665 meter (2,182 feet amsl) elevation sometime between 13,000 and 11,100 cal BP (Figure 30), based on dated alluvial fan deposits in Core 9, at an elevation of 665 meters, and the algal tufa formed near the outflow sill, at an elevation of 666.3 meters (2,186 feet). A continuous sequence of alluvial fan deposits in Core 9, above the 665 meter elevation, and radiocarbon dates on buried soils obtained by Davis (Davis and Panlaqui 1978) at her Stake 1 locality, and by Basgall (2004) at Basalt Ridge, indicate China Lake did not reach or exceed the sill level after 12,000 to 11,000 cal BP (Figure 30). Any high-water stands within

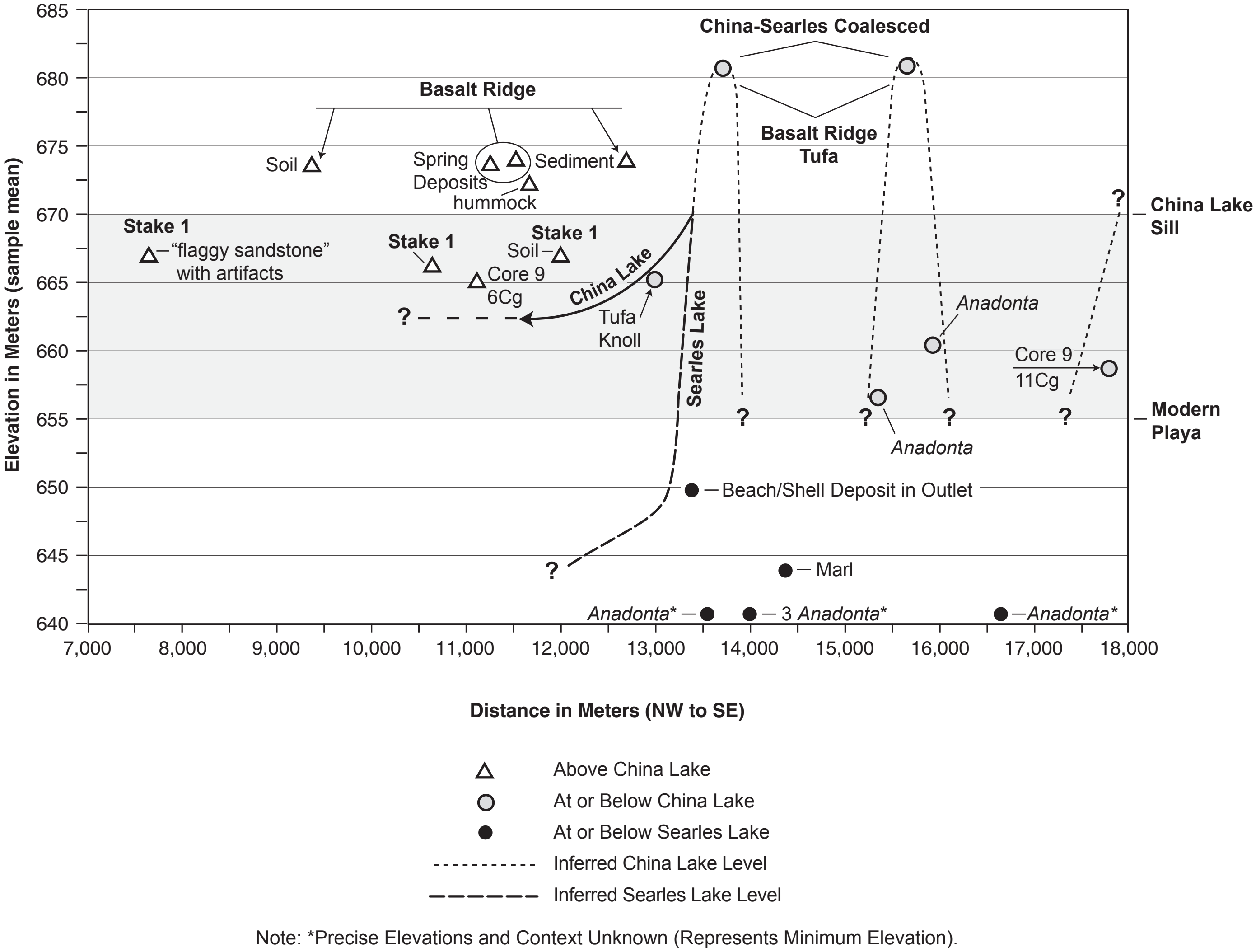


Figure 30. Lake History Based on the Age, Nature, and Elevation of Radiocarbon-Dated Samples.

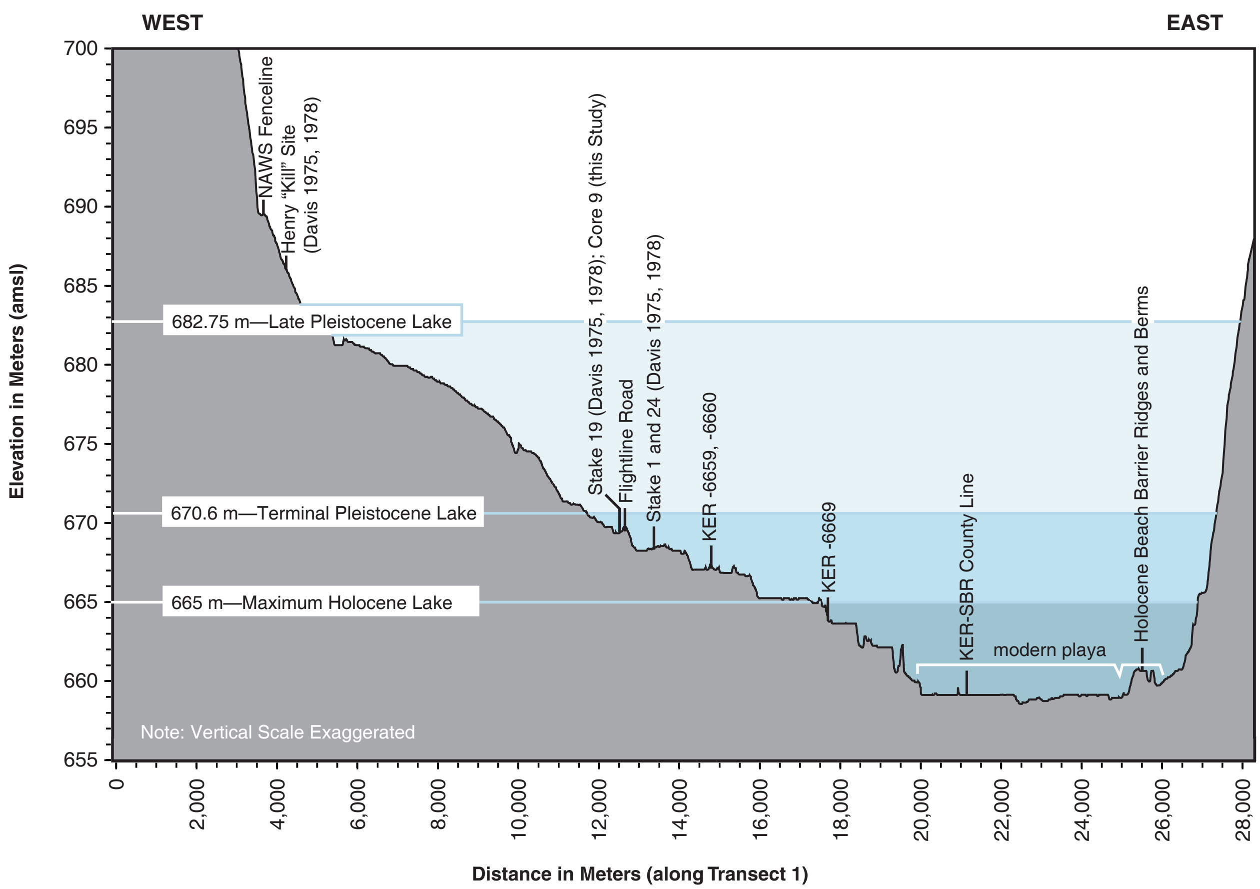


Figure 31. Elevation of Former Shore Lines and Lake Levels in Relation to Modern Topographic Features and Selected Prehistoric Sites

the basin during the remainder of the Holocene would have resulted in a maximum water depth of no greater than ten meters (33 feet), based on the elevation of the modern playa at 655 meters (2,149 feet) amsl. This would have resulted in a lake roughly 97 square kilometers in size, with a water volume of just 377,000 cubic meters—90% less volume and 75% less area than the Late Pleistocene high stand.

Beach berms and barrier ridges along the eastern side of China Lake Basin (see Figure 23 and Figure 31), occur at an elevation of roughly 662 meters (2,172 feet) amsl and appear to have been formed during brief Holocene transgressions or represent recessional features, post-dating 13,000 cal BP, based on the dated tufa sample at an elevation of about 666 meters (2,186 feet) amsl. Preliminary photon-stimulated-luminescence dating of the beach ridges is consistent with this interpretation, suggesting these features formed sometime between about 8,000 and 13,000 years ago (Berger in Giambastiani 2008), during the Terminal Pleistocene/ Early Holocene.

TERRESTRIAL LANDFORM HISTORY

Between about 10,400 and 9800 cal BP, a substantial shift in depositional regimes is apparent across Indian Wells Valley and the broader northwestern Mojave Desert, represented by the accumulation of coarse-grained alluvial fan deposits which now form extensive piedmonts along valley margins. In fan-head positions, these Holocene-age deposits are set below Pleistocene-age fan surfaces, but mantle the older deposits toward the valley bottom. This period of fan rejuvenation follows an extended interval of landscape stability during the Terminal Pleistocene/ Early Holocene, represented by widespread stratigraphic unconformities marked by buried soils dating to this time period.

Holocene-age deposits form modern fan surfaces bordering local washes and immediately overlie fine-grained sediments deposited as inset terraces during the Terminal Pleistocene/ Early Holocene at Little Dixie Wash and Indian Wells Canyon. Along Little Dixie Wash, younger fan deposits also extend onto the distal portions of older fans, forming a continuous apron across both surfaces (see Figure 28). Dates from inset terraces at Little Dixie Wash localities 1 and 3 indicate fan progradation began after 10,900 to 10,700 cal BP. This is consistent with a stratified alluvial fan sequence identified at the confluence of Freeman Gulch and Little Dixie Wash at Locality 5 (see Figure 15), which began forming before ~7800 and 7200 cal BP.

In Indian Wells Canyon, fan aggradation began sometime after 11,190 cal BP, but before 9810 cal BP, based on a date from the uppermost loamy sand stratum and one from a buried soil formed on the overlying coarse-grained fan deposit. On the piedmont bordering the western side of Indian Wells Valley, Young (2007) reported a date of 10,246 cal BP (Beta-237063) from a buried soil capped by coarse fan deposits, while at the Basalt Ridge locality in China Lake Basin, Basgall (2004) reported a date of 9360 cal BP (Beta-170209) from a buried soil, also capped by coarse, distal fan/and or eolian deposits. Just south of Indian Wells Valley, in the Koehn Lake Basin (the outflow to Dove Springs Wash), Early Holocene fan rejuvenation is also marked by a buried soil dated to 10,640 cal BP (Beta-255187; Young 2009).

In Rose Valley, alluvial fan deposits began accumulating about 9800 cal BP in the North Borrow Pit, and in the South Borrow Pit after 11,775 cal BP, while buried soils formed on distal fan/playa deposits at Dead Chevy Flat, Cinder Flat, and Rose Valley Flat are dated 11,097, 10,370, and 8130 cal BP, respectively. At Little Lake just to the south of Cinder Flat, alluvial fan deposits capped a buried soil at the Stahl site (INY-182) dated 9600 cal BP (Schroth 1994), further suggesting fan aggradation was widespread in Rose Valley during this time period.

Combined, these records suggest that a prolonged period of alluvial fan stability during the Terminal Pleistocene/Early Holocene was interrupted, beginning in the Early Holocene, by widespread fan rejuvenation and deposition. Younger-dating buried soils in some of these same fans (e.g., Young 2007), indicate that punctuated fan deposition has been the dominant geomorphic process in the northwestern Mohave Desert through the Holocene.

COMPARISON WITH REGIONAL RECORDS

Up to about 13,400 cal BP effective precipitation and Sierra Nevada run-off was sufficient to maintain high-energy surface flows through the lower Owens River channel to China Lake Basin. These inflows periodically resulted in a coalesced lake between China Lake and Searles Basins. After this time however, surface flows through the lower Owens River stopped and China and Searles lakes declined rapidly. The two lakes eventually separated, when water levels dropped below the China Lake Basin outflow sill by 13,400 cal BP. For some period of time the lakes remained at elevations approaching the outflow sill (~670 meters amsl), but by 11,100 cal BP, China Lake had dropped below 665 meters amsl.

Searles and Owens Lake Basins

The lacustrine record for China Lake presented here corresponds reasonably well with the reported sequence of high and low lake stands in the adjoining and inter-connected basins of Owens and Searles Lakes. However, interpretations of the mechanisms responsible for Terminal Pleistocene/Early Holocene lake level fluctuations in Owens and Searles basins are currently at odds. A recent study by Bacon et al. (2006) concluded that Owens Lake probably stopped overflowing to Rose Valley and China Lake Basin after 15,500 cal BP. The record from Searles Basin reported by Smith (2009) and others (e.g., Benson et al. 1990; Smith and Street-Perrott 1983), identify substantial evidence for lake stands in Searles Basin up to about 12,900 cal BP (ca. 11,000 RCYBP) attributing this to sustained input from the Owens River via outflow from Owens and China Lake (Smith 2009:81-83). Despite differences in the interpretation of the source of water in put, calibrated radiocarbon dates from these interconnected basins demonstrate that intervals of high and low lake levels largely correspond from the Terminal Pleistocene into the Early Holocene.

In Searles Basin, Smith (2009:Figure 39) recognizes a high stand at about 18,700 cal BP (15,500 RCYBP) followed by declining lake levels between about 18,200 and 16,600 cal BP (15,500-13,500 RCYBP), similar to a decline in China Lake levels after 17,780 cal BP (14,610 RCYBP) as evinced by beach deposits below the outflow elevation in Core 9. Owens Lake is also inferred to be nearly dry during this period (Bacon et al. 2006:Figure 3). Subsequently, the Searles lake record suggests a coalesced lake formed in China Lake and Searles Basins at around 15,500 cal BP, reflected in the China Lake Basin by off-shore lacustrine deposits above the beach sands in Core 9 (Stratum VI, 7Cu), and tufa deposits at Basalt Ridge dated 15,650 cal BP. This high stand is also consistent with Bacon et al.'s (2006:Figure 3) suggestion that water levels in Owens Lake rose to the sill level and overflowed into the lower Owens River channel about 15,500 cal BP.

Smith (2009:75, Figure 39) indicates Searles Lake rose once again between 13,900 and 12,900 cal BP (12,000-11,000 RCYBP), when it coalesced with China Lake. We believe that Smith (2009:Table 5) based the youngest age of the final transgression on a radiocarbon date of 10,900 RCYBP or 12,500 cal BP obtained on tufa reported by Garcia et al. (1993) from an elevation of 689 meters (2,261 feet) amsl in Searles Basin. Uranium-series dating of this same sample provided a much older date of 17,000 RCYBP (Garcia et al. 1993; Smith 2009:Table5), however, suggesting the tufa may relate to an earlier high stand. Lin et al. (1998) re-sampled tufa deposits from this same location and generated a date of 12,070 ± 100 RCYBP or 13,900 cal BP, very similar to the date and elevation of the last high stand recognized in China Lake Basin. This final coalesced lake is represented at an elevation of 681 meters amsl by a second Basalt Ridge tufa, dated 13,700 cal BP (11870 ± 120 RCYBP). Evidence developed for the current study indicates lake levels declined precipitously in China Lake and Salt Wells Valley after this date, closely matching a decline of more than 20 meters in Owens Lake dated about 13,200 cal BP (Bacon et al. 2006:Table 3, Figure 3) and extremely low lake levels in Searles basin after 12,900 cal BP (Smith 2009:75).

To the extent that the Searles and China Lake records agree that a coalesced lake persisted in these basins until just before 13,400 cal BP, current information suggests this high stand could not have been the result of overflow from Owens Lake. According to Bacon et al. (2006) Owens Lake last spilled into the lower Owens River much earlier (ca. 15,500 cal BP). If true, evidence for high-energy surface flows in the lower Owens River channel and high lake levels in China Lake and Searles Basins after 15,000 cal BP derive solely from Sierran run-off into Rose Valley and Indian Wells Valley. However, it remains an open question whether local drainages alone could cause China and Searles lakes to coalesce, without input from Owens Lake and the larger Owens River watershed (e.g., Smith 2009:83). Even if run-off into Rose Valley and Indian Wells Valley after 15,000 cal BP was sufficient to cause a unified lake stand, equal, if not larger, amounts of water would be expected to enter the upper Owens River from the Sierra, potentially causing Owens Lake to rise and spill over (e.g., Smith 2009:83). Unfortunately, channel deposits in the lower Owens River bed dated to before 13,400 cal BP cannot be directly attributed to overflow from Owens Lake, yet their presence indicates high-energy surface flows through Rose Valley continued during the Terminal Pleistocene, a phenomenon not recorded in stratigraphic records after this time.

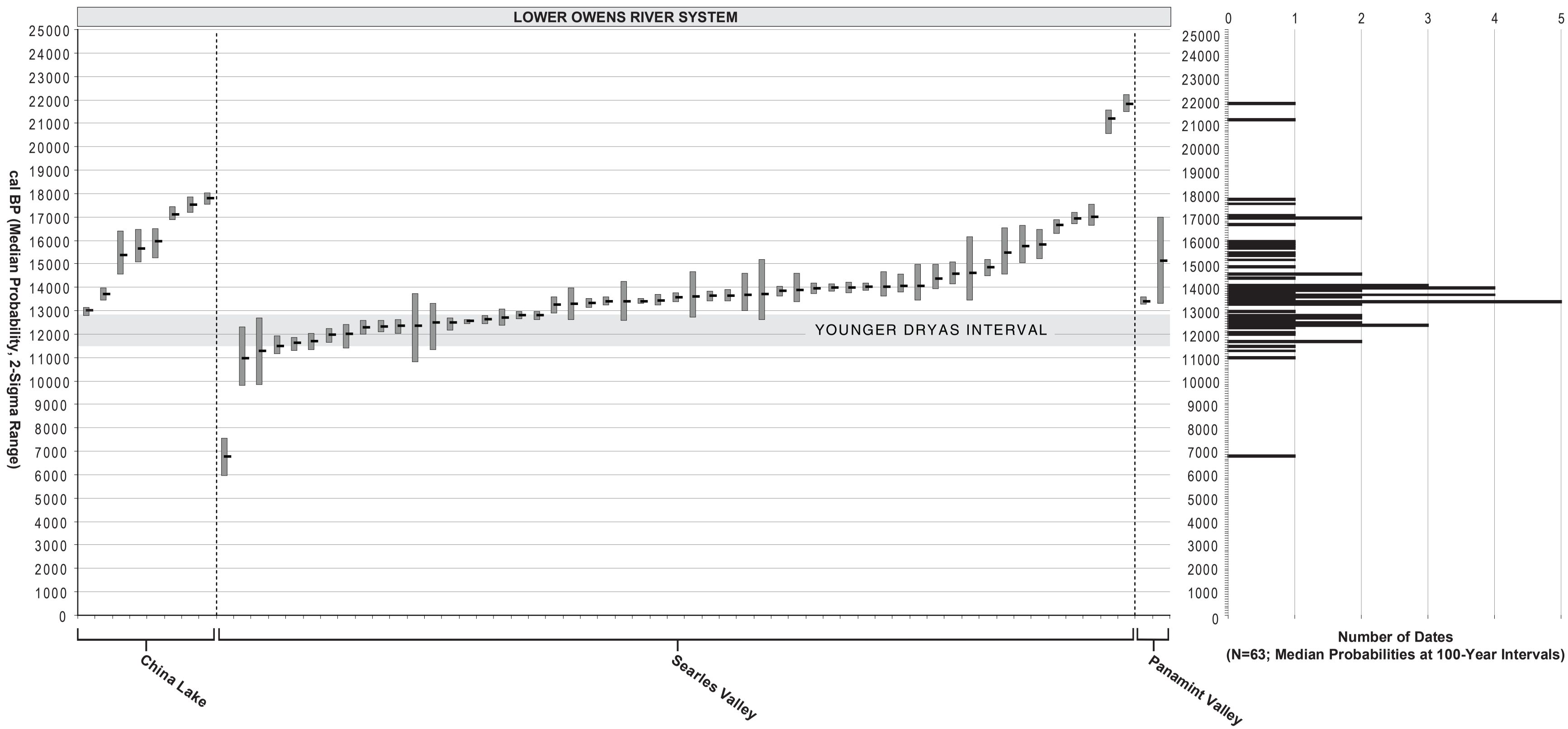
All dates from Searles Basin after about 12,000 cal BP (~10,200 RCYBP) are associated with the Upper Salt deposit, and represent a desiccated or dry lake (Smith 2009:Table 10). While radiocarbon dates from lacustrine-related deposits (e.g., tufa, marl, oolites, bivalves, gastropods, and organic sediments) in Searles Basin, suggest an intermittent lake may have persisted there until about 11,000 cal BP (Figure 32), a coalesced lake could not have extended into China Lake Basin. Radiocarbon-dated buried soils at elevations between 666 and 667 meters amsl (Davis and Panlaqui 1978), spring mats at an elevation of 674 meters (Basgall 2004), and alluvial fan deposits at 665 meters in Core 9, demonstrate that if a lake was present in China Lake Basin after 13,000 cal BP, it lay well below the basin's outflow sill at 670 meters amsl. These records further suggest that any Holocene lake in China Lake Basin was likely no greater than about ten meters deep, supporting Benson et al.'s (1990) contention that "lakes did not form in the Searles Lake Basin during the Holocene as the result of spill from the Owens Lake Basin" (Benson et al. 1990:270).

Other Mojave Desert Records

Radiocarbon evidence from several other lake basins in the Mojave Desert corresponds well to the China Lake record reported here. With the exception of the Mojave River system (e.g., Silver Lake, Soda Lake, Afton Canyon, and Mojave River), virtually all dated samples indicate that vestigial pluvial lakes in this region were gone by about 11,000 cal BP (Figure 32 and Figure 33). As the Mojave River system has its headwaters in the Peninsular Ranges of western California (see Figure 4), this drainage appears to have continued to receive extra-local surface flows periodically up to about 10,000 cal BP, and occasionally thereafter (Wells et al. 2003). However, the last sustained high stand at Lake Mojave occurred during the Lake Mojave II Period, which ended about 13,000 cal BP (11,400 RCYBP). This is almost precisely the same time as the last period of high lake stands recognized in China Lake Basin and Searles Basin. Most other lake basins in the Mojave Desert (e.g., Coyote Lake, Bristol Lake, Koehn Lake, Panamint Valley, Death Valley), appear to have also dried by about 13,000 cal BP (Figure 32 and Figure 33), roughly corresponding to the beginning of the Younger Dryas. Radiocarbon evidence suggests some of these basins may have periodically held water later in time, but none of the dated samples evince persistent lake stands after 11,000 cal BP (Figure 32 and Figure 33).

Overall, effective moisture in the wider Indian Wells Valley region appears to have remained comparatively high after 13,000 cal BP resulting in the formation of spring seeps and minor, episodic, surface flows in the lower Owens River channel, some local washes, and in China Lake Basin, probably fed by local and extra-local sources of ground water. This period does not appear to have been uniformly wetter. Rather, the geomorphic record suggests brief periods of higher effective moisture, which largely ended in the China Lake region by 9000 cal BP. This correlates with the Intermittent Lake III Period at Lake Mojave (Wells et al. 2003), dated between 13,000 and about 9800 cal BP (11,400 to 8700 ^{14}C BP).

Depositional pulses of fine-grained sediments and the development of organic-rich horizons between 12,600 and about 8000 cal BP recorded in Rose Valley and local washes, correlate almost precisely with similar ground-water records from black mats and other fluvial deposits (Unit E) reported by Quade et al. (2003) from western Nevada in the eastern Mojave Desert (Figure 34). Isolated spring deposits from China Lake Basin dated between 11,400 and 11,200 cal BP (Basgall 2004) and at Rogers Ridge in Nelson Basin at Fort Irwin dated between 9200 and 8800 cal BP (Jenkins 1985), are also indicative of this period of higher groundwater discharge during the Early Holocene. While wetter conditions persisted as late as 8000 cal BP in some locations, a comparison of regional records (Figure 34) shows that the most sustained period of elevated groundwater discharge correlates almost precisely with the end of the Younger Dryas (ca. 12,000 to 11,600 cal BP).



Note: Includes dates from tufa, marl, oolites, bivalves, gastropods, and organic sediments only; does not include dates obtained on other sources of CaCo3.

Figure 32. Radiocarbon Dates Relevant to the Lacustrine History of the Lower Owens River System.

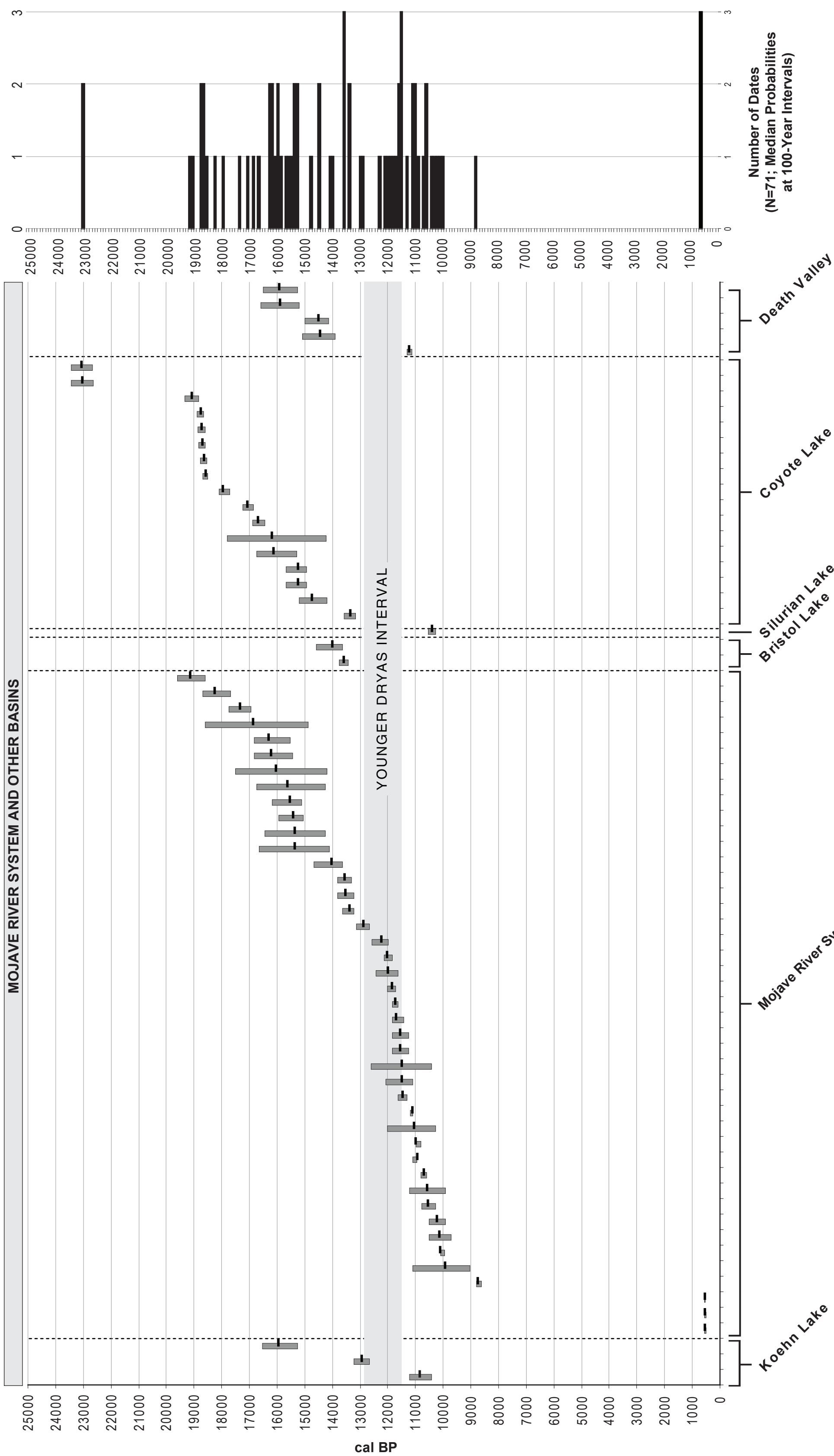


Figure 33. Radiocarbon Dates Relevant to the Lacustrine History of the Mojave River System and Other Enclosed Basins.

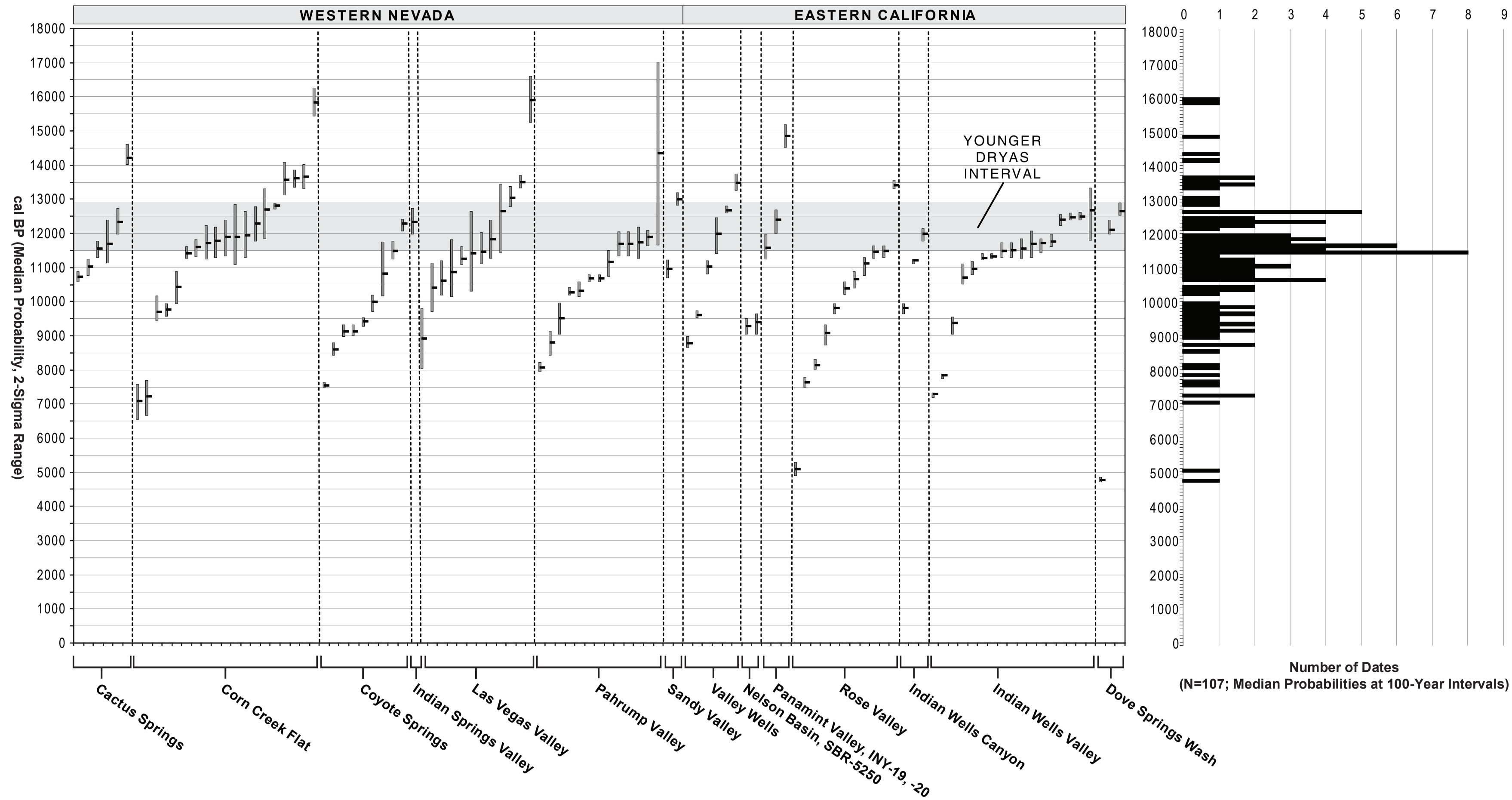


Figure 34. Radiocarbon Dates from Terrestrial Spring, Marsh, "Black Mat," and other Wetland Deposits in the Mojave Desert.

An abrupt shift in geomorphic processes is characteristic of the final phase of the Pleistocene/Holocene transition in Indian Wells Valley. Beginning after about 10,400 cal BP, an extended period of landscape stability was interrupted by depositional cycles recorded in numerous alluvial fans across this region. Harvey et al. (1999), McDonald et al. (2003), and Miller et al. (2010) have previously recognized this phenomenon elsewhere in the Mojave Desert, attributing it to shifts in climate and vegetation associated with the Pleistocene/Holocene transition. Declines in vegetative cover at the beginning of the Holocene, combined with a shift from mainly winter to summer (monsoonal) precipitation, appear to be responsible for these widespread geomorphic changes (Harvey et al. 1999; McDonald et al. 2003; Miller et al. 2010). An isotopic record from ostracodes recovered in basal alluvial fan deposits in Rose Valley (see Appendix D) supports the notion that greater seasonal rainfall from increased monsoonal activity, as opposed to simply vegetation shifts, are responsible for these widespread depositional responses (McDonald et al. 2003).

CONCLUSIONS

Analysis of the geomorphic and hydrologic records of surface water inflows and lake level histories in Indian Wells Valley document a three-part shift during the Terminal Pleistocene and Early Holocene that strongly correlates with other geomorphic and fluvial information from the central and eastern Mojave Desert. Similarities in these records indicate that effective moisture during the Terminal Pleistocene/Early Holocene in the Mojave Desert was higher than anytime since. Pluvial lakes in China and Searles Basins reached high stands at the height of the glacial maximum (ca. 20,000 cal BP), in concert with other pluvial lakes in the Mojave Desert (e.g., Lake Manly, Lake Mojave, etc.). Lake levels appear to have fluctuated until about 13,000 cal BP, coincident with the onset of the Younger Dryas. Occasional lake stands may have occurred after that time in the larger basins of the Mojave Desert (e.g., Searles Lake) or those fed by extra-local water sources (e.g., Owens Lake and Lake Mojave) If a lake was present in China Lake Basin during the Holocene, it could have only been intermittent, and did not reach above 665 meters amsl, far below the outflow sill to Searles Basin at 670 meters. Groundwater-related deposits including organic-rich black mats, dating between about 12,600 and 10,000 cal BP, are preserved in several drainages entering China Lake Basin, and are consistent with region-wide evidence for high groundwater levels and increased spring discharge during the Terminal Pleistocene and first part of the Holocene.

Terminal Pleistocene/ Earliest Holocene stratigraphic and paleoenvironmental records identified by this study have established a firm foundation for future archaeological research in the China Lake area. The pluvial lake history of China Lake Basin is much better resolved based on this synthesis, adding clarity to the conflicting interpretations drawn from adjacent lake basins. The pluvial system was in substantial decline by the beginning of the Clovis Period (ca. 13,500 to 12,900 cal BP), but a lake persisted in China Lake Basin through much of this interval. After 13,000 cal BP, around the beginning of the Younger Dryas, groundwater was the primary source for surface flows throughout Indian Wells Valley and elsewhere in the Mojave Desert, expressed mainly as isolated spring seeps and as wetlands in inset terrace positions along major washes and streams. Former lake basins appear to have periodically held water through this interval, but well below previous high stands. A rapid decline in effective precipitation during the Early Holocene is marked by widespread alluvial fan deposition in the Mojave Desert, most likely related to periodic summer monsoons.

6. CONCLUSION AND OUTLINE FOR STEP 2

Step 1 of the DoD Legacy Program study "Constructing a Regional Historical Context for Terminal Pleistocene/Early Holocene Archaeology of the North-Central Mojave Desert" is now complete. The objective of this initial step was to reconstruct the paleoenvironment during the Pleistocene/Holocene transition (15,000-8000 cal BP). This investigation was an unqualified success and provides a firm foundation for creating a strong historical context for early human occupation in the northern Mojave Desert (which will be carried out in Step 2 of the project). This paleoenvironmental research identified and dated a three-stage geomorphic and hydrological transition tied to deterioration in effective moisture. Initially, Pleistocene pluvial lake levels declined, and China Lake and Searles lake basins became hydrologically separated by 13,400 cal BP. China Lake, however, persisted until just after 13,000 cal BP. Subsequently, localized wetland habitats flourished as high groundwater levels and spring discharge continued to deliver surface flows to local washes and the China Lake Basin area. These wetland habitats largely disappeared by ~9000 cal BP as groundwater levels dropped, and alluvial fan deposition increased.

IMPLICATIONS FOR EARLY HUMAN SETTLEMENT AND SITE PRESERVATION

Each of the paleoenvironmental changes described above almost certainly had an effect on the subsistence economies of early foraging groups and the location and preservation of archaeological sites from the Terminal Pleistocene and Early Holocene. Notably, sites in China Lake and Searles Basins dating to pre-Clovis and Clovis time segments (15,000 to 13,000 cal BP) should occur above the Terminal Pleistocene lake high stand, at elevations greater than 670 to 680 meters amsl. In contrast, post-Clovis age sites from the Younger Dryas Terminal Pleistocene and Preboreal Early Holocene (13,000 to 10,500 cal BP) should be much more widely distributed and will likely occur below the prior lake high stand on the valley floor. Archaeological deposits from the Late Pleistocene (i.e., Pre-Clovis and Clovis intervals) and Terminal Pleistocene/ Early Holocene are also expected to occur along the lower Owens River channel and other local washes where surface water flows persisted and localized wetland habitats developed. As surface water flows declined in the Early Holocene, sites from this time period are expected to cluster near active spring seeps and close to the China Lake playa where near-surface groundwater created periodic playa lakes and associated wetland habitats attractive to early foraging groups. However, widespread alluvial fan activation beginning in the Early Holocene may have buried many archaeological deposits from the Pleistocene-Holocene transition. Such buried sites are expected to occur where Holocene-age distal fans intersect former lake margins and overtop older fan remnants adjacent to major washes, particularly those draining the eastern Sierra Nevada. Finally, we would anticipate a very different settlement distribution in the latter portion of the Early Holocene (after 9000 to 8000 cal BP) and into the Middle Holocene, as groundwater levels declined and wetland habitats disappeared from valley basins and Sierra-fed streams,, and only the most productive springs continued to provide surface water flows.

STEP 2 – HISTORICAL CONTEXT

Paleoenvironmental results, just described, provide a firm foundation for conducting Step 2 and successfully completing the overall project objectives. This entails creating a strong historical context for understanding the archaeology of the Terminal Pleistocene and Early Holocene. This will strengthen stewardship, provide a consistent and rigorous basis for determinations of eligibility for the National Register of Historic Places, and greatly assist in the management of these cultural resources, as required by Section 110 of the National Historic Preservation Act. As discussed in the proposal, Step 2 will entail reconstructing Terminal Pleistocene/Early Holocene plant and animal communities to understand fluctuations in resource potential, and re-examining Terminal Pleistocene/Early Holocene archaeological sites within the north-central Mojave Desert to reconstruct changing land-use patterns.

To accomplish these objectives, Step 2 will be comprised of four elements. First, the nature of local habitats will be reconstructed across this three-stage Terminal Pleistocene/Early Holocene transition. This is necessary since rapid climate change at the end of the Pleistocene created novel plant and animal co-associations that lack modern analogs. This habitat reconstruction will concentrate on identifying the range of available food resources and their relative abundance at various points in time. Ancient plant communities will be reconstructed based on pollen identification and analysis from alluvial sections, cores, and possibly packrat middens. Changes in the type and abundance of animal resources (large and small fauna as well as extinct megafauna) will be derived from a synthetic, temporal analysis of a large body of existing paloenotological data in the region.

Next, new analysis of existing Terminal Pleistocene/Early Holocene archaeological site collections within the north-central Mojave Desert will be conducted using modern methods and techniques. First, we will focus on dating assemblages. This analysis will capitalize on our recent success in distinguishing discrete artifact scatters dating to different temporal segments within the Terminal Pleistocene/Early Holocene using new obsidian hydration methods (e.g., Byrd 2006, 2007, 2010; Byrd et al. 2010; Rosenthal 2010). Previously, most obsidian artifacts from Early sites were considered unsuitable for obsidian hydration dating owing to extensive surface weathering; new techniques that obtain readings from small cracks created during initial manufacture have overcome this obstacle. Fortunately, the extensive Terminal Pleistocene/Early Holocene archaeological record in the north-central Mojave region (especially at NAWS China Lake and Fort Irwin NTC) has an abundance of obsidian artifacts from the nearby, well-studied Coso Volcanic field. By combining obsidian hydration results from flakes and formed artifacts, with diagnostic projectile points and their hydration readings, sites can be classified by age and in relationship to our three-stage paleoenvironmental reconstruction.

Subsequently, sites within each temporal segment will be analyzed from a functional and technological standpoint. This will include consideration of site and assemblage size, raw material reliance, and variation between tool types (focusing on variation in the relative emphasis on chert, obsidian, and other coarser-grained volcanic rocks), flaked stone reduction strategies (especially biface and core reduction), and the range and relative emphasis on particular tool types (such as different types of scrapers and crescents). These insights into manufacturing traditions and tool kits will form a basis for inferring site function, resource emphasis, and potential historical relationships to other cultural complexes in California and the intermountain west (e.g., Beck and Jones 2010; Graf and Schmidt 2007; Fitzgerald et al. 2005; Madsen 2004).

Step 2 will conclude with the construction of a GIS-linked data base that presents regional patterns in site distribution at different points in time. New archaeological and paleoenvironmental data will be integrated into a GIS-derived diachronic model of early human settlement. This model will highlight diachronic trends in regional site distribution patterns. The overall results will fill data gaps, provide a basis for systematizing data collection, identify areas where buried archaeological sites of specific ages may be located, and result in a new and appropriate historic context for evaluating Terminal Pleistocene/Early Holocene sites in the north-central Mojave region.

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APPENDIX A

GEOLOGICAL SAMPLE LOCALITY STRATIGRAPHIC DESCRIPTIONS

Appendix A: Indian Wells Canyon, Right (East) Bank

Depth (cm)	Horizon	Description
0-80	AC	Brown (10YR 5/3; dry) loamy sand, massive to single grain structure, stratified, 10 to 25% gravels, soft consistency, and clear smooth lower contact.
80-120	2Ab	Grayish brown (10YR 5/2, dry) loamy sand, massive to weak fine subangular blocky structure, 10 to 25% gravels, soft to slightly hard consistency, contains flaked stone debitage, and gradual smooth lower contact.
120-220	2Cu	Light gray (10YR 7/2, dry) sand, massive to single grain structure, 10 to 25% gravels and few angular cobbles, loose to soft consistency, poorly sorted, well bedded, and abrupt smooth lower contact.
220-240	3Ab	Dark gray (10YR 4/1, dry) loamy sand, massive to weak fine subangular blocky structure, 10 to 25% gravels, slightly hard consistency, and clear smooth lower contact.
240-320	3Cox	Brown (7.5YR 4/3, dry) sand, 10 to 25% gravels, massive to single grain structure, soft consistency, prominent oxidization throughout, and abrupt smooth lower contact.
320-350	4Ab	Dark grayish brown (10YR 4/2, dry) loamy sand, massive structure, 10 to 25% gravels, soft to slightly hard consistency, and abrupt smooth lower contact.
350-370	5Cox	Light olive brown (2.5YR 5/4, dry) fine sand, massive to single grain structure, soft consistency, well sorted, discontinuous oxidization patches near upper and lower contacts, and abrupt smooth lower contact.
370-375	6Ob	Dark gray (10YR 4/1, dry) sandy loam, weak medium platy structure, >10% gravels, soft consistency, and clear smooth lower contact.
375-425	6Cox	Strong brown (7.5YR 5/6, dry) sand, massive to single grain structure, 50 to 75% gravels, loose consistency, poorly sorted and bedded, nearly continuous oxidation throughout horizon, abrupt smooth lower contact.
425-435	7Cu1	Brown (7.5YR 5/3, dry) very fine sand, massive to single grain structure, soft consistency, well sorted, clear smooth lower contact.
435-445	7Cu2	Brown (7.5YR 5/3, dry) very fine sand, massive to single grain structure, soft consistency, well sorted, continuous oxidization throughout horizon, abrupt smooth lower contact.
445-446	8Ob	Dark grayish brown (10YR 4/2, dry) sandy clay loam, massive to weak fine granular structure, >10% small gravels, soft consistency, and abrupt smooth lower contact.
>446	9Cox	Strong brown (7.5YR 5/6, dry) sand, massive to single grain structure, 10 to 25% gravels, loose to soft consistency, continuous oxidation throughout horizon.

Appendix A: Little Dixie Wash, Locus 1, Left (West) Bank

Depth (cm)	Horizon	Description
0-40	A	Yellowish brown (10YR 6/4; dry) loamy sand, weak fine to very fine granular structure, >10% small to medium subangular and subrounded gravels, soft consistency, and gradual lower contact.
40-170	Cu	Light yellowish brown (2.5Y 6/3; dry) fine to medium sand, single grain structure, >10% small gravels, loose consistency, well sorted, and abrupt smooth lower contact.
170-200	2Ab	Gray (10YR 6/1, dry) sandy loam, strong to moderate fine to medium granular to subangular blocky structure, hard consistency, few snail shells, common small abandoned root holes, clear smooth lower contact.
200-250	2Cu	Light brownish gray (2.5Y 6/2; dry) sandy clay loam, weak medium to coarse subangular blocky structure, hard consistency, few powdery CaCo3 filaments on ped faces, and abrupt smooth lower contact.
250-280	3Ab	Gray (2.5Y 5/1, dry) silty clay, strong fine to medium angular blocky structure, very hard consistency, few oxidization mottles, few CaCo3 nodules, few small root holes, clear smooth lower contact.
280-305	3Cox	Light yellowish brown (2.5Y 6/4; dry) sandy loam, massive structure, slightly hard to hard consistency, common abandoned root holes and oxidization mottles, and clear smooth lower contact.
0-170	A/Cu	Light yellowish brown (2.5Y 6/3; dry) sand, single grain structure, 10 to 25% small to large gravels, loose to soft consistency, and abrupt wavy lower contact.
170-195	2Bwb	Light gray (10YR 7/2, dry) silty clay loam, moderate fine to medium subangular blocky structure, hard consistency, some CaCo3 coatings on ped faces and root holes, abrupt smooth lower contact.
195-210	3Ab	Light grayish brown (10YR 6/2, dry) silty clay, strong fine to medium subangular blocky structure, hard consistency, contains small snail shells, clear smooth lower contact.
210-260	3Cu	Light yellowish brown (2.5Y 6/3; dry) loamy sand, massive structure, slightly hard consistency, and abrupt smooth lower contact.
260-265	4Ab	Grayish brown (2.5Y 5/2, dry) silty clay, strong fine to medium subangular blocky structure, hard consistency, contains small snail shells, clear smooth lower contact.
265-295	4Cu	Light brownish gray (2.5Y 6/2; dry) silty loam, weak coarse subangular blocky structure, slightly hard consistency, common mica flecks, and abrupt smooth lower contact.
295-300	5Ab	Grayish brown (10YR 5/2, dry) silty clay, strong fine to medium subangular blocky structure, hard consistency, few oxidization mottles, abrupt smooth lower contact.
300-310	5Cox	Light brownish gray (2.5Y 6/2; dry) silt loam, moderate medium to coarse subangular blocky structure, common oxidization mottles, abrupt and smooth lower contact.
310-330	6Ab	Gray (2.5Y 5/1, dry) silty clay, strong fine to medium subangular blocky structure, hard to very hard consistency, few small oxidization mottles in root holes, clear smooth lower contact.
330-340	6Cu	Light brownish gray (2.5Y 6/2; dry) silty clay, moderate coarse subangular blocky structure, hard consistency, few small oxidization mottles in root holes, and abrupt smooth lower contact.
340-370	7Ab	Grayish brown (10YR 5/2, dry) silty clay, strong medium to coarse angular blocky to prismatic structure, hard to very hard consistency, and few small oxidization mottles in root holes.

Appendix A: Dixie Wash, Fan Locus 5, Left (West) Bank

Depth (cm)	Stratum	Horizon	Description
0-193	VI	Cu	Pale brown (10YR 6/4; dry) sand, massive to single grain structure, 10-25% small to medium subangular to rounded gravels, loose to soft consistency, and an abrupt smooth lower contact.
193-220	V	2Ab	Brown (10YR 5/3, dry) sandy clay loam, moderate fine to medium subangular blocky structure, soft to slightly hard consistency, and an abrupt smooth lower contact.
220-245	IV	3Ab	Brown (10YR 5/3, dry) sandy clay loam, moderate medium subangular blocky structure, hard consistency, and an abrupt smooth lower contact.
245-275	IV	3Cu	Brown (10YR 5/3, dry) sandy loam, massive structure, <10% small rounded gravels, hard consistency, and an abrupt smooth lower contact. Chert scraper found in situ near base of this horizon.
275-295	III	4Ab	Light brownish gray (2.5Y 6/2; dry) silty clay loam, moderate medium subangular blocky structure, hard consistency, common iron oxide mottles in upper 5-10 cm, and a clear smooth lower contact.
295-350	III	4Cu	Light brownish gray (2.5Y 6/2; dry) coarse sand to sandy loam, massive to single grain structure, 10-25% small to medium angular to subrounded gravels, slightly hard consistency, 20 cm layer of fine sand at abrupt smooth lower contact.
350-364	II	5Ab	Light brownish gray (2.5Y 6/2; dry) sandy clay loam, weak fine subangular blocky structure, hard to very hard consistency, few root holes, and a clear smooth lower contact.
364-380	II	5Cox	Light brownish gray (2.5Y 6/2; dry) loamy sand, massive structure, >10% small gravels, soft consistency, and an abrupt smooth lower contact.
380-398	I	6Ab	Light yellowish brown (2.5Y 6/3; dry) sandy loam, weak to moderate fine granular structure, slightly hard consistency, common iron oxide mottles, and a clear smooth lower contact.
298->420	I	6Cu	Light yellowish brown (2.5Y 6/3; dry) coarse sand, single grain structure, >10% small angular to subrounded gravels, loose consistency, poorly sorted, and an abrupt smooth lower contact.

Appendix A: Dove Springs Wash, Left (Northeast) Bank, Whistler Local 5771

Depth	Horizon	Description
(see figure)	A	Brown (10YR 5/3; dry) loamy sand, massive structure, 10 to 25% small to large subrounded to rounded gravels, soft consistency, and clear smooth lower contact.
	Cu	Pale brown (10YR 6/2, dry) sand, single grain structure, 10 to 25% small to large subrounded to rounded poorly sorted upward fining gravels, loose consistency, and abrupt wavy lower contact.
	2Ab	Brown (10YR 5/3; dry) loamy sand, weak medium subangular blocky structure, soft consistency, and clear smooth lower contact.
	2Cu	Pale brown (10YR 6/2, dry) very fine sand, massive structure, soft consistency, and abrupt wavy lower contact.
	3Ab	Grayish brown (10YR 5/2; dry) loamy sand, weak fine subangular blocky structure, soft consistency, and abrupt smooth lower contact.
	3Cu	Pale brown (10YR 6/2, dry) medium to coarse sand, massive to single grain structure, moderately sorted, loose consistency, and abrupt smooth lower contact.
	4Ab	Grayish brown (10YR 5/2; dry) loamy sand, weak medium subangular blocky structure, soft consistency, and clear smooth lower contact.
	4Cu	Pale brown (10YR 6/2, dry) very fine sand, massive structure, well sorted, soft consistency, and abrupt smooth lower contact.
	5Ab	Dark grayish brown (10YR 4/2; dry) sandy clay loam, moderate fine to medium subangular blocky structure, soft consistency, and clear smooth lower contact.
	5Cu	Very pale brown (10YR 7/3, dry) medium to coarse sand, single grain structure, poorly sorted, loose consistency, and clear smooth lower contact.
	6Ab	Light brownish gray (10YR 6/2; dry) loamy sand, >10% small subrounded to rounded gravels, weak medium subangular blocky structure, slightly hard consistency, and clear smooth lower contact.
	6Cox	Very pale brown (10YR 7/3, dry) medium to coarse sand, massive to single grain structure, poorly sorted, soft to slightly hard consistency, and abrupt smooth lower contact.
	7Ab	Brown (10YR 5/3; dry) sandy loam, weak medium subangular blocky structure, soft consistency, and clear smooth lower contact.
	7Cu	Pale yellow (2.5Y 7/3, dry) fine to coarse sand, massive to single grain structure, well sorted and bedded, soft consistency, and abrupt smooth lower contact.
	8Ab	Grayish brown (10YR 5/2; dry) loamy sand, weak fine subangular blocky structure, soft consistency, and abrupt smooth lower contact.
	8Cu	Light brownish gray (10YR 6/2, dry) loamy very fine sand, massive structure, well sorted, soft to slightly hard consistency, and clear smooth lower contact.
	9Ab	Grayish brown (10YR 5/2; dry) loamy sand, weak fine subangular blocky structure, soft consistency, and clear smooth lower contact.
	9Cu	Very pale brown (10YR 7/3, dry) medium to coarse sand, massive to single grain structure, poorly sorted, loose consistency, and abrupt smooth lower contact.
	10Ab	Dark gray (10YR 4/1; dry) silty clay, strong medium to coarse subangular blocky structure, hard consistency, common oxidized mottles in small to medium root holes, and clear smooth lower contact.
	10Cox	Light yellowish brown (2.5Y 6/3, dry) silty clay, weak medium subangular blocky structure, hard consistency, common oxidized mottles in small to medium root holes, and clear smooth lower contact.
	11Ab	Grayish brown (10YR 5/2; dry) silty clay, strong medium to coarse subangular blocky structure, slightly hard to hard consistency, few oxidized mottles in root holes, and clear smooth lower contact.
	11Cox	Light brownish gray (2.5Y 6/2, moist) fine sand, <10% small subrounded to rounded gravels, massive to single grain structure, soft to slightly hard consistency, few oxidized mottles in root holes, and abrupt smooth lower contact.
	12Ab	Very dark grayish brown (10YR 3/2; moist) sandy loam, >10% small subrounded to rounded gravels, moderate fine subangular blocky structure, soft to slightly hard consistency, few oxidized mottles, common small root holes, and clear smooth lower contact.
	12Cu	Pale red (2/5YR 7/3, dry) medium to coarse sand, >10% small subrounded to rounded gravels, massive to single grain structure, slightly hard consistency, and clear smooth lower contact.
	13Ab	Very dark gray (10YR 3/1; dry) sandy loam, 10% small gravels, weak granular structure, and hard consistency.

Appendix A: Core 9—Charley Range, West of Flight Line Road

Depth (cm)	Horizon	Description
0-46	A	Very pale brown (10YR 7/3, dry) silt, weak fine to medium subangular blocky structure, slightly hard consistency, very few fine root hole, strongly effervescent with HCL (~5% $CaCO_3$), and a clear smooth lower contact.
46-91	Cu	Very pale brown (10YR 7/3, dry) loamy sand, massive to single grain structure, loose consistency, strongly effervescent with HCL (~5% $CaCO_3$), and an abrupt smooth lower contact.
91-152	2Akb	Light yellowish brown (2.5Y 6/3, dry) silt, weak fine subangular blocky structure, slightly hard consistency, common soft $CaCO_3$ masses, and violently effervescent with HCL (>10% $CaCO_3$).
152-213		no recovery
213-268	2Cu?	Pale yellow (2.5Y 7/3, dry) sand, massive to single grain structure, loose consistency, strongly effervescent with HCL (~5% $CaCO_3$), and an abrupt lower contact.
268-287	3Ab	Light olive brown (2.5Y 5/3, dry) silt, weak fine subangular blocky structure, soft consistency, few fine root holes, noneffervescent with HCL, and an abrupt lower contact
287-305	3Cu	Pale yellow (2.5Y 7/3, dry) medium to coarse sand, single grain structure, loose consistency, and a clear lower contact.
305-381	4Akb	Light olive grey (5Y 6/2, dry) silty clay, moderate fine subangular blocky structure, slightly hard consistency, few fine root holes, few hard $CaCO_3$ nodules near upper contact, strongly effervescent with HCL (~5% $CaCO_3$), and an abrupt lower contact
381-396	5Akb	White (5Y 8/1, dry) sandy clay loam, moderate fine subangular blocky structure, hard consistency, violently effervescent with HCL (>10% $CaCO_3$), and an abrupt lower contact
396-457	6Cg	Pale olive (5Y 6/3, dry) silty clay, moderate fine subangular blocky structure, hard consistency, noneffervescent with HCL, few small hard $CaCO_3$ nodules in upper 5cm, and an abrupt lower contact.
457-756	7Cu	Light gray (2.5Y 7/2, dry) sand, single grain structure, <10% small to medium subrounded to water worn gravels, loose consistency, moderately sorted and bedded with few thin layers of black sand, and an abrupt lower contact.
756-762	8C	Light gray (2.5Y 7/1, dry) sandy loam, massive structure, hard consistency, noneffervescent with HCL, weakly cemented with gypsum, and a clear lower contact.
762-914	9Cu	Various color fine to coarse sand, single grain structure, <10% small to medium subangular to rounded gravels, loose consistency, noneffervescent with HCL, moderately sorted and bedded with few thin black sand layers, and an abrupt smooth lower contact.
914-930	10Cg1	Olive gray (5Y 5/2, dry) sandy loam, massive structure, slightly hard consistency, noneffervescent with HCL, and an abrupt lower contact.
930-994	10Cg2	Gray (5Y 5/1, dry) very fine sand, single grain structure, loose consistency, noneffervescent with HCL, coarse sand in lower 5cm, and an abrupt lower contact.
994-1061	11Cg	Olive gray (5Y 5/2, dry) very fine sand, single grain structure, loose consistency, noneffervescent with HCL, coarse sand in lower 5cm, and an abrupt lower contact.
1061-1067	12Cg	Greenish gray (5GY 6/1, dry) sandy clay loam, massive structure, slightly hard consistency, noneffervescent with HCL, and an abrupt lower contact.

Appendix A: Descriptions of Cores 3, 4, 5, 6, 7, and 8

CORE		DESCRIPTION
Core 3		**Baker Range, Former Owens River Channel?**
Depth (cm)	**Horizon**	**Description**
0-91	A	Brown sandy loam
91-229	Cu	Brown gravely sand containing few small cobbles. Coring rig met refusal @ 229 cm below surface due to rock
Core 4		**Baker Range, former channel area**
Depth (cm)	**Horizon**	**Description**
0-152	A/C	Silty sand
152-168	2Ab	Silty clay loam
168-229	2Cu	Sand with small gravel
>229	3R	Refusal due to rock and cobbles?
Core 5		**Baker Range, swale on mid-fan setting, hollow stem auger**
Depth (cm)	**Horizon**	**Description**
0-61	A	Tan silty sand
>61	Cu	coarse gravel and subrounded to rounded cobbles
61-152		skipped
152-610	2Cu	alternating layers of sand, gravel, and loess
610-914	2Cu	alternating layers of sand, gravel, and loess with coarse oxidized gravel at base
914-1280	2Cu	coarse and fine sand
Core 6		**Baker Range, mid-fan setting, hollow stem auger**
Depth (cm)	**Horizon**	**Description**
0-122	A/C	Sand with few large gravels and small cobbles at 122cmbs
122 to 244	Cu	fining upwards sand
244 to 518	Cu	coarse angular granitic sand
518-914		loose sand and gravel, no recovery.
914-975		fining downwards sand
975-1036		skipped
1036-1097		fine well-sorted sand
1097-1158		skipped
1158-1219		fine well-sorted sand
Core 7		**Baker Range, dune setting**
Depth (cm)	**Horizon**	**Description**
0-122	A/C	loose sand
122-183	2Ab	buried dune soil
183-381	2Cu	loose fine sand
381-457	3Ab	buried dune soil
457-610	4R	Basalt scoria and angular gravel
Core 8		**Charlie Range, playa setting, hollow stem auger**
Depth (cm)	**Horizon**	**Description**
0-457	Multiple	Alternating playa and dunes deposits. Basalt scoria cobble in sand at 4.5 m
457-610	Multiple	Alternating layers of playa and dune deposits
610-792	Single	coarse alluvial sand and gravel
792-914	Cg	Gleyed fine grained lake or playa deposit.
914-1067	C	Beach sand and gravel
1067-1219	C/Cg	Beach sand and gravel with lacustrine deposit at base
1219-1280		Beach sand overlying desiccated lake
1280-1372		Sand overlying lacustrine deposit at base of core

APPENDIX B

RADIOCARBON LABORATORY DATING RESULTS AND METHODS

BETA

Consistent Accuracy
Delivered On Time

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
beta@radiocarbon.com
www.radiocarbon.com

Mr. Darden Hood
President

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

The Radiocarbon Laboratory Accredited to ISO-17025 Testing Standards (PJLA Accreditation #59423)

Final Report

The final report package includes the final date report, a statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, billing documents (containing balance/credit information and the number of samples submitted within the yearly discount period), and peripheral items to use with future submittals. The final report includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied. The final report has been sent by mail and e-mail (where available).

Pretreatment

Pretreatment methods are reported along with each result. All necessary chemical and mechanical pretreatments of the submitted material were applied at the laboratory to isolate the carbon, which may best represent the time event of interest. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated, making their ^{14}C ages more subjective than samples, which can be fully pretreated. Some materials receive no pretreatments. Please look at the pretreatment indicated for each sample and read the pretreatment glossary to understand the implications.

Analysis

Materials measured by the radiometric technique were analyzed by synthesizing sample carbon to benzene (92% C), measuring for ^{14}C content in one of 53 scintillation spectrometers, and then calculating for radiocarbon age. If the Extended Counting Service was used, the ^{14}C content was measured for a greatly extended period of time. AMS results were derived from reduction of sample carbon to graphite (100 %C), along with standards and backgrounds. The graphite was then detected for ^{14}C content in one of 9 accelerator-mass-spectrometers (AMS).

The Radiocarbon Age and Calendar Calibration

The "Conventional ^{14}C Age (*)" is the result after applying $^{13}C/^{12}C$ corrections to the measured age and is the most appropriate radiocarbon age. If an "*" is attached to this date, it means the $^{13}C/^{12}C$ was estimated rather than measured (The ratio is an option for radiometric analysis, but included on all AMS analyses.) Ages are reported with the units "BP" (Before Present). "Present" is defined as AD 1950 for the purposes of radiocarbon dating.

Results for samples containing more ^{14}C than the modern reference standard are reported as "percent modern carbon" (pMC). These results indicate the material was respiring carbon after the advent of thermo-nuclear weapons testing and is less than ~ 50 years old.

Applicable calendar calibrations are included for materials between about 100 and 19,000 BP. If calibrations are not included with a report, those results were too young, too old, or inappropriate for calibration. Please read the enclosed page discussing calibration.

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Calendar Calibration at Beta Analytic

Calibrations of radiocarbon age determinations are applied to convert BP results to calendar years. The short-term difference between the two is caused by fluctuations in the heliomagnetic modulation of the galactic cosmic radiation and, recently, large scale burning of fossil fuels and nuclear devices testing. Geomagnetic variations are the probable cause of longer-term differences.

The parameters used for the corrections have been obtained through precise analyses of hundreds of samples taken from known-age tree rings of oak, sequoia, and fir up to about 10,000 BP. Calibration using tree-rings to about 12,000 BP is still being researched and provides somewhat less precise correlation. Beyond that, up to about 20,000 BP, correlation using a modeled curve determined from U/Th measurements on corals is used. This data is still highly subjective. Calibrations are provided up to about 19,000 years BP using the most recent calibration data available.

The Pretoria Calibration Procedure (Radiocarbon, Vol 35, No.1, 1993, pg 317) program has been chosen for these calendar calibrations. It uses splines through the tree-ring data as calibration curves, which eliminates a large part of the statistical scatter of the actual data points. The spline calibration allows adjustment of the average curve by a quantified closeness-of-fit parameter to the measured data points. A single spline is used for the precise correlation data available back to 9900 BP for terrestrial samples and about 6900 BP for marine samples. Beyond that, splines are taken on the error limits of the correlation curve to account for the lack of precision in the data points.

In describing our calibration curves, the solid bars represent one sigma statistics (68% probability) and the hollow bars represent two sigma statistics (95% probability). Marine carbonate samples that have been corrected for $^{13}C/^{12}C$, have also been corrected for both global and local geographic reservoir effects (as published in Radiocarbon, Volume 35, Number 1, 1993) prior to the calibration. Marine carbonates that have not been corrected for $^{13}C/^{12}C$ are adjusted by an assumed value of 0 %0 in addition to the reservoir corrections. Reservoir corrections for fresh water carbonates are usually unknown and are generally not accounted for in those calibrations. In the absence of measured $^{13}C/^{12}C$ ratios, a typical value of -5 %0 is assumed for freshwater carbonates.

(Caveat: the correlation curve for organic materials assume that the material dated was living for exactly ten years (e.g. a collection of 10 individual tree rings taken from the outer portion of a tree that was cut down to produce the sample in the feature dated). For other materials, the maximum and minimum calibrated age ranges given by the computer program are uncertain. The possibility of an "old wood effect" must also be considered, as well as the potential inclusion of younger or older material in matrix samples. Since these factors are in determinant error in most cases, these calendar calibration results should be used only for illustrative purposes. In the case of carbonates, reservoir correction is theoretical and the local variations are real, highly variable and dependent on provenience. Since imprecision in the correlation data beyond 10,000 years is high, calibrations in this range are likely to change in the future with refinement in the correlation curve. The age ranges and especially the intercept ages generated by the program must be considered as approximations.)

PRETREATMENT GLOSSARY
Standard Pretreatment Protocols at Beta Analytic

Unless otherwise requested by a submitter or discussed in a final date report, the following procedures apply to pretreatment of samples submitted for analysis. This glossary defines the pretreatment methods applied to each result listed on the date report form (e.g. you will see the designation "acid/alkali/acid" listed along with the result for a charcoal sample receiving such pretreatment).

Pretreatment of submitted materials is required to eliminate secondary carbon components. These components, if not eliminated, could result in a radiocarbon date, which is too young or too old. Pretreatment does not ensure that the radiocarbon date will represent the time event of interest. This is determined by the sample integrity. Effects such as the old wood effect, burned intrusive roots, bioturbation, secondary deposition, secondary biogenic activity incorporating recent carbon (bacteria) and the analysis of multiple components of differing age are just some examples of potential problems. The pretreatment philosophy is to reduce the sample to a single component, where possible, to minimize the added subjectivity associated with these types of problems. If you suspect your sample requires special pretreatment considerations be sure to tell the laboratory prior to analysis.

"acid/alkali/acid"

The sample was first gently crushed/dispersed in deionized water. It was then given hot HCI acid washes to eliminate carbonates and alkali washes (NaOH) to remove secondary organic acids. The alkali washes were followed by a final acid rinse to neutralize the solution prior to drying. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of the sample. Each chemical solution was neutralized prior to application of the next. During these serial rinses, mechanical contaminants such as associated sediments and rootlets were eliminated. This type of pretreatment is considered a "full pretreatment". On occasion the report will list the pretreatment as "acid/alkali/acid - insolubles" to specify which fraction of the sample was analyzed. This is done on occasion with sediments (See "acid/alkali/acid - solubles"

Typically applied to: charcoal, wood, some peats, some sediments, and textiles "acid/alkali/acid - solubles"

On occasion the alkali soluble fraction will be analyzed. This is a special case where soil conditions imply that the soluble fraction will provide a more accurate date. It is also used on some occasions to verify the present/absence or degree of contamination present from secondary organic acids. The sample was first pretreated with acid to remove any carbonates and to weaken organic bonds. After the alkali washes (as discussed above) are used, the solution containing the alkali soluble fraction is isolated/filtered and combined with acid. The soluble fraction, which precipitates, is rinsed and dried prior to combustion.

"acid/alkali/acid/cellulose extraction"

Following full acid/alkali/acid pretreatments, the sample is bathed in (sodium chlorite) $NaClO_2$ under very controlled conditions (Ph = 3, temperature = 70 degrees C). This eliminates all components except wood cellulose. It is useful for woods that are either very old or highly contaminated.

Applied to: wood

"acid washes"

Surface area was increased as much a possible. Solid chunks were crushed, fibrous materials were shredded, and sediments were dispersed. Acid (HCI) was applied repeatedly to ensure the absence of carbonates. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of each sample. The sample was not be subjected to alkali washes to ensure the absence of secondary organic acids for intentional reasons. The most common reason is that the primary carbon is soluble in the alkali. Dating results reflect the total organic content of the analyzed material. Their accuracy depends on the researcher's ability to subjectively eliminate potential contaminants based on contextual facts.

Typically applied to: organic sediments, some peats, small wood or charcoal, special cases

PRETREATMENT GLOSSARY
Standard Pretreatment Protocols at Beta Analytic
(Continued)

"collagen extraction: with alkali" or "collagen extraction: without alkali"

The material was first tested for friability ("softness"). Very soft bone material is an indication of the potential absence of the collagen fraction (basal bone protein acting as a "reinforcing agent" within the crystalline apatite structure). It was then washed in de-ionized water, the surface scraped free of the outer most layers and then gently crushed. Dilute, cold HCI acid was repeatedly applied and replenished until the mineral fraction (bone apatite) was eliminated. The collagen was then dissected and inspected for rootlets. Any rootlets present were also removed when replenishing the acid solutions. "With alkali" refers to additional pretreatment with sodium hydroxide (NaOH) to ensure the absence of secondary organic acids. "Without alkali" refers to the NaOH step being skipped due to poor preservation conditions, which could result in removal of all available organics if performed.

Typically applied to: bones

"acid etch"

The calcareous material was first washed in de-ionized water, removing associated organic sediments and debris (where present). The material was then crushed/dispersed and repeatedly subjected to HCI etches to eliminate secondary carbonate components. In the case of thick shells, the surfaces were physically abraded prior to etching down to a hard, primary core remained. In the case of porous carbonate nodules and caliches, very long exposure times were applied to allow infiltration of the acid. Acid exposure times, concentrations, and number of repetitions, were applied accordingly with the uniqueness of the sample.

Typically applied to: shells, caliches, and calcareous nodules

"neutralized"

Carbonates precipitated from ground water are usually submitted in an alkaline condition (ammonium hydroxide or sodium hydroxide solution). Typically this solution is neutralized in the original sample container, using deionized water. If larger volume dilution was required, the precipitate and solution were transferred to a sealed separatory flask and rinsed to neutrality. Exposure to atmosphere was minimal.

Typically applied to: Strontium carbonate, Barium carbonate
(i.e. precipitated ground water samples)

"carbonate precipitation"

Dissolved carbon dioxide and carbonate species are precipitated from submitted water by complexing them as ammonium carbonate. Strontium chloride is added to the ammonium carbonate solution and strontium carbonate is precipitated for the analysis. The result is representative of the dissolved inorganic carbon within the water. Results are reported as "water DIC".

Applied to: water

"solvent extraction"

The sample was subjected to a series of solvent baths typically consisting of benzene, toluene, hexane, pentane, and/or acetone. This is usually performed prior to acid/alkali/acid pretreatments.

Applied to: textiles, prevalent or suspected cases of pitch/tar contamination, conserved materials.

"none"

No laboratory pretreatments were applied. Special requests and pre-laboratory pretreatment usually accounts for this.

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

June 24, 2009

Dr. William Hildebrandt/D. Craig Young
Far Western Anthropological Research
Group, Incorporated
PO Box 758
Virginia City, NV 89440

RE: Radiocarbon Dating Results For Samples FW718-13, FW718-14, FW718-15, FW718-16, FW718-17, FW718-18, FW718-19

Dear Dr. Hildebrandt and Dr. Young:

Enclosed are the radiocarbon dating results for seven samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the MASTERCARD card provided. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/D. Craig Young — Report Date: 6/24/2009

Far Western Anthropological Research Group, Incorporated — Material Received: 5/29/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260150	7300 +/- 40 BP	-23.7 o/oo	7320 +/- 40 BP

SAMPLE : FW718-13
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 6240 to 6070 (Cal BP 8190 to 8020)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260151	9140 +/- 50 BP	-22.8 o/oo	9180 +/- 50 BP

SAMPLE : FW718-14
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 8550 to 8280 (Cal BP 10500 to 10240)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260152	4410 +/- 40 BP	-23.0 o/oo	4440 +/- 40 BP

SAMPLE : FW718-15
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 3340 to 3210 (Cal BP 5290 to 5160) AND Cal BC 3190 to 2920 (Cal BP 5140 to 4880)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260153	9400 +/- 50 BP	-24.5 o/oo	9410 +/- 50 BP

SAMPLE : FW718-16
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 8800 to 8560 (Cal BP 10740 to 10520)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260154	8090 +/- 50 BP	-23.1 o/oo	8120 +/- 50 BP

SAMPLE : FW718-17
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 7250 to 7230 (Cal BP 9200 to 9180) AND Cal BC 7190 to 7040 (Cal BP 9140 to 8990)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/D. Craig Young

Report Date: 6/24/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260155	6720 +/- 50 BP	-22.2 o/oo	6770 +/- 50 BP

SAMPLE : FW718-18
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 5730 to 5620 (Cal BP 7680 to 7570)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260156	9710 +/- 50 BP	-24.1 o/oo	9720 +/- 50 BP

SAMPLE : FW718-19
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic material): acid washes
2 SIGMA CALIBRATION : Cal BC 9280 to 9140 (Cal BP 11230 to 11090) AND Cal BC 8970 to 8940 (Cal BP 10920 to 10890)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.7:lab. mult=1)

Laboratory number: **Beta-260150**

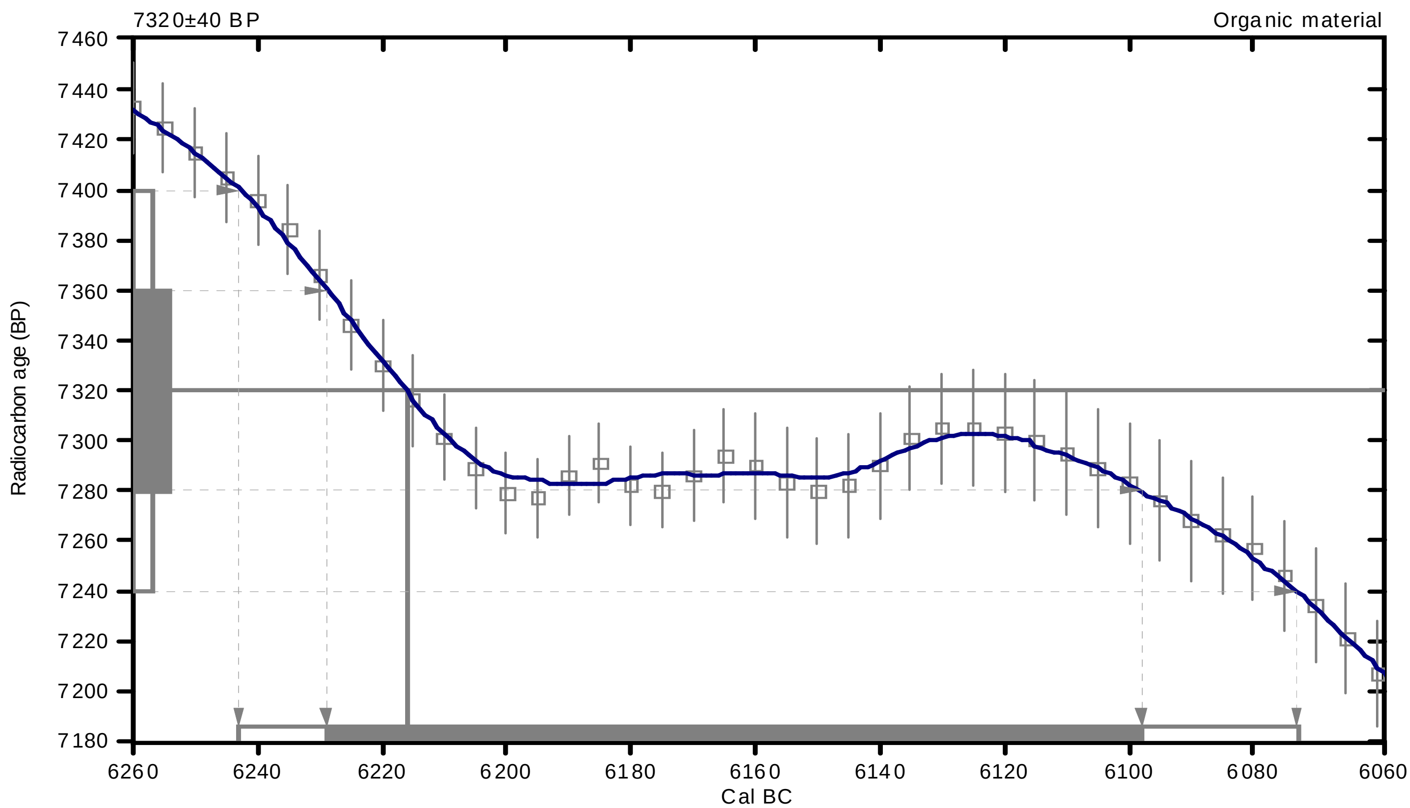
Conventional radiocarbon age: **7320±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 6240 to 6070 (Cal BP 8190 to 8020)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 6220 (Cal BP 8170)

1 Sigma calibrated result: (68% probability) Cal BC 6230 to 6100 (Cal BP 8180 to 8050)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.8:lab. mult=1)

Laboratory number: **Beta-260151**

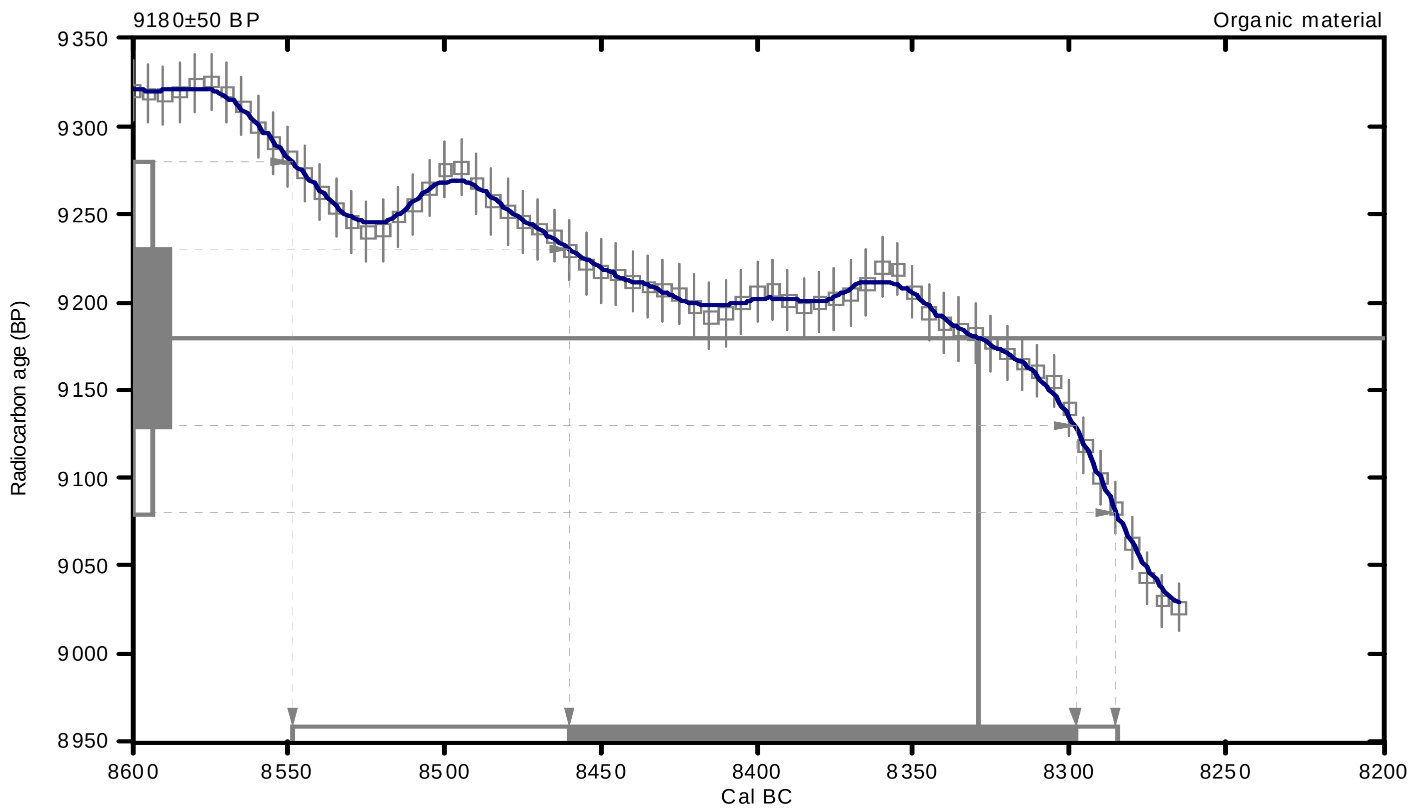
Conventional radiocarbon age: **9180±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 8550 to 8280 (Cal BP 10500 to 10240)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 8330 (Cal BP 10280)

1 Sigma calibrated result: (68% probability) Cal BC 8460 to 8300 (Cal BP 10410 to 10250)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

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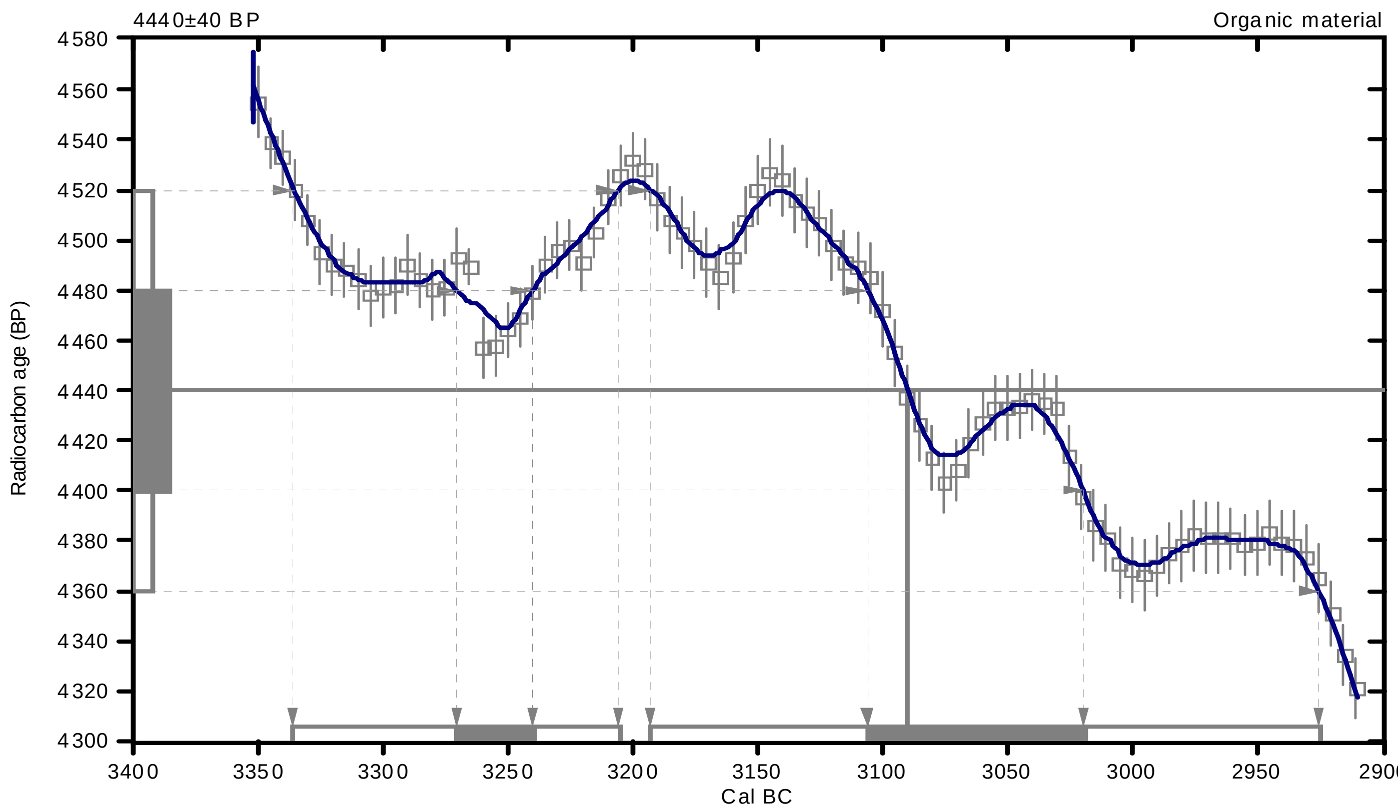
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23:lab. mult=1)

Laboratory number:	**Beta-260152**
Conventional radiocarbon age:	**4440±40 BP**
2 Sigma calibrated results: **(95% probability)**	**Cal BC 3340 to 3210 (Cal BP 5290 to 5160) and** **Cal BC 3190 to 2920 (Cal BP 5140 to 4880)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 3090 (Cal BP 5040)
1 Sigma calibrated results: (68% probability)	Cal BC 3270 to 3240 (Cal BP 5220 to 5190) and Cal BC 3110 to 3020 (Cal BP 5060 to 4970)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.5:lab. mult=1)

Laboratory number: **Beta-260153**

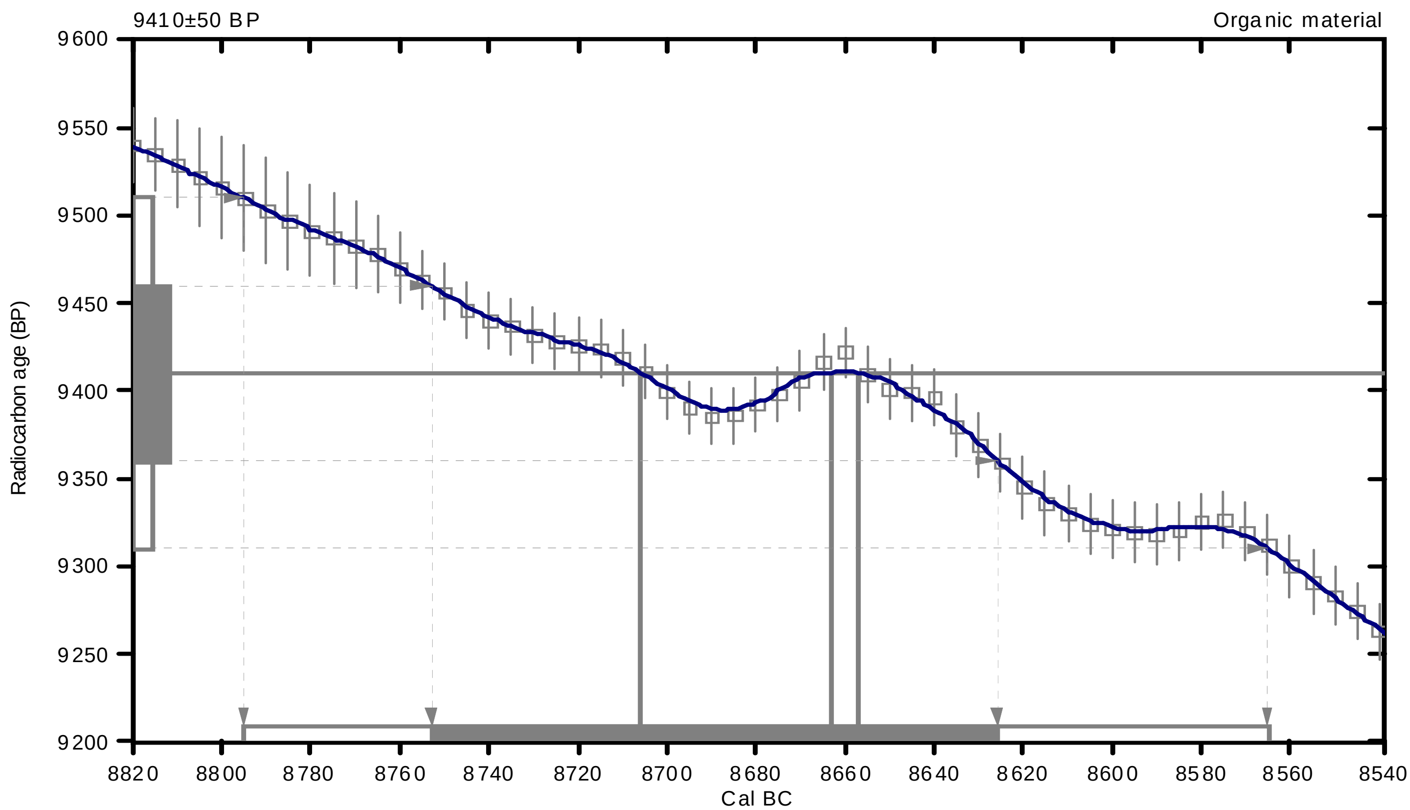
Conventional radiocarbon age: **9410±50 BP**

2 Sigma calibrated result: **Cal BC 8800 to 8560 (Cal BP 10740 to 10520)**
(95% probability)

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 8710 (Cal BP 10660) and
Cal BC 8660 (Cal BP 10610) and
Cal BC 8660 (Cal BP 10610)

1 Sigma calibrated result: Cal BC 8750 to 8630 (Cal BP 10700 to 10580)
(68% probability)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: **Beta-260154**

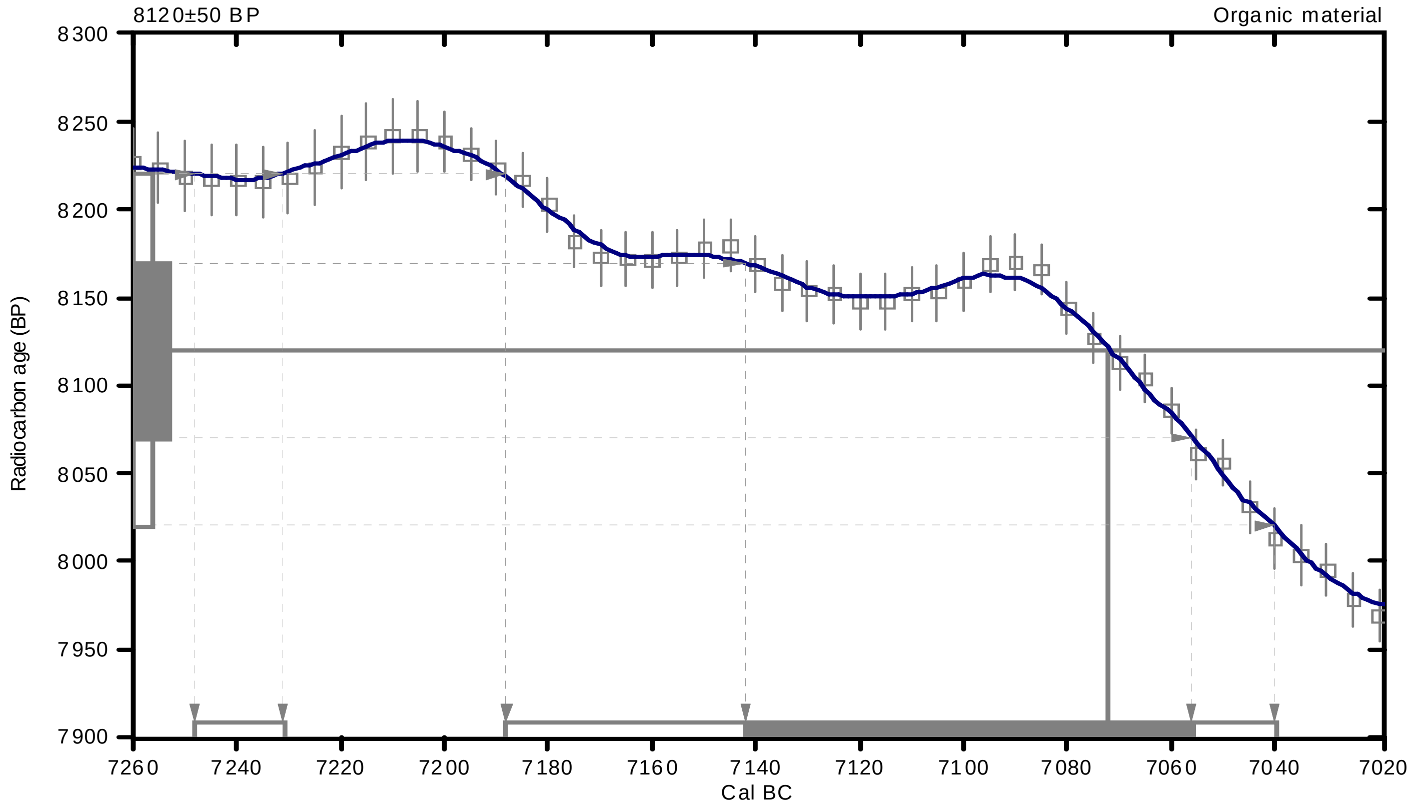
Conventional radiocarbon age: **8120±50 BP**

2 Sigma calibrated results: **Cal BC 7250 to 7230 (Cal BP 9200 to 9180) and**
(95% probability) **Cal BC 7190 to 7040 (Cal BP 9140 to 8990)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 7070 (Cal BP 9020)

1 Sigma calibrated result: Cal BC 7140 to 7060 (Cal BP 9090 to 9010)
(68% probability)



References:

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.2:lab. mult=1)

Laboratory number: **Beta-260155**

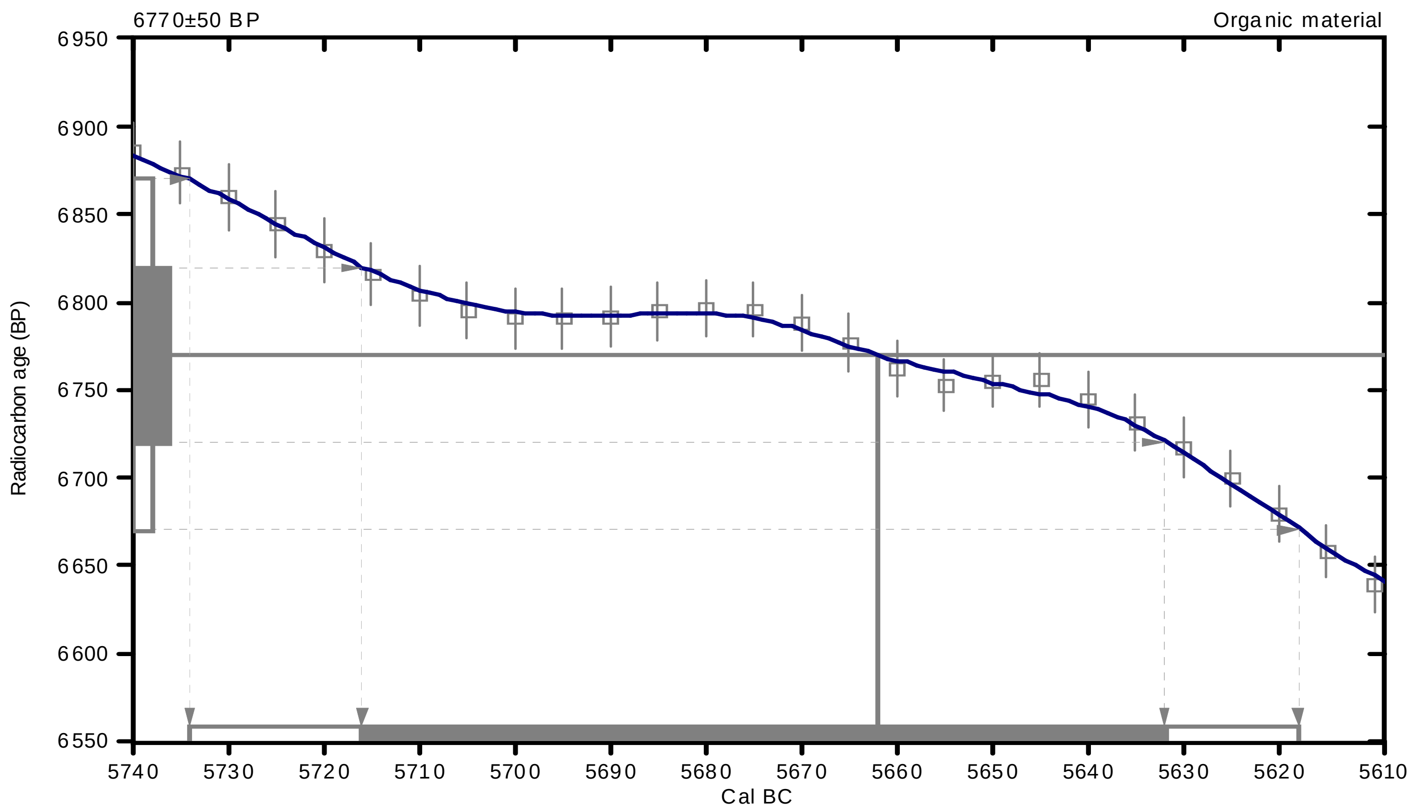
Conventional radiocarbon age: **6770±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 5730 to 5620 (Cal BP 7680 to 7570)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 5660 (Cal BP 7610)

1 Sigma calibrated result: (68% probability) Cal BC 5720 to 5630 (Cal BP 7670 to 7580)



References:

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Calibration Database

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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number: **Beta-260156**

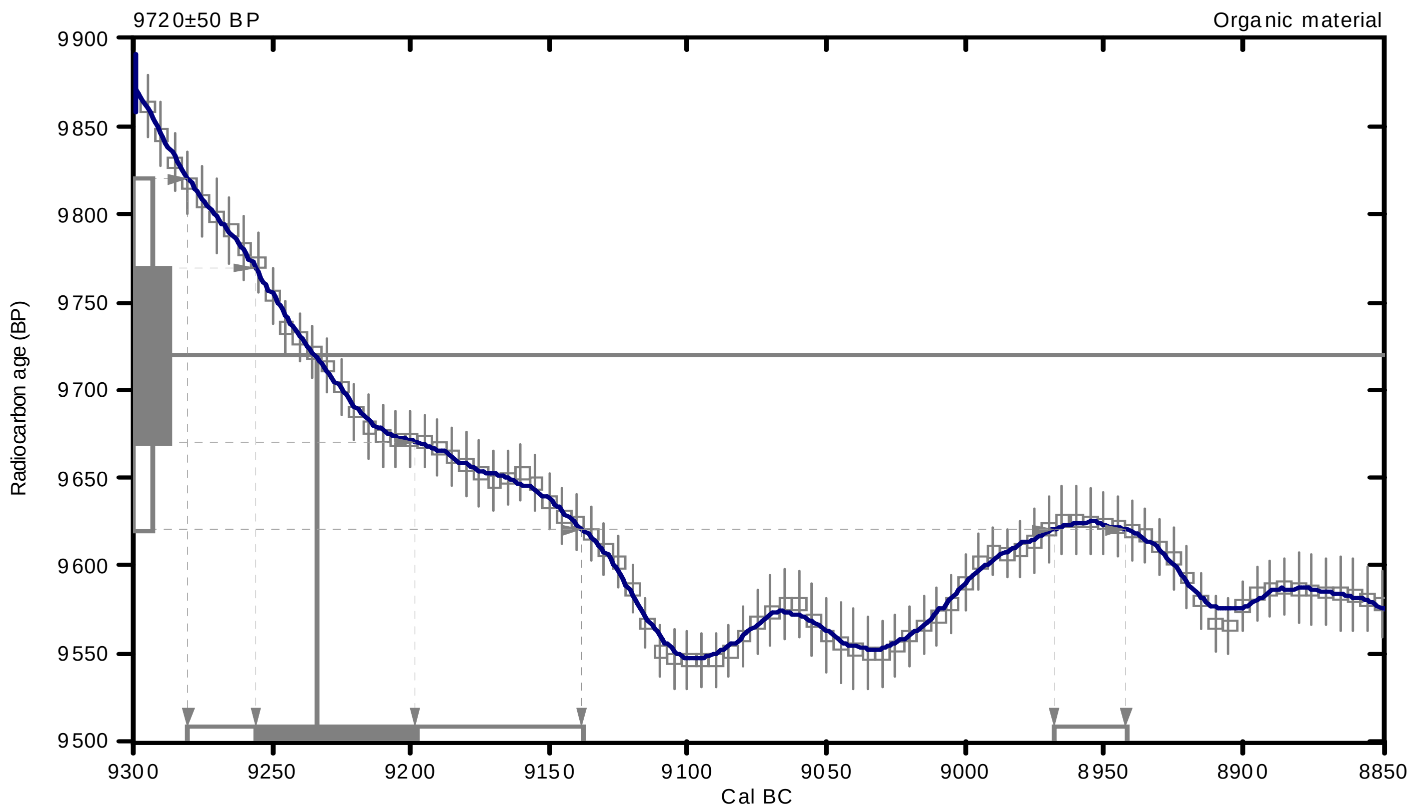
Conventional radiocarbon age: **9720±50 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 9280 to 9140 (Cal BP 11230 to 11090) and Cal BC 8970 to 8940 (Cal BP 10920 to 10890)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 9230 (Cal BP 11180)

1 Sigma calibrated result: (68% probability) Cal BC 9260 to 9200 (Cal BP 11210 to 11150)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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Fax: 305 663 0964
Beta@radiocarbon.com
www.radiocarbon.com

Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

February 9, 2010

Dr. William Hildebrandt/Liz Honeysett
Far Western Anthropological Group
2727 Del Rio Place
Suite A
Davis, CA 95618
USA

RE: Radiocarbon Dating Results For Samples IW1-300, LDW1-175, LDW1-190-205, LDW1-260-280

Dear Dr. Hildebrandt and Ms. Honeysett:

Enclosed are the radiocarbon dating results for four samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

Thank you for prepaying the analyses. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Liz Honeysett — Report Date: 2/9/2010

Far Western Anthropological Group — Material Received: 1/11/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 272225	9740 +/- 50 BP	-24.5 o/oo	9750 +/- 50 BP

SAMPLE : IW1-300
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 9290 to 9170 (Cal BP 11240 to 11120)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 272226	9780 +/- 60 BP	-11.6 o/oo	10000 +/- 60 BP

SAMPLE : LDW1-175
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (shell): acid etch
2 SIGMA CALIBRATION : Cal BC 9810 to 9300 (Cal BP 11760 to 11250)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 272227	9610 +/- 50 BP	-25.3 o/oo	9610 +/- 50 BP

SAMPLE : LDW1-190-205
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 9230 to 8800 (Cal BP 11180 to 10740)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 272228	10130 +/- 60 BP	-25.6 o/oo	10120 +/- 60 BP

SAMPLE : LDW1-260-280
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 10050 to 9450 (Cal BP 12000 to 11400)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.5:lab. mult=1)

Laboratory number: **Beta-272225**

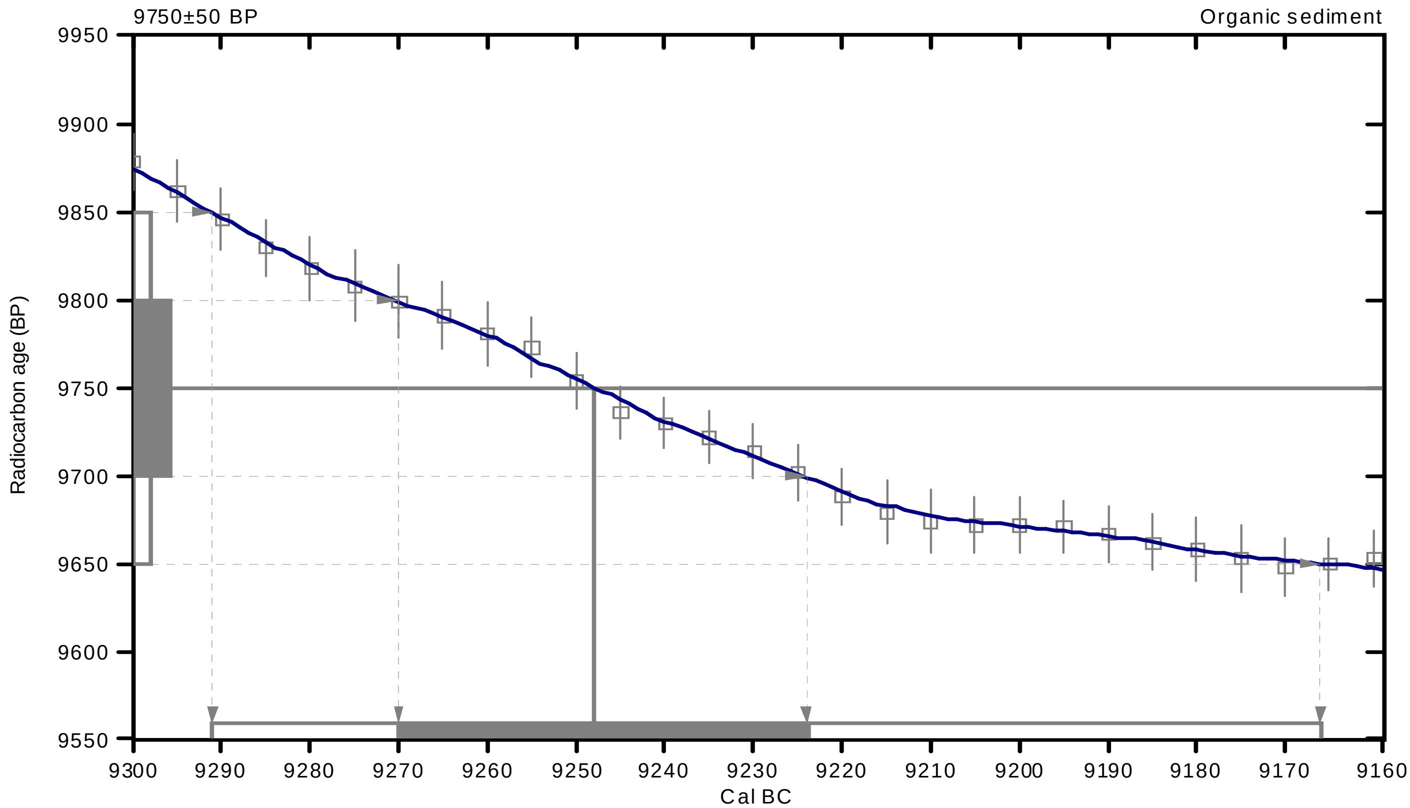
Conventional radiocarbon age: **9750±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 9290 to 9170 (Cal BP 11240 to 11120)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 9250 (Cal BP 11200)

1 Sigma calibrated result: (68% probability) Cal BC 9270 to 9220 (Cal BP 11220 to 11170)



References:

Database used

INTCAL04

Calibration Database

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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.6:lab. mult=1)

Laboratory number: **Beta-272226**

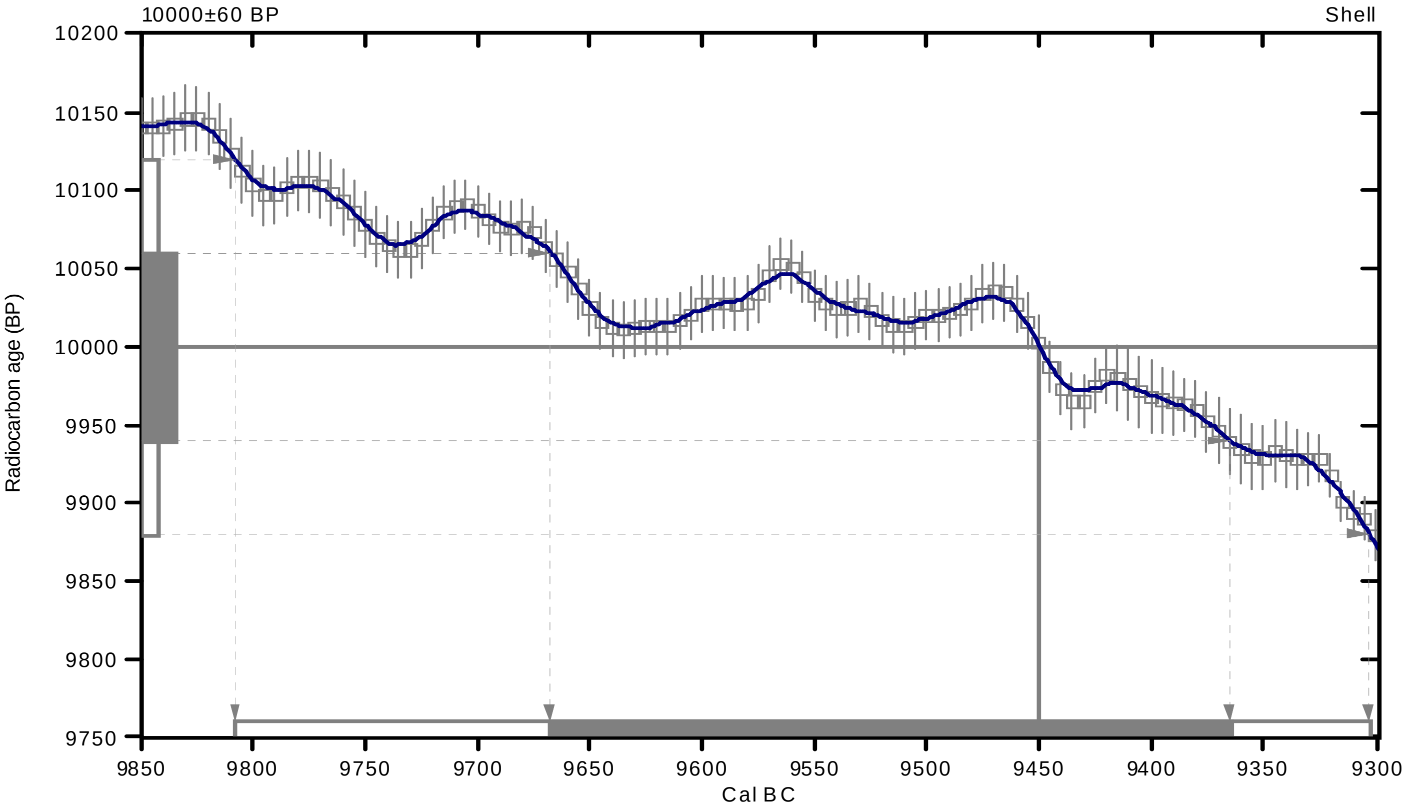
Conventional radiocarbon age: **10000±60 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 9810 to 9300 (Cal BP 11760 to 11250)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 9450 (Cal BP 11400)

1 Sigma calibrated result: (68% probability) Cal BC 9670 to 9360 (Cal BP 11620 to 11320)



References:

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Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number: **Beta-272227**

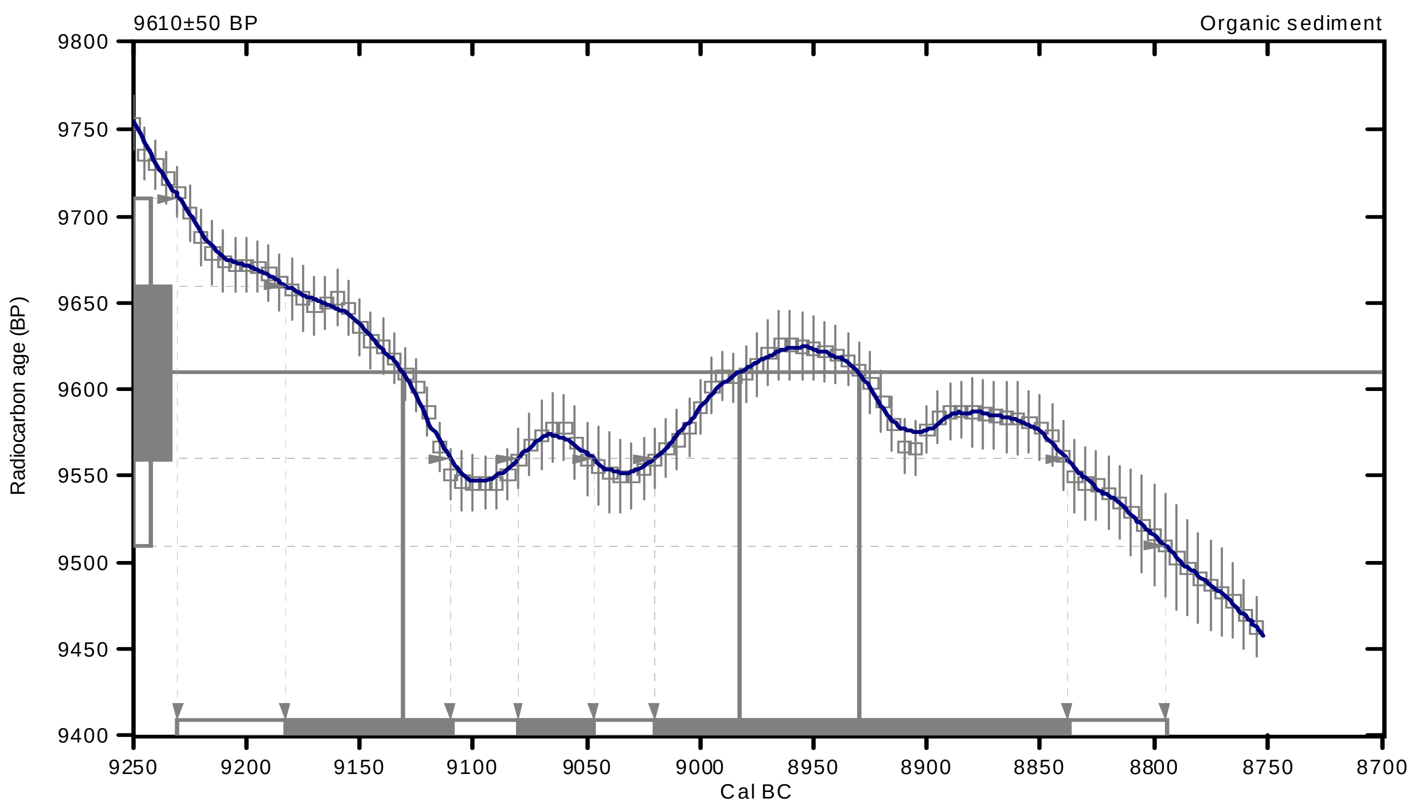
Conventional radiocarbon age: **9610±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 9230 to 8800 (Cal BP 11180 to 10740)**

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal BC 9130 (Cal BP 11080) and
Cal BC 8980 (Cal BP 10930) and
Cal BC 8930 (Cal BP 10880)

1 Sigma calibrated results: (68% probability)
Cal BC 9180 to 9110 (Cal BP 11130 to 11060) and
Cal BC 9080 to 9050 (Cal BP 11030 to 11000) and
Cal BC 9020 to 8840 (Cal BP 10970 to 10790)



References:

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INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.6:lab. mult=1)

Laboratory number: **Beta-272228**

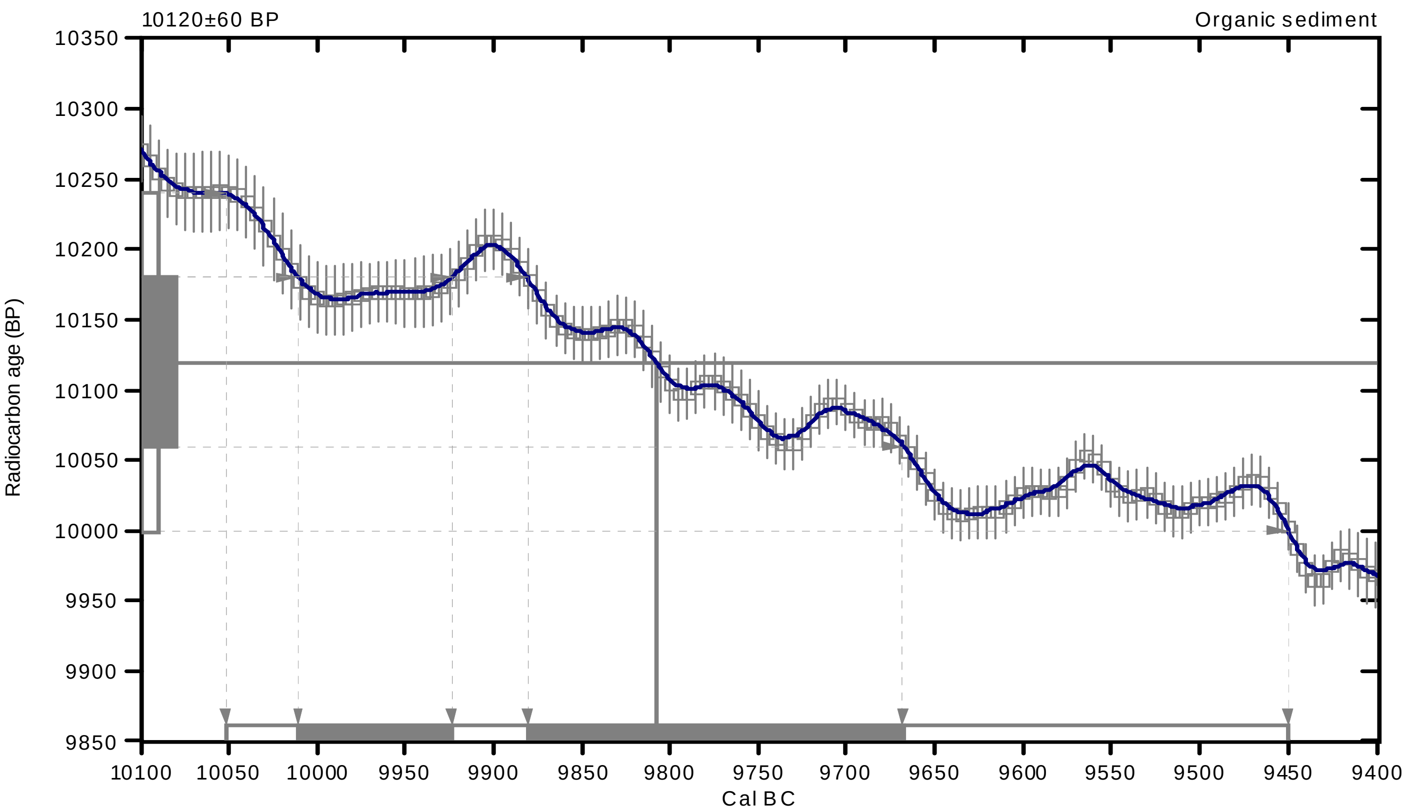
Conventional radiocarbon age: **10120±60 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 10050 to 9450 (Cal BP 12000 to 11400)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 9810 (Cal BP 11760)

1 Sigma calibrated results: (68% probability) Cal BC 10010 to 9920 (Cal BP 11960 to 11870) and Cal BC 9880 to 9670 (Cal BP 11830 to 11620)



References:

Database used

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Mathematics

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

June 28, 2010

Dr. William Hildebrandt/ Jack Meyer
Far Western Anthropological Group
2727 Del Rio Place
Suite A
Davis, CA 95618
USA

RE: Radiocarbon Dating Results For Samples CLDW-T3-5Ab, CLIW-60b

Dear Dr. Hildebrandt/ Mr. Meyer:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

Our invoice was previously emailed. Please, forward it to the appropriate officer or send VISA charge authorization. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
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MIAMI, FLORIDA, USA 33155
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REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Jack Meyer — Report Date: 6/28/2010

Far Western Anthropological Group — Material Received: 6/16/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280734	10520 +/- 50 BP	-25.6 o/oo	10510 +/- 50 BP

SAMPLE : CLDW-T3-5Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 10740 to 10420 (Cal BP 12690 to 12370) AND Cal BC 10310 to 10300 (Cal BP 12260 to 12250)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280735	10240 +/- 50 BP	-24.8 o/oo	10240 +/- 50 BP

SAMPLE : CLIW-60b
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 10180 to 9820 (Cal BP 12120 to 11770)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.6:lab. mult=1)

Laboratory number: **Beta-280734**

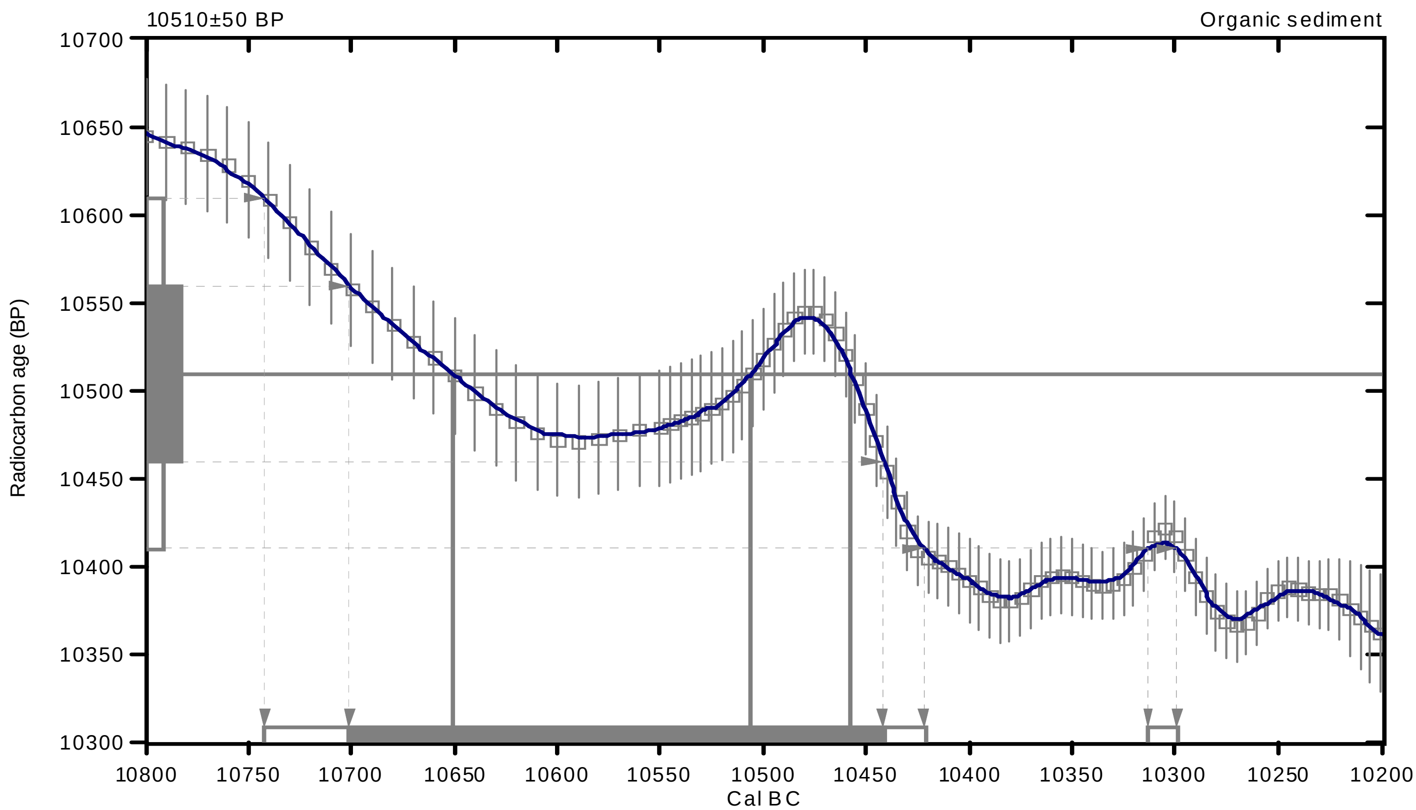
Conventional radiocarbon age: **10510±50 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 10740 to 10420 (Cal BP 12690 to 12370) and Cal BC 10310 to 10300 (Cal BP 12260 to 12250)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 10650 (Cal BP 12600) and
Cal BC 10510 (Cal BP 12460) and
Cal BC 10460 (Cal BP 12410)

1 Sigma calibrated result: (68% probability) Cal BC 10700 to 10440 (Cal BP 12650 to 12390)



References:

Database used

INTCAL04

Calibration Database

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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.8:lab. mult=1)

Laboratory number: **Beta-280735**

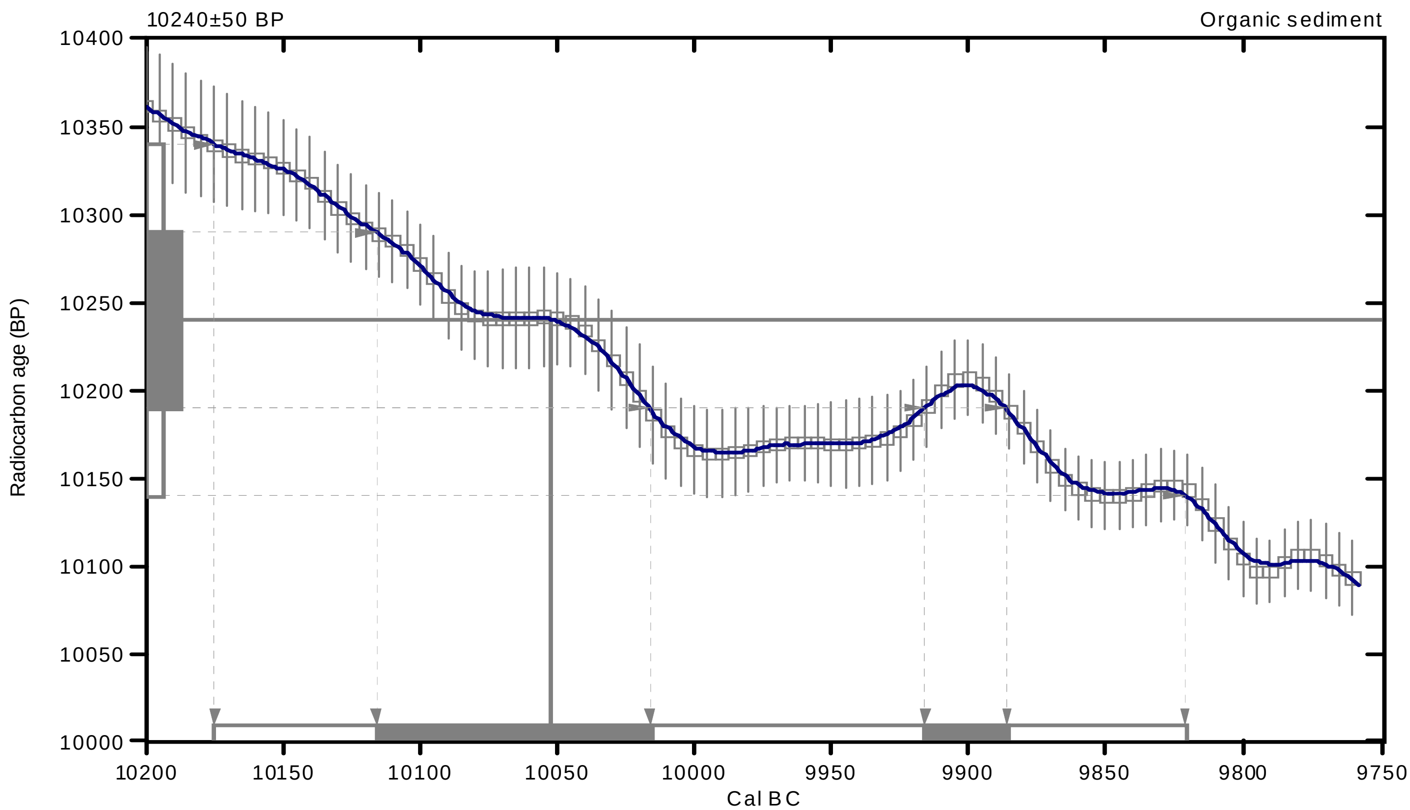
Conventional radiocarbon age: **10240±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 10180 to 9820 (Cal BP 12120 to 11770)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 10050 (Cal BP 12000)

1 Sigma calibrated results: (68% probability) Cal BC 10120 to 10020 (Cal BP 12070 to 11970) and Cal BC 9920 to 9890 (Cal BP 11870 to 11840)



References:

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Ronald Hatfield
Christopher Patrick
Deputy Directors

July 8, 2010

Dr. William Hildebrandt/Jack Meyer
Far Western Anthropological Group
2727 Del Rio Place
Suite A
Davis, CA 95618
USA

RE: Radiocarbon Dating Result For Sample CLDSL-57715Ab

Dear Dr. Hildebrandt and Mr. Meyer:

Enclosed is the radiocarbon dating result for one sample recently sent to us. It provided plenty of carbon for an accurate measurement and the analysis proceeded normally. As usual, the method of analysis is listed on the report sheet and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analysis. It was analyzed with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the MASTERCARD card provided. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
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MIAMI, FLORIDA, USA 33155
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REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Jack Meyer — Report Date: 7/8/2010

Far Western Anthropological Group — Material Received: 6/23/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280993	4200 +/- 40 BP	-23.4 o/oo	4230 +/- 40 BP

SAMPLE : CLDSL-57715Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 2910 to 2850 (Cal BP 4860 to 4800) AND Cal BC 2810 to 2750 (Cal BP 4760 to 4700)
Cal BC 2720 to 2700 (Cal BP 4670 to 4650)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.4:lab. mult=1)

Laboratory number: **Beta-280993**

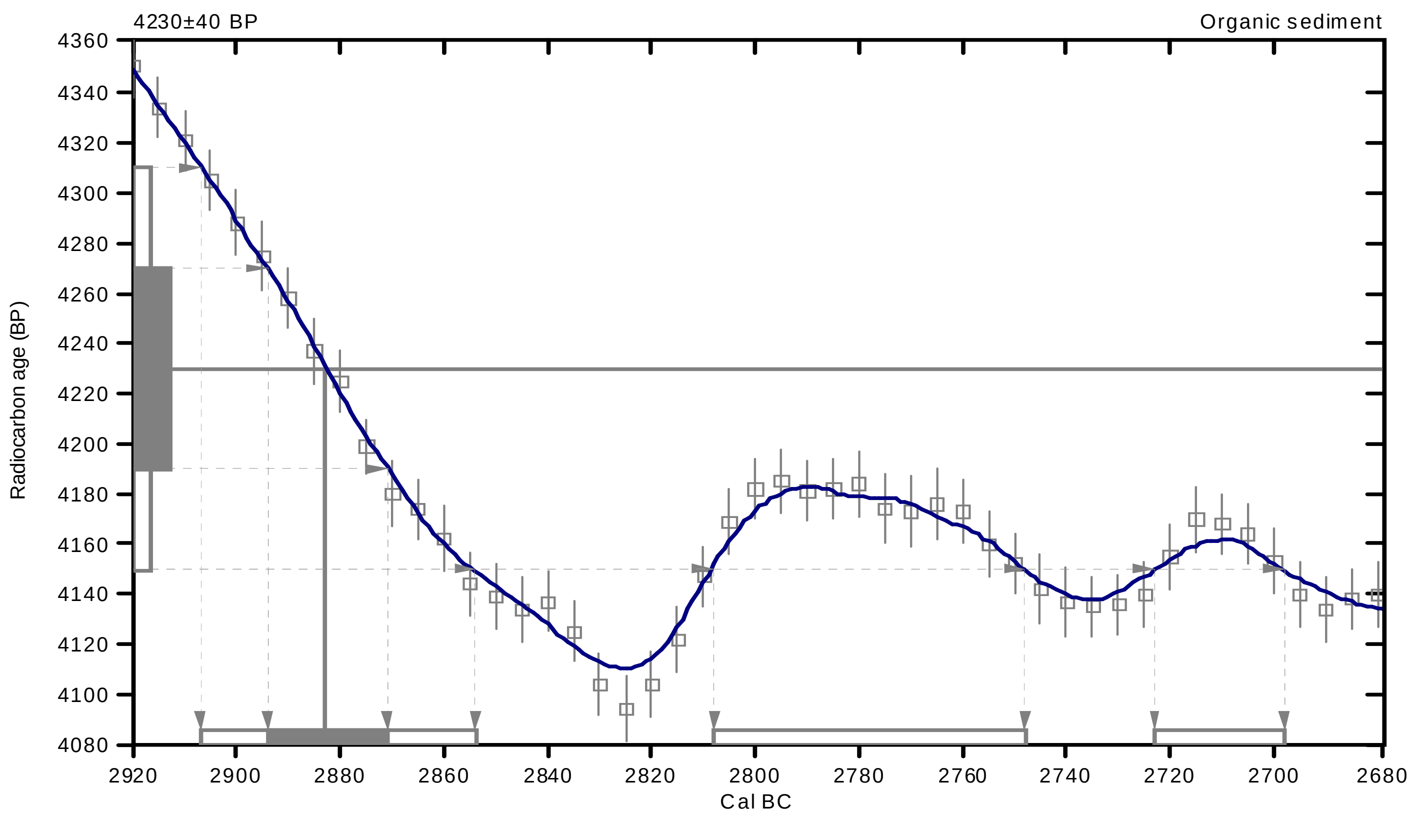
Conventional radiocarbon age: **4230±40 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 2910 to 2850 (Cal BP 4860 to 4800) and Cal BC 2810 to 2750 (Cal BP 4760 to 4700) and Cal BC 2720 to 2700 (Cal BP 4670 to 4650)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2880 (Cal BP 4830)

1 Sigma calibrated result: (68% probability) Cal BC 2890 to 2870 (Cal BP 4840 to 4820)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

July 13, 2010

Dr. William Hildebrandt/Jack Meyer
Far Western Anthropological Group
2727 Del Rio Place
Suite A
Davis, CA 95618
USA

RE: Radiocarbon Dating Results For Samples CLC9-6Cg, CLC9-11Cg, CLDW-T3-3Ab, CLDW-T3-7Ab, CLOK-tufa, CLRV-NCTP-3Cu, CLRV-SCTP-40b, CLSB-snail

Dear Dr. Hildebrandt and Mr. Meyer:

Enclosed are the radiocarbon dating results for eight samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the MASTERCARD card provided. A receipt is enclosed with the paper report copy. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Jack Meyer — Report Date: 7/13/2010

Far Western Anthropological Group — Material Received: 6/14/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280679	9710 +/- 50 BP	-26.3 o/oo	9690 +/- 50 BP

SAMPLE : CLC9-6Cg
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 9260 to 9120 (Cal BP 11220 to 11070) AND Cal BC 9000 to 8920 (Cal BP 10950 to 10870)

Beta - 280680	14600 +/- 50 BP	-24.6 o/oo	14610 +/- 50 BP

SAMPLE : CLC9-11Cg
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 15960 to 15550 (Cal BP 17910 to 17500)

Beta - 280681	9930 +/- 40 BP	-25.2 o/oo	9930 +/- 40 BP

SAMPLE : CLDW-T3-3Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 9450 to 9290 (Cal BP 11400 to 11240)

Beta - 280682	10460 +/- 40 BP	-25.5 o/oo	10450 +/- 40 BP

SAMPLE : CLDW-T3-7Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 10670 to 10490 (Cal BP 12620 to 12440) AND Cal BC 10470 to 10270 (Cal BP 12420 to 12220) Cal BC 10270 to 10210 (Cal BP 12220 to 12160)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

BETA ANALYTIC INC.
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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Jack Meyer

Report Date: 7/13/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280683	10950 +/- 50 BP	+4.6 o/oo	11440 +/- 50 BP

SAMPLE : CLOK-tufa
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (carbonate rock): acid etch
2 SIGMA CALIBRATION : Cal BC 11420 to 11270 (Cal BP 13370 to 13220)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280684	8790 +/- 40 BP	-25.0 o/oo	8790 +/- 40 BP

SAMPLE : CLRV-NCTP-3Cu
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 8170 to 8120 (Cal BP 10120 to 10070) AND Cal BC 7970 to 7720 (Cal BP 9920 to 9670)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280685	11570 +/- 50 BP	-25.9 o/oo	11560 +/- 50 BP

SAMPLE : CLRV-SCTP-40b
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 11520 to 11350 (Cal BP 13470 to 13300)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 280686	11270 +/- 50 BP	-8.0 o/oo	11550 +/- 50 BP

SAMPLE : CLSB-snail
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (shell): acid etch
2 SIGMA CALIBRATION : Cal BC 11510 to 11340 (Cal BP 13460 to 13290)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.3:lab. mult=1)

Laboratory number: **Beta-280679**

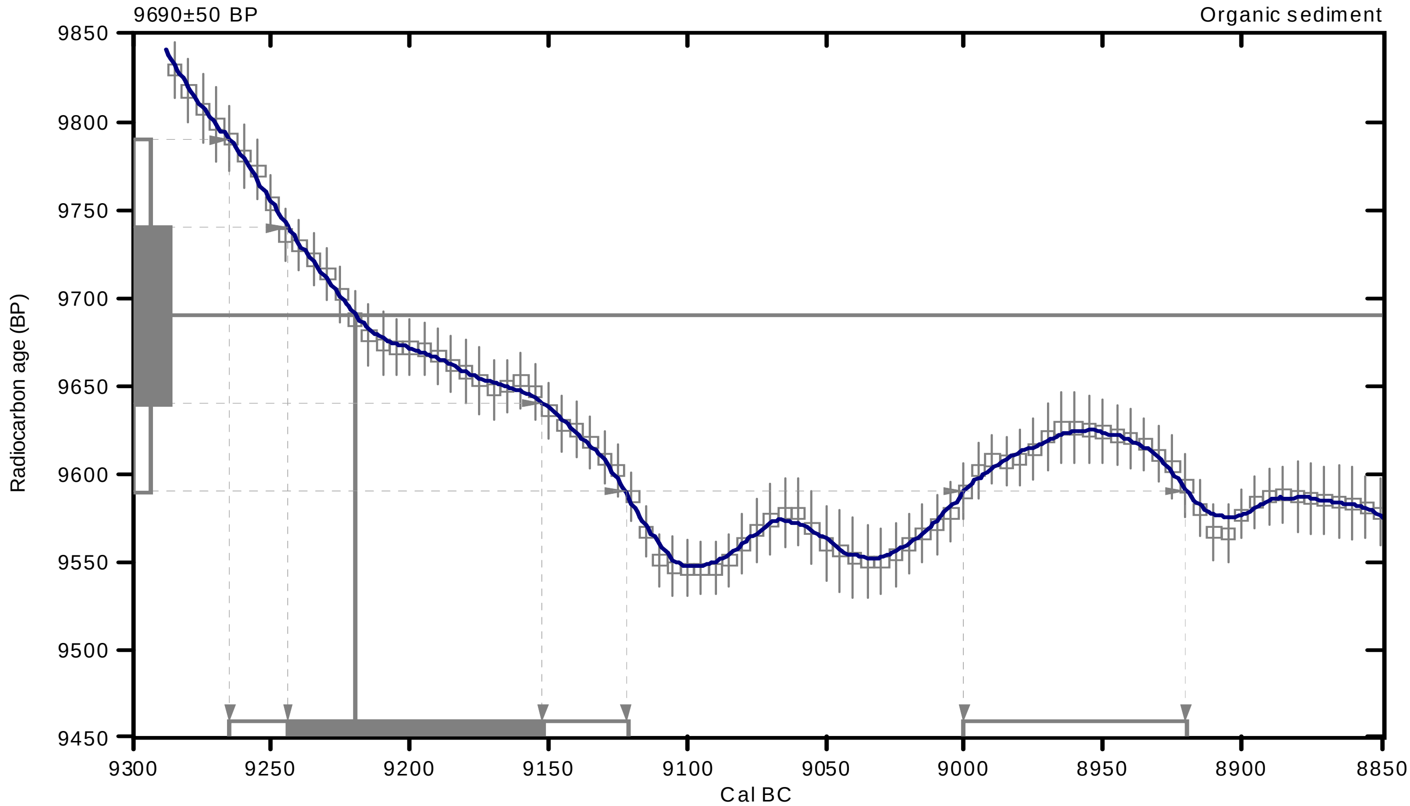
Conventional radiocarbon age: **9690±50 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 9260 to 9120 (Cal BP 11220 to 11070) and Cal BC 9000 to 8920 (Cal BP 10950 to 10870)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 9220 (Cal BP 11170)

1 Sigma calibrated result: (68% probability) Cal BC 9240 to 9150 (Cal BP 11190 to 11100)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.6:lab. mult=1)

Laboratory number: **Beta-280680**

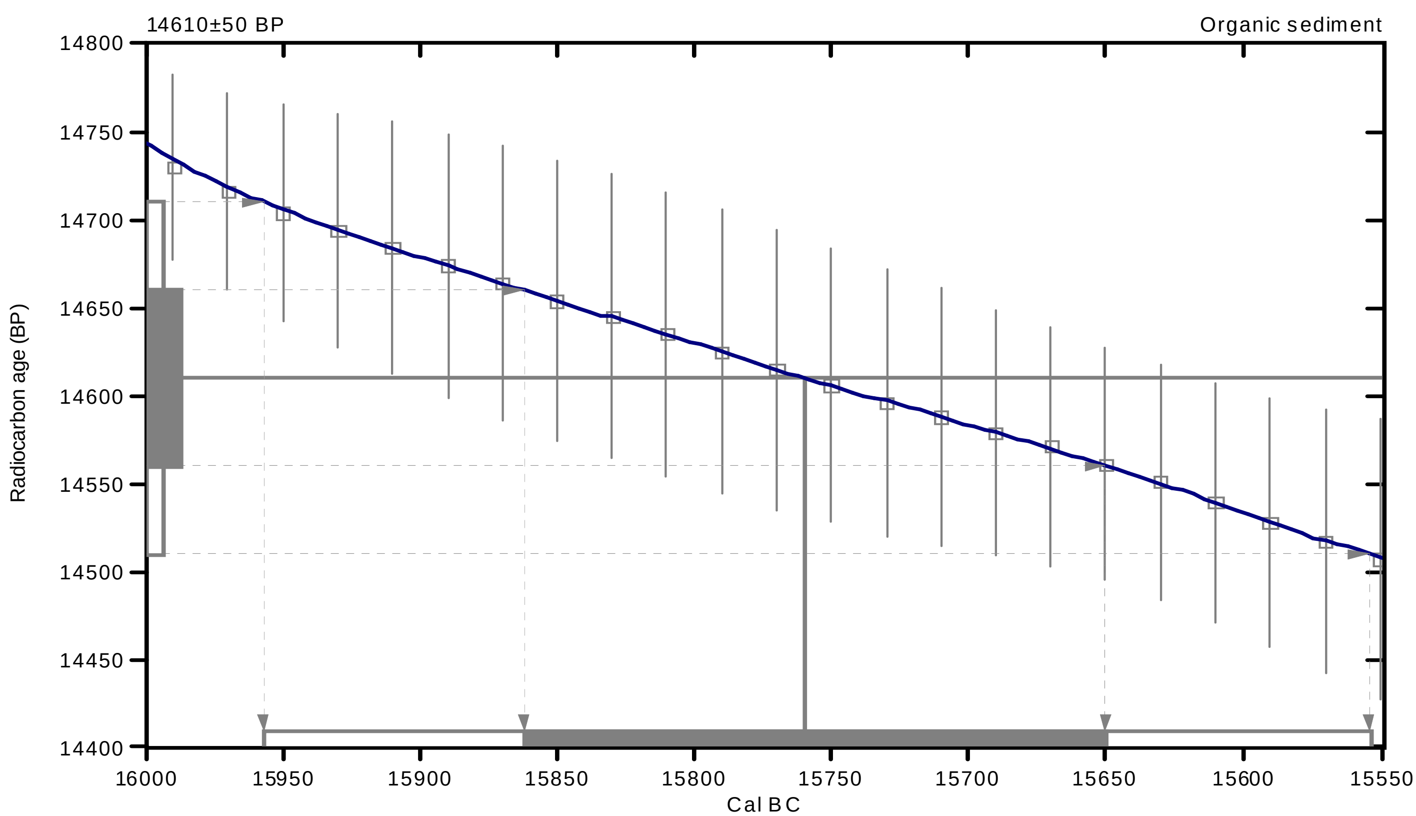
Conventional radiocarbon age: **14610±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 15960 to 15550 (Cal BP 17910 to 17500)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 15760 (Cal BP 17710)

1 Sigma calibrated result: (68% probability) Cal BC 15860 to 15650 (Cal BP 17810 to 17600)



References:

Database used

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INTCAL04 Radiocarbon Age Calibration

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Mathematics

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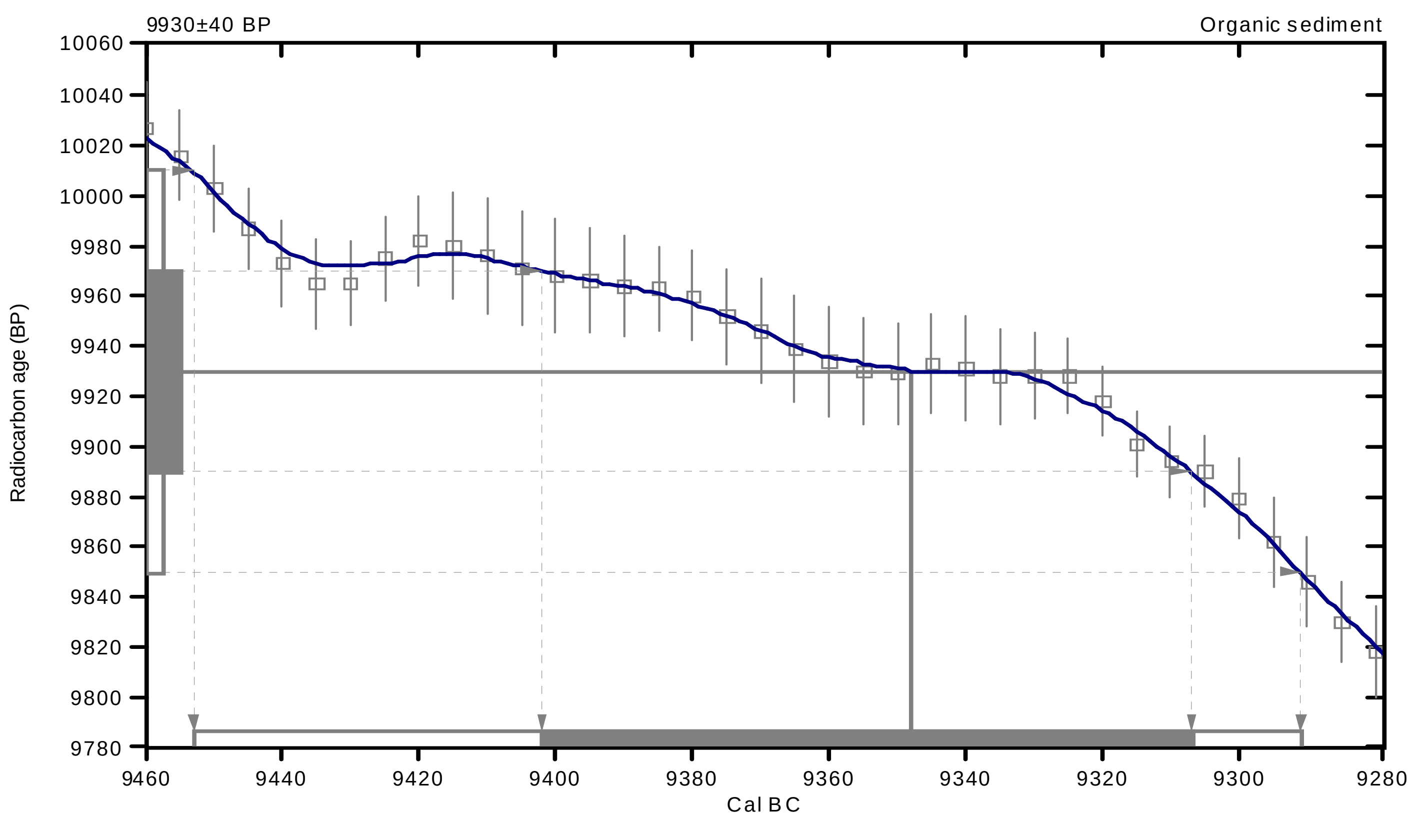
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

Laboratory number:	**Beta-280681**
Conventional radiocarbon age:	**9930±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 9450 to 9290 (Cal BP 11400 to 11240)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 9350 (Cal BP 11300)
1 Sigma calibrated result: (68% probability)	Cal BC 9400 to 9310 (Cal BP 11350 to 11260)



References:

Database used

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Calibration Database

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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.5:lab. mult=1)

Laboratory number: **Beta-280682**

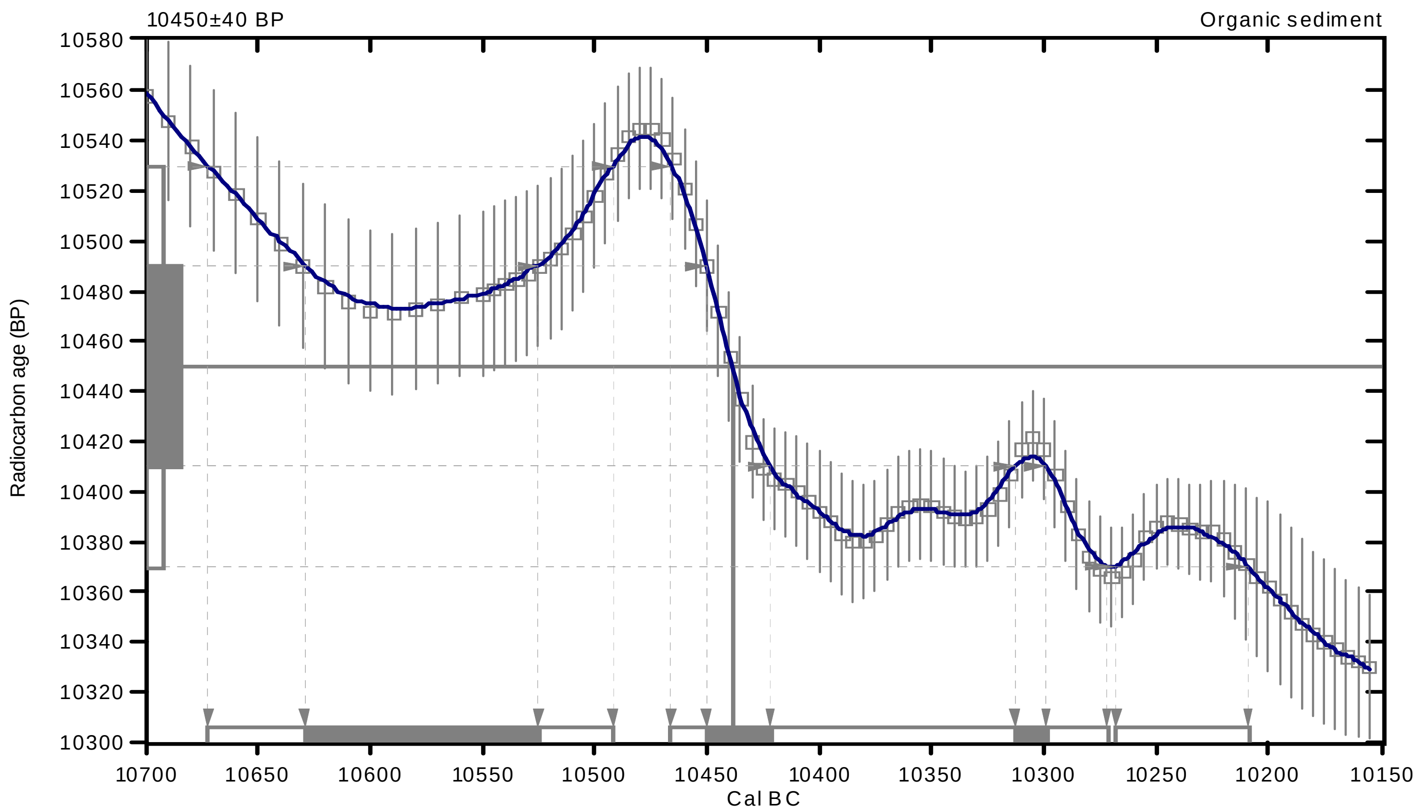
Conventional radiocarbon age: **10450±40 BP**

2 Sigma calibrated results: **Cal BC 10670 to 10490 (Cal BP 12620 to 12440) and**
(95% probability) **Cal BC 10470 to 10270 (Cal BP 12420 to 12220) and**
Cal BC 10270 to 10210 (Cal BP 12220 to 12160)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 10440 (Cal BP 12390)

1 Sigma calibrated results: Cal BC 10630 to 10520 (Cal BP 12580 to 12480) and
(68% probability) Cal BC 10450 to 10420 (Cal BP 12400 to 12370) and
Cal BC 10310 to 10300 (Cal BP 12260 to 12250)



References:

Database used
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INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=4.6:lab. mult=1)

Laboratory number: **Beta-280683**

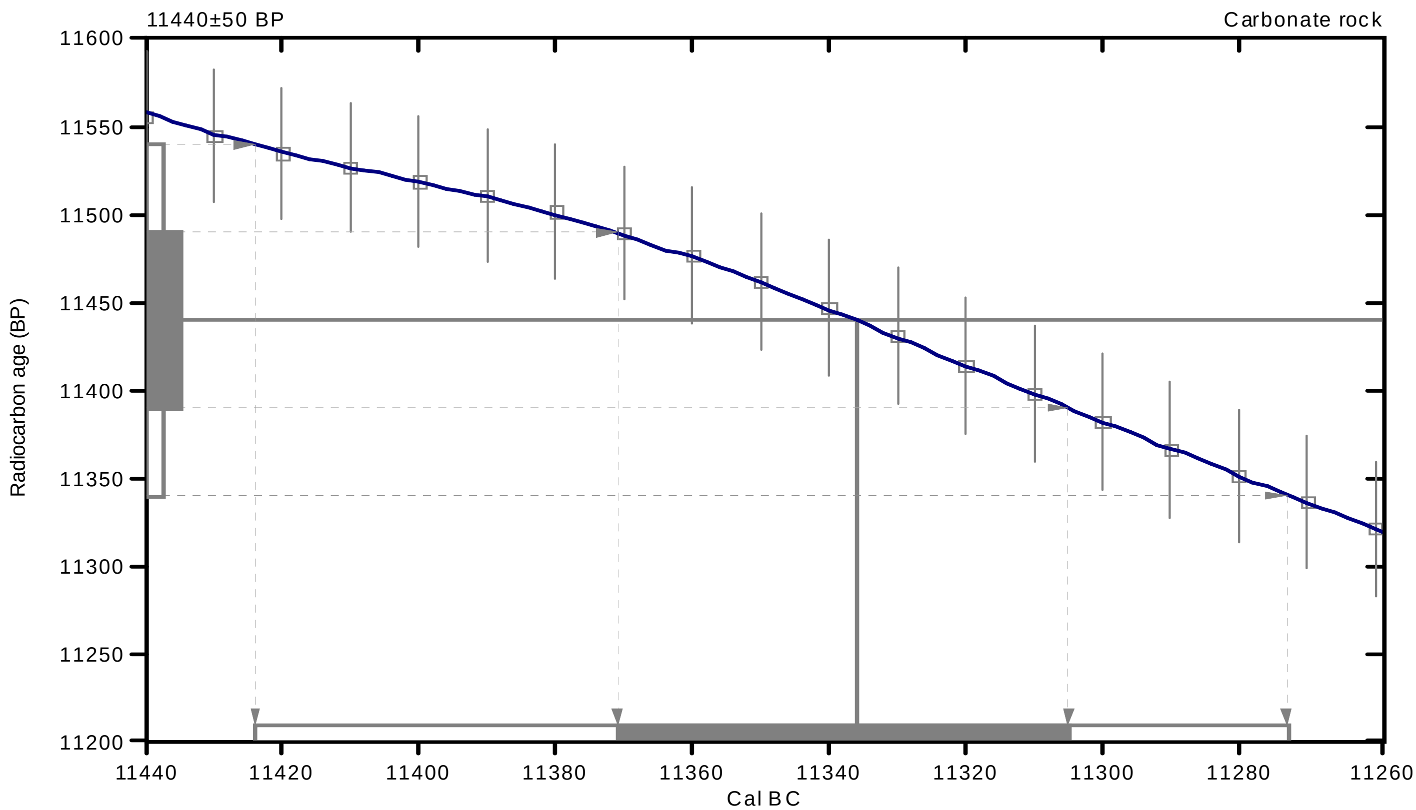
Conventional radiocarbon age: **11440±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 11420 to 11270 (Cal BP 13370 to 13220)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 11340 (Cal BP 13290)

1 Sigma calibrated result: (68% probability) Cal BC 11370 to 11300 (Cal BP 13320 to 13260)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25:lab. mult=1)

Laboratory number: **Beta-280684**

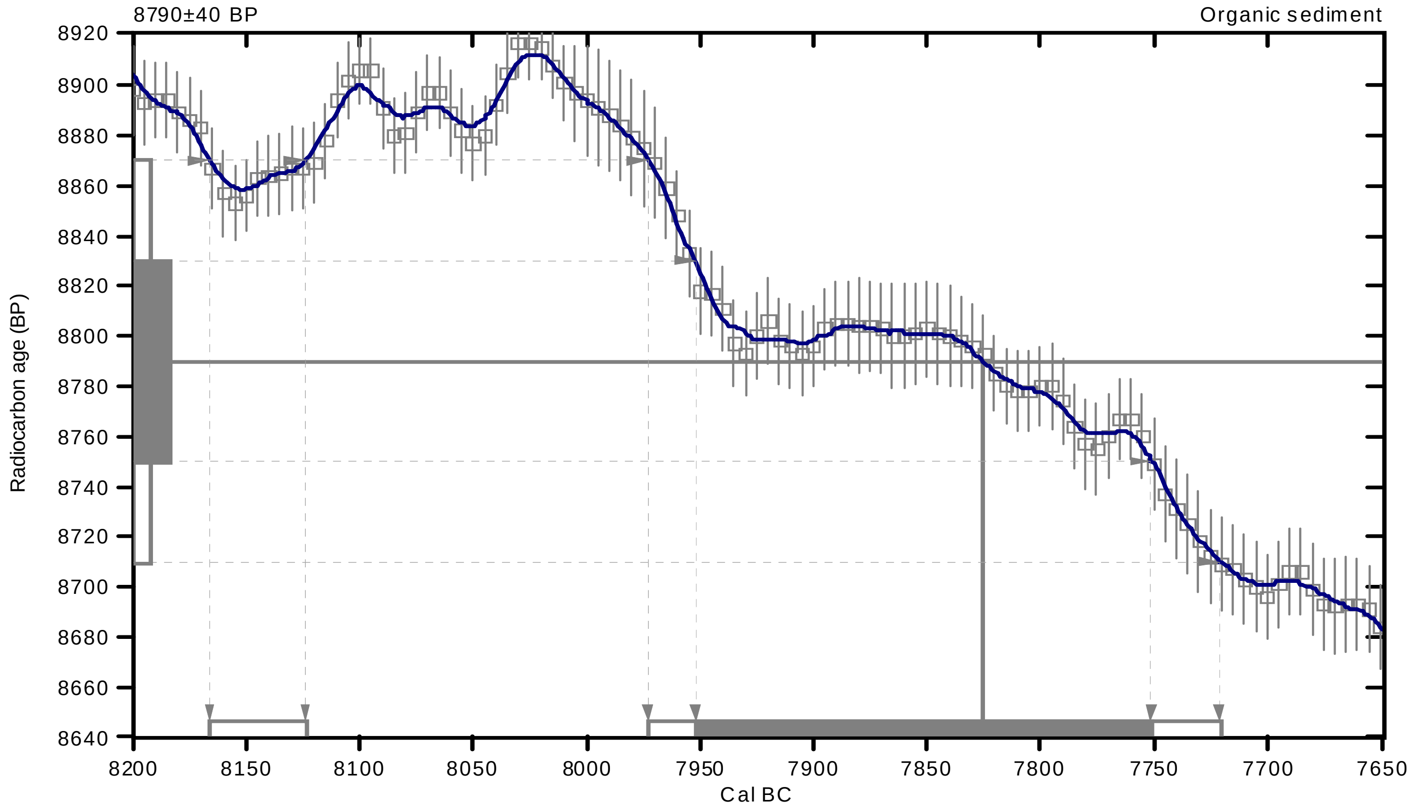
Conventional radiocarbon age: **8790±40 BP**

2 Sigma calibrated results: **Cal BC 8170 to 8120 (Cal BP 10120 to 10070) and**
(95% probability) **Cal BC 7970 to 7720 (Cal BP 9920 to 9670)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 7820 (Cal BP 9780)

1 Sigma calibrated result: Cal BC 7950 to 7750 (Cal BP 9900 to 9700)
(68% probability)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9:lab. mult=1)

Laboratory number: **Beta-280685**

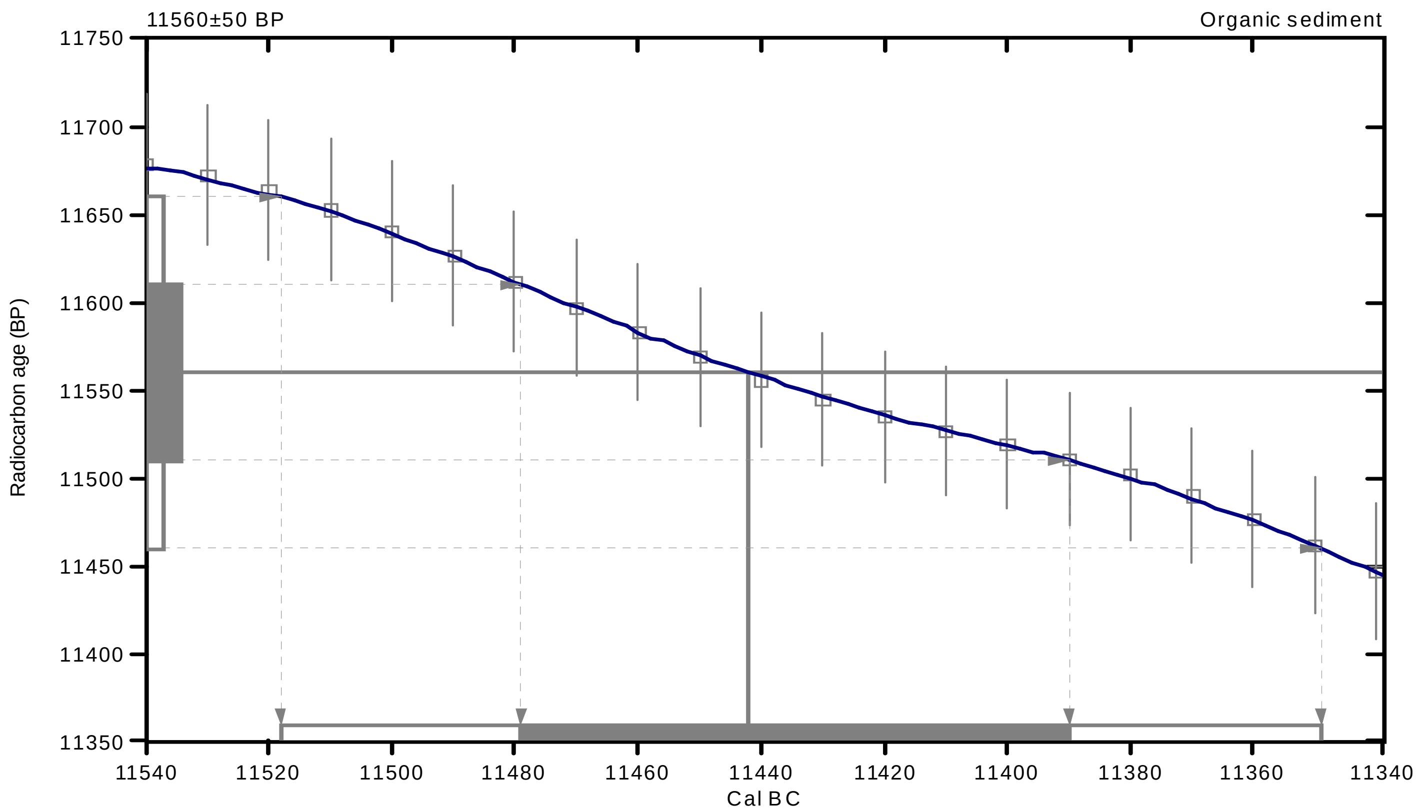
Conventional radiocarbon age: **11560±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 11520 to 11350 (Cal BP 13470 to 13300)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 11440 (Cal BP 13390)

1 Sigma calibrated result: (68% probability) Cal BC 11480 to 11390 (Cal BP 13430 to 13340)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-8:lab. mult=1)

Laboratory number: **Beta-280686**

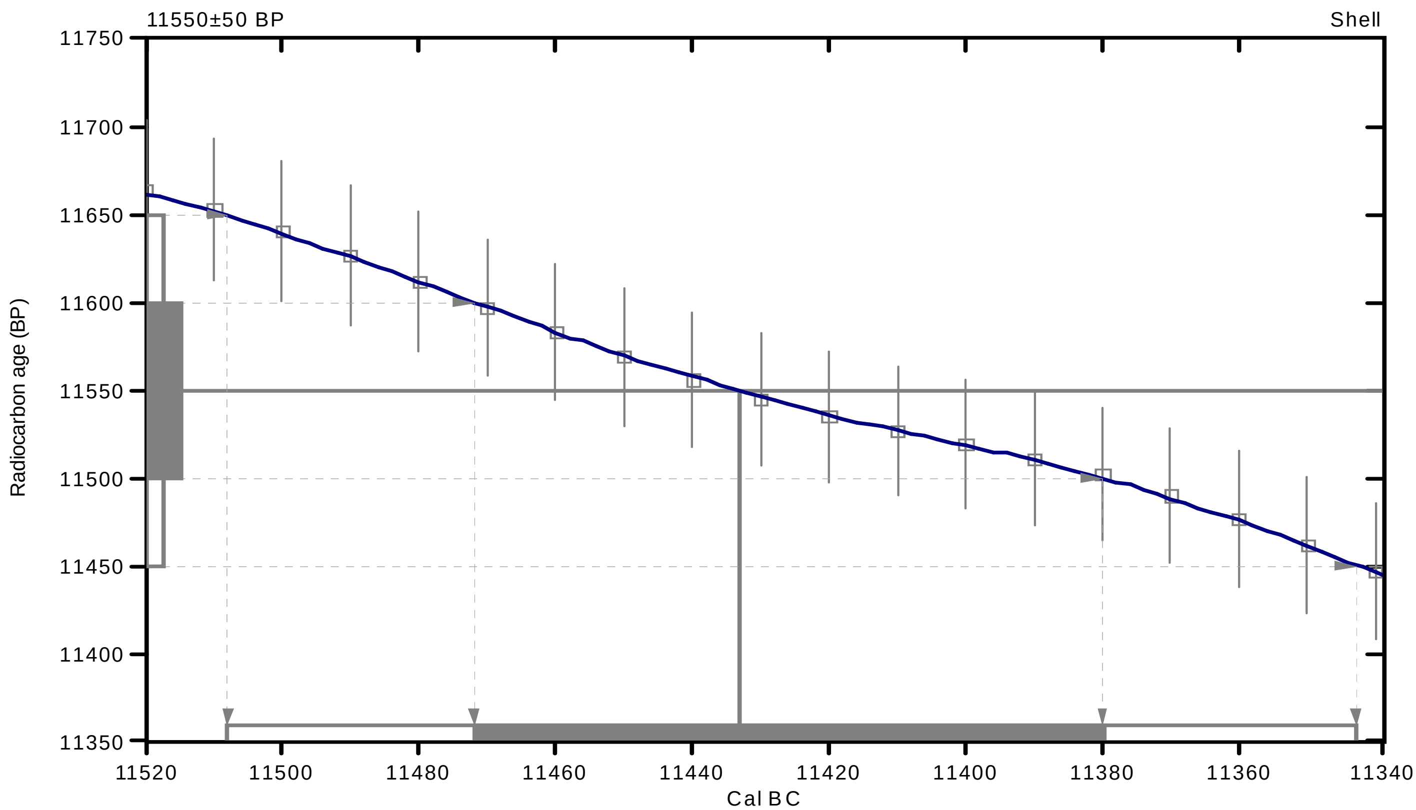
Conventional radiocarbon age: **11550±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 11510 to 11340 (Cal BP 13460 to 13290)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 11430 (Cal BP 13380)

1 Sigma calibrated result: (68% probability) Cal BC 11470 to 11380 (Cal BP 13420 to 13330)



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Darden Hood
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Christopher Patrick
Deputy Directors

July 15, 2010

Dr. William Hildebrandt/Jack Meyer
Far Western Anthropological Group
2727 Del Rio Place
Suite A
Davis, CA 95618
USA

RE: Radiocarbon Dating Results For Samples CLDW-L5-3Ab, CLDW-L5-4Ab

Dear Dr. Hildebrandt and Mr. Meyer:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the MASTERCARD card provided. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. William Hildebrandt/Jack Meyer — Report Date: 7/15/2010

Far Western Anthropological Group — Material Received: 6/28/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 281207	6960 +/- 40 BP	-23.2 o/oo	6990 +/- 40 BP

SAMPLE : CLDW-L5-3Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 5980 to 5760 (Cal BP 7930 to 7710)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 281208	6310 +/- 40 BP	-23.2 o/oo	6340 +/- 40 BP

SAMPLE : CLDW-L5-4Ab
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 5450 to 5450 (Cal BP 7400 to 7400) AND Cal BC 5380 to 5220 (Cal BP 7330 to 7170)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.2:lab. mult=1)

Laboratory number: **Beta-281207**

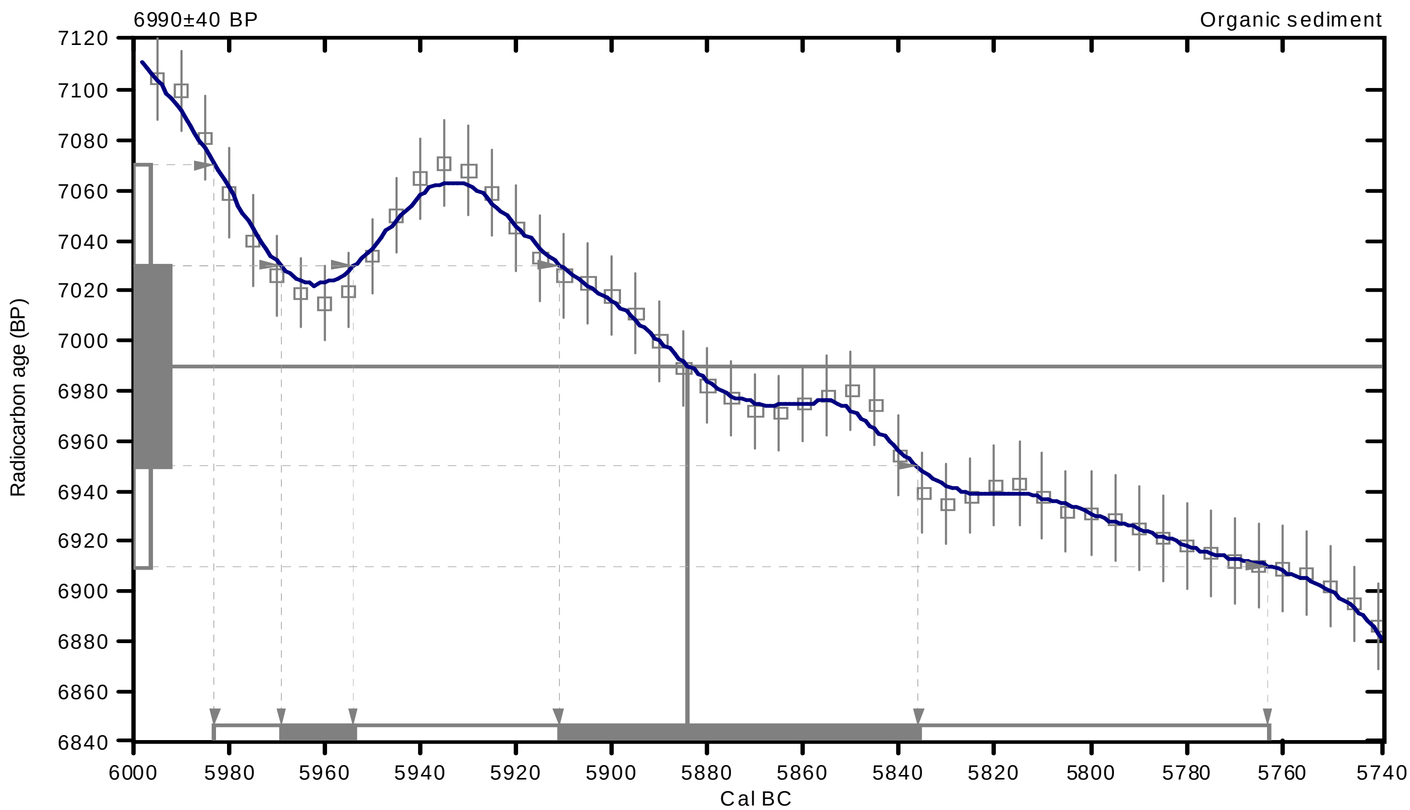
Conventional radiocarbon age: **6990±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 5980 to 5760 (Cal BP 7930 to 7710)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 5880 (Cal BP 7830)

1 Sigma calibrated results: (68% probability) Cal BC 5970 to 5950 (Cal BP 7920 to 7900) and Cal BC 5910 to 5840 (Cal BP 7860 to 7790)



References:

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Mathematics

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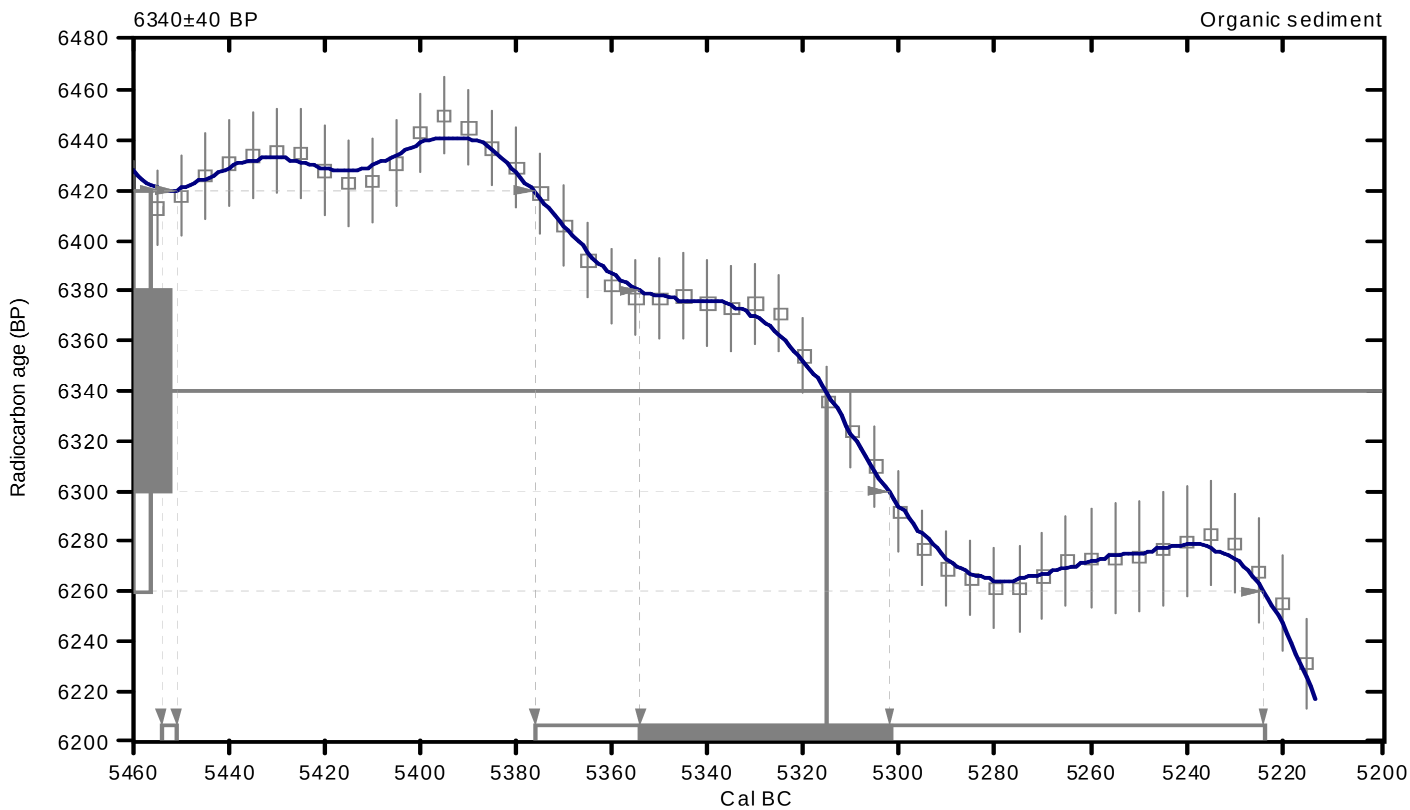
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.2:lab. mult=1)

Laboratory number:	**Beta-281208**
Conventional radiocarbon age:	**6340±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 5450 to 5450 (Cal BP 7400 to 7400) and Cal BC 5380 to 5220 (Cal BP 7330 to 7170)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 5320 (Cal BP 7260)
1 Sigma calibrated result: (68% probability)	Cal BC 5350 to 5300 (Cal BP 7300 to 7250)



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General Statement of ^{14}C Procedures
at the National Ocean Sciences AMS Facility

All laboratory preparations for AMS radiocarbon analyses of submitted samples occur in the NOSAMS Sample Preparation Lab unless otherwise noted on the attached report of Final Results. Procedures appropriate to the raw material being analyzed include: acid hydrolysis (HY), oxidation (OC or DOC), or stripping of CO_2 gas from water (WS) samples. Carbon dioxide, whether submitted directly (GS) or generated at the NOSAMS Facility, is reacted with Fe catalyst to form graphite. Graphite is pressed into targets, which are analyzed by accelerator mass spectrometry along with primary and secondary standards and process blanks. The primary standard NBS Oxalic Acid I (NIST-SRM-4990) is used for all ^{14}C measurements. Every group of samples processed includes an appropriate blank, which is analyzed concurrently with the group. Process blank materials include IAEA C-1 Carrara marble and TIRI F Icelandic Doublespar for inorganic carbon and gas samples; FIRI A and B wood as well as FISONS acetanilide for organic carbon samples; a ^{14}C- free groundwater for DIC (dissolved inorganic carbon) samples; and Alfa Aeasar graphite powder for AMS machine background.

Fraction Modern (Fm) is a measurement of the deviation of the $^{14}C/C$ ratio of a sample from "modern." Modern is defined as 95% of the radiocarbon concentration (in AD 1950) of NBS Oxalic Acid I normalized to $\delta^{13}C_{VPDB}$ = -19 per mil (Olsson, 1970). AMS results are calculated using the internationally accepted modern value of 1.176 ±0.010 x 10^{-12}(Karlen, *et. al.*,1964) and a final ^{13}C-correction is made to normalize the sample Fm to a $\delta^{13}C_{VPDB}$ value of -25 per mil. NOSAMS has two accelerators for radiocarbon measurement, either a 3 Megavolt Tandetron system or a 500 kilovolt compact AMS system.

Stable isotope measurements of sample $\delta^{13}C$ are used to correct Fm values measured on the Tandetron system. These are typically made at the NOSAMS Facility with either a VG PRISM or VG OPTIMA mass spectrometer by analyzing a split of the CO_2 gas generated prior to graphite production. Some carbonate samples are reacted and measured directly with the VG PRISM ISOCARB. These $\delta^{13}C$ values and source used to calculate the Fm of a sample are specified in the report of Final Results.

AMS analyses made on the 500 kilovolt AMS system are corrected using measured $^{12}C/.^{13}C$ ratios. Measured $^{12}C/.^{13}C$ ratios are not reported.

Reporting of ages and/or activities follows the convention outlined by Stuiver and Polach (1977) and Stuiver (1980). Radiocarbon ages are calculated using 5568 (yrs) as the half-life of radiocarbon and are reported without reservoir corrections or calibration to calendar years. A $\Delta^{14}C$ activity normalized to 1950 is also reported according to these conventions. The activity, or $\Delta^{14}C$, of the sample is further corrected to account for the decay between collection (or death) and the time of measurement if a collection date is specified on the submittal form, otherwise $\Delta^{14}C$ is reported assuming that collection and measurement date are the same.

Atoms of ^{14}C contained in a sample are directly counted using the AMS method of radiocarbon analysis, therefore, internal statistical errors are calculated using the number of counts measured from each target in combination with the errors of the standard. An external error is calculated from the reproducibility of individual analyses for a given target. The error reported is the larger of the internal or external errors.

When reporting AMS results of samples run at the NOSAMS facility, accession numbers (e.g. OS-####'s) are required to be listed together with the results. To avoid confusion, we suggest tabulating OS-numbers and associated radiocarbon ages as they appear on the attached Final Report in addition to any subsequent corrections that may need to be made to the ages. We ask that published results acknowledge support from NSF by including the NSF Cooperative Agreement number, OCE-0753487. The NOSAMS facility would appreciate receiving reprints or preprints of papers referencing AMS analyses made at the NOSAMS facility.

Any sample material not consumed during sample preparation or AMS radiocarbon analysis is archived for two years at the NOSAMS Facility unless other arrangements are made by the submitter.

REFERENCES

Karlen, I., Olsson, I.U.,Kallburg, P. and Kilici, S., 1964. Absolute determination of the activity of two ^{14}C dating standards.ArkivGeofysik, 4:465-471.

Olsson, I.U., 1970. The use of Oxalic acid as a Standard.*In* I.U. Olsson, ed., Radiocarbon Variations and Absolute Chronology, Nobel Symposium, 12th Proc., John Wiley & Sons, New York, p. 17.

Stuiver, M. and Polach, H.A., 1977. Discussion: Reporting of ^{14}C data. Radiocarbon, 19:355-363.

Stuiver, M., 1980.Workshop on ^{14}C data reporting. Radiocarbon, 22:964-966.

National Ocean Sciences AMS Facility (NOSAMS) Radiocarbon Results (May, 3, 2010)

NOSAMS Accession #	*Type (Material)*	*Submitter Identification*		*Description*	*Age (14C BP)*	*Age Error (+/-)*	*d13C*	*F Modern*	*Fm Error*	*D14C*
OS- 79559	Plant/Wood	DSW-L#5771-5Ab	Strat. IX (X)	Near top of section	>Mod		-21.30	1.0542	0.0039	46.6
OS- 79586	Plant/Wood	DSW-L#5771-8Ab	Strat. V (VI)	Buried soil with snails	>Mod		-24.46	1.2152	0.0050	206.4
OS- 79560	Sediment Organic carbon	DSW-L#5771-13Ab	Strat. -I (I)	Basal buried soil	10300	60	-25.41	0.2782	0.0021	-723.8
OS- 79561	Plant/Wood	LDW-L#2-2Ab	Strat. II		>Mod		-20.38	1.1791	0.0040	170.5
OS- 79562	Plant/Wood	LDW-L#2-3ABkb	Strat. I	Buried soil	>Mod		-26.19	1.1961	0.0037	187.4
OS- 79584	Sediment Organic carbon	LDW-L#3-3Ab	Strat. V	Buried soil with snails	9440	95	-25.16	0.3086	0.0037	-693.6
OS- 79563	Sediment Organic carbon	LDW-L#3-4Ab	Strat. IV	Buried soil with snails	10000	55	-24.91	0.2873	0.0020	-714.8
OS- 79585	Sediment Organic carbon	LDW-L#3-5Ab	Strat. III	Buried soil - weak	10100	110	-25.09	0.2842	0.0038	-717.9
OS- 79564	Sediment Organic carbon	LDW-L#3-6Ab	Strat. II	Buried soil	10100	55	-25.45	0.2837	0.0019	-718.3
OS- 79565	Sediment Organic carbon	LDW-L#3-7Ab	Strat. I	Basal buried soil	10500	60	-25.73	0.2710	0.0020	-731.0
OS- 79583	Sediment Organic carbon	RV-NCTP-2Ab	Strat. III	Buried soil of floodplain facies	985	45	-21.99	0.8847	0.0049	-121.7
OS- 79566	Plant/Wood	RV-NCTP-3Cu	Strat. II	Channel facies	>Mod		-13.14	1.5640	0.0059	552.7
OS- 79587	Sediment Organic carbon	RV-SCTP-3Ab	Strat. III	Upper buried playa	9980	55	-24.12	0.2888	0.0020	-713.3
OS- 79567	Plant/Wood	RV-SCTP-4Ob	Strat. II	Lower buried playa	>Mod		-12.72	1.0625	0.0035	54.9

APPENDIX C

REGIONAL RADIOCARBON DATING COMPENDIUM

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
?	INY-2284, Portuguese Bench	Fan/Floodplain	Surface deposit	housefloor	Cultural	Charcoal (or wood?)	20	960	160	652	887	1185	Faull 2006 - SCA via A. Gold
?	INY-2284, Portuguese Bench	Fan/Floodplain	Surface deposit	housefloor	Cultural	Charcoal (or wood?)	20	1810	70	1562	1741	1884	Faull 2006 - SCA via A. Gold
?	INY-2284, Portuguese Bench	Fan/Floodplain	Surface deposit	housefloor	Cultural	Charcoal (or wood?)	20	1900	90	1609	1840	2057	Faull 2006 - SCA via A. Gold
?	INY-2750	Floodplain	Surface deposit	Locus B, Feature 01	Cultural	Shell-f (Anodonta)	-	1320	70	1071	1237	1345	Faull 2006 - SCA via A. Gold
?	KER-6106, Freeman Spring	Hill/Ridge/Floodplain	Surface deposit	charred material	Cultural	Charcoal	40	1110	40	932	1016	1090	Faull 2006 - SCA via A. Gold
?	KER-6106, Freeman Spring	Hill/Ridge/Floodplain	Surface deposit	charred material	Cultural	Charcoal	40	1110	50	931	1021	1141	Faull 2006 - SCA via A. Gold
?	KER-6106, Freeman Spring	Hill/Ridge/Floodplain	Surface deposit	charred material	Cultural	Charcoal	40	1130	60	930	1045	1178	Faull 2006 - SCA via A. Gold
?	INY, Death Valley/Titus Canyon	Fan	Surface lacustrine	Stratigraphic unit QLM4	Natural	Carbonate (tufa)	-	13120	80	15225	15916	16503	Klinger 2001
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	11070	60	12733	12962	13117	Koehler, 1995; Bacon et al. 2006
?	INY-5840, Airport Lake	Basin/Floodplain	Surface deposit	Feature 03, disturbed rock ring	Cultural	Charcoal	5	460	50	428	508	557	McGuire and Gilreath 1998
?	INY-5840, Airport Lake	Basin/Floodplain	Surface deposit	Feature 09, circular rock ring	Cultural	Charcoal	10	510	40	500	533	560	McGuire and Gilreath 1998
?	INY-5840, Airport Lake	Basin/Floodplain	Surface deposit	Feature 08, circular rock ring	Cultural	Charcoal	10	930	40	763	849	927	McGuire and Gilreath 1998
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	9270	60	10255	10448	10587	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	9670	60	11060	11071	11215	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	10610	60	12418	12562	12664	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	11120	60	12765	13004	13163	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	11870	60	13486	13724	13869	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley, north	Lake/Playa	Surface lacustrine	Northern Owens Lake	Natural	Shell-f (freshwater)	1	12670	60	14581	15001	15252	Orme and Orme 1993; Bacon et al. 2006
?	INY, Owens Valley (east)	Lake/Playa	Surface lacustrine	Eastern Owens Lake	Natural	Shell-f (freshwater)	-	19670	60	23206	23535	23845	Orme and Orme 2000; Bacon et al. 2006
?	SBR, Searles, Core X-52	Lake/Playa	Buried lacustrine	Upper Salt, basin	Natural	Organic sediment(?)	760	5300	200	4790	5278	5749	Peng et al. 1978 reported by Ramirez 2004
?	SBR, Searles, Core X-52	Lake/Playa	Buried lacustrine	Upper Salt, basin	Natural	Organic sediment(?)	2150	8700	200	8449	8940	9423	Peng et al. 1978 reported by Ramirez 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Surface lacustrine	Southeast shoreline, Trench 2	Natural	Carbonate (CaC03)	30	6333	48	7165	7266	7333	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Lacustrine	Southeast shoreline, Trench 3	Natural	Carbonate (CaC03)	39	9056	72	10118	10221	10414	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Lacustrine	Southeast shoreline, Trench 1	Natural	Carbonate (CaC03)	25	10041	62	11273	11555	11823	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 2	Natural	Carbonate (CaC03)	70	13001	69	15134	15638	16334	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 3	Natural	Carbonate (CaC03)	107	20643	213	24008	24643	25129	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 1	Natural	Carbonate (CaC03)	95	22611	191	26701	27315	27942	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 3	Natural	Carbonate (CaC03)	77	22824	469	26212	27457	28519	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 1	Natural	Carbonate (CaC03)	90	24734	255	28914	29604	30281	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 1	Natural	Carbonate (CaC03)	80	24942	204	29423	29843	30280	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 2	Natural	Carbonate (CaC03)	130	28366	228	31846	32665	33331	Ramirez de Bryson 2004
?	SBR, Searles Lake, SE Shore	Lake/Playa	Buried lacustrine	Southeast shoreline, Trench 3	Natural	Carbonate (CaC03)	62	29438	186	33486	34133	34637	Ramirez de Bryson 2004
?	SBR, Searles, Christmas Ridge	Lake/Playa	Lacustrine	TU5-A, southeast shoreline	Natural	Carbonate (CaC03)	20	18508	155	21549	22068	22416	Ramirez de Bryson 2004
?	SBR, Searles, Lagunita Site	Lake/Playa	Lacustrine	TU2-A	Natural	Carbonate (CaC03)	30	9870	50	11198	11270	11396	Ramirez de Bryson 2004
?	SBR, Searles, Lagunita Site	Lake/Playa	Lacustrine	TU2-B	Natural	Carbonate (CaC03)	40	10830	50	12593	12703	12873	Ramirez de Bryson 2004
?	SBR, Searles, Lagunita Site	Lake/Playa	Buried lacustrine	TU2-C	Natural	Carbonate (CaC03)	85	21645	408	24795	25929	27055	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	23	9040	55	10124	10212	10295	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	35	9200	56	10242	10364	10507	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	95	10864	59	12605	12737	12906	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	60	11489	65	13190	13345	13482	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	142	11546	63	13260	13386	13581	Ramirez de Bryson 2004
?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	T-5 arroyo cutbank	Natural	Carbonate (CaC03)	128	11720	64	13400	13569	13751	Ramirez de Bryson 2004
?	INY, Coso Range, Little Lake Flt	Floodplain/Playa	Buried alluvium	From bulldozer trench (50 m L x 4 m D) on playa surface of sag pond in fault zone	Natural	Charcoal	-	2545	160	2300	2603	2999	Roquemore 1981
?	INY-5830, Airport Lake	Basin/Floodplain	Surface deposit	Locus A, N63/W54, Feature B, basalt cobble concentration	Cultural	Charcoal	10	830	50	672	747	802	Rosenthal and Eerkens 2003
?	INY-5840, Airport Lake	Basin/Floodplain	Surface deposit	Feature 02, circular rock ring	Cultural	Charcoal	10	660	40	553	615	611	Rosenthal and Eerkens 2003
?	INY-5840, Airport Lake	Basin/Floodplain	Surface deposit	Feature 01, circular rock ring	Cultural	Charcoal	10	710	40	637	667	726	Rosenthal and Eerkens 2003
?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Carbonate (oolites)	-	4770	60	5444	5506	5602	Smith et al. 1997; Bacon et al. 2006
?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Organic sediment (marl)	-	12000	60	12954	13169	13312	Smith et al. 1997; Bacon et al. 2006
?	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Dates Qe3 unit - early Holocene eolian deposit (dune sand)	Natural	Shell-f (Anodonta)	-	10003	120	11222	11542	11847	Wells et al. 1987, 1989, 1990; McDonald et al. 2003
?	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Dates Ql2 unit - lates Holocene lacustrine deposit	Natural	Shell-f (Anodonta)	1	10990	120	12635	12876	13121	Wells et al. 1987, 1989, 1990; McDonald et al. 2003
?	INY-3415, Rochester Cave	Cave/Shelter	Surface deposit	Hearth	Cultural	Charcoal	-	150	15	170	187	281	Yohe and Parr 1987; Yohe 1992
A-0442	NV, Las Vegas Vly, Gilcrease Ranch	Spring Mound	Buried spring	Unit E2, 64, dates early spring activity	Natural	Organic (tufa)	-	10810	400	11399	12640	13436	Haynes 1967
A-0451	KER, China Lake, Core MD-1	Lake/Playa	Buried lacustrine	Drill hole 10 ft N of Smith and Pratt 1957 Core MD-1, with cattail, sedge, and other aquatic plant pollen	Natural	Shell-f (Anodonta)	747	28170	2150	31052	32666	34672	Damon, Haynes, and Long 1964 -RCJ
A-0464	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 67a, minimum age of spring	Natural	Organic (black mat)	-	9870	400	10290	11414	12645	Haynes 1967
A-0470	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E1, 53, concretionary masses of algal (?) tufa, maxmum age of spring	Natural	Organic (tufa)	-	13400	230	15223	15903	16597	Haynes 1967
A-0471	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 49, Cauliflower-like masses of algal (?) tufa, maxmum age of spring	Natural	Organic (tufa)	-	10160	160	11242	11814	12394	Haynes 1967
A-1470	SBR, Tunnel Ridge	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	10330	300	11195	12039	12757	King and Van Devender, 1977
A-1538	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	9980	180	11069	11547	12150	King and Van Devender, 1977
A-1548	SBR, Falling Arches	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	11650	190	13146	13518	13875	Rowlands, 1978
A-1550	SBR, Tunnel Ridge	Cave/Shelter	Surface deposit	Yucca brevifolia leaves	Natural	Packrat Midden	1	12670	260	14015	14965	16270	King and Van Devender, 1977
A-1551	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Nolina bigelovii leaves	Natural	Packrat Midden	1	9920	130	11103	11437	11842	Van Devender, 1977a
A-1580	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	8910	380	9118	10023	11105	King and Van Devender, 1977
A-1582	SBR, Tunnel Ridge	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	12330	350	13414	14475	15667	Wells, 1983a
A-1615	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	10430	170	11701	12256	12662	Mead et al. 1978
A-1616	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Nolina bigelovii leaves	Natural	Packrat Midden	1	10840	170	12418	12757	13121	Rowlands, 1978
A-1620	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	10030	160	11170	11604	12148	Mead et al. 1978

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
A-1621	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	11520	160	13106	13387	13741	King and Van Devender, 1977
A-1655	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	9600	170	10413	10924	11345	Van Devender, 1977a
A-1661, A-1662, and A-1664	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Midden debris	Natural	Packrat Midden	1	10600	105	12362	12511	12703	King and Van Devender, 1977
A-1663	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Nolina bigelovii leaves	Natural	Packrat Midden	1	9600	160	10490	10926	11314	King and Van Devender, 1977
A-1666	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Pinus monophylla)	Natural	Packrat Midden	1	12960	210	14801	15654	16652	King and Van Devender, 1977
A-1668	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	9160	170	9741	10351	10780	King and Van Devender, 1977
A-1761	KER, Indian Wells, Robber's Roost	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	12960	270	14524	15644	16736	McCarten and Van Devender, 1988
A-1762	KER, Indian Wells, Robber's Roost	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	12820	400	14015	15342	16705	McCarten and Van Devender, 1988
A-1763	KER, Indian Wells, Robber's Roost	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	13800	400	15424	16840	17858	McCarten and Van Devender, 1988
A-2465	NV, Corn Creek Flat	Spring Mound	Buried channel	Unit E2	Natural	Wood (?)	-	10980	270	12233	12930	13410	Quade et al. 1998
A-2570	NV, Corn Creek Flat	Spring Mound	Buried spring	CSCarb.-11a	Natural	Organic (black mat)	-	6220	250	6535	7085	7573	Quade 1986
A-2571	NV, Corn Creek Flat	Spring Mound	Buried spring	CS81Carb.-11b	Natural	Organic (black mat)	-	8640	150	9404	9686	10172	Quade 1986
A-2585	NV, Corn Creek Flat	Spring Mound	Buried spring	CS81Carb. 3a	Natural	Organic (black mat)	-	10090	160	11214	11694	12239	Quade 1986
A-3650	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	8040	120	8594	8909	9276	Van Devender et al. 1990b
A-3731	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9310	150	10200	10528	10878	Van Devender et al. 1990b
A-3732	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	8180	130	8752	9143	9470	Van Devender and Hawksworth, 1986
A-3734	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9330	110	10239	10536	10791	Van Devender et al. 1990b
A-3943	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	8540	100	9290	9528	9777	Van Devender and Hawksworth, 1986
A-3944	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	10490	110	12055	12383	12621	Van Devender et al. 1990b
A-4537	NV, Corn Creek Flat	Spring Mound	Buried spring	CS81Carb. 13b	Natural	Organic (black mat)	-	10220	210	11259	11935	12641	Quade et al. 1998
A-4538	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-29b	Natural	Wood (carbonized)	425	8610	150	9371	9648	9967	Quade et al. 1998
A-4539	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-7b	Natural	Wood (carbonized)	505	10090	200	11172	11716	12400	Quade et al. 1998
A-4540	NV, Pahrump/Browns Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-21b	Natural	Wood (carbonized)	-	8120	210	8543	9036	9501	Quade et al. 1998
A-4590	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Surface deposit	PVCarb.-15a (DE-1)	Natural	Charcoal	15	8570	170	9239	9598	9972	Quade et al. 1995
A-4591	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-37b, base of brown silt cap unit	Natural	Wood (carbonized)	335	8480	160	9031	9465	9892	Quade et al. 1998
A-4592	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried soil	PVCarb.-31b, basal channel paleosol, overlies mammoth molar	Natural	Wood (carbonized)	625	11190	210	12804	13101	13464	Quade et al. 1998
A-4593	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-33b	Natural	Wood (carbonized)	405	10940	390	11710	12828	13676	Quade et al. 1995
A-4594	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-11b	Natural	Wood (carbonized)	555	10380	380	11095	12119	13065	Quade et al. 1995
A-4595	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-34b	Natural	Wood (carbonized)	415	8600	170	9260	9642	10176	Quade et al. 1998
A-4606	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb-35b	Natural	Organic (black mat)	405	9120	110	10118	10310	10578	Quade et al. 1998
A-4607	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried spring	PVCarb.-26b	Natural	Organic (black mat)	505	10090	100	11303	11668	12038	Quade et al. 1998
A-4607	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb.-26b	Natural	Organic (black mat)	405	10090	100	11303	11668	12038	Quade et al. 1998
A-4608	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb.-10b	Natural	Organic (black mat)	300	8510	190	9025	9510	9951	Quade et al. 1998
A-4609	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-39b	Natural	Wood (carbonized)	435	10920	160	12630	12902	13198	Quade et al. 1998
A-4861	NV, Corn Creek Flat	Spring Mound	Buried spring	CS81Carb. 6b	Natural	Organic (black mat)	-	9220	180	9905	10426	10878	Quade et al. 1995
A-4862	NV, Corn Creek Flat	Spring Mound	Buried channel	CSC87-2b	Natural	Wood (carbonized)	-	11580	240	12994	13456	13914	Quade et al. 1998
A-4899	NV, Corn Creek Flat	Spring Mound	Buried spring	Unit D of Haynes	Natural	Shell-f (fresh)	-	28090	1080	31277	32407	33696	Quade et al. 1995
A-4901	NV, Corn Creek Flat	Spring Mound	Buried channel	CSC87-8b	Natural	Wood (carbonized)	-	11870	200	13290	13725	14150	Quade et al. 1998
A-4981	MNO, White Mountains	Hill/Ridge	Surface deposit	Falls Canyon 1 site	Natural	Packrat Midden	1	8790	110	9555	9846	10160	Jennings and Elliot-Fisk 1990(?)
A-4986	NV, Sandy Valley	Floodplain/Arroyo	Buried spring	SAV.Carb.-1b	Natural	Organic (black mat)	-	11020	140	12808	12976	13200	Quade et al. 1995
A-4987	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-5b	Natural	Organic (black mat)	-	6340	260	6634	7208	7691	Quade et al. 1998
A-4988	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-3b	Natural	Organic (black mat)	-	11800	180	13290	13649	14011	Quade et al. 1998
A-4990	NV, Sandy Valley	Floodplain/Arroyo	Buried spring	SVC87-1b	Natural	Organic (black mat)	-	9620	110	10667	10951	11229	Quade et al. 1998
A-4993	NV, Corn Creek Flat	Spring Mound	Buried spring	CS81Carb.3b	Natural	Organic (black mat)	-	10140	130	11260	11768	12189	Quade et al. 1995
A-4994	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-6b	Natural	Organic (black mat)	-	10390	150	11749	12270	12784	Quade et al. 1998
A-4995	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-7b	Natural	Organic (black mat)	-	10200	130	11318	11884	12391	Quade et al. 1998
A-4996	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-1b	Natural	Organic (black mat)	-	11760	130	13323	13608	13862	Quade et al. 1995
A-5035	NV, Indian Springs Valley	Spring Mound	Buried spring	Unit E of Haynes	Natural	Organic (black mat)	-	10410	110	11965	12316	12723	Quade et al. 1995
A-5222	NV, S. Coyote Springs	Floodplain/Arroyo	Buried spring	SCySCarb.-1b	Natural	Organic (black mat)	-	9970	90	11217	11469	11775	Quade et al. 1995
A-5223	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-5b	Natural	Organic (black mat)	-	9500	280	10146	10813	11751	Quade et al. 1995
A-5224	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-6b	Natural	Organic (black mat)	-	7790	90	8403	8584	8791	Quade et al. 1998
A-5305	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.Carb.-6b	Natural	Organic (black mat)	-	10410	110	11965	12316	12723	Quade et al. 1995
A-5306	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb.-38b	Natural	Organic (black mat)	435	9760	130	10716	11149	11503	Quade et al. 1998
A-5438	NV, Pahrump/Browns Spring	Floodplain/Arroyo	Buried spring	PVCarb.-22b	Natural	Organic (black mat)	-	7230	100	7914	8059	8217	Quade et al. 1998
A-5439	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried alluvium	PVCarb.-41b	Natural	Wood (carbonized)	435	8600	130	9371	9624	9948	Quade et al. 1998
A-5440	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-8a	Natural	Wood (carbonized)	575	10450	150	11953	12364	12807	Quade et al. 1998
A-5625	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-8b	Natural	Organic (black mat)	-	8145	80	8950	9104	9321	Quade et al. 1998
A-5626	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-9b	Natural	Organic (black mat)	-	8400	70	9254	9418	9535	Quade et al. 1998
A-5627	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried soil	PVCarb.-36b	Natural	Wood (carbonized)	455	10170	80	11590	11840	12113	Quade et al. 1998
A-5881	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.Carb.-7b	Natural	Organic (black mat)	-	10060	200	11104	11671	12396	Quade et al. 1998
AA-0?	KER, China Lake, Core SB01	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB01, far northwestern IWV; alluvial deposits date last Owens River overflow?	Natural	Organic sediment	6718	11215	150	12726	13088	13361	Couch Appendix B in Tetra Tech EM Inc. 2003
AA-0?	KER, China Lake, Core SB04	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB04, west Ridgecrest near Brady and Sydor streets	Natural	Organic sediment	1859	19590	300	22505	23380	24144	Couch Appendix B in Tetra Tech EM Inc. 2003
AA-0?	KER, China Lake, Core SB11	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB11, near intersection of N China Lake Blvd and E French Ave.	Natural	Organic sediment	9310	3250	95	3262	3486	3698	Couch Appendix B in Tetra Tech EM Inc. 2003
AA-0?	KER, China Lake, Core SB11	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB11, near intersection of N China Lake Blvd and E French Ave.	Natural	Organic sediment	14447	10195	150	11308	11870	12411	Couch Appendix B in Tetra Tech EM Inc. 2003

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
AA-0?	KER, China Lake, hummock	Lake/Playa	Surface lacustrine	TT13-SL01, N of golf course & Knox Rd; gypsum-rich silty clay hummock dates lake dessication	Natural	Organic sediment	45	10070	155	11203	11658	12153	Couch Appendix B in Tetra Tech EM Inc. 2003
AA-0?	SBR, China Lake, SL-01	Lake/Playa	Buried lacustrine	TT43-SL01 in lower lake basin;from near-shore death assemblage	Natural	Shell-f (gastropod)	159	12825	170	14542	15351	16418	Couch Appendix B in Tetra Tech EM Inc. 2003
AA-00380	SBR, Redtail Peak	Cave/Shelter	Surface deposit	Wood (Pinus monophylla needles)	Natural	Packrat Midden	1	11360	500	11988	13245	14641	King and Van Devender, 1977
AA-012405	SBR-5250, Rogers Ridge	Fan	-	Olivella bead	Cultural	Shell-m (Olivella)	-	10495	85	10875	11224	11707	Basgall and Hall 1994
AA-01576	SBR, Whipple Mountains	Cave/Shelter	Surface deposit	Larrea tridentata twigs	Natural	Packrat Midden	1	11015	110	12653	12898	13125	Van Devender, 1990b
AA-02519	MNO, Mono Lake	Lake Basin	Lacustrine	Core in 2.8 m of water placed in Post Office Creek delta; Tsoyowata ash at 363 cm	Natural	Organic sediment (gyttja)	455	7485	120	8028	8287	8481	Davis 1999
AA-02520	MNO, Mono Lake	Lake Basin	Lacustrine	Core in 2.8 m of water placed in Post Office Creek delta in 1986	Natural	Organic sediment (gyttja)	605	8990	105	9736	10084	10303	Davis 1999
AA-04450	MNO, Tioga Pass Pond	Glacial Lake	Buried lacustrine	TP (2)	Natural	Organic sediment	298	8760	240	9278	9840	10430	Anderson 1990
AA-04692	MNO, Mono Lake	Lake Basin	Lacustrine	Core in 2.8 m of water placed in Post Office Creek delta in 1986	Natural	Organic sediment (gyttja)	715	10765	105	12528	12670	12921	Davis 1999
AA-04898	SBR, Valley Wells	Spring mound	Fossil spring	Black organic mat from fossil spring	Natural	Organic (black mat)	90	10250	160	11392	11977	12448	Quade et al. 1995
AA-05879	SBR, Valley Wells	Spring mound	Fossil spring	Black organic mat from fossil spring	Natural	Organic (black mat)	-	11600	120	13241	13459	13745	Quade et al. 1998
AA-05902	MNO, Mono Lake	Lake Basin	Lacustrine	Core in 2.8 m of water placed in Post Office Creek delta in 1986; large thinolite tufa crystals	Natural	Carbonate (tufa)	658	9450	95	10484	10721	11105	Davis 1999
AA-08620	INY-0182, Stahl Site	Fan/Floodplain	Buried deposit	Trench 20, Unit 04	Cultural	Shell-m (Olivella A1)	75	8670	85	8592	8969	9302	Schroth 1994
AA-08621	INY-0182, Stahl Site	Fan/Floodplain	Buried deposit	Trench 20, Unit 09	Cultural	Shell-m (Olivella A1)	115	8625	110	8521	8901	9295	Schroth 1994
AA-08622	INY-0182, Stahl Site	Fan/Floodplain	Buried deposit	Trench 20, Unit 06	Cultural	Shell-m (Olivella A1)	165	8400	85	8356	8621	8966	Schroth 1994
AA-10535	INY-0182, Stahl Site	Fan/Floodplain	Buried soil	Trench 21, Unit 01, carbonized matter on large mammal bone	Cultural	Organic Matter (sinew or flesh?)	85	8625	60	9494	9597	9737	Schroth 1994
AA-10536	INY-0182, Stahl Site	Fan/Floodplain	Buried deposit	Trench 20, Unit 01 and 02, carbonized matter on large mammal bone	Cultural	Organic Matter (sinew or flesh?)	55	8900	65	9765	10018	10205	Schroth 1994
AA-14093	NV, Corn Creek Flat	Floodplain/Arroyo	Buried spring	CCS 4, aquatic snail, Physa virgata	Natural	Shell-f (gastropod)	-	13330	90	15404	15820	16258	Quade et al. 2003
AA-14101	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	SSW 1, aquatic snail, Gyraulus circumstratus	Natural	Shell-f (gastropod)	625	13240	180	11631	14325	17010	Quade et al. 2003
AA-14102	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried soil	HV 12, semi-aquatic, Succineidae	Natural	Shell-f (gastropod)	455	10180	130	11318	11845	12250	Quade et al. 2003
AA-14164	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	SSW 1, aquatic snail, Gyraulus parvus	Natural	Shell-f (gastropod)	435	10120	140	11243	11734	12187	Quade et al. 2003
AA-14166	NV, Corn Creek Flat	Floodplain/Arroyo	Buried spring	CCS 6, semi-aquatic snail, Succineidae, within black mat (Beta-86431)	Natural	Organic (black mat)	-	10050	70	11286	11578	11827	Quade et al. 2003
AA-15825/6	KER-3939, Clark Wash	Fan/Floodplain	Buried deposit	Trench 9, Qf1	Natural	Charcoal	138	11470	105	13124	13331	13569	McGill et al. 2009
AA-61607	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Pedogenic hardground with dense lower carbonate-cemented layer	Natural	Carbonate (mixed)	1	11522	71	13228	13369	13577	Numelin et al. 2007
AA-61608	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Buff travertine with shell fragments	Natural	Carbonate (mixed)	1	10909	68	12606	12782	12969	Numelin et al. 2007
AA-62076	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Carbonate-cemented angular alluvial gravels	Natural	Carbonate (CaC03)	1	12905	77	15013	15436	16141	Numelin et al. 2007
AA-62077	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Carbonated rind between rounded lacustrine cobbles	Natural	Carbonate (CaC03)	1	11905	74	13568	13759	13946	Numelin et al. 2007
AA-62078	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Brown, nodular travertine	Natural	Carbonate (CaC03)	1	13826	84	16736	16921	17147	Numelin et al. 2007
Beta- (written comm.)	SBR, Silver Lake	Lake/Playa	Surface deposit	Northwest Silver Lake, El Capitan BR II	Natural	Shell-f (Anodonta)	5	11640	160	13201	13507	13819	Weldon 1982; Wells et al. 2003
Beta-?	SBR, Marble Canyon	Fan	Buried soil	From 3Bkb horizon in west wall of trench across fault	Natural	Soil (SOM)	243	9710	50	11070	11149	11236	Spotila and Anderson 2003
Beta-002155	SBR, Ivanpah Mountains	Cave/Shelter	Buried deposit	Near center of Late Pleist.-Early Holo. faunal deposit in Kokoweef Cave (SBCM site no. SBC1.11.13)	Natural	Charcoal	640	9830	150	10746	11280	11811	Goodwin and Reynolds 1989; Bell and Jass 2004
Beta-010790	SBR-5250, Rogers Ridge	Fan	-	Trench 5	Natural	?	18	7910	420	7921	8817	9774	Jenkins 1985; Gilreath 1987; CRD 1996
Beta-012840	SBR-5250, Rogers Ridge	Fan	Fossil spring?	N1043/E940, Feature 3	Natural	Soil (SOM)	60	8410	140	9022	9379	9632	Jenkins 1985
Beta-012843	SBR-5250, Rogers Ridge	Fan	Fossil spring?	N1047/E933, Feature 4, spring pit or well	Natural	Soil (SOM)	25	8300	110	9023	9285	9493	Jenkins 1985
Beta-012844	SBR-5250, Rogers Ridge	Fan	Buried deposit	N918/E965	Natural	?	25	8420	210	8855	9386	9934	Jenkins 1985; Gilreath 1987; CRD 1996
Beta-018449	KER, Dove Springs Wash	Floodplain/Arroyo	Buried soil	From "lignitic sand" at base of oldest inset terrace in canyon; chalcedony flake in same stratum 40 m away; Qyw4 LP-EH unit of Miller and Amorosa 2006	Natural	Charcoal (confier branch)	245	10730	110	12511	12642	12894	Whistler 1990, 1994; Miller and Amoroso 2007
Beta-021199	SBR, Soda Lake	Lake/Playa	Surface deposit	Beach Ridge-Soda Lake, Elephant Ridge complex	Natural	Shell-f (Anodonta)	40	11690	130	13293	13549	13804	Wells et al. 2003
Beta-021200	SBR, Silver Lake	Lake/Playa	Surface deposit	Beach Ridge III, El Capitan complex	Natural	Shell-f (Anodonta)	1	10000	120	11219	11538	11846	Wells et al. 2003
Beta-024342	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Silver Lake Sil-M Core (south end of lake)	Natural	Organic sediment	305	9330	95	10247	10533	10765	Wells et al. 2003
Beta-026456	SBR, Silver Lake	Lake/Playa	Surface deposit	Beach Ridge I, El Capitan complex	Natural	Shell-f (Anodonta)	143	13310	120	15500	16300	16827	Brown 1990; Wells et al. 2003
Beta-029552	SBR, Silver Lake	Lake/Playa	Surface deposit	Beach Ridge V, El Capitan complex	Natural	Shell-f (Anodonta)	138	9060	120	9885	10215	10522	Wells et al. 2003
Beta-029553	SBR, Silver Lake	Lake/Playa	Surface deposit	Tidewater Basin Beach, Ridge II-Silver Lake	Natural	Shell-f (Anodonta)	262	15940	310	18570	19114	19592	Brown 1990; Wells et al. 1989; Wells et al. 2003
Beta-030156	INY, Two Goblin	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9540	100	10641	10885	11172	Koehler and Anderson 1995
Beta-033103	INY, Two Goblin	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	7840	70	8452	8646	8796	Koehler and Anderson 1995
Beta-038745	KER-2584, Red Rock Burial	Terrace	Surface deposit	Whistler Site, south of powerlines, east of Dove Spring Wash, 6-7 m above channel	Cultural	Bone (human)	5	3740	65	3898	4099	4294	Sutton 1992
Beta-038750	INY-3812	Fan (inset)	Surface deposit	House structure, post 2	Cultural	Charcoal	92	1600	60	1354	1485	1618	Delacorte et al.1993
Beta-039767	INY-3433, Coso Trans. Line	Hill/Ridge	Surface deposit	S8/E9, Feature 04, circular rock hearth w/millingstones	Cultural	Charcoal	15	90	60	8	121	151	Hildebrandt and Wohlgemuth 1995
Beta-040162	INY-3812	Fan (inset)	Surface deposit	Locus 1, housefloor, post 10	Cultural	Charcoal	128	1340	50	1172	1268	1346	Delacorte et al.1993
Beta-045472	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	-	Natural	Organic (black mat)	-	11630	90	13295	13486	13693	DuBarton et al. 1991
Beta-045473	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	-	Natural	Organic (black mat)	-	9820	100	11067	11246	11621	DuBarton et al. 1991
Beta-045611, ETH-7129	SBR-5251, Tiefort Basin	Dune (inland)	Surface deposit	Locus A, E3/S43, Feature 2C ash pit w/Anodonta shells	Cultural	Charcoal (w/shells)	80	6640	65	7429	7522	7610	Hall 1994
Beta-045612	SBR-5251, Tiefort Basin	Dune (inland)	Surface deposit	Locus H, from rock cluster/hearth feature	Cultural	Charcoal	-	820	70	665	750	835	Hall 1994
Beta-051957	INY, Owens Valley, Swansea Bay	Lake/Playa	Surface lacustrine	Swansea Bay (S), high barrier beach, sample 5	Natural	Shell-f (Anodonta)	1	11880	130	13423	13722	14001	Orme and Orme 2008
Beta-052398	INY, Owens Valley, Swansea Bay	Lake/Playa	Surface lacustrine	Swansea Bay (N), low barrier beach, sample 8	Natural	Shell-f (Anodonta)	1	10610	70	12400	12555	12684	Orme and Orme 2008
Beta-052489	SBR, Granite Mountains	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	11470	70	13167	13330	13468	Koehler et al. 2005
Beta-052552	INY-3033, Coso Trans. Line	Hill/Ridge	Surface deposit	Unit 01, basalt tablelands	Cultural	Charcoal	15	400	50	421	449	521	Hildebrandt and Wohlgemuth 1995
Beta-052553	INY-3455, Coso Trans. Line	Hill/Ridge	Surface deposit	Unit 01, Locus of INY-3017, basalt tablelands	Cultural	Charcoal	40	101	50	9	120	151	Hildebrandt and Wohlgemuth 1995
Beta-053846	INY, Owens River Terrace	Floodplain/Terrace	Surface deposit	From Bqk-horizon in Q2 (i.e., T2) terrace, soil pit 203	Natural	Carbonate (clast coating)	75	6840	100	7559	7689	7870	Pinter, Keller, and West 1994
Beta-054341	INY, Owens Valley, Swansea Bay	Lake/Playa	Surface lacustrine	Swansea Bay (S), intermediate beach, sample 7	Natural	Shell-f (Anodonta)	1	11120	70	12750	13002	13178	Orme and Orme 2008
Beta-054713	INY, Lubkin Canyon	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	7990	50	8696	8860	9007	Koehler and Anderson 1995
Beta-054714	INY, Lubkin Canyon	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9460	50	10567	10703	10804	Koehler and Anderson 1995

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Beta-055681	INY-0328/H, Owens Valley	Fan/Floodplain	Buried lacustrine	Locus D, BHT 1, organic soil, Stratum Iva	Natural	Organic sediment (marl)	66	9440	150	9493	9862	10218	Delacorte 1999
Beta-055684	INY-2750	Floodplain	Surface deposit	N121/W62.5	Cultural	Shell-f (Anodonta)	5	590	60	522	598	663	Delacorte 1999
Beta-055880	INY, Lubkin Canyon	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	7840	100	8445	8672	8983	Koehler and Anderson 1995
Beta-058386	INY, Owens Valley, Swansea Bay	Lake/Playa	Buried lacustrine	Swansea Bay (N), gravel pit, death bed, sample 10	Natural	Shell-f (gastropod)	70	9580	100	10656	10927	11198	Orme and Orme 2008
Beta-059783	INY, Corsair	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	8700	80	9528	9689	9929	Koehler and Anderson 1995
Beta-066967	INY-3806/H	Fan/Terrace (alluvial)	Surface deposit	Unit 02	Natural	Shell-f (freshwater)	85	11970	90	13586	13828	14051	Gilreath 1995
Beta-067673	INY, Owens Valley, Dolomite Site	Lake/Playa	Buried lacustrine	From silty sand below 50 cm of sandy overburden	Natural	Shell-f (Anodonta)	50	11070	60	12733	12962	13117	Koehler 1995
Beta-073466	NV, Corn Creek Flat	Spring Mound	Buried channel	CSCarb.27b	Natural	Wood (carbonized)	-	12400	60	14125	14416	14824	Quade et al. 1998
Beta-073629	NV, Corn Creek Flat	Spring Mound	Buried channel	CSWood1	Natural	Wood (carbonized)	-	11540	50	13259	13373	13502	Quade et al. 1998
Beta-073958	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-2b	Natural	Organic (black mat)	-	10390	60	12050	12275	12406	Quade et al. 1998
Beta-073959	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-3b	Natural	Organic (black mat)	-	8160	70	8981	9119	9321	Quade et al. 1998
Beta-073960	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-4b	Natural	Organic (black mat)	-	6670	50	7457	7539	7616	Quade et al. 1998
Beta-073961	NV, N. Coyote Springs	Floodplain/Arroyo	Buried spring	NCySC-7b	Natural	Organic (black mat)	-	8880	80	9698	9986	10202	Quade et al. 1998
Beta-073963	NV, Corn Creek Flat	Spring Mound	Buried spring	CSC87-9b	Natural	Organic (black mat)	-	8760	60	9550	9765	9938	Quade et al. 1998
Beta-073967	NV, Corn Creek Flat	Spring Mound	Buried channel	CSCarb.28a	Natural	Wood (carbonized)	-	12410	60	14137	14434	14839	Quade et al. 1998
Beta-073968	NV, Corn Creek Flat	Spring Mound	Buried channel	CSCarb.28b	Natural	Wood (carbonized)	-	12490	50	14234	14598	14937	Quade et al. 1998
Beta-073969	NV, Corn Creek Flat	Spring Mound	Buried channel	CSCarb.30b	Natural	Wood (carbonized)	-	12180	110	13773	14053	14509	Quade et al. 1998
Beta-073971	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-12b	Natural	Wood (carbonized)	455	9810	60	11124	11227	11354	Quade et al. 1998
Beta-073972	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-13b	Natural	Wood (carbonized)	270	9650	70	10767	10989	11202	Quade et al. 1998
Beta-073973	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried alluvium	PVCarb.-14b	Natural	Wood (carbonized)	170	9060	60	10147	10225	10407	Quade et al. 1998
Beta-073974	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb.-47b	Natural	Organic (black mat)	300	7920	160	8407	8785	9140	Quade et al. 1998
Beta-073975	NV, Pahrump/Stump Spring	Floodplain/Arroyo	Buried spring	PVCarb.-27b	Natural	Organic (black mat)	210	9440	50	10547	10675	10790	Quade et al. 1998
Beta-073975	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	PVCarb.-27b	Natural	Organic (black mat)	435	9440	50	10547	10675	10790	Quade et al. 1998
Beta-074392	NV, Corn Creek Flat	Floodplain/Arroyo	Buried spring	CCS 5, aquatic snail, Pyrgulopsis	Natural	Shell-f (gastropod)	-	10750	60	12688	12801	12864	Quade et al. 2003
Beta-074873	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	HV 11, semi-aquatic snail, Succineidae	Natural	Shell-f (gastropod)	405	9090	60	10171	10249	10420	Quade et al. 2003
Beta-074883	NV, Pahrump/Hidden Valley	Floodplain/Arroyo	Buried spring	HV 11, terrestrial snail, Stagnicola caperata	Natural	Shell-f (gastropod)	405	10190	60	11616	11886	12100	Quade et al. 2003
Beta-082061	INY, Owens Valley, Swansea Bay	Lake/Playa	Surface lacustrine	Owens River, fan delta, sample 6 (from gully cutbank?)	Natural	Shell-f (Anodonta)	1	11370	110	13059	13244	13463	Orme and Orme 2008
Beta-082062	INY, Owens Valley, Centennial	Lake/Playa	Surface lacustrine	Centennial shore, beach ridge, sample 4	Natural	Shell-f (Anodonta)	1	12430	80	14112	14518	15016	Orme and Orme 2008
Beta-082063	INY, Owens Valley, Swansea Bay	Lake/Playa	Buried lacustrine	Swansea Bay (N), gravel pit, low barrier beach, sample 9	Natural	Shell-f (Anodonta)	110	10510	80	12133	12441	12606	Orme and Orme 2008
Beta-084315	NV, Corn Creek Flat	Spring Mound	Buried channel	Section OCI-11, CSC-29b	Natural	Wood (carbonized)	75	12810	60	14900	15126	15413	Quade et al. 1998; Quade et al. 2003
Beta-084316	NV, Corn Creek Flat	Spring Mound	Buried channel	Section OC-11, CSC-27b	Natural	Wood (carbonized)	25	12100	60	13806	13951	14095	Quade et al. 1998; Quade et al. 2003
Beta-084781	NV, Corn Creek Flat	Spring Mound	Buried channel	Section OC-11, terrestrial snail, Vallonia cyclophorella	Natural	Shell-f (gastropod)	55	12800	80	14836	15115	15453	Quade et al. 2003
Beta-085542	SBR, Silurian Lake	Lake/Playa	Buried lacustrine	Si-1-II, Core at southern end of playa	Natural	Organic sediment	1800	9210	70	10239	10380	10524	Anderson and Wells 2003b
Beta-086427	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.Carb.8	Natural	Wood (carbonized)	-	10030	60	11270	11536	11772	Quade et al. 2003
Beta-086429	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.QUADE90-100, semi-aquatic snail, Succineidae	Natural	Shell-f (gastropod)	95	12300	60	13999	14193	14611	Quade et al. 2003
Beta-086431	NV, Corn Creek Flat	Floodplain/Arroyo	Buried spring	CCS 6,	Natural	Organic (black mat)	-	9970	50	11248	11412	11622	Quade et al. 2003
Beta-094111	SBR, Lake Dumont/Salt Creek, site?	Lake/Playa	Surface deposit	DU-3-Qal, Alluvium, from dark gray ashy layer over oxidized burn layer (possible hearth?)	Natural	Charcoal	60	9200	60	10237	10366	10514	Anderson and Wells 2003b
Beta-097593	INY, Death Valley (west)	Lake/Playa	Buried lacustrine	Core 9	Natural	Organic sediment	800	9780	60	11088	11207	11316	Anderson and Wells 2003a
Beta-097595	INY, Death Valley, Devil's Speedway	Lake/Playa	Buried lacustrine	Core 10	Natural	Organic sediment	300	12420	60	14122	14492	14981	Anderson and Wells 2003a
Beta-158755	INY, Owens Valley, Keeler	Fan/Floodplain	Buried deposit	Swansea (east Owens Lake)	Natural	Shell-f (freshwater)	-	9540	90	10648	10887	11168	Bacon et al. 2006
Beta-163551	INY, Owens River Bluff	Basin/Floodplain	Buried marsh	lithofacies 4b, west bank Owens River ~600 m ESE of Quaker	Natural	Charcoal	-	9990	40	11268	11454	11624	Bacon, Pezzopane, and Burke 2003
Beta-163552	INY, Owens River Bluff	Basin/Floodplain	Buried marsh	lithofacies 4b	Natural	Organic sediment	300	10480	40	12373	12456	12586	Bacon, Pezzopane, and Burke 2003
Beta-163553	INY, Owens River Bluff	Basin/Floodplain	Buried marsh	lithofacies 4b	Natural	Organic sediment	300	9560	40	10729	10932	11092	Bacon, Pezzopane, and Burke 2003
Beta-163554	INY, Owens Valley, Alabama Gates	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 2	Natural	Charcoal	270	9060	40	10179	10224	10260	Bacon, Pezzopane, and Burke 2003
Beta-163555	INY, Owens Valley, Alabama Gates	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 2	Natural	Organic sediment	270	9030	60	10116	10203	10292	Bacon, Pezzopane, and Burke 2003
Beta-163556	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 4	Natural	Organic sediment	200	9160	50	10230	10328	10435	Bacon, Pezzopane, and Burke 2003
Beta-163557	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 4	Natural	Organic sediment	200	9680	50	11065	11109	11218	Bacon, Pezzopane, and Burke 2003
Beta-163558	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 4	Natural	Charcoal	200	9920	50	11225	11325	11414	Bacon, Pezzopane, and Burke 2003
Beta-165600	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 13b, Trench 4	Natural	Charcoal	100	9300	60	10282	10494	10608	Bacon, Pezzopane, and Burke 2003
Beta-166887	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Carbonate (tufa)	1	15990	90	18893	19148	19408	Bacon et al. 2006
Beta-166888	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Carbonate (tufa)	1	10990	70	12677	12862	13084	Bacon et al. 2006
Beta-166889	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Shell-f (freshwater)	1	20350	120	23870	24274	24553	Bacon et al. 2006
Beta-166890	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Carbonate (tufa)	1	10640	70	12420	12582	12696	Bacon et al. 2006
Beta-168600	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4a, Pit 4	Natural	Charcoal	315	12580	60	14445	14819	15177	Bacon, Pezzopane, and Burke 2003
Beta-168601	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4a, Pit 4	Natural	Charcoal	315	12590	60	14462	14842	15189	Bacon, Pezzopane, and Burke 2003
Beta-168602	INY, Owens Valley, Quaker	Basin/Floodplain	Buried marsh	lithofacies 4a, Pit 4	Natural	Charcoal	315	12730	60	14710	15096	15544	Bacon, Pezzopane, and Burke 2003
Beta-170208	INY-5825, Basalt Ridge, spring	Lake/Playa	Surface deposit	S48/W30.5, Stain 1, Spring Peat, at Basalt Ridge	Natural	Organic (black mat)	4	10010	110	11233	11543	11839	Basgall 2004
Beta-170209	INY-5825, Basalt Ridge, soil	Lake/Playa	Buried soil	S50/W17, Buried Soil Unit, at Basalt Ridge	Natural	Organic sediment	40	8390	130	9022	9361	9557	Basgall 2004
Beta-170210	INY-5825, Basalt Ridge, spring	Lake/Playa	Buried spring	S48/W30.5, Stain 1, Spring Peat, at Basalt Ridge	Natural	Organic (black mat)	42	9870	50	11198	11270	11396	Basgall 2004
Beta-190570	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	From spillway between China and Searles lakes, coll by R. Kaldenberg	Natural	Shell-f (Anodonta)	1	12080	260	13412	14036	14977	Hildebrandt and Darcangelo 2004
Beta-190572	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	From spillway between China and Searles lakes, coll by R. Kaldenberg	Natural	Shell-f (Anodonta)	1	12110	170	13583	14011	14676	Hildebrandt and Darcangelo 2004
Beta-211384	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	RLK # AMP-01, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Natural	Shell-f (Anodonta)	1	12120	90	13740	13972	14225	Kaldenberg 2006; Rogers 2009
Beta-211385	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	RLK # AMP-02, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Natural	Shell-f (Anodonta)	1	12150	60	13818	13996	14175	Kaldenberg 2006; Rogers 2009

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
Beta-211386	SBR, Searles, Salt Wells Valley	Lake/Playa	Surface deposit	RLK # AMP-03, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Cultural	Shell-m (Haliotis)	1	560	60	511	588	655	Kaldenberg 2006; Rogers 2009
Beta-211387	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	RLK # AMP-04, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Natural	Shell-f (Anodonta)	1	11700	100	13338	13556	13776	Kaldenberg 2006; Rogers 2009
Beta-211388	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	RLK # AMP-05, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Natural	Shell-f (Anodonta)	1	12110	70	13786	13957	14148	Kaldenberg 2006; Rogers 2009
Beta-211389	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	RLK #AMP-06, "in Salt Wells Valley west of road between CLP and ammunition storage areas, near high-water overflow between lakes"	Natural	Shell-f (Anodonta)	1	13470	70	16254	16645	16901	Kaldenberg 2006; Rogers 2009
Beta-211390	SBR, Searles, Salt Wells Valley	Lake/Playa	Surface lacustrine	RLK # AMP-07, wood ash from under roasting pit	Cultural	Charcoal (wood)	1	350	40	313	399	495	Kaldenberg 2006; Rogers 2009
Beta-220691	SBR-12390, China Lake	Lake/Playa	Lacustrine	Parcel 18, test unit	Natural	Shell-f (Anodonta)	15	13130	80	15233	15939	16518	Byrd 2007
Beta-220692	SBR-12391, China Lake	Lake/Playa	Lacustrine	Parcel 16, test unit, snail shell	Natural	Shell-f (gastropod)	15	14390	70	17164	17504	17849	Byrd 2007
Beta-237061	KER, Indian Wells Canyon	Fan	Buried soil	Profile IK-01, 2Ab buried terrace locality	Natural	Soil (SOM)	270	8790	40	9627	9811	9939	China Lake Legacy project 718
Beta-237062	KER, Indian Wells Valley, IK-03	Fan	Buried soil	Profile IK-03, median fan locality	Natural	Soil (SOM)	115	2790	60	2766	2897	3039	Young 2007
Beta-237063	KER, Indian Wells Valley, T1	Fan	Buried soil	Trench 1, medial fan buried surface	Natural	Soil (SOM)	130	9100	40	10194	10246	10300	Young 2007
Beta-237064	KER, Indian Wells Valley, T2	Fan	Buried soil	Trench 2, medial-distal fan buried surface	Natural	Soil (SOM)	55	4510	40	5039	5163	5310	Young 2007
Beta-237065	KER, Indian Wells Valley, T5	Fan	Buried soil	Trench 5, distal plain locality	Natural	Soil (SOM)	70	2510	40	2458	2587	2743	Young 2007
Beta-249418	KER, China Lake, Core SB01	Lake/Playa	Buried Lacustrine	Bore Hole TTIWV-SB01	Natural	Organic sediment	5258	16250	80	19215	19416	19583	China Lake Legacy project 718
Beta-249419	KER, China Lake, Core SB01	Lake/Playa	Buried soil	Bore Hole TTIWV-SB01	Natural	Soil (SOM)	6371	12160	70	13788	14008	14224	China Lake Legacy project 718
Beta-254726	KER, Beacon Solar/Cantil	Fan/Floodplain	Buried soil	Pine Tree Wash, Stratum 2	Natural	Soil (SOM)	150	12730	70	14672	15095	15562	Young 2009
Beta-255187	KER, Beacon Solar/Cantil	Fan/Floodplain	Buried soil	TL3, Stratum 3	Natural	Soil (SOM)	220	9490	50	10640	10760	10871	Young 2009
Beta-259414	KER, China Lake, Core SB05	Lake/Playa	Buried Lacustrine	Bore Hole TTIWV-SB05	Natural	Organic sediment	3079	180	40	131	176	230	China Lake Legacy project 718
Beta-260150	INY, Rose Valley flat	Lake/Playa	Surface deposit	Auger 2, Rose Valley Flat	Natural	Organic sediment	15	7320	80	7994	8129	8323	China Lake Legacy project 718
Beta-260151	INY, Rose Valley, Cinder flat	Lake/Playa	Buried deposit	Auger 4, Cinder Flat	Natural	Organic sediment	70	9180	100	10184	10369	10588	China Lake Legacy project 718
Beta-260152	INY, Rose Valley, Lava end	Lake/Playa	Buried soil	Column Sample, Lava End; 2Ab horizon below Cartago soil	Natural	Organic sediment	60	4440	80	4867	5074	5295	China Lake Legacy project 718
Beta-260153	INY, Rose Valley, Lava end	Lake/Playa	Buried deposit	Column Sample, Lava End; black mat below Cartago soil	Natural	Organic (black mat)	165	9410	100	10372	10656	10887	China Lake Legacy project 718
Beta-260154	INY, Rose Valley, Lava end	Lake/Playa	Buried deposit	Column Sample, Lava End; black mat below Cartago soil	Natural	Organic (black mat)	180	8120	100	8703	9065	9321	China Lake Legacy project 718
Beta-260155	INY, Rose Valley, Lava end	Lake/Playa	Buried soil	Lava End Rose Valley Flat; 2Ab horizon below Cartago soil	Natural	Organic sediment	50	6770	100	7458	7627	7797	China Lake Legacy project 718
Beta-260156	INY, Rose Valley, Dead Chevy	Lake/Playa	Buried soil	Auger 7, Dead Chevy Flat, 2Ab	Natural	Soil (SOM)	90	9720	100	10742	11097	11289	China Lake Legacy project 718
Beta-272225	KER, Indian Wells Canyon	Fan	Buried soil	Profile IK-01, 3Ab soil near base of cutbank	Natural	Soil (SOM)	300	9750	50	11088	11190	11250	China Lake Legacy project 718
Beta-272226	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried spring/soil	Locality 1, cutbank along west side of wash, 2Ab	Natural	Shell-f (gastropod, Fossaria?)	175	10000	60	11262	11486	11722	China Lake Legacy project 718
Beta-272227	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Locality 1, cutbank along west side of wash, 2Ab	Natural	Soil (SOM)	198	9610	50	10766	10944	11167	China Lake Legacy project 718
Beta-272228	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Locality 1, cutbank along west side of wash, 3Ab	Natural	Soil (SOM)	270	10120	60	11590	11746	11988	China Lake Legacy project 718
Beta-280679	KER, China Lake, Core 9	Floodplain/Playa	Buried alluvium	Core 9, 6Cg, pale olive silty clay, distal fan, slough, or playa above coarse beach deposit	Natural	Organic sediment	427	9690	50	11067	11123	11225	China Lake Legacy project 718
Beta-280680	KER, China Lake, Core 9	Floodplain/Playa	Buried alluvium	Core 9, 11Cg, olive gray near-shore sand below coarse beach deposit	Natural	Organic sediment	1064	14610	50	17501	17780	18026	China Lake Legacy project 718
Beta-280681	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Local 4, Auger 1, T-3(?) terrace, 3Ab horizon	Natural	Soil (SOM)	155	9930	40	11235	11324	11410	China Lake Legacy project 718
Beta-280682	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Local 4, Auger 1, T-3(?) terrace, 7Ab horizon	Natural	Soil (SOM)	268	10450	40	12202	12387	12549	China Lake Legacy project 718
Beta-280683	SBR, China Lake, tufa knoll	Lake/Playa	Surface lacustrine	Algal tufa on granitic bedrock knoll W of lake outlet	Natural	Carbonate (tufa)	1	11110	50	12773	13000	13138	China Lake Legacy project 718
Beta-280684	INY, Rose Valley, north pit	Floodplain	Buried alluvium	RV-NCTP-3Cu Strat. II, within coarse channel facies	Natural	Organic sediment	255	8790	40	9627	9811	9939	China Lake Legacy project 718
Beta-280685	INY, Rose Valley, south pit	Lake/Playa	Buried playa	RV-SCTP-4Ob Strat. II, lower playa, east side	Natural	Organic sediment	470	11560	50	13276	13395	13567	China Lake Legacy project 718
Beta-280686	SBR, Searles, Salt Wells Valley	Lake/Playa	Surface lacustrine	Beach deposit of sand, marl, and Anodonta shells perched on bedrock outcrop below China Lake outlet in Searles Lake basin	Natural	Shell-f (gastropod)	1	11550	50	13267	13387	13537	China Lake Legacy project 718
Beta-280734	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Local 4, Auger 1, T-3(?) terrace, 5Ab horizon	Natural	Soil (SOM)	210	10510	50	12375	12473	12610	China Lake Legacy project 718
Beta-280735	KER, Indian Wells Canyon	Fan	Buried soil	Profile IK-01, 6Ob, thin peaty layer near terrace base	Natural	Organic sediment	373	10240	50	11758	11984	12142	China Lake Legacy project 718
Beta-280993	KER, Dove Springs Wash	Floodplain/Arroyo	Buried soil	DSW-L#5771-5Ab Strat. X (IX in field)	Natural	Soil (SOM)	107	4230	40	4685	4753	4861	China Lake Legacy project 718
Beta-281207	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Local 5, Freeman Gulch fan, left bank, 3Ab, with flaketool near base of 3Cu	Natural	Soil (SOM)	233	6990	40	7718	7827	7882	China Lake Legacy project 718
Beta-281208	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	Local 5, Freeman Gulch fan, left bank, 4Ab, below flaketool in 3Cu	Natural	Soil (SOM)	285	6340	40	7168	7273	7331	China Lake Legacy project 718
C-0599	NV, Leonard Rockshelter	Lake/Playa	Buried lacustrine	Bat guano lying directly on sand/gravel beach at 4,175 ft, underlain by UCLA-298	Natural	Organic (coprolite)	0	11199	570	11332	13082	14451	Fergusson and Libby 1964
C-0894	SBR, Searles Lake, Core 129	Lake/Playa	Buried lacustrine	Core 129, sub by W.A. Gale of American Potash and Chemical Co., Whittier, CA	Natural	Organic sediment (mud)	2246	10494	560	9798	11270	12688	Libby 1954; Flint and Gale 1959
CAMS-?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Organic sediment (marl)	-	9700	60	10036	10218	10418	Benson et al. 1997; Bacon et al. 2006
CAMS-?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Organic sediment (marl)	-	10450	60	10897	11133	11246	Benson et al. 1997; Bacon et al. 2006
CAMS-?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Organic sediment (marl)	-	11280	60	12246	12456	12627	Benson et al. 1997; Bacon et al. 2006
CAMS-?	INY, Owens Valley, playa	Lake/Playa	Buried lacustrine	Owens Playa	Natural	Organic sediment (marl)	-	12850	60	13790	13961	14152	Benson et al. 1997; Bacon et al. 2006
CAMS-?	INY-0019/20, Panamint, Lake Hill	Lake/Playa	Buried spring	Lake Hill Basin auger, base of black mat with many snails and ostracodes, transition from lake to spring; same site as Davis 1970	Natural	Shell-f (gastropod)	312	12575	40	14489	14833	15174	Jayko et al. 2005, 2008
CAMS-?	INY, Panamint Valley	Lake/Playa	Surface lacustrine	Reefal tufa with encased gastropods on Lake Hill bedrock (Site 1)	Natural	Carbonate (tufa/gastropod)	1	11550	70	13256	13392	13602	Jayko et al. 2008
CAMS-000078	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 1.2	Natural	Peat (silt)	148	3990	70	4239	4466	4646	Throckmorton and Reheis 1993
CAMS-000080	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 2.6	Natural	Organic sediment (clay)	413	8810	80	9602	9866	10168	Throckmorton and Reheis 1993
CAMS-000081	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried soil	Core 3.6, A horizon	Natural	Soil (SOM)	469	8900	80	9736	10006	10222	Throckmorton and Reheis 1993
CAMS-000082	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried soil	Core 2.7, A horizon	Natural	Soil (SOM)	464	9630	80	10740	10962	11200	Throckmorton and Reheis 1993
CAMS-000085	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried soil	Core 4.12, A horizon	Natural	Soil (SOM)	896	9900	80	11187	11345	11628	Throckmorton and Reheis 1993
CAMS-000092	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 7.4	Natural	Organic sediment (silt)	236	5780	80	6405	6580	6749	Throckmorton and Reheis 1993
CAMS-000094	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 7.6	Natural	Organic sediment (silt)	423	9440	80	10491	10693	10883	Throckmorton and Reheis 1993
CAMS-000095	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 7.7	Natural	Peat	474	10130	140	11248	11752	12238	Throckmorton and Reheis 1993
CAMS-000096	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 7.7	Natural	Peat	526	11380	90	13096	13248	13407	Throckmorton and Reheis 1993
CAMS-000097	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 7.8	Natural	Organic sediment (silt)	573	12330	200	13815	14378	15008	Throckmorton and Reheis 1993
CAMS-004657	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	711	11140	70	12001	12267	12557	Bischoff, Stafford, and Meyer 1997

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CAMS-004662	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	372	2990	70	2973	3175	3356	Bischoff, Stafford, and Meyer 1997
CAMS-004663	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	402	3060	70	3067	3267	3410	Bischoff, Stafford, and Meyer 1997
CAMS-004664	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	512	4760	80	5315	5491	5612	Bischoff, Stafford, and Meyer 1997
CAMS-004671	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	721	11360	70	12346	12547	12698	Bischoff, Stafford, and Meyer 1997
CAMS-004672	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	527	8930	70	9036	9256	9433	Bischoff, Stafford, and Meyer 1997
CAMS-004675	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	599	9980	70	10289	10508	10672	Bischoff, Stafford, and Meyer 1997
CAMS-006310	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	523	8280	120	8147	8422	8746	Bischoff, Stafford, and Meyer 1997
CAMS-006314	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	480	4970	70	5594	5712	5797	Bischoff, Stafford, and Meyer 1997
CAMS-006315	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	480	4980	70	5600	5722	5799	Bischoff, Stafford, and Meyer 1997
CAMS-006316	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	465	4330	100	4787	4935	5148	Bischoff, Stafford, and Meyer 1997
CAMS-006317	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	382	3750	70	3903	4116	4299	Bischoff, Stafford, and Meyer 1997
CAMS-006318	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	382	3950	70	4217	4396	4578	Bischoff, Stafford, and Meyer 1997
CAMS-006319	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	429	3800	60	4073	4194	4410	Bischoff, Stafford, and Meyer 1997
CAMS-006320	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	429	4070	60	4422	4580	4714	Bischoff, Stafford, and Meyer 1997
CAMS-006326	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	502	4680	80	5278	5415	5594	Bischoff, Stafford, and Meyer 1997
CAMS-006327	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Carbonate (oolites)	502	4680	100	5257	5407	5601	Bischoff, Stafford, and Meyer 1997
CAMS-013469	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	537	12570	80	13439	13678	13867	Benson et al. 1997, 2002
CAMS-013470	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	594	13680	70	15064	15514	16251	Benson et al. 1997, 2002
CAMS-013527	INY, Owens Valley, Core OL90-2	Lake/Playa	Buried lacustrine	Core OL90-2	Natural	Organic sediment (marl)	567	13080	60	14023	14380	14915	Benson et al. 1997, 2002
CAMS-020025	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	479	9170	60	9369	9502	9682	Benson et al. 1997, 2002; Mensing 2001
CAMS-020026	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	558	9520	60	9744	9991	10178	Benson et al. 1997, 2002; Mensing 2001
CAMS-020027	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	732	9680	60	9997	10196	10393	Benson et al. 1997, 2002; Mensing 2001
CAMS-020028	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	789	11520	60	12567	12673	12859	Benson et al. 1997, 2002; Mensing 2001
CAMS-020218	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	853	12650	70	13571	13769	13967	Benson et al. 1997, 2002; Mensing 2001
CAMS-020219	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	907	13360	70	14419	14895	15227	Benson et al. 1997, 2002; Mensing 2001
CAMS-021541	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	913	13270	70	14209	14704	15115	Benson et al. 1997, 2002; Mensing 2001
CAMS-022388	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	558	9540	60	9776	10015	10194	Benson et al. 1997, 2002; Mensing 2001
CAMS-059870	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	709	10050	50	10450	10578	10744	Benson et al. 1997, 2002; Mensing 2001
CAMS-059871	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	725	10870	50	11390	11755	12001	Benson et al. 1997, 2002; Mensing 2001
CAMS-059872	INY, Owens Valley, Core OL84B	Lake/Playa	Buried lacustrine	Core OL84B	Natural	Organic sediment (marl)	829	12230	50	13205	13349	13483	Benson et al. 1997, 2002; Mensing 2001
CAMS-076411	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	80	10150	40	11684	11829	11999	Owens et al. 2007
CAMS-076412	SBR, Silver Lake	Lake/Playa	Buried lacustrine	?	Natural	Shell-f (Anodonta)	116	12960	50	15084	15514	16185	Owens et al. 2007
CAMS-076413	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	54	9640	40	10786	10981	10974	Owens et al. 2007
CAMS-076414	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	70	10090	40	11403	11675	11826	Owens et al. 2007
CAMS-076415	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	57	9990	40	11268	11454	11624	Owens et al. 2007
CAMS-076416	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	40	10100	40	11593	11705	11835	Owens et al. 2007
CAMS-076417	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	52	10250	40	11818	12006	12132	Owens et al. 2007
CAMS-076418	SBR, Silver Lake	Lake/Playa	Buried lacustrine	?	Natural	Shell-f (Anodonta)	105	12900	50	15024	15401	15948	Owens et al. 2007
CAMS-076419	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	50	7910	40	8599	8731	8798	Owens et al. 2007
CAMS-076420	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	50	8960	50	9916	10086	10094	Owens et al. 2007
CAMS-076421	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	50	9550	40	10916	10927	11089	Owens et al. 2007
CAMS-076422	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	50	9460	40	10576	10698	10789	Owens et al. 2007
CAMS-076423	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	-	480	40	475	520	556	Owens et al. 2007
CAMS-076424	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	-	520	50	497	543	567	Owens et al. 2007
CAMS-076425	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	-	480	40	475	520	556	Owens et al. 2007
CAMS-076426	SBR, Silver Lake	Lake/Playa	Surface lacustrine	?	Natural	Shell-f (Anodonta)	-	9660	40	11066	11094	11199	Owens et al. 2007
CAMS-098308	INY, Owens Valley, Willow Dip	Lake/Playa	Buried lacustrine	Maximum age of sand-tufa berm from lake highstand, Willow Dip Arroyo wall; w/obsidian flake	Natural	Carbonate (tufa)	65	5580	35	6297	6359	6413	Stine in Bryd and Hale 2003
DE-239	INY, Franklin Lake	Lake/Playa	Buried lacustrine	Well 10	Natural	Organic sediment?	1220	13100	150	15158	15877	16586	RCJ 1988
DE-240	INY, Franklin Lake	Lake/Playa	Buried lacustrine	Well GS-8	Natural	Organic sediment?	1100	12350	180	13873	14436	15079	RCJ 1988
DIC-2824	SBR, Silver Lake	Lake/Playa	Surface deposit	Northwest Silver Lake, El Capitan BR II	Natural	Shell-f (Anodonta)	5	11530	95	13189	13381	13629	Wells et al. 2003
ETH-(4 dates)	NV, Yucca Mtn, Crater Flat	Fan	Surface deposit	Pooled mean in-age of Little Cones unit, Calib 5.01	Natural	Organic (rock varnish)	1	9164	111	10229	10335	10441	Peterson et al. 1995
ETH-0?	SBR, Searles, Navy Road	Lake/Playa	Lacustrine	Dry wash W of Navy-Randsburg Rd, SL93-12	Natural	Carbonate (tufa)	1	12070	100	13703	13926	14185	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C3c	Natural	Organic sediment (marl)	1	11200	100	12010	12347	12608	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C3b	Natural	Organic sediment (marl)	1	12200	100	13119	13327	13527	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C2	Natural	Organic sediment (marl)	1	12300	100	13218	13418	13695	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C2, shell with sand	Natural	Shell-f (Anodonta?)	1	11770	100	13392	13615	13828	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C3a	Natural	Shell-f (Anodonta?)	1	11970	100	13575	13827	14059	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C1a	Natural	Organic sediment (marl)	1	12900	100	13749	14033	14565	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Strat. C1c	Natural	Organic sediment (marl)	1	13200	100	14119	14579	15079	Lin et al. 1998
ETH-0?	SBR, Searles, Poison Canyon	Lake/Playa	Buried lacustrine	Surface location, SL93-21	Natural	Organic sediment (marl)	1	13800	95	15170	15803	16460	Lin et al. 1998
ETH-3187	NV, Yucca Mtn, Crater Flat	Fan	Surface deposit	Min-age of Little Cones unit, CFP-26	Natural	Organic (rock varnish)	1	10180	540	11168	11875	12782	Peterson et al. 1995
ETH-5268	NV, Yucca Mtn, Crater Flat	Fan	Surface deposit	Min-age of Little Cones unit, JWB-38	Natural	Organic (rock varnish)	1	8425	140	9286	9444	9537	Peterson et al. 1995
ETH-5270	NV, Yucca Mtn, Crater Flat	Fan	Surface deposit	Min-age of Little Cones unit, JWB-41	Natural	Organic (rock varnish)	1	11135	210	12884	13043	13217	Peterson et al. 1995
GaK-01425	MNO, Adobe Valley, S.R. 120	Lake/Playa	Buried marsh	Core 2, southeast Black Lake, peat near base of Core	Natural	Peat	534	11350	350	12569	13220	13943	Batchelder 1970
GaK-01854	MNO, Adobe Valley, S.R. 120	Lake/Playa	Buried marsh	Black lake Bog, Core 4, peat below diatamceous clay at base of Core	Natural	Peat	614	8550	210	9087	9575	10171	Batchelder 1970
GaK-02486	MNO, Adobe Valley, S.R. 120	Lake/Playa	Buried marsh	Core 2, southeast Black Lake, peat below Ash 5	Natural	Peat	324	5230	110	5839	6013	6220	Batchelder 1970

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
Gro-1802	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Lower Salt, 070-80 cm above base of, suspect date	Natural	Carbonate (CaC03)	2575	30770	400	34689	35362	36312	Flint and Gale 1959; Stuiver 1964
Gro-1805	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Lower Salt, 168-177 cm above base of	Natural	Carbonate (CaC03)	3437	31420	600	34741	35864	36987	Flint and Gale 1959; Stuiver 1964
Gro-1808	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Lower Salt, 021-24 cm below top of	Natural	Carbonate (CaC03)	2523	22290	200	26187	26861	27681	Flint and Gale 1959; Stuiver 1964
Gro-1814	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Lower Salt, 240-250 cm below top of	Natural	Carbonate (CaC03)	2745	25270	230	29532	30044	30528	Flint and Gale 1959; Stuiver 1964
GX-03119	KER, China Lake, Stake 24	Lake/Playa	Buried soil	Strong paleosol, single (trench?), datum 2184 ft	Natural	Carbonate (nodule)	-	12170	200	13632	14138	14995	Davis 1978
GX-03441	KER, China Lake, Stake 1	Lake/Playa	Buried lacustrine	Stake 1, Trench 2, "flaggy sandstone" w/artifacts ~15 cm above	Natural	Organic sediment	85	5975	150	6463	6826	7174	Davis 1978
GX-03442	KER, China Lake, Stake 1	Lake/Playa	Buried soil	Stake 1, Trench 3, stratum A-1 (3ABKb), w/sandblasted flakes, suspect per Davis	Natural	Organic sediment	100	10275	165	11402	12023	12547	Davis 1978
GX-03443	KER, China Lake, Stake 1	Lake/Playa	Buried lacustrine	Stake 1, Trench 3, stratum A-2, "flaggy sandstone" with artifacts	Natural	Organic sediment	100	6775	260	7166	7645	8164	Davis 1978
GX-03444	KER, China Lake, Stake 1	Lake/Playa	Buried lacustrine	Stake 1, Trench 3, stratum B, no associated artifacts, younger than overlying date	Natural	Organic sediment	180	9360	365	9552	10633	11629	Davis 1978
GX-03445	KER, China Lake, Stake 1	Lake/Playa	Buried lacustrine	Stake 1, Trench 3, stratum C, overlies upper artifact layer, marks late lake retreat	Natural	Organic sediment	68	2465	180	2104	2531	2949	Davis 1978
GX-03446	INY-5825, Basalt Ridge, sediment	Lake/Playa	Surface deposit	Site 1, beside Collection Area A, Mammoth #6, Basalt Ridge	Natural	Organic sediment	5	10800	310	11768	12669	13318	Davis 1978
GX-06178	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	10460	330	11236	12189	12966	Spaulding 1980
GX-06180	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9515	185	10294	10830	11237	Spaulding 1980
GX-06182	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Miscellaneous twigs and midden debris	Natural	Packrat Midden	1	10090	380	10646	11706	12658	Spaulding 1983
GX-06183	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	10325	350	11082	12013	12920	Spaulding 1983
GX-06185	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Miscellaneous twigs	Natural	Packrat Midden	1	7930	285	8281	8822	9474	Spaulding 1980
GX-06186	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Miscellaneous twigs	Natural	Packrat Midden	1	8925	360	9239	10037	11093	Spaulding 1980
GX-06188	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	8905	265	9409	9992	10705	Spaulding 1980
GX-06189	SBR, Marble Mountains	Cave/Shelter	Surface deposit	Miscellaneous twigs	Natural	Packrat Midden	1	10555	210	11711	12380	12909	Spaulding 1980
GX-06217	INY, Horse Thief Hills	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	10690	280	11704	12531	13189	Spaulding 1980
GX-06231	INY, Eureka View	Cave/Shelter	Surface deposit	Miscellaneous twigs	Natural	Packrat Midden	1	8330	250	8591	9275	9914	Spaulding 1980
GX-07804	INY, Death Valley	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	9455	310	9887	10757	11752	Woodcock, 1986
GX-07805	INY, Death Valley	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	9090	300	9534	10246	11092	Woodcock, 1986
GX-07806	INY, Death Valley	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	11210	380	12372	13079	13881	Woodcock, 1986
GX-07807	INY, Death Valley	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	13060	460	14110	15703	16923	Woodcock, 1986
GX-07812	INY, Death Valley	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	10230	320	11070	11900	12714	Woodcock, 1986
GX-10417	SBR, Calico Lakes-site?	Lake/Playa	Buried deposit	Extinct large mammal, mole, and fish bones, SBCM locality 1.76.35 (Calico Lakes Phase I)	Natural	Bone (apatite)	289	12800	900	13063	15295	17659	Reynolds & Reynolds 1985; Reheis et al. 2007
GX-10418	SBR, Calico Lakes-site?	Lake/Playa	Buried deposit	Extinct large mammal, mole, and fish bones, SBCM locality 1.76.35 (Calico Lakes Phase I)	Natural	Charcoal	177	9050	350	9422	10199	11198	Reynolds & Reynolds 1985; Reheis et al. 2007
GX-10420	SBR, Solid Waste	Lake/Playa	Buried deposit	Fossil mole bones, SBCM locality 1.76.33 (Solid Waste site)	Natural	Charcoal	337	12210	430	13190	14357	15931	Reynolds & Reynolds 1985; Reheis et al. 2007
GX-10421	SBR, Luz Foundation	Lake/Playa	Buried deposit	Fossil horse and small vertebrates recovered in deposits above sample	Natural	Charcoal	308	10910	425	11601	12750	13677	Reynolds & Reynolds 1985; Reheis et al. 2007
GX-12275	MNO, White Mountains	Hill/Ridge	Surface deposit	Falls Canyon 2 site	Natural	Packrat Midden	1	7810	450	7704	8716	9677	Jennings and Elliot-Fisk 1990(?)
GX-12276	INY, Volcanic Tableland	Cave/Shelter	Surface deposit	Neotoma sp. fecal pellets	Natural	Packrat Midden	1	9830	280	10494	11315	12220	Jennings, 1996
I-0?	KER, China Lake, Core SB03	Lake/Playa	Buried lacustrine	Bore Hole TT37-SB03	Natural	Organic sediment	1790	16480	80	19419	19592	19636	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	KER, China Lake, Core SB14	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB14	Natural	Organic sediment	3642	14690	70	17579	17870	18069	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	KER, China Lake, Core SB23	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB23, several hundred ft SW of G-1 Tower Rd along old B-29 cutoff rd.	Natural	Organic sediment	5044	18690	60	22114	22308	22483	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	KER, China Lake, Core SB27	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB27	Natural	Organic sediment	3199	17380	50	20345	20723	21141	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	KER, China/Mirror Lake, SB10	Lake/Playa	Buried lacustrine	Bore Hole TTIWV-SB10, southwest of Mirror lake	Natural	Organic sediment	8992	18280	60	21490	21824	22154	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	SBR, China Lake, SL-01	Lake/Playa	Buried lacustrine	TT43-SL01 in lower lake basin; from near-shore death assemblage	Natural	Shell-f (gastropod)	159	14060	50	16866	17098	17447	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	SBR, Searles, Salt Wells Valley	Lake/Playa	Lacustrine	SWV, from base of large tufa tower below east slope of Lone Butte	Natural	Organic sediment (marl)	1	13040	120	13893	14346	14965	Couch Appendix B in Tetra Tech EM Inc. 2003
I-0?	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction, unreported date per H.C. Smith	Natural	Shell-f (Anodonta)	25	12820	350	14080	15346	16635	Hubbs et al. 1962; Wallace and DeCosta 1964
I-00443	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Upper of two shell layers exposed in gravel quarry in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	173	12820	240	14223	15348	16448	Hubbs, Bien, and Suess 1965 (RCJ); Ore and Warren 1971
I-00444	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Upper of two shell layers exposed in gravel quarry in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	40	9670	300	10238	11048	12025	Hubbs, Bien, and Suess 1965 (RCJ); Ore and Warren 1971
I-03690	SBR, Clark Mountain	Cave/Shelter	Surface deposit	Wood (Pinus monophylla)	Natural	Packrat Midden	1	12460	190	13926	14575	15195	Mehringer and Ferguson, 1969
I-07342	KER, Koehn Lake/Garlock Flt.	Lake/Playa	Surface lacustrine	From offset beach ridge on Garlock Fault	Natural	Carbonate (tufa)	1	11030	160	12621	12918	13222	LaJoie card file (USGS-EQ 14)
I-07717	KER, Koehn Lake/Garlock Flt.	Lake/Playa	Buried lacustrine	Carbonate-cemented layer in test pit on crest of 1st spur near bifurcation of gravel bar on Garlock Fault	Natural	Carbonate (tufa)	213	9505	160	10386	10822	11221	LaJoie card file (USGS-EQ 30)
L-?	MNO, Mono Basin, Wilson Creek	Lake Basin	Buried lacustrine	Type section cutbank along Wilson Creek	Natural	Crustacean (ostracodes)	225	13300	500	14184	15991	17246	LaJoie 1968
LJ-0200	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction, collected by Woodward of Union Oil Co; associated with Lake Mojave points	Natural	Shell-f (Anodonta)	40	9310	240	9902	10554	11219	Hubbs et al. 1962; Wallace and DeCosta 1964; Meighan 1965; Ore and Warren 1971
LJ-0932	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	40	9930	400	10395	11486	12590	Ore and Warren 1971; Wells et al. 1989
LJ-0933	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	173	13340	550	14174	16022	17512	Ore and Warren 1971; Wells et al. 1989
LJ-0958	SBR, Coyote Lake	Lake/Playa	Surface lacustrine	From shoreline NE of Coyote Lake (playa)	Natural	Shell-f (Anodonta)	1	13470	600	14199	16183	17790	Hubbs, Bien, and Suess 1965 (RCJ)
LJ-0977	INY-0019/20, Panamint, Lake Hill	Lake/Playa	Surface lacustrine	West side of Lake Hill, lowest shoreline, with stone tools	Natural	Carbonate (tufa)	1	12670	700	13280	15115	16974	Hubbs, Bien, and Suess 1965 (RCJ)
LJ-935	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Wave-rounded tufa 30 cm above upper shell bed in gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Carbonate (tufa)	10	8830	400	8989	9931	11107	Hubbs et al. 1965
nr	SBR, Valley Wells	Spring mound	Fossil spring	From light brown silt unit that caps Unit E2	Natural	Shell-f (gastropod)	-	7930	50	8628	8778	8983	Pigati and Miller 2008
nr	SBR, Valley Wells	Spring mound	Fossil spring	From light brown silt unit that caps Unit E2	Natural	Shell-f (gastropod)	-	8630	60	9493	9601	9744	Pigati and Miller 2008
nr	SBR, Valley Wells	Spring mound	Fossil spring	Organic-rich clay in Unit E2	Natural	Organic sediment	-	9650	50	10784	11011	11198	Pigati and Miller 2008
nr	SBR, Valley Wells	Spring mound	Fossil spring	Organic-rich clay in Unit E2	Natural	Organic sediment	-	10780	40	12570	12661	12791	Pigati and Miller 2008
nr	SBR, Blackhawk Landslide	Pond	Surface deposit	Freshwater pond formed on landslide debris	Natural	Shell-f (freshwater)	45	17070	550	19203	20358	21569	Stout 1977
OS-72583	INY, Owens Lake, south	Lake/Playa	Buried lacustrine	5Cg, Strat II, upper lacustrine in E wall of gully	Natural	Soil (SOM)	185	9310	50	10371	10514	10609	Meyer, Rosenthal, and Young 2010

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
OS-72584	INY, Owens Lake, south	Lake/Playa	Buried lacustrine	6Cg, Strat I, lower lacustrine in E wall of gully	Natural	Soil (SOM)	230	9230	55	10250	10396	10522	Meyer, Rosenthal, and Young 2010
OS-72752	INY, Owens Lake, south	Lake/Playa	Buried lacustrine	2Cg, uppermost buried lacustrine shell/death bed, south lakeshore	Natural	Bone (fish)	385	7440	75	8154	8263	8395	Meyer, Rosenthal, and Young 2010
OS-72826	INY, Owens River Bluff	Floodplain	Buried soil	2Cu, carbon layer, S bank of T3 terrace below sand layer mapped as Mazourka-Eclipse; same age as lithofacies 4a of Bacon	Natural	Soil (SOM)	155	12650	220	14024	14896	15958	Meyer, Rosenthal, and Young 2010
OS-72855	INY, Owens Lake, south	Lake/Playa	Buried soil	3Ab, Strat. IV, E wall of gully, stratum underlies buried hearth	Natural	Soil (SOM)	125	5950	40	6676	6778	6882	Meyer, Rosenthal, and Young 2010
OS-79560	KER, Dove Springs Wash	Floodplain/Arroyo	Buried soil	DSW-L#5771-13Ab Strat. I (-I in field), basal unit	Natural	Soil (SOM)	440	10300	60	11953	12102	12393	China Lake Legacy project 718
OS-79563	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	LDW-L#3-4Ab Strat. IV, with snails, west bank	Natural	Soil (SOM)	263	10000	55	11263	11482	11717	China Lake Legacy project 718
OS-79564	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	LDW-L#3-6Ab Strat. II, west bank	Natural	Soil (SOM)	320	10100	55	11399	11697	11844	China Lake Legacy project 718
OS-79565	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	LDW-L#3-7Ab Strat. I, basal unit, west bank	Natural	Soil (SOM)	350	10500	60	12369	12454	12598	China Lake Legacy project 718
OS-79566	INY, Rose Valley, north pit	Floodplain	Buried alluvium	RV-NCTP-3Cu Strat. II, channel facies, north	Natural	Plant (modern roots)	255	>Mod.			0		China Lake Legacy project 718
OS-79583	INY, Rose Valley, north pit	Floodplain	Buried soil	RV-NCTP-2Ab Strat. III, north wall	Natural	Soil (SOM)	75	985	45	788	883	971	China Lake Legacy project 718
OS-79584	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	LDW-L#3-3Ab Strat. V, with snails, west bank	Natural	Soil (SOM)	203	9440	95	10479	10703	11099	China Lake Legacy project 718
OS-79585	KER, Indian Wells, Little Dixie	Floodplain/Arroyo	Buried soil	LDW-L#3-5Ab Strat. III, weak soil, west bank	Natural	Soil (SOM)	298	10100	110	11271	11688	12058	China Lake Legacy project 718
OS-79587	INY, Rose Valley, south pit	Lake/Playa	Buried soil	RV-SCTP-3Ab Strat. III, upper playa, east side	Natural	Soil (SOM)	210	9980	55	11250	11447	11645	China Lake Legacy project 718
QC-0937	SBR, Solar One	Lake/Playa	Surface deposit	Associated with granitic river sands and lenses of silts (channel deposits?)	Natural	Charcoal	60	7350	115	7968	8169	8377	Reynolds & Reynolds 1985; Reheis et al. 2007
RC/SM-36	SBR, Searles Lake, Core X-16	Lake/Playa	Buried lacustrine	Upper Salt, mud seam below top of	Natural	Organic sediment (marl)	805	10270	450	9764	10942	12320	Flint and Gale 1959; Bray and Burke 1960 (RCJ); Smith 1979
RC/SM-50	SBR, Searles Lake, Core X-16	Lake/Playa	Buried lacustrine	Upper Salt, mud seam below top of	Natural	Organic sediment (marl)	1007	11400	600	10777	12357	13722	Flint and Gale 1959; Bray and Burke 1960 (RCJ); Smith 1979
UCIAMS-10336	RIV, Lake Elsinore	Lake/Playa	Submerged lacustrine	Core LESS02-8	Natural	Organic sediment	142	6845	25	7615	7674	7722	Kirby, Lund, and Poulsen 2005
UCIAMS-10337	RIV, Lake Elsinore	Lake/Playa	Submerged lacustrine	Core LESS02-8	Natural	Organic sediment	301	8390	50	9290	9422	9502	Kirby, Lund, and Poulsen 2005
UCIAMS-10338	RIV, Lake Elsinore	Lake/Playa	Submerged lacustrine	Core LESS02-8	Natural	Organic sediment	463	12570	60	14429	14796	15163	Kirby, Lund, and Poulsen 2005
UCLA-0298	NV, Leonard Rockshelter	Lake/Playa	Buried lacustrine	Small gastropods (Amnicola sp.) in sandy beach deposit forming base of shelter, overlain by C-599	Natural	Shell-f (gastropod)	-	13000	1000	13057	15532	18042	Fergusson and Libby 1964
UCLA-0510	NV, Las Vegas Vly, Tule Springs	Floodplain/Arroyo	Buried alluvium	Unit E1, Fenley Hunter Trench Locality 4, fine Charcoal/silt from prairie fire?	Natural	Charcoal (w/black mat)	61	9000	1000	8015	10274	12823	Fergusson and Libby 1964
UCLA-0512	NV, Las Vegas Vly, Tule Springs	Floodplain/Arroyo	Buried channel-mat	Unit E1, Fenley Hunter Trench Locality 4, Charcoal from gray silty clay on gravel; w/small bone tool and camel bone frags	Natural	Charcoal (w/black mat)	366	12400	350	13583	14491	15487	Fergusson and Libby 1964
UCLA-0521	NV, Las Vegas Vly, Tule Springs	Floodplain/Arroyo	Buried channel	Unit E1, 17, lower channel fill in gray silty sand on gravel, assoc with mammoth, antelope, and camel, same context as UCLA-543 shell	Natural	Wood (carbonized)	34	12920	220	14430	15261	15987	Fergusson and Libby 1964; Haynes 1967
UCLA-0522	NV, Las Vegas Vly, Tule Springs	Floodplain/Arroyo	Buried channel-mat	Unit E1, Locality 37, Trench 9, Site 5, from lower channel fill in gray silty sand on gravel, assoc with mammoth, antelope, and camel (burned digging stick?)	Natural	Charcoal (w/black mat)	54	13000	200	14765	15377	16057	Fergusson and Libby 1964
UCLA-0529	NV, Las Vegas Vly, Gilcrease Ranch	Spring Mound	Buried spring	Unit E2, 62a, top of Gilcrease Spring	Natural	Organic (black mat)	74	9200	250	9697	10402	11131	Haynes 1967
UCLA-0530	NV, Corn Creek Flat	Spring Mound	Buried spring	Unit E1, 76a, buried by E2 at base/center of Corn Creek Spring	Natural	Organic (black mat)	-	10800	300	11812	12694	13297	Haynes 1967
UCLA-0537	NV, Las Vegas Vly, Gilcrease Ranch	Spring Mound	Buried spring	Unit E2, 63a, buried by sand, dates start of spring	Natural	Organic (black mat)	305	9920	150	11075	11449	12026	Haynes 1967
UCLA-0541	NV, Corn Creek Flat	Spring Mound	Buried spring	Unit E1, 77a, base of spring mat under gray silt	Natural	Organic (black mat)	-	11700	250	13092	13566	14081	Haynes 1967
UCLA-0542	NV, Corn Creek Flat	Spring Mound	Buried spring	Unit E2, 75a, base of Corn Creek Spring 8 under gray silt	Natural	Organic (black mat)	-	10200	350	11066	11894	12841	Haynes 1967
UCLA-0548	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 46, spring mat at base of upper E2, below pink/gray silt, assoc w/camel and snail	Natural	Wood (carbonized)	-	8000	400	8006	8908	9799	Fergusson and Libby 1964; Haynes 1967
UCLA-0549	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 48, minimum date of spring; below pink/gray silt, assoc w/camel and snail	Natural	Organic (black mat)	-	9520	300	10119	10844	11822	Fergusson and Libby 1964; Haynes 1967
UCLA-0550	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 60a, minimum age of spring, below pink/gray silt, assoc w/ snail fauna	Natural	Organic (black mat)	-	11100	200	12764	13036	13382	Haynes 1967
UCLA-0551	NV, Las Vegas Vly, Ellington Scarp	Spring Mound	Buried spring	Unit E2, 61a, minimum age of spring, below pink/gray silt, assoc w/snail fauna	Natural	Organic (black mat)	-	9350	200	10178	10603	11197	Haynes 1967
UCLA-0755	INY, Death Valley, Pyramid Peak	Cave/Shelter	Surface deposit	Packrat Midden	Natural	Packrat Midden	1	11600	160	13164	13467	13786	Wells and Berger 1967
UCLA-0757	SBR, Negro Butte	Cave/Shelter	Surface deposit	Uriniferous material	Natural	Packrat Midden	1	9140	140	9907	10331	10691	Wells and Berger 1967
UCLA-0989	INY-0020, Panamint, Lake Hill	Lake/Playa	Buried spring/marsh	Organic mat below fan surface, follows former lake bed; "probably assoc w/Paleo-Indian habitation" Davis 1970	Natural	Organic (black mat)	150	10020	120	11230	11564	11983	Berger and Libby 1966 (RCJ); Davis 1970
UCLA-0990	INY-0019, Lake Hill, Panamint Vly	Lake/Playa	Buried spring/marsh	Trench 2, North end of Lake Hill, underlies cultural	Natural	Plant (burnt reeds)	36	10520	140	11986	12393	12682	Berger and Libby 1966 (RCJ); Davis 1970
UCLA-1093A	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Stratum 2?	Cultural	Charcoal	158	2240	145	1924	2244	2553	Berger and Libby 1967 - RCJ; Clewlow et al. 1970
UCLA-1093B	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Stratum 2?	Cultural	Charcoal	198	2900	80	2848	3051	3266	Berger and Libby 1967 - RCJ; Clewlow et al. 1970
UCLA-1093C	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Stratum 3 or 4?	Cultural	Charcoal	219	3520	80	3606	3798	3988	Berger and Libby 1967 - RCJ; Clewlow et al. 1970
UCLA-1093D	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Stratum 3 or 4?	Cultural	Charcoal	250	3580	80	3686	3883	4090	Berger and Libby 1967 - RCJ; Clewlow et al. 1970
UCLA-1093E	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Stratum 3 or 4?	Cultural	Charcoal	290	3900	180	3871	4328	4830	Berger and Libby 1967 - RCJ; Clewlow et al. 1970
UCLA-1800	KER, China Lake, Mammoth 4	Lake/Playa	Lacustrine	1972 date on in situ bone, Mammoth #4, T25S, R40E, Sec. 28, NE1/4	Natural	Bone (mammoth ivory)	1	18600	4500	20965	22181	23526	Davis 1978
UCLA-1911A	INY-5825, Basalt Ridge, tufa	Lake/Playa	Surface deposit	Summit of ridge, may be 500-1000 yrs too old	Natural	Carbonate (tufa)	1	12970	150	15036	15649	16469	Davis 1978
UCLA-1911B	INY-5825, Basalt Ridge, tufa	Lake/Playa	Surface deposit	Summit of ridge, may be 500-1000 yrs too old	Natural	Carbonate (tufa)	1	11870	120	13428	13711	13970	Davis 1978
UCLA-2601	SBR, Afton Canyon	Lake Basin/Shore	Surface deposit	in situ on the highest shoreline of Lake Manix	Natural	Shell-f (Anodonta)	1	13900	1325	14845	16854	18585	Meek 1989
UCLA-2609	SBR, Coyote Lake	Lake/Playa	Surface deposit	?	Natural	Shell-f (Anodonta)	-	12570	120	14160	14735	15189	Meek 1994a; Jefferson 2003
UCLA-2609A	SBR, Coyote Lake	Lake/Playa	Surface deposit	?	Natural	Shell-f (Anodonta)	-	11480	100	13136	13339	13570	Meek 1994a; Jefferson 2003
UCLA-2609B	SBR, Coyote Lake	Lake/Playa	Surface deposit	?	Natural	Shell-f (Anodonta)	-	13230	145	15264	16108	16724	Meek 1994a; Jefferson 2003
UCR-01143	SBR-0199, Newberry Cave	Cave/Shelter	Surface deposit	Extinct ground sloth ribs	Natural	Bone (ground sloth)	1	11600	500	12526	13538	15099	Davis 1981; Moratto 1984
UCR-0149	SBR, Lucerne Valley, Ord Mountain	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds) from midden	Natural	Packrat Midden	1	11850	550	12580	13894	15658	Taylor 1975 (RCJ); King 1976a
UCR-0181	SBR, Lucerne Valley	Cave/Shelter	Surface deposit	Midden #13, Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	12100	400	13131	14165	15294	Taylor 1975 (RCJ); King 1976a
UCR-0185	SBR, Lucerne Valley	Cave/Shelter	Surface deposit	Miscellaneous twigs	Natural	Packrat Midden	1	7820	570	7588	8748	9958	King 1976a
UCR-0186	SBR, Lucerne Valley	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	8300	780	7568	9335	11283	King 1976a
UCR-0187	SBR, Lucerne Valley	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	11100	420	11953	12962	13869	King 1976a
UCR-0249	SBR, Lucerne Valley	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	7800	350	7972	8691	9473	King 1976a
UCR-0347	INY, Death Valley/Titus Canyon	Cave/Shelter	Surface deposit	Wood (Juniperus sp. twigs/seeds)	Natural	Packrat Midden	1	9680	300	10242	11064	12033	Wells and Woodcock 1985
UCR-2323	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Surface deposit	Locus 1, X-3, Feature 10, rock-lined hearth, Stratum 1	Cultural	Charcoal	50	110	50	8	123	151	Yohe 1992, 1998; CRD 1996

Appendix C: China Lake Radiocarbon Database Listed by (1) Lab/Sample No., (2) Source Reference, and (3) State/County

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
UCR-2324	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried soil	Locus 1, X-1, Feature 12, upper rock-lined pit hearth, Strat. 2	Cultural	Charcoal	140	1400	50	1258	1316	1401	Yohe 1992, 1998; CRD 1996
UCR-2325	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1 (north end), Feature 15 or Hearth A, base of Stratum 3 or 4, top of Stratum 4 or 5?	Cultural	Charcoal	300	5460	80	6169	6250	6407	Yohe 1992, 1998; CRD 1996
UCR-2327	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried soil	W-1, Feature 13 and 14, reused pit hearth, Stratum 2 top	Cultural	Charcoal	70	280	50	272	365	485	Yohe 1992, 1998; CRD 1996
UCR-2328	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Backhoe Trench 1, Feature 16 or Hearth B, on top of lower midden, Stratum 3 or 4?	Cultural	Charcoal	230	3240	60	3358	3466	3593	Yohe 1992, 1998; CRD 1996
UCR-2333	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried soil	W-1, Feature 13 and 14, reused pit hearth, Stratum 2 top	Cultural	Charcoal	65	590	60	522	598	663	Yohe 1992, 1998; CRD 1996
UCR-2335	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried soil	Locus 1, X-1, Feature 12, upper rock-lined pit hearth, Strat. 2	Cultural	Charcoal	85	1360	70	1167	1280	1402	Yohe 1992, 1998; CRD 1996
UCR-2341	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	E-5, Feature 11, roasting feature below Feat. 2, Strat. 3 or 4?	Cultural	Charcoal	275	4030	100	4280	4528	4826	Yohe 1992, 1998; CRD 1996
UCR-2373	INY-0372, Rose Spring, Locus 3	Fan/Terrace (alluvial)	Surface deposit	Locus 3, TU-1, hearth	Cultural	Charcoal	45	2240	100	1987	2233	2491	Yohe 1992, 1998; CRD 1996
UCR-2388	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Locus 1, X-1, base of Stratum 1 and top of Stratum 2	Cultural	Charcoal	45	330	50	302	393	496	Yohe 1992, 1998; CRD 1996
UCR-2513	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	Locus 1, X-1, loose Charcoal concentration, Stratum 2	Cultural	Charcoal	205	2070	90	1865	2049	2214	Yohe 1992, 1998; CRD 1996
UCR-2533	INY-0372, Rose Spring, Locus 2	Fan/Terrace (alluvial)	Surface deposit	Locus 2, TU-14, midden	Cultural	Charcoal	45	900	60	722	823	927	Yohe 1992, 1998; CRD 1996
UCR-2534	INY-0372, Rose Spring, Spring Locus	Fan/Terrace (alluvial)	Surface deposit	Spring Locus, SL-2, hearth within housepit	Cultural	Charcoal	45	150	10	172	191	277	Yohe 1992, 1998; CRD 1996
UCR-2535	INY-0372, Rose Spring, Spring Locus	Fan/Terrace (alluvial)	Surface deposit	Spring Locus, SL-2, hearth within housepit	Cultural	Charcoal	35	150	10	172	191	277	Yohe 1992, 1998; CRD 1996
UCR-2536	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried deposit	E-5, Feature 11, roasting feature below Feat. 2, Strat. 3 or 4?	Cultural	Charcoal	265	4460	110	4838	5106	5326	Yohe 1992, 1998; CRD 1996
UCR-2537	INY-0372, Rose Spring, Locus 1	Fan/Terrace (alluvial)	Buried soil	W-1, Feature 13 and 14, reused pit hearth, Stratum 2 top	Cultural	Charcoal	100	330	60	289	392	504	Yohe 1992, 1998; CRD 1996
USGS-0070	MNO, Mono Basin	Lake Basin	Surface lacustrine	Tufa on wood from south lakeshore, 3 meters above present lake level, coll by GI Smith	Natural	Carbonate (tufa)	1	1730	60	1527	1644	1814	(RCJ - year?)
USGS-0635	KER, Koehn Lake/Garlock Flt.	Lake/Playa	Surface lacustrine	Inner rind of lithoid tufa in near-surface gravel of pluvial lake shoreline bar offset along Garlock fault	Natural	Carbonate (tufa)	15	13130	80	15233	15939	16518	Robinson and Trimble 1983 (RCJ)
USGS-2212b	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.Carb.-2b	Natural	Organic (black mat)	-	9680	100	10733	11016	11245	Quade and Pratt 1989
USGS-2213b	NV, Cactus Springs	Floodplain/Arroyo	Buried spring	Cac. Spr.Carb.-2b	Natural	Organic (black mat)	-	9460	60	10556	10710	10871	Quade and Pratt 1989
USGS-2327(?)	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Unit B	Natural	Shell (fresh-mollusc)	1	18270	130	21451	21824	22233	Benson et al. 1990
USGS-2328B	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (tufa)		12580	50	14473	14832	15179	Benson et al. 1990
USGS-2339	INY, Owens Valley, Alabama Gates	Basin/Floodplain	Buried marsh	lithofacies 4b, Trench 3	Natural	Organic sediment	115	10190	70	11601	11879	12136	Beanland and Clark, 1994; Bacon et al. 2003
USGS-2841	SBR, Searles, Pinnacles Wash	Lake/Playa	Buried lacustrine	East side of dry wash, Unit A 3 over A1	Natural	Carbonate (tufa)	1	25070	140	29531	29928	30275	Garcia et al. 1993
USGS-2842	SBR, Searles, Pinnacles Wash	Lake/Playa	Buried lacustrine	East side of dry wash, Unit A 3 over A1	Natural	Carbonate (tufa)	1	28770	240	32504	33274	34460	Garcia et al. 1993
USGS-2843	SBR, Searles, Pinnacles Wash	Lake/Playa	Buried lacustrine	East side of dry wash, 0.3 m above base of Strat Unit A1, beach sand	Natural	Carbonate (CaC03)	1	31970	290	36136	36503	37150	Garcia et al. 1993
USGS-2844	SBR, Searles, Pinnacles Wash	Lake/Playa	Lacustrine	East side of dry wash, on Strat Unit A 4	Natural	Carbonate (tufa pod)	1	17770	170	20510	21181	21551	Garcia et al. 1993
USGS-2845	SBR, Searles, Navy Road	Lake/Playa	Lacustrine	Dry wash W of Navy-Randsburg Rd, Strat. Unit A	Natural	Carbonate (lithoid tufa)	1	10570	40	12421	12538	12618	Garcia et al. 1993
USGS-609	INY, Owens Valley, Alabama Hills	Lake/Playa	Surface lacustrine	Lithoid tufa from beach gravels near top of shoreline deposit N of Lone Pine; approximate highstand age, max. age of Yermo fan surface	Natural	Carbonate (tufa)	1	20670	130	24325	24672	25025	Wagner et al. 1981; Fullerton 1986; Lubetkin and Clark, 1988; Bacon et al. 2006
W-0892	SBR, Searles Lake, Smith Core	Lake/Playa	Buried lacustrine	Overburden Mud, base of, deposited after lake	Natural	Organic carbon (diseminated)	681	12390	400	13430	14588	16173	Rubin and Berthold 1961 (RCJ), Smith 1979
W-1317	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (tufa)	1	11670	400	12678	13581	14654	Benson et al. 1990
W-1325	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (tufa)	1	11780	300	12956	13662	14603	Benson et al. 1990
W-1327	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (oolites)	1	11400	350	12593	13271	13982	Benson et al. 1990
W-1419	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Organic carbon (tufa)		11720	500	12580	13688	15171	Benson et al. 1990
W-1575	SBR, Searles Lake, basin	Lake/Playa	Surface lacustrine	Shell from sand layer 8 ft above valley floor, S of highway, 0.5 miles E of mouth of Salt Wells Canyon, coll by GI Smith	Natural	Shell-f (Anodonta)	1	28870	1000	31992	33406	34604	Ives, Levin, and Meyer 1967 (RCJ)
W-1680	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (oolites)	1	11490	400	12554	13376	14263	Benson et al. 1990
W-5643	NV, Corn Creek Flat	Floodplain/Arroyo	Buried channel	Unit E1, C horizon overlying buried soil	Natural	Wood (carbonized)	160	12600	300	13863	14726	15608	Quade 1986
W-5646	NV, Corn Creek Flat	Floodplain/Arroyo	Buried channel	Unit E1, with molluscs	Natural	Wood (carbonized)	165	12630	300	13900	14768	15667	Quade 1986
W-6411	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 1.8	Natural	Peat (silt)	568	11180	250	12716	13100	13610	Throckmorton and Reheis 1993
W-6412	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 1.5	Natural	Peat (silt)	337	8270	140	8973	9241	9537	Throckmorton and Reheis 1993
W-6413	NV, Fish Lake, Leidy Creek	Lake/Playa	Buried marsh	Core 1.3	Natural	Peat (silt)	210	6215	90	6883	7109	7321	Throckmorton and Reheis 1993
WSU-1464	INY, Little Lake	Floodplain	Buried marsh	Whole sediment Core	Natural	Peat (Scirpus/Typha)	1134	5060	140	5581	5810	6182	Shepard and Chatters 1976 (RCJ)
WSU-1466	INY, Little Lake	Floodplain	Buried marsh	Whole sediment Core	Natural	Peat (Scirpus/Typha)	801	3920	120	4065	4353	4652	Shepard and Chatters 1976 (RCJ)
WSU-1474	INY, Little Lake	Floodplain	Buried marsh	Whole sediment Core	Natural	Peat (Scirpus/Typha)	596	3020	120	2875	3198	3456	Mehringer and Sheppard 1974; Shepard and Chatters 1976 (RCJ)
WW-4044	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Shell-f (freshwater)	1	20970	100	24562	25003	25439	Bacon et al. 2006
WW-4045	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Carbonate (tufa)	1	14475	40	17246	17623	17893	Bacon et al. 2006
WW-4519	INY, Rose Valley, south pit	Lake/Playa	Buried soil	Black mat on upper playa, contain snails per Jayko; same as Record 6057	Natural	Soil (SOM)	210	10000	40	11275	11473	11637	Jayko 2010, unpublished field notes
WW-4562	SBR, Coyote Lake	Lake/Playa	Surface deposit	sandy mud	Natural	Shell-f (Anodonta)	-	19330	70	22614	23036	23428	Dudash 2006?
WW-4563	SBR, Coyote Wash	Lake/Playa	Buried lacustrine	Lake beds overlain by Qya4	Natural	Shell-f (unknown)	-	12815	45	14919	15239	15660	Miller et al. 2009
WW-4564	SBR, Coyote Lake	Lake/Playa	Surface deposit	sandy mud	Natural	Shell-f (Anodonta)	-	12815	45	14919	15239	15660	Dudash 2006?
WW-4782	INY, Owens Valley, Keeler	Lake/Playa	Surface lacustrine	Near Keeler (east Owens Lake)	Natural	Shell-f (Anodonta)	1	13010	40	15145	15638	16301	Bacon et al. 2006
WW-4799	SBR, Chambless	Lake/Playa	Buried lacustrine	Upper bed below Qya4	Natural	Shell-f (gastropod, Fossaria)	-	11720	60	13404	13569	13746	Miller et al. 2009
WW-4800	SBR, Chambless	Lake/Playa	Buried lacustrine	Upper bed below Qya4	Natural	Shell-f (gastropod, Pupillid)	-	12110	140	13614	13988	14588	Miller et al. 2009
WW-5144	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	14770	45	17673	17959	18084	Dudash 2006?
WW-5145	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	15475	45	18566	18689	18841	Dudash 2006?
WW-5146	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	15377	45	18514	18627	18769	Dudash 2006?
WW-5147	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	15580	45	18622	18752	18890	Dudash 2006?
WW-5327 H	INY, Slate Canyon, Keeler	Fan/Floodplain	Surface deposit	Fault fissure in south wall of natural wash exposure	Natural	Organic sediment	185	12460	170	13996	14573	15160	Bacon, Jayko, and McGeehin 2005
WW-5327 L	INY, Slate Canyon, Keeler	Fan/Floodplain	Surface deposit	Fault fissure in south wall of natural wash exposure	Natural	Organic sediment	185	9502	75	10579	10820	11100	Bacon, Jayko, and McGeehin 2005
WW-5328 L	INY, Slate Canyon, Keeler	Fan/Floodplain	Surface deposit	South wall of natural wash exposure, Inyo Mtn Fault	Natural	Organic sediment	185	11010	100	12662	12892	13111	Bacon, Jayko, and McGeehin 2005
WW-5329 L	INY, Slate Canyon, Keeler	Fan/Floodplain	Surface deposit	South wall of natural wash exposure, Inyo Mtn Fault	Natural	Organic sediment	100	11346	95	13068	13226	13427	Bacon, Jayko, and McGeehin 2005
WW-5351	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	15495	45	18577	18703	18850	Dudash 2006?

Lab or Sample No.	State/County, Site/Locality	Deposit or Landform	Dated Deposit	Location, Provenience, and/or Description	Type	Material Dated	AVE Depth cm	14C BP (CRCY)	1-Sigma Error (±)	Lower 2-Sigma cal BP	Cal BP (med. prob.)	Upper 2-Sigma cal BP	Source Reference
WW-5352	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	15845	45	18810	19055	19324	Dudash 2006?
WW-5353	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	14005	40	16819	17046	17248	Dudash 2006?
WW-5354	SBR, Coyote Lake	Lake/Playa	Surface deposit	lacustrine sand	Natural	Shell-f (Anodonta)	-	13480	35	16404	16669	16873	Dudash 2006?
WW-5355	SBR, Coyote Lake	Lake/Playa	Surface deposit	sand and gravel	Natural	Shell-f (Anodonta)	-	15260	45	18469	18564	18692	Dudash 2006?
WW-5519	SBR, Coyote Lake	Lake/Playa	Surface lacustrine	lacustrine sand	Natural	Shell-f (Anodonta)	-	19350	70	22625	23055	23443	Dudash 2006?
WW-5717	SBR, East Cronese Lake	Lake/Playa	Surface deposit	Upright shell in sand bed	Natural	Shell-f (Anodonta)	-	85	35	18	108	145	Miller et al. 2009
Y-0574b	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Well X-20 made by American Potash and Chemical Co.	Natural	Organic sediment (marl)	2403	10700	130	11142	11492	11942	Deevey et al. 1959 (RCJ), Smith 1979
Y-0575b	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Well X-20 made by American Potash and Chemical Co.	Natural	Organic sediment (marl)	2503	12730	210	13351	13879	14613	Deevey et al. 1959 (RCJ), Smith 1979
Y-1048	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Core, middle of capping sands	Natural	Wood (twig)	240	3520	190	3375	3821	4299	Stuiver 1964; Davis 1978; Smith 1979
Y-1200	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	163	6560	140	7238	7457	7678	Stuiver 1964
Y-1200 B	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Organic sediment (marl)	163	6630	390	5921	6760	7547	Stuiver 1964
Y-1201	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	460	9370	180	10231	10626	11156	Stuiver 1964
Y-1202	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	947	10770	180	12372	12679	13102	Stuiver 1964
Y-1202 B	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Organic sediment (marl)	947	11010	150	11383	12008	12416	Stuiver 1964
Y-1203	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	1144	10270	100	11616	12040	12423	Stuiver 1964
Y-1204	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	1282	10130	170	11242	11760	12228	Stuiver 1964
Y-1204 B	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Organic sediment (marl)	1282	11510	150	12343	12680	13083	Stuiver 1964
Y-1205	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	1591	9390	200	10219	10658	11199	Stuiver 1964
Y-1206	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	1860	9520	180	10370	10837	11239	Stuiver 1964
Y-1207	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Upper Salt section in testhole L-U-1	Natural	Carbonate (CaC03)	1970	9510	80	10580	10841	11108	Stuiver 1964
Y-1208 B-1	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10680	90	12407	12606	12780	Stuiver 1964
Y-1208 B-2	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10900	90	12600	12784	12979	Stuiver 1964
Y-1209	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaCo3)	2275	10300	80	11801	12108	12412	Stuiver 1964
Y-1209 B	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10230	80	11618	11953	12224	Stuiver 1964
Y-1210	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaC03)	2275	11140	100	12741	13015	13251	Stuiver 1964
Y-1210 B-1	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10060	90	11272	11609	11844	Stuiver 1964
Y-1210 B-2	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10410	120	11954	12271	12601	Stuiver 1964
Y-1211	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaC03)	2275	10680	110	12379	12599	12885	Stuiver 1964
Y-1211 B	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10590	110	12131	12492	12695	Stuiver 1964
Y-1212	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	10440	90	12055	12322	12579	Stuiver 1964
Y-1212 B	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Organic carbon (diseminated)	2275	11800	130	13369	13641	13916	Stuiver 1964
Y-1213	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaC03)	2275	12770	230	14179	15205	16365	Stuiver 1964
Y-1214	SBR, Searles Lake, Core X-23	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaC03)	2275	17380	280	20028	20734	21452	Stuiver 1964
Y-1215	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	Parting Mud, average thickness of Cores is 371 cm; actual depths not reported	Natural	Carbonate (CaCo3)	2275	19050	250	22195	22771	23437	Stuiver 1964
Y-1216	SBR, Searles Lake, Core X-20	Lake/Playa	Buried lacustrine	From Lower Salt and Bottom Mud	Natural	Carbonate (CaCo3)	3600	22290	340	25951	26876	27868	Stuiver 1964
Y-1221	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Lower Salt, 546-549 cm below top, suspect date	Natural	Carbonate (CaC03)	3048	25470	500	29408	30251	31096	Stuiver 1964
Y-1222 B	SBR, Searles Lake, Core L-U-1	Lake/Playa	Buried lacustrine	Lower Salt, 785-788 cm below top, suspect date	Natural	Carbonate (CaC03)	3287	24070	400	27982	28897	29610	Stuiver 1964
Y-1585	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Outlet channel, error often misreported as ± 100	Natural	Shell-f (Anodonta)	50	13290	160	15404	16205	16811	Ore and Warren 1971; Berger and Meek 1992; Wells et al. 1989; Wells et al. 2003
Y-1586	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Beach ridge	Natural	Shell-f (Anodonta)	262	14220	140	16908	17312	17737	Ore and Warren 1971; Wells et al. 1989
Y-1587	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Beach ridge	Natural	Shell-f (Anodonta)	262	15020	240	17662	18234	18690	Ore and Warren 1971; Wells et al. 1989
Y-1589	SBR, Silver Lake	Lake/Playa	Buried lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	173	12960	350	14240	15609	16746	Ore and Warren 1971
Y-1591	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	97	10370	100	11954	12232	12567	Ore and Warren 1971; Wells et al. 1989
Y-1593	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Gravel Pit in NE 1/4 of Sec. 29 3.2 km W of SL Junction	Natural	Shell-f (Anodonta)	79	10250	100	11602	11996	12418	Ore and Warren 1971; Wells et al. 1989
Y-2406	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Bench Mark Bay, northwest beaches	Natural	Shell-f (Anodonta)	40	9940	160	11073	11483	12062	Ore and Warren 1971; Wells et al. 2003
Y-2407	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Bench Mark Bay, northwest beaches	Natural	Shell-f (Anodonta)	100	9010	140	9685	10113	10507	Ore and Warren 1971; Wells et al. 2003
Y-2408	SBR, Silver Lake	Lake/Playa	Surface lacustrine	Bench Mark Bay, northwest beaches	Natural	Shell-f (Anodonta)	30	12120	160	13608	14018	14661	Ore and Warren 1971; Wells et al. 1989
Y-2467	INY, Death Valley, Tule Spring	Fan/Floodplain	Buried deposit	Core 68-7 on valley floor east of Hanapuah fan	Natural	Organic sediment (humate)	845	12980	700	13488	15528	17250	Hooke 1972
Y-2470	INY, Death Valley, Badwater fan	Fan/Floodplain	Buried deposit	Core 68-10 on valley floor west of Badwater fan	Natural	Organic sediment (humate)	1360	11900	200	13277	13753	14240	Hooke 1972
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (tufa)	1	10100	100	11303	11687	12046	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (oolites)	1	10690	400	11309	12466	13307	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Surface lacustrine	Parting Mud, Unit C, below lake level	Natural	Shell (fresh-mollusc)	1	11370	160	12872	13240	13608	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (oolites)	1	12870	200	14543	15464	16525	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (oolites)	1	13020	200	15007	15758	16643	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Carbonate (tufa)	1	13810	120	16667	16916	17198	Benson et al. 1990
Y-unknown	SBR, Searles Lake, outcrop	Lake/Playa	Lacustrine	Parting Mud, Unit C, below lake level	Natural	Shell (fresh-mollusc)	1	13880	200	16599	16991	17547	Benson et al. 1990

APPENDIX D

MICRO-INVERTEBRATES FROM THE CHINA LAKE BASIN ENVIRONS
BY DR. MANUEL R. PALACIOS-FEST

APPENDIX D
MICRO-INVERTEBRATES FROM THE CHINA LAKE LEGACY PROJECT, CALIFORNIA

TNESR REPORT 10-09

Manuel R. Palacios-Fest

Abstract: The combined analysis of ostracodes and mollusks (micro-invertebrates) constitute a powerful tool for reconstructing ancient environments in the northern Mojave Desert. China Lake, one of the missing areas in the study of micro-invertebrates offered a unique opportunity to close the gap with other associated lakes in the region, like Owens Lake, Searles Lake, Panamint Lake, and those of the Mojave Drainage Basin (Lake Mojave). Two significantly different environmental settings were identified through ostracode and mollusk analysis identified in this study as the spring-related environments and the lake basin environments. Lack of age control posed a major obstacle in defining the paleoenvironmental history of China Lake. The spring-related sites, however, contained a faunal assemblage consistent with the transition from the latest Pleistocene to earliest Holocene (Bølling/Allerød-Younger Dryas) recorded elsewhere in the area. The lake basin, by contrast, in spite of its fauna similar to that identified at Owens Lake, Searles Lake, and Panamint Lake could not be placed in time.

INTRODUCTION

Micro-invertebrate paleoecology is a powerful tool for reconstructing the paleoenvironmental history of aquatic environments. Diverse and abundant micro-invertebrates (ostracodes and mollusks), are common in nonmarine environments where they are sensitive to variations in pH, temperature, salinity, and water chemistry, among other factors. Similarly, the stable isotopes (carbon and oxygen) of ostracodes shells provide relevant information on the chemical and physical properties of the host waters.

Ostracodes are microscopic crustaceans characterized by a hinged bivalve carapace made of calcite ranging in size between 0.5 and 2 mm. The carapace is the only body part that is preserved in the geologic record (Pokorný, 1978; Horne et al., 2002). In continental waters they are mostly benthic, although some species are nektic and may swim around the vegetation (Forester, 1991). This group colonized continental aquatic systems as early as the Carboniferous but has thrived in the oceans since the Cambrian. Today, ostracodes are diverse and abundant in marine and nonmarine environments. Paleontologists have devoted more time to the study of ostracodes than have biologists—hence the poorly understood ecology of ostracodes. Recent progress on the application of ostracodes as indicators of hydrogeologic variations, however, calls for additional studies of the ecology of springs and seeps, as well as their associated wetlands or cienegas (Forester, 1983, 1986; De Deckker, 1983; Palacios-Fest, 1994, 2008; Palacios-Fest et al., 1994, 2001; Holmes and Chivas, 2002). Mollusks associated with the ostracode fauna are also an important element in paleolimnological analysis.

Mollusks include the bivalve clams and mussels (Bivalvia) and the univalve snails (Gastropoda). Mollusks are soft bodied and unsegmented, with a body organized into a muscular foot, a head region, a visceral mass, and a fleshy mantle that secretes a shell of proteinaceous and crystalline calcium carbonate (aragonite) materials. Both marine and nonmarine species exist. The nonmarine species, which are the subject of this study, include several families of snails (the aquatic Planorbidae, Ancylidae, and Lymnaeidae and the terrestrial Pupillidae) and at least one family of clams (Pisidiidae). The associations of mollusks in the sediments reflect the water quality, salinity, and streamflow (Rutherford, 2000; Dillon and Stewart, 2003). For example, the occurrence of juveniles alone in a sample is interpreted as the introduction of early-stage individuals during warm or warming months (Rutherford, 2000). If the population reaches stability and adults are encountered, then it is assumed that the feature held water for a relatively prolonged period. Some species, like *Pisidium* sp. require well-oxygenated, lotic (flowing) waters and prefer neutral to alkaline pH but cannot tolerate organic pollution present in the marsh. By contrast, other species, like *Physa virgata*, can tolerate poorly oxygenated (but not disoxic), lentic (standing) waters and can tolerate some organic pollution and eutrophic conditions (Dillon and Stewart, 2003). The latter species prefer lakes, wetlands, ponds, and the calmest areas of coastal rivers. Like the ostracode signatures, the signatures of mollusks are used in this study to integrate the paleoecological characteristics of the China Lake Legacy Project area in California.

Stable-isotope (δ18O and δ13C) geochemistry based on ostracode valves is another approach to paleoclimatic reconstructions. Lister (1988) and Eyles and Schwarcz (1991), followed by numerous other researchers (e.g., Lewis et al., 1994; von Grafenstein et al., 2000; Wrozyna et al., 2010), have pursued the utility of carbon and oxygen isotopes in ostracodes for these reconstructions. The isotopic record from ostracode valves allowed these investigators to establish the rate and timing of climate change across space. For example, Lister (1988) determined the Alpine deglaciation, Holocene climatic changes, and changing lacustrine productivity of Lake Zürich, whereas Wrozyna et al. (2010) utilized stable isotopes to identify lake-level changes in Lake Nam Co, southern Tibet, during the past 600 years. Stable-isotope studies of ostracodes have proved their significance in paleoenvironmental reconstructions.

The purpose of this investigation is to combine routine paleoecological analysis of micro-invertebrates with the stable-isotope geochemistry (δ18O and δ13C) of ostracodes to reconstruct the late Pleistocene environmental history of China Lake, California.

MATERIALS AND METHODS

A total of 38 sediment samples from China Lake (20), Dove Springs Wash (3), Little Dixie Wash (12), Rose Valley (3) and the China Lake outlet (CLSB) areas within the China Lake region were analyzed for micro-invertebrates to reconstruct China Lake's environmental history. The sediment samples were prepared using routine procedures (Forester, 1988) modified by Palacios-Fest (1994). Samples were air-dried, weighed, and soaked in boiling distilled water with 1 g of Alconox to disaggregate the sediments. Then they were left to sit at room temperature for 5 days and were stirred once a day during that period. Using a set of three-sieves, the samples were wet-sieved to separate the coarse (>1 mm), medium (>106 µm), and fine (>63 µm) sand fractions to help identify the system's paleohydraulics. The very fine sand and silt and clay fractions were washed out at this stage. Therefore, the particle-size analysis departs from the formal USDA procedure (USDA 2003) and it is used only as a rough reference in this study. It is important to highlight that the possible discrepancy between the approach used in this investigation and that of the USDA is the result of grouping the very fine sands with the finer fractions, which in fact change the total percentage of sand, but does not affect the actual behavior of sands in the ecosystem. The value of the approach used here is that it provides a quick and easy way to process the data and to estimate the patterns of water discharge into the aquatic system overtime. More detailed particle-size analysis may be conducted using the appropriate research methods. The data are shown in Table 1. Table 2 shows the mineralogical composition per sample.

All samples were analyzed under a low-power microscope to identify fossil contents and faunal assemblages (Table 3). Both mollusks and ostracodes occurred in some samples (Tables 4-7). Ostracodes (Table 4) occurred in 13 samples across the area, ranging in abundance from extremely rare to extremely abundant (1-1119) (Table 5); whereas mollusks (Table 6) were recorded in six samples ranging in abundance from extremely rare to common (1-42)* (Table 7). Total and relative abundance was recorded from the sediment samples. Based on Delorme (1969, 1989), standard taphonomic parameters, like fragmentation, abrasion, disarticulation (carapace/valve; C/V ratios), and adulthood (adult/juvenile; A/J ratios) were recorded to establish the synecology (ecology of the communities) as opposed to the autoecology (ecology of single species) of the ecosystem (Adams et al. 2002). The taphonomic parameters were used to recognize degrees of transport and/or burial characteristics like desiccation and sediment compaction. The rates of fragmentation, abrasion and disarticulation are realistic indicators of transport; commonly these parameters show increasing damage with increasing transport. One must be cautious in using this criterion, but the nature of the deposits suggests that micro-invertebrates may reflect the lake's hydraulic properties. Other features like encrustation and coating were used to determine authigenic mineralization or stream action, respectively. Corrosion was used as an indicator of diagenetic effects overtime. The redox index and color of valves reflected burial conditions. The A/J and C/V ratios were used as indicators of biocenosis (Whatley 1983; Palacios-Fest et al. 2001).

Finally, in an attempt to obtain an isotopic record from China Lake, all samples containing ostracodes were searched for specimens to conduct stable isotope (δ13C and δ18O) analysis. Twenty-four valves of *Ilyocypris bradyi* were used for this analysis conducted at the Environmental Isotope Laboratory of the University of Arizona. Four valves were available from RV-NCTP-3Cu (Rose Valley), ten from DSW-L#5771-5Ab (Dove Springs Wash) split into two batches of five to make a replicate, and ten more from DSW-L#5771-8AB also split into two batches of five (Table 8). Other specimens were corroded and unfeasible for isotope analysis. Oxygen and carbon stable isotope ratios were measured using an automated carbonate preparation device (KIEL-III) coupled to a gas-ratio mass spectrometer (Finnigan MAT 252). Samples were reacted with dehydrated phosphoric acid under vacuum at 70°C. The isotope ratio measurement is calibrated based on repeated measurements of NBS-19 and NBS-18 and precision is ± 0.046 ‰ for δ18O and ±0.019‰ for δ13C (1sigma). Isotopic data for calcites are reported in delta notation relative to the VPDB international scale (Coplen 1994).

RESULTS

THE SEDIMENTARY RECORD

Table 1 and Figure 1, respectively show the textural classification and particle-size diagrams of all sites studied. A single sample from Horizon 3Cu from the Rose Valley, North Caltrans Pit was composed of dark gray (2.5Y 4/1) medium sand (Figure 1a). The mineral composition was dominated by quartz, feldspars, tufa, and more rarely biotite, mollusk and ostracode fragments (Table 2). The unit was fossiliferous (Table 3). The 3Cu Horizon yielded a radiocarbon date of 7861 BC from about 250 cm below ground surface (cm bgs) (Table 1; Chapter 4, this volume).

Two unfossiliferous samples from Rose Valley, South Caltrans Pit varied from very dark grayish brown (2.5Y 3/2) silty clay (Horizon 4Ob) to dark grayish brown (2.5Y 4/2) sand (Horizon 3Ab) (Figure 1b). Quartz, tufa, and feldspars were the dominant minerals followed by biotite, root casts, and charcoal. As shown in Table 1, A sample from the 3Ab Horizon submitted for age control yielded a date of 9497 BC; whereas, another from the 4Ob Horizon produced a date of 11445 BC (see Chapter 4, this volume).

At Dove Springs Wash Locality # 5771 three samples were analyzed for micro-invertebrates consisting of dark grayish brown (2.5Y 4/2) sandy silt to light yellowish brown (2.5Y 6/4) sandy to silty clay (Table 1; Figure 1c). Quartz, tufa, and feldspars dominated the mineral assemblage associated with root casts, pyrite, biotite, charcoal, and more rarely shell fragments (Table 2). Horizons 5Ab and 8Ab were fossiliferous (Table 3). Of the three horizons analyzed for micro-invertebrates and submitted for age control, the 13Ab Horizon yielded a date of 10152 BC, while the 5Ab Horizon returned a date of 2803 BC (Table 1; Chapter 4, this volume).

Twelve samples from Little Dixie Wash (LDW) in three locations ranged from grayish brown (2.5Y 5/2) sandy silty clay to pale yellow (2.5Y 7/3) silty clay or from grayish brown (10YR 5/2) sandy silty clay to (10YR 8/1) clay at FW-CLDW-T3 (Table 1; Figures 1d-g). The mineral composition was dominated by quartz and feldspars, sometimes alternating with tufa or gypsum. Other minerals occurring at LDW were biotite, charcoal, root casts, and more rarely shell fragments and schist (Table 2). Samples LDW1, 190-205-2Ab and LDW-L#3-4Ab contained micro-invertebrates (Table 3). Radiocarbon dates were obtained from three of four sites sampled at Little Dixie Wash. Locality #1 produced three dates in stratigraphic order, including two from the 2Ab Horizon of 8994 BC and 9536 BC, and one from the 3Ab Horizon of 9796 BC. Locality #3 produced a geochronological sequence in stratigraphic order ranging from 10504 BC to 8753 BC (Table 1; Chapter 4, this volume). By contrast, Locality #4 generated dates from three strata (3Ab, 5Ab, and 7Ab horizons) between 9374 and 10523 BC, the lower two of which are in reversed startigraphic order (Table 1; Chapter 4, this volume).

Eighteen core samples and two surface samples from China Lake basin were also analyzed for micro-invertebrates. Cores TTIWV-SB01, TTIWV-SB05, TTIWV-SB08, TTIWV-SB10, and TTIWV-SB28 consisted of greenish gray (Gley 1 8/1) silty sand to light gray (10YR 7/2) clay (Table 1; Figure 1h-n). The mineral composition of the core samples was dominated by quartz, tufa, feldspars, followed by biotite, gypsum, root casts, and to a lesser extent charcoal, shell and bone fragments (Table 2). Fossils occurred in cores TTIWV-SB05, TTIWV-SB08, and TTIWV-SB10. The remaining cores (TTIWV-SB01, and TTIWV-SB28) were unfossiliferous (Table 3). Core TTIWV-SB01 yielded two radiocarbon dates in reverse order (see Chapter 4, this volume for explanation). No dates are available from other cores.

The two surface samples from the Lava End Locality consisted of light brownish gray (10YR 6/2) silty sand (Table 1). The samples consist of light greenish gray (Gley 1 8/1) silty sand to greenish gray (Gley 1 6/1) sandy silty clay composed of abundant tufa, gypsum, and quartz. Other minerals included feldspars, biotite, and root casts (Table 2). The samples were unfossiliferous (Table 3). The Lava End Locality yielded two radiocarbon dates in stratigraphic order (Table 1; Chapter 4, this volume).

A separate sample of mollusk shells was submitted for identification. The sample (CLSB-snails) was collected from a lacustrine beach deposit composed of sand and marl with *Anodonta* shells that is perched atop of bedrock outcrop below the outlet of China Lake within the Searles Lake basin in an area sometimes known as Salt Wells Valley (Meyer, personal communication). The radiocarbon dates obtained from *Helisoma* sp. yielded a calibrated age of 13,387±50 years B.P. (11,437 B.C.) (Table 1; Chapter 4, this volume).

THE BIOLOGICAL RECORD

Table 3 summarized the biological contents of China Lake samples and the overall taphonomic characteristics recorded. Ostracodes and mollusks were present. Eleven ostracode species were identified from the China Lake Legacy Project: *Limnocythere sappaensis* Staplin 1963, *Limnocythere ceriotuberosa* Delorme 1967, *Cyprideis beaconensis* (Leroy), 1943, *Cypridopsis vidua* (O.F. Muller, 1776), *Candona patzcuaro* Tressler 1954, *Fabaeformiscandona caudata* (Kaufmann 1900), *Fabaeformiscandona acuminata* (Fischer, 1851) Danielopol 1980, *Ilyocypris bradyi* Sars, 1890, *Eucypris meadensis* Gutentag & Benson 1962, and *Cypridopsis okeechobei* Furtos 1933, as well as an unknown Species 1. Table 4 shows the ecological requirements of the ostracode species identified in this study. Table 5 displays the total and relative abundance by species, the adulthood and disarticulation ratios

Mollusks were equally diverse (seven species) including the snails *Physa virgata* (Gould, 1855), *Fossaria parva* (Lea, 1841), *Gyraulus parvus* (Say, 1817), *Tryonia* sp. Stimpson, 1865, *Pseudosuccinea columella* (Say, 1825), *Helisoma* (*Carinifex) newberryi* (Lea, 1858), and the clam *Pisidium casertanum* (Poli, 1795). Table 6 shows the ecological requirements of the mollusk species identified in this study.

Based upon the ostracode composition a paleosalinity index was developed (Table 5). The qualitative paleosalinity index takes into consideration the salinity tolerance of the species present in the area based on our current knowledge of their ecological requirements presented in the North American Nonmarine Ostracodes Database (NANODe) website (Forester et al. 2005) and other references (Palacios-Fest, 1994; Curry 1999). The equation used for the present study is:

SI = [5(% *Limnocythere sappaensis*) + 4(% *Limnocythere ceriotuberosa*) + 3(% *Cyprideis beaconensis*) + 2(% *Cypridopsis vidua*) + (% *Candona patzcuaro*)] - [(% *Fabaeformiscandona caudata*) + 2(% *Fabaeformiscandona acuminata*) + 3(% *Ilyocypris bradyi*) + 4(% *Eucypris meadensis*) + 5(*Cypridopsis okeechobei*)]

The index positively weighs species with incrementally higher salinity tolerances and negatively weighs species with incrementally lower salinity tolerances. In spite of the fragmented record, the paleosalinity index shows predominance of saline conditions throughout the area's environmental history (see Interpretation and Discussion Sections below).

Continental ostracodes and mollusks inhabit waters of different hydrochemical composition, but at the species level many are very sensitive to water chemistry. Ostracode and mollusk assemblages can be used to recognize the three major water types defined by Eugster and Hardie (1978):

- Type I: Ca^{2+}, Mg^{2+}, and HCO_3^- -dominated water; typically freshwater or very low salinity conditions.
- Type II: Ca^{2+} -enriched/HCO_3^- - depleted water; additionally containing the combinations of Na^+, Mg^{2+}, SO_4^{2-}, or Na^+, Mg^{2+}, Cl^-; ranges from low salinity to hypersaline conditions.
- Type III: Ca^{2+} -depleted/HCO_3^- + CO_3^{2-} (alkaline)-enriched water; usually containing combinations of Na^+, Mg^{2+}, Cl^-, or Na^+, Mg^{2+}, SO_4^{2-}; ranges from low salinity hypersaline conditions.

This spectrum clearly shows that water chemistry plays a major role in the geographic distribution of micro-invertebrates. In addition to water chemistry, temperature is another factor that affects the distribution of these organisms, as their latitudinal distribution demonstrates. Many ostracode species respond to temperature through both reproductive and survival ability (De Deckker and Forester 1988; Delorme and Zoltai 1984; Forester 1987). For example, *Cytherissa lacustris* is limited to water temperatures lower than 23°C, and is common in subpolar regions, whereas *Limnocythere bradburyi* is restricted to warm temperatures of low to mid-latitudes (Delorme 1978; Forester 1985). Their sensitivity to temperature makes ostracodes very useful for paleoclimate reconstructions (Cohen et al. 2000; Palacios-Fest 2002). Once the ecological requirements of ostracodes are determined, it is possible to reconstruct paleoenvironments from the geologic record (Delorme 1969; Holmes et al. 2002; Palacios-Fest 1994). Similarly, Sharpe (2002, 2003) has documented some of the ecological preferences of several mollusk species in Western North America. The mollusk record was used to integrate the following paleoenvironmental reconstruction.

THE STABLE ISOTOPE DATA

Stable isotope values for *Ilyocypris bradyi* are shown in Table 8. In spite of the limited number of intervals used for this analysis some matters to consider include:

1. Based on the more than 5 specimens measured with each sample the effects of seasonal variability were eliminated. This makes the $\delta^{18}O$ values more representative of the average climate regardless of the probable seasonal biases in the timing of ostracode growth;
2. The $\delta^{18}O$ values are most responsive to temperature change and to the $\delta^{18}O$ values of the water (which change in response to climate). In this sense, RV-NCTP-3Cu shows the most positive values. DSW-L#5771-5Ab and DSW-L#5771-8Ab show more negative values with the latter being the most negative. Lack of significant variability among the data suggests that the $\delta^{18}O$ obtained from *I. bradyi* reflect changes in water $\delta^{18}O$ rather than temperature (which Dettman estimates to be around 12°C, personal communication). If this is correct, the more positive values imply increasing aridity or heavier seasonal rains (like the monsoon); whereas the more negative values may indicate less evaporation. During a wet period, the volume of a closed-basin lake increases, which typically drives the $\delta^{18}O$ value in the lake to decrease, whereas during a dry period the $\delta^{18}O$ value in the lake increases as the lake shrinks (Benson et al. 2002); thus constraining the direction of lake-level oscillations in the absence of surface data.
3. The $\delta^{13}C$ values mainly result from micro-habitat variability and cannot be used for a paleoenvironmental reconstruction.

INTERPRETATION

The combined information of ostracodes and mollusks provides solid evidence for environmental change over time in the area of study. For example, a sharp contrast is evident between the China Lake core samples (FW718o) and the spring related samples analyzed to date. The core samples show an assemblage dominated by saline, standing water systems dominated by *Limnocythere sappaensis*, *Limnocythere ceriotuberosa*, and *Cyprideis beaconensis* (the three most common species in the cores); whereas the spring samples contain an assemblage dominated by crenophilous (spring-prone), stream, and dilute water species like *Ilyocypris bradyi*, *Eucypris meadensis* and *Cypridopsis okeechobei*. This drastic difference may indicate the hydrochemical evolution of China Lake over time. To answer this question it is important first to establish the relationship between the China Lake basin and the springs studied. Is it possible that they are parts of the whole system? Is it possible that as water flows away from the springs the water chemistry changes to the point of hosting such different assemblages? Next, I will interpret the environmental history of China Lake starting from the potential water sources, moving down into the lake basin.

Site Rose Valley, North Caltrans Pit (RV-NCTP):

The North Caltrans Pit at Rose Valley is located along the former Owens River channel, north of China Lake Basin, and was represented by a single sample from Horizon 3Cu (stratum II). The relatively coarse sediments accumulated in this horizon are consistent with the coarse-channel facies fining-upwards into overbank floodplain facies. Figure 1a shows that medium sand conformed more than 65% of the particle-size analysis indicating a moderately high energy environment.

The poor biological composition is consistent with this interpretation. Three species of micro-invertebrates, two ostracodes and one mollusk occurred in Horizon 3Cu. The ostracodes *Ilyocypris bradyi* (about 72%) and *Fabaeformiscandona acuminata* (about 28%) suggest a dilute, spring source (Table 5). As shown in Table 4, *F. acuminata's* salinity tolerance is below 1000 mg L-1 total dissolved solids (TDS) (Forester et al. 2005) implying that the pit is close to the water source (Figure 2a).

Two specimens of *Tryonia* sp. were identified in the sample (Table 7). The genus *Tryonia* is known to prefer low to moderate salinity (1000-2000 mg L-1 TDS; Sharpe 2002, 2003) (Table 6). Therefore, it is inferred that ostracodes and mollusks reflect the environmental conditions prevailing at Horizon 3Cu during deposition.

Five valves of *I. bradyi* were analyzed for carbon and oxygen isotopes at the Department of Geosciences of the University of Arizona. As discussed in the Results section, the δ18O value obtained from sample RV-NCTP-3Cu are the most positive obtained from China Lake suggesting arid conditions or greater seasonal rainfall at the time of deposition of Horizon 3Cu (Table 8). A date 7861 BC suggests this sample dates to the early Holocene.

Site Rose Valley, South Caltrans Pit (RV-SCTP):

The South Caltrans Pit at Rose Valley located just south of the north pit along the Haiwee Creek was represented by two horizons in stratigraphic contact (II/4Ob and III/3Ab). The older unit (II/4Ob) consisted of fine-grained deposits forming a thin stratum (about 75% very fine sand, silt, and clay). Horizon 3Ab is a thick, gravelly, fining-upward medium sand (about 67%) overlying Horizon 4Ob (Figure 1b). The samples were unfossiliferous. Based on organic sediments, Horizon 3Ab yielded a calibrated radiocarbon age of 11,447±55 years B.P (9497 B.C.), the terminal Younger Dryas. By contrast, organic material from the underlying Horizon 4Ob yielded a date of 11445 BC (Table 1; Chapter 4, this volume), prior to the Younger Dryas.

Site Rose Valley, Lava End Locality:

Two samples from the black mat at the Lava End Locality were analyzed for micro-invertebrates. The two strata consisted mostly of medium sand (greater than 41%) implying an alluvial floodplain deposit where tufa and gypsum were most abundant (Figure 1m; Table 2). The site was unfossiliferous. Organic sediments from the black mat yielded calibrated radiocarbon dates ranging from 9,065±100 years B.P. (7115 B.C.) to 10,656±100 years B.P. (8706 B.C.), latest Pleistocene to earliest Holocene. Lack of micro-invertebrates prevents establishing the paleoenvironmental history of the site. However, black mat horizons have previously been associated with the transition from the warm dry climate of the terminal Allerød to the glacially cold Younger Dryas, so climate change is recorded at the Lava End Locality (Huckell and Haynes 2007).

Site Dove Springs Wash (DSW-L#5771):

At the southwest end of China Lake is the Dove Springs Wash, Locality #5771. The wash drains into Koehn Lake to the south (see Chapter 4, this Volume for details). Dove Springs Wash consists of stratified alluvial floodplain/lacustrine deposits that form an inset terrace along the main valley axis. Three isolated horizons were analyzed for micro-invertebrates. Horizon 5Ab consisted mostly of very fine sand, silt and clay (about 79%) (Figure 1c). The fine sediments indicate a ponded deposit that held an abundant ostracode record (dry mass of 2.6 specimens per gram of sediment). Four species were identified at Horizon 5Ab including Eucypris meadensis (the most abundant), *Ilyocypris bradyi*, *Fabaeformiscandona acuminata*, and *Cypridopsis vidua* (Figure 2b). *Eucypris meadensis*, a dilute-water, spring-related species and *Ilyocypris bradyi*, a spring- and stream-related species settled a biocenosis in the area at the time of deposition (see Table 4). Dominance of *Eucypris meadensis* indicates salinity did not exceed 1000 mg L-1 TDS (Forester et al. 2005).

Ten valves of I. bradyi, in two batches of five shells each, were analyzed for carbon and oxygen isotopes at the Department of Geosciences of the University of Arizona. In the previous section it was highlighted that the Dove Springs Wash data are more negative than those obtained from Rose Valley. It is inferred in this study that these values (replicates 1 and 2) indicate less evaporation during deposition of Horizon 5Ab (Table 8). The stable isotope signature is consistent with the dilute water inference from micro-invertebrates.

During deposition of the earlier Horizon 8Ab, very fine sand, silt, and clay (about 59%) accumulated in a ponded or floodplain environment (Figure 1c). Two ostracode and three mollusk species were identified from Horizon 8Ab including *I. bradyi* and *E. meadensis* accompanied by the gastropods *Physa virgata* and *Tryonia* sp. and the clam *Pisidium casertanum*. Dilute waters hosted this faunal association. Salinity did not exceed 2000 mg L-1 TDS, the maximum tolerance for *Tryonia* sp. but more likely was close to 1000 mg L-1 TDS, the maximum tolerance for *E. meadensis* (Forester et al. 2005; Sharpe 2002, 2003) (Figure 2b).

The stable isotope analysis of ten valves of *I. bradyi*, in two batches of five shells each, from Horizon 8Ab yielded δ13C and δ18O values similar to those at Horizon 5Ab. As for this latter horizon, it is inferred that the δ18O values (replicates 1 and 2) in Horizon 8Ab reflect less evaporation (Table 8). The stable isotope signature is consistent with the dilute water inference from micro-invertebrates.

The lowermost Horizon 13Ab consisted of coarse- to medium-sand (about 66%) indicating a high-energy alluvial deposit (Figure 1c). The unit was unfossiliferous. Based on organic sediments, Horizon 13Ab yielded a calibrated radiocarbon age of 12,102±60 years B.P (10,152 BC), middle Younger Dryas. The uppermost 5Ab Horizon returned a date of 2803 BC, falling near the end of the middle Holocene. Lack of age control for Horizon 8Ab prevents establishing the site's complete paleoenvironmental history (Table 1; Chapter 4, this Volume).

Site Little Dixie Wash (LDW):

North of Dove Springs Wash, three localities (1, 2, and 3) were excavated along the Little Dixie Wash (LDW). Little Dixie Wash consists of stratified alluvial floodplain/lacustrine deposits that form an inset terrace along the main valley axis. LDW-Locality #1 was represented by two separate samples. Horizon 2Ab consisted of sandy silty clay (Figure 1d) indicating a moderately low-energy environment.

Horizon 3Ab, not in direct contact with the previous unit, consisted of very fine sand, silt, and clay (about 83%) suggesting a low-energy system. The units were unfossiliferous. Dates of 8994 and 9536 BC were obtained from organic material and *Helisoma (Carinifex) newberryi* shell associated with Horizon 2Ab. Organic material from the 3Ab Horizon returned a date of 9796 BC.

Two samples from LDW-Locality #2 were analyzed for micro-invertebrates. Horizon II/2Ab was formed by very fine sand, silt, and clay (about 79%) indicative of low-energy conditions in a ponded system (Figure 1e); whereas, Horizon I/3ABkb consisted of silty sand (about 63%) suggesting moderately high-energy conditions. The aquatic gastropod *Helisoma (Carinifex) newberryi* was the only species identified from Horizon 2Ab (Table 7). The poor micro-invertebrate record and lack of age control limits the paleoenvironmental reconstruction of Locality #2.

At LDW-Locality #3 five samples in stratigraphic continuity generated a coarsening upwards sequence ranging from silty clay to silty sand (Figure 1f). Increasing particle-size indicates increasing energy overtime from a wetland to a spring-flow environment. Gypsum crystals were abundant in the lower horizons (5Ab to 7Ab), disappearing from the upper two units (3Ab and 4Ab) where micro-invertebrates were recovered. Ostracodes and mollusks occurred at LDW-Locality #3 (Table 3). Three dilute water, spring-related ostracode species were identified at Horizon 4Ab including *Fabaeformiscandona acuminata, Eucypris meadensis,* and *Cypridopsis okeechobei*. This assemblage suggests water salinity did not exceed 1000 mg L-1 TDS (Forester et al. 2005). In addition four aquatic gastropods occurred at the same horizon: *Pseudosuccinea columella, Helisoma (Carinifex) newberryi, Gyraulus parvus*, and *Fossaria parva* (Figure 2c). All four species support a wide range of salinity in a variety of environments from swamps to streams (Table 6; Sharpe 2002, 2003). LDW-Locality #3 offered the most complete age control in the region with an age range from 12,454±60 years B.P. (10,504 B.C.) to 10,703±95 years B.P. (8753 B.C.), the Younger Dryas. Ecologically, the micro-invertebrates, sediments, and mineral composition indicate the gradual advancement of cold, wet climate as the Younger Dryas progressed at the end of the Pleistocene.

By contrast, LDW-Locality #4 consisting of three samples from three separate horizons (3Ab, 5Ab, and 7Ab) show very fine sand, silt, and clay dominated each environment ranging from 74% to 95% (Table 1; Figure 1g). The fine particle-size recorded at each of these horizons advocates for alluvial floodplain conditions. All three units were unfossiliferous (Table 3). Radiocarbon dates from organic material range from 10523 BC to 9374 BC. Lack of stratigraphic continuity prevents establishing the geochronology of events.

Site China Lake Basin (Cores):

TTIWV-SB01:

Two separate samples from core TTIWV-SB01 were analyzed for micro-invertebrates. The upper sample (5212-5303 cm bgs) consisted predominantly of fine sediments (about 49%) and medium sand (about 38%) suggesting an alluvial floodplain environment deprived of micro-invertebrates. The lower sample (6279-6340 cm bgs) consisted also of a combination of fine sediments (about 50%) and medium sand (about 39%) part of an unfossiliferous alluvial floodplain (Figure 1h; Table 3). The calibrated radiocarbon dates generated from each sample yielded ages in reverse stratigraphic order. The upper unit yielded an age of 19,416±70 years B.P. (17,466 B.C.); whereas the lower unit yielded an age of 14,008±80 years B.P. (12,058 B.C.) (Table 1; Chapter 4, this Volume). Lack of micro-invertebrates and the age reversal prevent the paleoenvironmental reconstruction of core TTIWV-SB01 location.

TTIWV-SB05:

Core TTIWV-SB05 consisting of four samples in stratigraphic continuity at the base of the record was composed of medium sand (about 77%) in a clay matrix fining upwards to very fine sand, silt, and clay (about 64%) implying a gradual decrease in energy (Figure 1i). Micro-invertebrates occurred throughout the stratigraphic column. Ostracodes were extremely abundant at the base of the record decreasing sharply upcore to rare and extremely rare. For descriptive purposes three biostratigraphic zones were recognized at SB-05. Zone 1 contained the most abundant ostracode composition with *Limnocythere sappaensis* dominating the environment (about 48%) associated with *Limnocythere ceriotuberosa* (32%), *Candona patzcuaro* (about 19%) and a few specimens of *Fabaeformiscandona caudata*? (less than 1%). Occurrence of *L. sappaensis*, a high-salinity tolerant species, indicates China Lake was developing hypersaline conditions. However, at the time of deposition of Zone 1, salinity was probably below 5000 mg L-1 TDS the maximum tolerance for C. patzcuaro (Table 4; Forester et al. 2005). This interpretation is supported by the moderately common presence of gypsum (Table 2). Zone 2, an interval not studied for micro-invertebrates, is assumed to be ecologically unfeasible for biological contents (a biological hiatus). Lack of information on this segment of core SB05 does not warrant further analysis. Ostracodes re-appear in Zone 3 where they are rare to extremely rare. *Limnocythere ceriotuberosa*, *C. patzcuaro*, and *F. caudata*? were the species recorded. A single shell of a juvenile gastropod *Helisoma (Carinifex) newberryi* was identified at 3109-3170 cm bgs. Low to high fragmentation and abrasion (5-30%) characterized the shells. Most specimens were coated by authigenic calcite or gypsum and heavily corroded (Table 3). While fragmentation and abrasion may imply transport, encrustation, coating and corrosion indicate diagenetic alteration. The poor faunal assemblage associated with the taphonomic parameters supports the hypothesis that ostracodes were reworked to the site. Three highly controversial radiocarbon dates place the environmental history of SB05 as a modern event. However, the fact that these materials proceed from more than 30 m bgs argues against this possibility.

TTIWV-SB08:

Two samples from SB08 were analyzed for micro-invertebrates. The upper sample (2256-2316 cm bgs) consisted mostly of very fine sand, silt, and clay (about 85%); whereas the lower (2377-2438 cm bgs) contained a lower proportion of the same particle-size fraction (about 64%) (Figure 1j). Tufa and gypsum were the dominant minerals in both units indicating hypersaline conditions, confirmed by the extremely rare occurrence of the ostracodes *L. sappaensis* and *L. ceriotuberosa.* Lack of age control prevents further interpretation of the site's environmental history.

TTIWV-SB10:

Core TTIWV-SB10 consisting of five samples obtained from three separate intervals identified as zones 1, 2, and 3 (Figure 1k). At the base of core SB10, Zone 1 (below 5250 cm bgs) was composed mainly of silty sand (more than 50% sand). Biotite was the dominant mineral associated with tufa and gypsum crystals (Table 2). Zone 1 was unfossiliferous. The high concentration of authigenic minerals forming the sand fraction suggests a hypersaline environment at the time of deposition. A biological hiatus was identified between 4250 and 5250 cm bgs, no samples were analyzed from this interval. Zone 2 consisted of very fine sand, silt and clay (about 76% to 87%) dominated by tufa, quartz, and gypsum. Ostracodes were common to very abundant throughout the interval. Three species prevailed in Zone 2 *Cyprideis beaconesis, L. ceriotuberosa,* and *F. caudata*? associated with *L. sappaensis*, and more rarely *C. patzcuaro* (Figure 2f; Table 5). The relative abundance of *F. caudata?* and the adulthood ratios of all other species indicate that ostracodes established a biocenosis in a dilute water environment regardless the presence of high-salinity tolerant species like *L. sappaensis*, *C. beaconensis*, and *L. ceriotuberosa* (Figure 2f). Another hiatus is identified above Zone 2. No samples were available for analysis. Zone 3 is a brief interval atop the record that resulted unfossiliferous. To date, no radiocarbon dates have been obtained from core SB10 preventing the historical reconstruction of the environments.

TTIWV-SB28:

Two separate samples from SB28 were analyzed for micro-invertebrates. The two units consisted of very fine sand, silt, and clay (greater than 73%) composed mostly of clastic sediments with some authigenic minerals (tufa and gypsum) (Figure 1l). Gypsum was more abundant at the lower unit. A single reworked valve of F. caudata? was identified in the upper sample (732-808 cm bgs). Core SB28 reflects an alluvial floodplain environment deprived of micro-invertebrates (Table 3). Lack of age control limits further interpretation.

CLC-8, Cg:

A single sample from core CLC-8, Horizon Cg was analyzed for micro-invertebrates. Dominated by medium sand (about 56%), the unit was unfossiliferous (Figure 1n; Tables 2 and 3). No further interpretation is warranted.

CLC-9:

Two samples from core CLC-9 horizons 6Cg and 11Cg were analyzed for micro-invertebrates. Horizon 6Cg reflects distal fan or slough deposits that overlie coarse, sorted beach sand and gravel. The particle-size analysis conducted in this study indicates the unit is mostly very fine sand, silt, and clay (about 78%) (Figure 1n). Downcore, Horizon 11Cg reflects lacustrine deposits that underlie beach deposits. It was composed of medium sand (about 59%) (Figure 1n). Neither stratum contained micro-invertebrates; therefore, a paleoecological interpretation is not warranted. The age control, however, indicates that the upper unit accumulated sometime around 11,123±50 years B.P. (9173 B.C.); while the lower unit formed around 17,780±50 years B.P. (15,830 B.C.) (Table 1). That is, this interval includes the transition from the latest Pleistocene to earliest Holocene (Allerød-Younger Dryas).

Site China Lake Shell Beach (CLSB):

Snails from a lacustrine beach deposit consisting of sand and marl with *Anodonta* shells were identified as *Helisoma (Carinifex) newberryi*. The site locates below the outlet of China Lake within Searles Lake basin in an area sometimes known as Salt Wells Valley. Occurrence of P. trivolvis suggests a slow flowing (lentic) aquatic system (Table 7). A radiocarbon date obtained from a mollusk shell (H. (C.) newberryi) yielded an age of 13,387±50 years B.P. (11,437 B.C.), the early Allerød.

DISCUSSION

The ostracode and mollusk records from the latest Pleistocene to the earliest Holocene at China Lake provide fragmentary evidence for changing limnological and climatic environments in the northern Mojave Desert. The paleoenvironments of spring-related sites may be placed during the transition from the late Pleistocene (19,416±70 cal. years B.P.) to the earliest Holocene (9,065±100 cal. years B.P.), including parts of the Bølling/Allerød (14,008±80 to 12,454±60 cal. years B.P.) to the Younger Dryas (12,454±55 to 11,482±55 cal. years B.P.). The China Lake basin cores, however, yielded poor or nil geochronological control, therefore, the environments described in this study cannot be placed in time with respect to neighboring locations (e.g., Owens Lake, Searles Lake).

To understand the significance of the species present in the area it is important to consider their modern ecology. The ostracodes *Limnocythere ceriotuberosa* Delorme, 1967, *Limnocythere sappaensis Staplin*, 1963, *Candona patzcuaro* Tressler 1954, *Fabaeformiscandona acuminata* (Fischer, 1851), and *Fabaeformiscandona caudata* (Kaufmann 1900), the most common species in the China Lake area, today live in lakes that have varied chemical, thermal, and hydroclimatic characteristics (Bradbury and Forester 2002; Forester 1986, 1987, 1991; Forester et al. 2005a; Delorme 1989; Forester et al. 1994; Smith and Forester 1994). For example, *C. patzcuaro* lives in lakes, wetlands, and springs from Canada to central Mexico thriving in a wide range of salinity (dilute to saline waters). In saline waters the species prefers a low alk/Ca ratio often associated with *Limnocythere staplini* (Forester et al. 2005a) or *L. ceriotuberosa*, as it is the case in the present investigation. Its ability to live in environments with high physical and chemical variability makes it suitable to thrive in the China Lake area. Its occurrence in the lake cores is inferred to indicate sharp environmental gradients in a frequently changing system.

F. caudata lives from Canada to northern Mexico in streams, flowing springs, and lakes supported by streams in the dilute water solute field capable of supporting Ca-enriched waters (Table 4). In the China Lake area, as for Owens Lake and other lakes in the Death Valley its occurrence may indicate a relatively dilute system supported by significant streamflow (Forester et al. 2005b).

Little information is available for *F. acuminata*, a rare species reported in western North America from southwestern Alberta to southern Nevada (Delorme 1970; Forester et al. 2005a). For the first time, the species is identified from the southern Great Basin in southeastern California in Younger Dryas sediments of the Little Dixie Wash, Locality 3 (11,482±55 cal years BP). This species also occurs in early Holocene sediments of the North Caltrans Pit in Rose Valley (9811±40 cal years BP) and middle Holocene deposits (4753±40 cal years B.P.) at Dove Springs Wash, Locality 5771 (Table 5). The co-occurrence of *F. acuminata* with other fresh-water species like *Ilyocypris bradyi, Eucypris meadensis, Cypridopsis vidua*, and *Cypridopsis okeechobei* in the China Lake area advocates for a dilute water spring supported by significant streamflow and ground-water recharge. As shown in Table 4, with the exception of *C. vidua*, these species prefer low to moderate salinity and low alk/Ca ratios. *Cypridopsis vidua's* euryhaline (wide-salinity tolerance) properties are not in conflict with this interpretation since the species thrives in springs and streams. In addition, ostracodes are associated with the gastropods *Gyraulus parvus, Fossaria parva*, and *Helisoma (Carinifex) newberryi* all common in fresh-water lakes and permanent streams (Miller 1989; Sharpe 2002) consistent with Younger Dryas cold-wet conditions.

Limnocythere ceriotuberosa lives in fresh and saline lakes from Canada to northern Mexico (Baja California, Palacios-Fest unpublished data). Hydrochemically, the species prefers the low alk/Ca ratio but thrives through the lower portion of the high alk/Ca ratio where it may co-exist with *Limnocythere sappaensis* (Forester et al. 2005a, b). The species is known to live in lakes that receive seasonal pulse of surface water or groundwater alternating with periods of evaporation. Apparently, this annual variability is important for the species to complete its life-cycle. Its occurrence in the China Lake basin cores implies seasonally high streamflow into an alkaline system.

Limnocythere sappaensis has a wide geographic range, living in lakes, wetlands, and springs from Canada to central Mexico where high alk/Ca ratios and high TDS dominate the lake (Forester et al. 2005a, b). Its presence in the China Lake basin cores indicates periods of alkaline-saline conditions supported by streamflow. According to Forester (1983) the species cannot tolerate low alk or high Ca waters and so could not survive in China Lake at any time when high-Ca springs dominated the valley bottom hydrology.

The previous paragraphs show a significant contrast between the spring-related areas and the China Lake basin. The faunal assemblage recorded from cores TTIWV-SB05, SB08, SB-10 and SB-28 is similar to that reported elsewhere in the southern Great Basin (e.g., Owens Lake, Carter 1997; Bacon et al. 2006; Death Valley, Lowenstein et al. 1999; Forester et al. 2005b; Lake Bonneville, Oviatt et al. 1999; Balch et al. 2005; Panamint Lake, Jayko et al. 2008). By contrast, the Mojave River Drainage Basin lacustrine systems (e.g., Silver Lake) contained very restricted faunal associations often times monospecific of *Limnocythere ceriotuberosa* and/or *Limnocythere bradburyi* (Wells et al. 1989). However, lack of age control forbids a discussion on the possible correlation among the several basins cited here.

CONCLUSIONS

- The China Lake Legacy Project offered a unique opportunity to analyze the micro-invertebrate fauna from the lake basin and surrounding areas.
- For the first time, *Fabaeformiscandona acuminata* was identified in the Little Dixie Wash springs, the Rose Valley springs, and Dove Springs Wash indicating a fresh-water source during the Younger Dryas and through the early and middle Holocene.

- The significant differences between the spring-related sites and the China Lake basin cores could not be placed in geochronological perspective due to the poor age control obtained from materials as diverse as organic sediments, plant/wood, or shell.
- Further micropaleontological and geochronological control would be necessary to generate a better paleoclimate history of China Lake.

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Appendix D: Sample Identification Numbers, Stratigraphic Position, Bulk and Residual Weight and Lithological Characteristics of Materials Analyzed for the China Lake Legacy Project, California.

Sample ID	Site/Bore Hole No.	Stratum	Depth	UTM Easting	UTM Northing	Bulk Wt.	Fraction Wt	>1mm	>106mm	>63mm	<63 mm	>1mm	>106mm	>63mm	<63 mm	Textural Classification	Munsell's Color Name	Code	Radiocarbon Dates*				
			(cm bgs)			(g)	(g)	(g)	(g)	(g)	(g)	(%)	(%)	(%)	(%)				Lab No.	Source	$^{12}C/^{13}C$	Calibrated Years B.P.	Calendar Years AD/BC
RV-NCTP-3Cu	Rose Valley, North Caltrans Pit	II/3Cu	250-260	415295	3991136	100.5	73.2	2.6	68.8	1.8	27.3	2.6	68.5	1.8	27.2	Sand	Dark gray	2.5Y 4/1	OS-79566	Plant/Wood	-13.1		Modern
RV-SCTP-3Ab	Rose Valley, South Caltrans Pit	III/3Ab	200-220	416035	3990462	100.2	71.5	1.4	67.4	2.7	28.7	1.4	67.3	2.7	28.6	Sand	Dark grayish brown	2.5Y 4/2	OS-79587	Organic sediments	-24.1	11,447±55	-9497
RV-SCTP-4Ob	Rose Valley, South Caltrans Pit	II/4Ob	470	416035	3990462	100.2	24.8	0.5	22.3	2.0	75.4	0.5	22.3	2.0	75.2	Silty clay	Very dark grayish brown	2.5Y 3/2	OS-79567	Plant/Wood	-12.7		Modern
DSW-L#5771-5Ab	Dove Springs Wash, Loc. 5771	IX (X)/5Ab	102-112	408904	3918620	100.7	21.2	2.8	16.7	1.7	79.5	2.8	16.6	1.7	78.9	Silty clay	Light yellowish brown	2.5Y 6/4	OS-79559	Plant/Wood	-21.3		Modern
DSW-L#5771-8Ab	Dove Springs Wash, Loc. 5771	V (VI)/8Ab	220-225	408904	3918620	100.3	40.8	0.7	38.9	1.2	59.5	0.7	38.8	1.2	59.3	Sandy silty clay	Light yellowish brown	2.5Y 6/3	OS-79586	Plant/Wood	-24.5		Modern
DSW-L#5771-13Ab	Dove Springs Wash, Loc. 5771	-I (I)/13Ab	430-450	408904	3918620	100.4	67.7	38.4	27.7	1.6	32.7	38.2	27.6	1.6	32.6	Silty sand	Dark grayish brown	2.5Y 4/2	OS-79560	Organic sediments	-25.4	12,102±60	-10152
LDW1, 190-205-2Ab	Little Dixie Wash, Loc. 1	II/2Ab	190-205	422956	3935635	100.4	58.5	11.5	45.0	2.0	41.9	11.5	44.8	2.0	41.7	Sandy silty clay	Grayish brown	2.5Y 5/2					
LDW1, 260-280-4Ab	Little Dixie Wash, Loc. 1	I/3Ab	260-280	422956	3935635	100.1	16.6	4.1	10.9	1.6	83.5	4.1	10.9	1.6	83.4	Silty clay	Gray	2.5Y 5/1					
LDW-L#2-2Ab	Little Dixie Wash, Loc. 2	II/2Ab	30-40	421743	3935117	99.6	20.9	2.9	17.2	0.8	78.7	2.9	17.3	0.8	79.0	Silty clay	Light brownish gray	2.5Y 6/2	OS-79561	Plant/Wood	-20.4		Modern
LDW-L#2-3ABkb	Little Dixie Wash, Loc. 2	I/3ABkb	50-60	421743	3935117	100.4	65.2	29.8	33.0	2.4	35.2	29.7	32.9	2.4	35.1	Sandy silt	Gray	2.5Y 6/1	OS-79562	Plant/Wood	-26.2		Modern
LDW-L#3-3Ab	Little Dixie Wash, Loc. 3	V/3Ab	195-210	422592	3935262	99.5	65.7	2.1	60.6	3.0	33.8	2.1	60.9	3.0	34.0	Silty sand	Pale yellow	2.5Y 7/3	OS-79584	Organic sediments	-25.2	10,703±95	-8753
LDW-L#3-4Ab	Little Dixie Wash, Loc. 3	IV/4Ab	260-265	422592	3935262	100.3	34.2	2.1	27.7	4.4	66.1	2.1	27.6	4.4	65.9	Sandy silty clay	Light gray	2.5Y 7/2	OS-79563	Organic sediments	-24.9	11,482±55	-9532
LDW-L#3-5Ab	Little Dixie Wash, Loc. 3	III/5Ab	295-300	422592	3935262	100.6	25.5	1.6	19.7	4.2	75.1	1.6	19.6	4.2	74.7	Sandy silty clay	Pale yellow	2.5Y 7/3	OS-79585	Organic sediments	-25.1	11,689±110	-9738
LDW-L#3-6Ab	Little Dixie Wash, Loc. 3	II/6Ab	310-330	422592	3935262	100.0	12.8	0.1	8.5	4.2	87.2	0.1	8.5	4.2	87.2	Silty clay	Light brownish gray	2.5Y 6/2	OS-79564	Organic sediments	-25.5	11,698±55	-9747
LDW-L#3-7Ab	Little Dixie Wash, Loc. 3	I/7Ab	340-360	422592	3935262	99.5	9.7	0.2	8.5	1.0	89.8	0.2	8.5	1.0	90.3	Silty clay	Grayish brown	2.5Y 5/2	OS-79565	Organic sediments	-25.7	12,454±60	-10504
FW-CLDW-T3, 3Ab	Little Dixie Wash, Loc. 4	3Ab	155	421761	3935245	51.5	2.5	0.7	1.4	0.4	49.0	1.4	2.7	0.8	95.1	Silty clay	Grayish brown	10YR 5/2					
FW-CLDW-T3, 5Ab	Little Dixie Wash, Loc. 4	5Ab	210	421761	3935245	51.4	13.4	1.0	11.4	1.0	38.0	1.9	22.2	1.9	73.9	Sandy silty clay	Gray	10YR 6/1					
FW-CLDW-T3, 7Ab	Little Dixie Wash, Loc. 4	7Ab	267	421761	3935245	53.5	2.6	0.5	1.6	0.5	50.9	0.9	3.0	0.9	95.1	Clay	White	10YR 8/1					
FW718o-11	TTIWV-SB01		5212-5303	423635	3961800	24.8	12.7	2.4	9.3	1.0	12.1	9.7	37.5	4.0	48.8	Silty sand	Light gray	10YR 7/1	Beta-249418	Organic sediments	-25.5	19,416±70	-17466**
FW718o-13	TTIWV-SB01		6279-6340	423635	3961800	31.3	15.7	2.6	12.1	1.0	15.6	8.3	38.7	3.2	49.8	Silty sand	Very pale brown	10YR 8/2	Beta-249419	Soil (SOM)	-27.4	14,008±80	-12058**
FW718o-01	TTIWV-SB05		3048-3109	437475	3944908	18.5	6.6	0.3	4.1	2.2	11.9	1.6	22.2	11.9	64.3	Sandy silty clay	Greenish gray	Gley 1 6/1	Beta-259414	Organic sediments	-22.8	176±40	1774
FW718o-02	TTIWV-SB05		3109-3170	437475	3944908	18.5	8.9	0.1	7.1	1.7	9.6	0.5	38.4	9.2	51.9	Silty clayey sand	Greenish gray	Gley 1 6/1					
FW718o-03	TTIWV-SB05		3170-3231	437475	3944908	14.0	5.2	0.1	4.3	0.8	8.8	0.7	30.7	5.7	62.9	Sandy silty clay	Greenish gray	Gley 1 6/1	Beta-259415	Plant (parts)	-22.4		Modern
FW718o-04	TTIWV-SB05		5730-5791	437475	3944908	11.6	9.9	0.4	8.9	0.6	1.7	3.4	76.7	5.2	14.7	Clayey sand	Greenish gray	Gley 1 6/1	Beta-259416	Plant (pine needles)	-21.9		Modern
FW718o-05	TTIWV-SB08		2256-2316	439201	3944941	20.7	3.1	0.2	2.7	0.2	17.6	1.0	13.0	1.0	85.0	Silty clay	Greenish gray	Gley 1 6/1					
FW718o-06	TTIWV-SB08		2377-2438	439201	3944941	18.6	6.6	0.1	6.0	0.5	12.0	0.5	32.3	2.7	64.5	Silty clay	Greenish gray	Gley 1 6/1					
FW718o-07	TTIWV-SB10		671-707	441112	3944072	30.4	7.0	1.0	5.4	0.6	23.4	3.3	17.8	2.0	77.0	Silty clay	Light gray	10YR 7/2					
FW718o-08	TTIWV-SB10		4023-4084	441112	3944072	23.2	3.0	0.2	1.9	0.9	20.2	0.9	8.2	3.9	87.1	Clay	Light gray	10YR 7/1					
FW718o-09	TTIWV-SB10		4084-4145	441112	3944072	30.0	7.1	0.3	5.1	1.7	22.9	1.0	17.0	5.7	76.3	Silty clay	Greenish gray	Gley 1 5GY 6/1					
FW718o-10	TTIWV-SB10		4145-4206	441112	3944072	23.8	3.9	0.1	3.2	0.6	19.9	0.4	13.4	2.5	83.6	Silty clay	Light greenish gray	Gley 1 10Y 7/1					
FW718o-12	TTIWV-SB10		6227-6279	441112	3944072	34.2	17.1	0.7	15.4	1.0	17.1	2.0	45.0	2.9	50.0	Silty sand	Light gray	10YR 7/1					
FW718o-14	MK29-SB01/ TTIWV-SB28		732-808			31.8	8.5	1.0	6.8	0.7	23.3	3.1	21.4	2.2	73.3	Silty clay	Greenish gray	Gley 1 5GY 5/1					
FW718o-15	MK29-SB01/ TTIWV-SB28		2865-3018			29.5	3.5	0.2	2.0	1.3	26.0	0.7	6.8	4.4	88.1	Clay	Grayish brown	10YR 5/2					
FW718o-16	Lava End Locality - Upper Black Mat	III/3Ob1	165	416269	3985690	21.5	10.4	0.2	8.9	1.3	11.1	0.9	41.4	6.0	51.6	Silty sand	Light brownish gray	10YR 6/2	Beta-260154	Organic sediments (black mat)	-23.1	9,065±100	-7115
FW718o-17	Lava End Locality - Lower Black Mat	III/3Ob2	180	416269	3985690	31.0	14.8	0.1	13.5	1.2	16.2	0.3	43.5	3.9	52.3	Silty sand	Light brownish gray	10YR 6/2	Beta-260153	Organic sediments (black mat)	-24.5	10,656±100	-8706
FW-CLC-8, Cg	China Lake	Cg	1204	431896	3959918	57.1	36.1	2.7	31.9	1.5	21.0	4.7	55.9	2.6	36.8	Silty sand	Light greenish gray	Gley 1 8/1					
FW-CLC-9, 06Cg	China Lake	VI/Cg	427	434038	3955277	49.1	10.7	0.3	9.9	0.5	38.4	0.6	20.2	1.0	78.2	Sandy silty clay	Greenish gray	Gley 1 6/1	Beta-280679	Organic sediments	-26.3	11,123±50	-9173
FW-CLC-9, 11Cg	China Lake	XI/Cg	1030	434038	3955277	70.8	43.8	1.2	41.8	0.8	27.0	1.7	59.0	1.1	38.1	Silty sand	Greenish gray	Gley 1 6/1	Beta-280680	Organic sediments	-24.5	17,780±50	-15830
FW-CLSB-Snails	Outlet	Surface	0	447540	3949962	0	0	0	0	0	0	0	0	0	0	---	---	---	Beta-280686	Shell-f (gastropod)	-8.0	13,387±50	-11437

* See Chapter 4, this volume

** Dates in reverse order

Table 1

Appendix D: Mineralogical Composition of Samples Analyzed.

Sample ID	Stratum	Depth	Quartz	Feldspars	Pyrite	Schist	Biotite	Tufa	Root Casts	Gypsum	Charcoal	Shell Fragments	Ostracode Fragments	Bone Fragments
		(cm bgs)												
RV-NCTP-3Cu	II/3Cu	250-260	VA	A			R	C				R	R	
RV-SCTP-3Ab	III/3Ab	200-220	A	C			R	VA	MC					
RV-SCTP-4Ob	II/4Ob	470	VA	A			MC	MC	R		C			
DSW-L#5771-5Ab	IX (X)/5Ab	102-112	A	MC	R			VA	C		R		R	
DSW-L#5771-8Ab	V (VI)/8Ab	220-225	VA	A	R		R	C	MC		VR	R	VR	
DSW-L#5771-13Ab	-I (I)/13Ab	430-450	VA	A			R				VR			
LDW1, 190-205-2Ab	II/2Ab	190-205	VA	A			VR	MC	R			R		
LDW1, 260-280-4Ab	I/3Ab	260-280	VA	A			R	C	MC	R				
LDW-L#2-2Ab	II/2Ab	30-40	VA	A			R	MC						
LDW-L#2-3ABkb	I/3ABkb	50-60	MC	MC				VA	C	A				
LDW-L#3-3Ab	V/3Ab	195-210	VA	C			R	A	MC			VR		
LDW-L#3-4Ab	IV/4Ab	260-265	C	MC			R	VA	C			VR	VR	
LDW-L#3-5Ab	III/5Ab	295-300	VA	C			R			A				
LDW-L#3-6Ab	II/6Ab	310-330	VA	C			R			A				
LDW-L#3-7Ab	I/7Ab	340-360	VA	C			R			A				
FW-CLDW-T3, 3Ab	3Ab	155	VA	C		VR	A							
FW-CLDW-T3, 5Ab	5Ab	210	VA	C			MC					VR		
FW-CLDW-T3, 7Ab	7Ab	267	VA	C				MC		R				
FW718o-11		5212-5303	VA	C			MC	C	R	MC				
FW718o-13		6279-6340	VA	C			MC	C	R	R				
FW718o-01		3048-3109	C	MC			C	VA	C	MC	VR		VR	
FW718o-02		3109-3170					MC	VA	C	C	VR	VR	VR	
FW718o-03		3170-3231					MC	VA	C	C	VR	VR	VR	
FW718o-04		5730-5791						VA	C	MC	VR		VR	
FW718o-05		2256-2316	C	MC			MC	VA	MC	A			VR	
FW718o-06		2377-2438						VA		A				
FW718o-07		671-707	VA	C				C	R	A				
FW718o-08		4023-4084	C	MC			MC	VA	R	C			VR	
FW718o-09		4084-4145	VA	MC			MC	VA	MC	C		VR	VR	VR
FW718o-10		4145-4206	A	MC			MC	VA	MC	C		VR	VR	
FW718o-12		6227-6279	A	C			VA	A	R	MC				
FW718o-14		732-808	VA	C			MC	MC	R	R			VR	
FW718o-15		2865-3018	VA	C			MC	A	MC	MC				
FW718o-16	III/3Ob1	165	C	MC			R	VA	MC	A				
FW718o-17	III/3Ob2	180	C	MC			R	VA	MC	VA				
FW-CLC-8, Cg	Cg	1204	VA	C			R	MC		R				
FW-CLC-9, 06Cg	VI/Cg	427	VA	C			C	MC		R	VR			
FW-CLC-9, 11Cg	XI/Cg	1030	VA	C			MC			R	R			
FW-CLSB-Snails	Surface	0												

Explanation of acronyms: VA = very abundant; A = abundant; C = common; MC = moderately common; R = rare; VR = very rare

Table 2

Appendix D: Paleontological Composition and Taphonomic Characteristics of Micro-invertebrates of Samples Analyzed.

Molluscs and Ostracodes were Recorded. Ostracodes are the Subject of this Study; the other Groups are only enlisted as Major Group.

Sample ID	Stratum	Depth	Ostracodes	Mollusks	Plant debris		Taphonomy Fragmentation	Abrasion	Encrustation*	Corrosion	Coating*	Redox Index	Color
		(cm bgs)	(#)	(#)	(%)		(%)	(%)	(%)	(%)	(%)		
RV-NCTP-3Cu	II/3Cu	250-260	28	2	2		10	10	0	20	0	0	Clear
RV-SCTP-3Ab	III/3Ab	200-220	0	0									
RV-SCTP-4Ob	II/4Ob	470	0	0									
DSW-L#5771-5Ab	IX (X)/5Ab	102-112	258	0	2		5	5	2	20	2	0, -2	Black, Clear
DSW-L#5771-8Ab	V (VI)/8Ab	220-225	78	42	2		2	2	2	20	2	0	Clear
DSW-L#5771-13Ab	-I (I)/13Ab	430-450	0	0									
LDW1, 190-205-2Ab	II/2Ab	190-205	0	34	2		10	10	0	10	0	0	White
LDW1, 260-280-4Ab	I/3Ab	260-280	0	0									
LDW-L#2-2Ab	II/2Ab	30-40	0	0									
LDW-L#2-3ABkb	I/3ABkb	50-60	0	0									
LDW-L#3-3Ab	V/3Ab	195-210	0	0									
LDW-L#3-4Ab	IV/4Ab	260-265	18	12	2		10	5	0	20	0	0	Clear
LDW-L#3-5Ab	III/5Ab	295-300	0	0									
LDW-L#3-6Ab	II/6Ab	310-330	0	0									
LDW-L#3-7Ab	I/7Ab	340-360	0	0									
FW-CLDW-T3, 3Ab	3Ab	155	0	0									
FW-CLDW-T3, 5Ab	5Ab	210	0	0									
FW-CLDW-T3, 7Ab	7Ab	267	0	0									
FW718o-11		5212-5303	0	0									
FW718o-13		6279-6340	0	0									
FW718o-01		3048-3109	3	0	2		30	20	5	100	100	0	White
FW718o-02		3109-3170	6	1	2		20	10	5	100	100	0	White
FW718o-03		3170-3231	2	0	2		5	2	5	100	100	0	White
FW718o-04		5730-5791	1119	0	2		15	5	15	20	100	0	White
FW718o-05		2256-2316	4	0			5	2	5	100	100	0	White
FW718o-06		2377-2438	0	0									
FW718o-07		671-707	0	0									
FW718o-08		4023-4084	21	0			15	5	5	20	100	0	White
FW718o-09		4084-4145	780	0			20	10	5	20	100	0, -1, -2	White to gray
FW718o-10		4145-4206	27	0			10	10	15	15	100	0, -1	White to light gray
FW718o-12		6227-6279	0	0									
FW718o-14		732-808	1	0			0	0	5	100	100	0	White
FW718o-15		2865-3018	0	0									
FW718o-16	III/3Ob1	165	0	0	2								
FW718o-17	III/3Ob2	180	0	0	2								
FW-CLC-8, Cg	Cg	1204	0	0									
FW-CLC-9, 06Cg	VI/Cg	427	0	0									
FW-CLC-9, 11Cg	XI/Cg	1030	0	0									
FW-CLSB-Snails	Surface	0	0	3			2	2	0	0	0	0	White

* Shells encrusted or coated by microcrystalline gypsum

Table 3

Appendix D: Ecological Requirements of Ostracode Species Recovered from China Lake, California.

Species	Habitat	Permanence	Temperature		Salinity* (mg L^{-1})	Chemistry* (meq L^{-1})		Paleo/Biogeography**
Limnocythere sappaensis Staplin, 1963	Lakes, ponds	Permanent or ephemeral	4-32°C	Eurythermic	500-100,000	6.0-10,000	Freshwater to Ca-rich	Worldwide
Limnocythere ceriotuberosa Delorme, 1967	Lakes, ponds	Permanent or ephemeral	2-32°C	Eurythermic	500-20,000	2.0-100	Freshwater to Ca-rich	Western North America
Cyprideis beaconensis (Leroy), 1943	Streams, lakes, ponds	Permanent	2-32°C	Eurythermic	5,000-10,000	0.5-1	Freshwater to Ca-rich	Western North America
Cypridopsis vidua (O.F. Müller, 1776)	Springs, streams, lakes	Permanent or ephemeral	2-32°C	Eurythermic	100-4,000	0.10-50	Freshwater to Ca-rich	Worldwide
Candona patzcuaro Tressler 1954	Springs, streams, lakes	Permanent or ephemeral	2-32°C	Eurythermic	200-5,000	0.5-30	Freshwater to Ca-rich	Worldwide
Fabaeformiscandona caudata (Kaufmann 1900)	Streams, flowing springs,lakes, ponds	Permanent	2-32°C	Eurythermic	10-5,000	0.5-10	Freshwater to Ca-rich	Across North America
Fabaeformiscandona acuminata (Fischer, 1851) Danielopol 1980	Lakes, ponds, springs	Permanent	7-25°C	Eurythermic	400-1,000	1.0-10	Freshwater to Ca-rich	Western North America but sparse
Ilyocypris bradyi Sars 1890	Streams, lakes, ponds	Permanent or ephemeral	7-25°C	Eurythermic	100-4,000	0.10-50	Freshwater to Ca-rich	Across North America
Eucypris meadensis Gutentag & Benson 1962	Springs, streams, lakes	Permanent	7-25°C	Eurythermic	300-1,000	0.7-10	Freshwater to Ca-rich	Western North America: from California to southern Nebraska
Cypridopsis okeechobei Furtos 1933	Springs, streams, lakes	Permanent	7-25°C	Eurythermic	50-800	1-5	Freshwater to Ca-rich	Across North America but sparse
Sources:								
Delorme (1969, 1989)								
Forester (1991)								
Forester et al. (2005)								
Külköylüoğlu and Vinyard (2000)								
Palacios-Fest (1994)								

Table 4

Appendix D: Total and Relative Abundance of Ostracode Species Recovered, including Adult/Juvenile (A/J) and Carapace/Valve (C/V) Ratios.

Sample ID	Stratum	Depth	Bulk Wt.	Ostracodes	Dry-Mass	*L. ceriotuberosa*				*L. sappaensis*				*C. beaconensis*				*C. vidua*				*C. patzcuaro*				*F. caudata?*				*F. acuminata*				*I. bradyi*				*E. meadensis*				*C. okeechobei*				Species 1				Paleosalinity
		(cm bgs)	(g)	#	Ostracodes/g	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	#	%	A/J	C/V	Index
RV-NCTP-3Cu	II/3Cu	250-260	100.5	28	0.3																									8	28.6	0.25	0.5	20	71.4	1	0													43
RV-SCTP-3Ab	III/3Ab	200-220	100.2																																															
RV-SCTP-4Ob	II/4Ob	470	100.2																																															
DSW-L#5771-5Ab	IX (X)/5Ab	102-112	100.7	258	2.6													13	5.0	0.69	0									13	5.0	0.08	0	53	20.5	0.70	0.08	179	69.4	0.33	0.01									-113
DSW-L#5771-8Ab	V (VI)/8Ab	220-225	100.3	78	0.8																													49	62.8	0.82	0	29	37.2	0.76	0									-12
DSW-L#5771-13Ab	-I (I)/13Ab	430-450	100.4																																															
LDW1, 190-205-2Ab	II/2Ab	190-205	100.4																																															
LDW1, 260-280-4Ab	I/3Ab	260-280	100.1																																															
LDW-L#2-2Ab	II/2Ab	30-40	99.6																																															
LDW-L#2-3ABkb	I/3ABkb	50-60	100.4																																															
LDW-L#3-3Ab	V/3Ab	195-210	99.5																																															
LDW-L#3-4Ab	IV/4Ab	260-265	100.3	18	0.2																									8	44.4	0	0					4	22.2	1	0	6	33.3	1	0.67					-189
LDW-L#3-5Ab	III/5Ab	295-300	100.6																																															
LDW-L#3-6Ab	II/6Ab	310-330	100.0																																															
LDW-L#3-7Ab	I/7Ab	340-360	99.5																																															
FW-CLDW-T3, 3Ab	3Ab	155	51.5																																															
FW-CLDW-T3, 5Ab	5Ab	210	51.4																																															
FW-CLDW-T3, 7Ab	7Ab	267	53.5																																															
FW718o-11		5212-5303	24.8																																															
FW718o-13		6279-6340	31.3																																															
FW718o-01		3048-3109	18.5	3	0.16																					3	100	0	0																					-200
FW718o-02		3109-3170	18.5	6	0.32																	3	50	0.33	0	3	50	0.33	0																					-150
FW718o-03		3170-3231	14.0	2	0.14					2	100	1	0																																					200
FW718o-04		5730-5791	11.6	1119	96.47	360	32.17	0.35	0.17	540	48.26	0.35	0.13									213	19.03	0.40	0	6	0.5	0.33	0																					173
FW718o-05		2256-2316	20.7	4	0.19	2	50	1	0	2	50	1	0																																					250
FW718o-06		2377-2438	18.6																																															
FW718o-07		671-707	30.4																																															
FW718o-08		4023-4084	23.2	21	0.91					3	14.29	1	0.67	3	14.29	0.33						4	19.05	0.25	0	11	52.38	0.18																						-81
FW718o-09		4084-4145	30.0	780	26	85	10.90	0.69	0.19	195	25	0.67	0.49	270	34.62	0.72	0.35					6	0.77	0.33	0	190	24.36	0.37	0																	40	5.13	0.38	0	52
FW718o-10		4145-4206	23.8	27	1.13	2	7.41	1	1	16	59.26	0.88	0.63	3	11.11	0.33	0					1	3.70	1	0	3	11.11	0.33	0																	2	7.41	1	0	104
FW718o-12		6227-6279	34.2																																															
FW718o-14		732-808	31.8	1	0.03																					1	100	1	0																					-200
FW718o-15		2865-3018	29.5																																															
FW718o-16	III/3Ob1	165	21.5																																															
FW718o-17	III/3Ob2	180	31.0																																															
FW-CLC-8, Cg	Cg	1204	57.1																																															
FW-CLC-9, 06Cg	6Cg	427	49.1																																															
FW-CLC-9, 11Cg	11Cg	1030	70.8																																															
FW-CLSB-Snails	Surface	0	0																																															

Appendix D: Ecological Requirements of Mollusk Species Recovered from the China Lake Legacy Project.

Species	Habitat	Permanence	Salinity*	Chemistry (in HCO_3/Ca)*	
Physa virgata (Gould, 1855)	Streams, lakes, ponds	Permanent or ephemeral	10-5,000 mg L^{-1}	1-5 mg L^{-1}	Freshwater to Ca- or HCO_3-rich
Fossaria parva (Lea, 1841)	Streams, lakes, ponds, marshes	Permanent or ephemeral or moist soil	200-5,000 mg L^{-1}	-2 to mg L^{-1}	Freshwater to Ca- or HCO_3-rich
Gyraulus parvus (Say, 1817)	Streams, lakes, ponds	Permanent or ephemeral or moist soil	10-5,000 mg L^{-1}	1-5 mg L^{-1}	Freshwater to Ca- or HCO_3-rich
Tryonia sp. Stimpson, 1865	Soft sediments, still water, springs	Permanent	1,000-2,000 mg L^{-1}	1-2 mg L^{-1}	Freshwater to Ca- or HCO_3-rich
Pseudosuccinea columella (Say, 1825)	Amphibious, weedy, lakes, streams, swamps	Permanent	NA	NA	NA
Helisoma (Carinifex) newberryi (Lea, 1858)	perennial freshwater lakes and permanent streams	Permanent (eutrophic environments)	NA	NA	NA
Pisidium casertanum (Poli, 1795)	Springs, lakes, streams	Permanent	~2,000 mg L^{-1}	~2 mg L^{-1}	Freshwater to Ca- or HCO_3-rich
NA= information not available					
Sources:					
Vokes and Miksicek, 1987					
Miksicek, 1989					
Bequaert and Miller, 1973					
Webb, 1942					
*Sharpe 2002, 2003					

Table 6

Appendix D: Total and Relative Abundance of Mollusk Species Recovered, including the Adult/Juvenile (A/J) Ratios.

Sample ID	Stratum/Horizon	Depth	Bulk Wt.	Mollusks	Dry-Mass	*P. virgata*			*Tryonia* sp.			*P. columella*			*Helisoma (Carinifex) newberryi*			*Gyraulus parvus*			*Fossaria parva*			*Pisidium casertanum*		
		(cm bgs)	(g)	(#)	Mollusks/g	#	%	A/J	#	%	A/J	#	%	A/J	#	%	A/J	#	%	A/J	#	%	A/J	#	%	A/J
RV-NCTP-3Cu	II/3Cu	250-260	100.5	2	0.02				2	100	0															
RV-SCTP-3Ab	III/3Ab	200-220	100.2																							
RV-SCTP-4Ob	II/4Ob	470	100.2																							
DSW-L#5771-5Ab	IX (X)/5Ab	102-112	100.7																							
DSW-L#5771-8Ab	V (VI)/8Ab	220-225	100.3	42	0.42	1	2.38	0	4	9.52	0													37	88.10	0.19
DSW-L#5771-13Ab	-I (I)/13Ab	430-450	100.4																							
LDW1, 190-205-2Ab	II/2Ab	190-205	100.4	34	0.34										34	100	0.09									
LDW1, 260-280-4Ab	I/3Ab	260-280	100.1																							
LDW-L#2-2Ab	II/2Ab	30-40	99.6																							
LDW-L#2-3ABkb	I/3ABkb	50-60	100.4																							
LDW-L#3-3Ab	V/3Ab	195-210	99.5																							
LDW-L#3-4Ab	IV/4Ab	260-265	100.3	12	0.12							1	8.33	0	3	25	0	4	33.33	0	4	33.33	0			
LDW-L#3-5Ab	III/5Ab	295-300	100.6																							
LDW-L#3-6Ab	II/6Ab	310-330	100.0																							
LDW-L#3-7Ab	I/7Ab	340-360	99.5																							
FW-CLDW-T3, 3Ab	3Ab	155	51.5																							
FW-CLDW-T3, 5Ab	5Ab	210	51.4																							
FW-CLDW-T3, 7Ab	7Ab	267	53.5																							
FW718o-11		5212-5303	24.8																							
FW718o-13		6279-6340	31.3																							
FW718o-01		3048-3109	18.5																							
FW718o-02		3109-3170	18.5	1	0.05										1	100	0									
FW718o-03		3170-3231	14.0																							
FW718o-04		5730-5791	11.6																							
FW718o-05		2256-2316	20.7																							
FW718o-06		2377-2438	18.6																							
FW718o-07		671-707	30.4																							
FW718o-08		4023-4084	23.2																							
FW718o-09		4084-4145	30.0																							
FW718o-10		4145-4206	23.8																							
FW718o-12		6227-6279	34.2																							
FW718o-14		732-808	31.8																							
FW718o-15		2865-3018	29.5																							
FW718o-16	III/3Ob1	165	21.5																							
FW718o-17	III/3Ob2	180	31.0																							
FW-CLC-8, Cg	Cg	1204	57.1																							
FW-CLC-9, 06Cg	VI/Cg	427	49.1																							
FW-CLC-9, 11Cg	XI/Cg	1030	70.8																							
FW-CLSB-Snails	Surface	0	0	3											3	100	1									

Table 7

Appendix D: Stable Isotope Data Obtained from Valves of Ilyocypris bradyi Present in Rose Valley, North Caltrans Pit and Dove Springs Wash.

Two batches of five specimens were clustered from the Dove Springs Wash to generate replicates to improve the paleoclimate signature.

Sample ID	Stratum/Horizon	Depth	$d^{13}C$ VPDB			C std dev			$d^{18}O$ VPDB			O std dev			Remarks
		(cm bgs)	Replica 1	Replica 2	Average	Replica 1	Replica 2	Average	Replica 1	Replica 2	Average	Replica 1	Replica 2	Average	
RV-NCTP-3Cu	II/3Cu	250-260	-3.85	---	-5.69	0.021	---	0.021	-7.54	---	-7.54	0.052	---	0.052	$d^{18}O$ values in shells reflect changes in water $d^{18}O$ rather than temperature. Increasing aridity at this time.
DSW-L#5771-5Ab	IX (X)/5Ab	102-112	-11.79	-11.54	-11.67	0.020	0.028	0.024	-9.52	-9.11	-9.31	0.053	0.041	0.047	Increasing winter precipitation or less evaporation. Less evaporation is inferred for the site at this time.
DSW-L#5771-8Ab	V (VI)/8Ab	220-225	-10.66	-10.85	-10.75	0.013	0.009	0.011	-9.93	-10.02	-9.98	0.040	0.037	0.039	Increasing winter precipitation or less evaporation. Less evaporation is inferred for the site at this time.

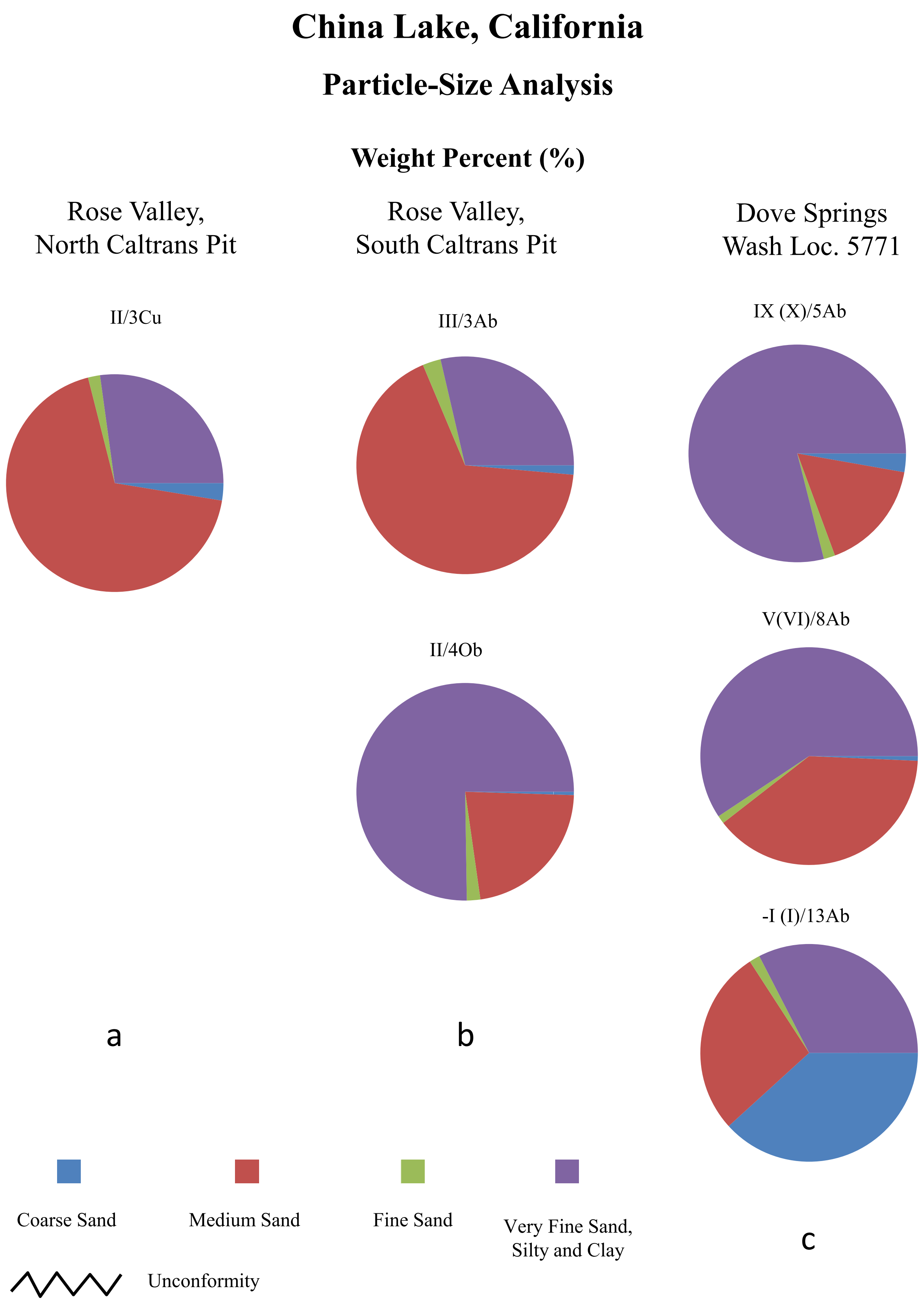

FIGURE 1.
Particle-size analysis of: (a) Rose Valley, North Caltrans Pit; (b) Rose Valley, South Caltrans Pit; (c) Dove Springs Wash Locality #5771.

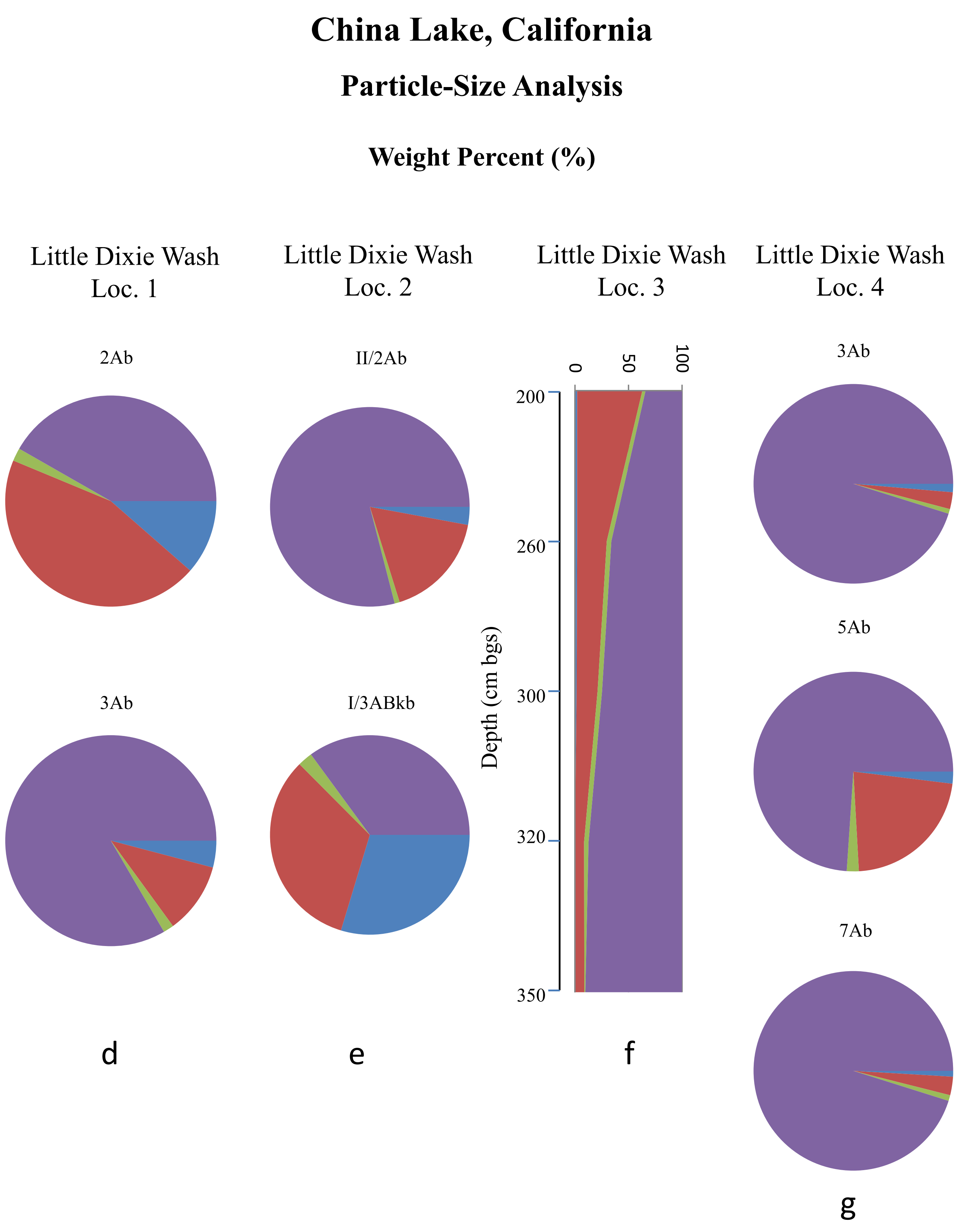

FIGURE 1 *continued*.
(d) Little Dixie Wash, Locality #1; (e) Little Dixie Wash, Locality #2; (f) Little Dixie Wash, Locality #3; (g) Little Dixie Wash, Locality #4

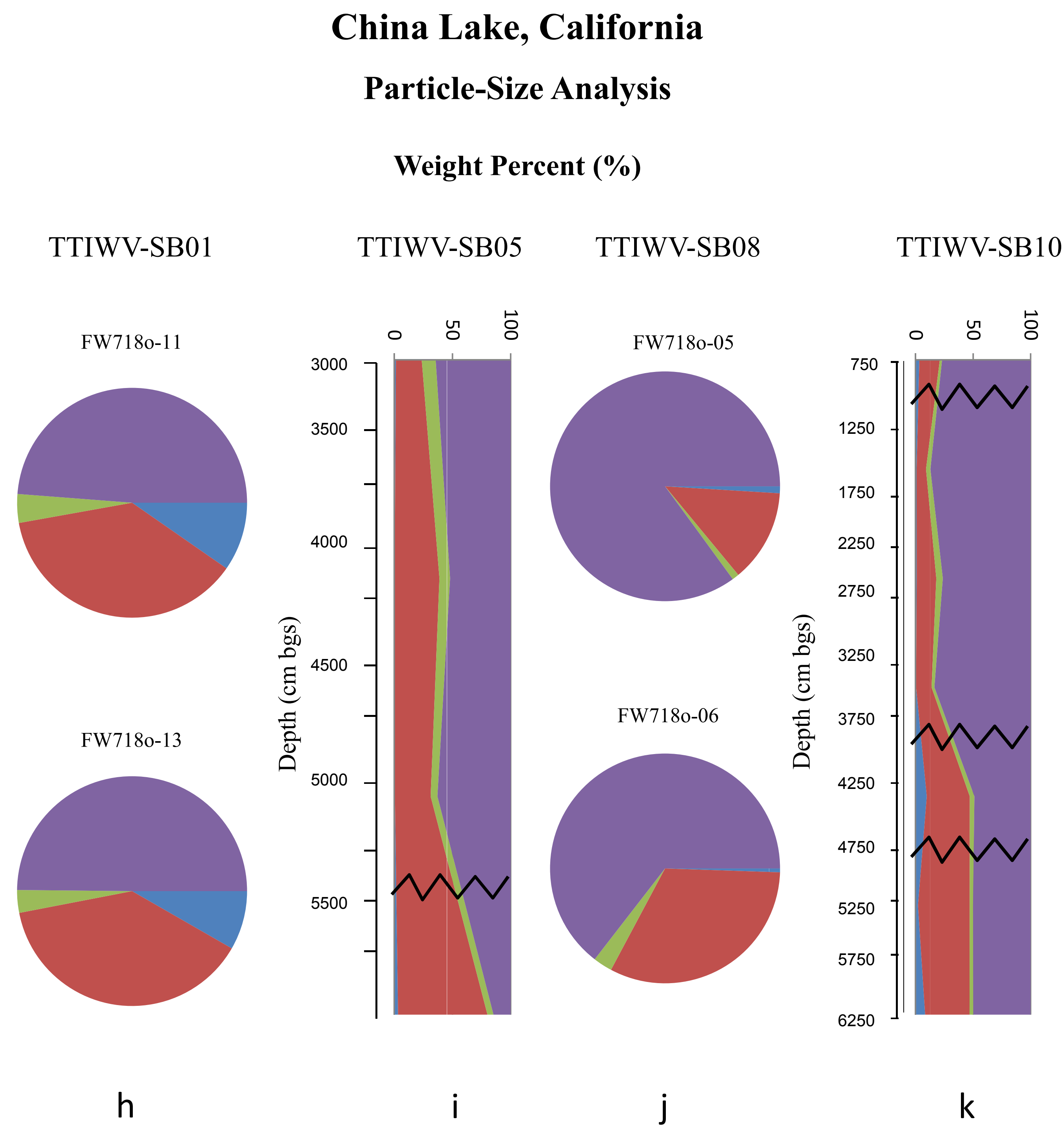

FIGURE 1 *continued.*
(h) bore hole TTIWV-SB01; (i) bore hole TTIWV-SB05; (j) bore hole TTIWV SB08;
(k) bore hole TTIWV-SB10

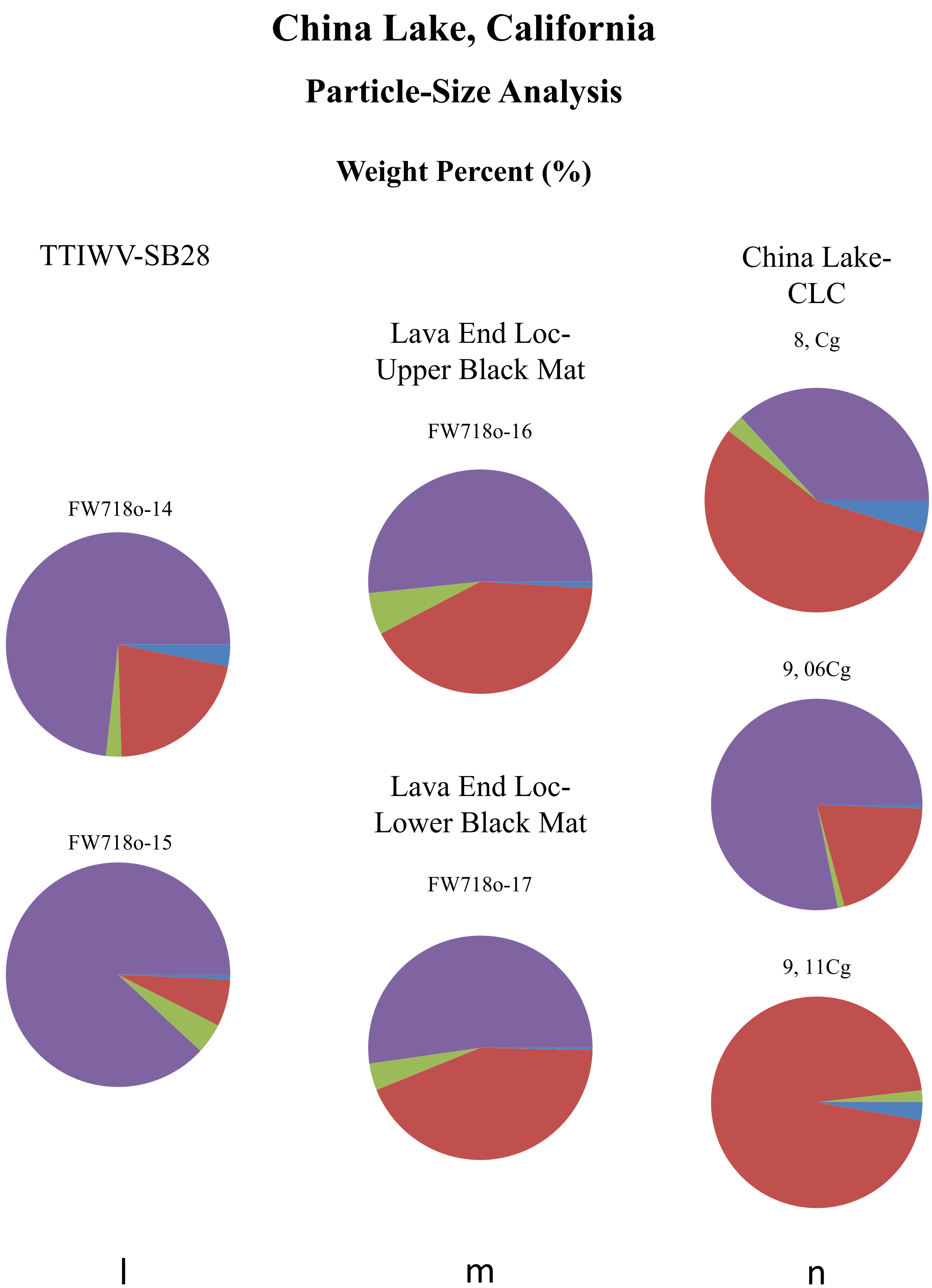

FIGURE 1 *continued*.
(l) bore hole TTIWV-SB28; (m) Lava End Locality- Upper Black Mat and Lower Black Mat; and (n) bore holes CLC-8 and 9. Particle-size analysis is described in the text.

China Lake, California

RV-NCTP-3Cu

(Rose Valley, North Caltrans Pit)

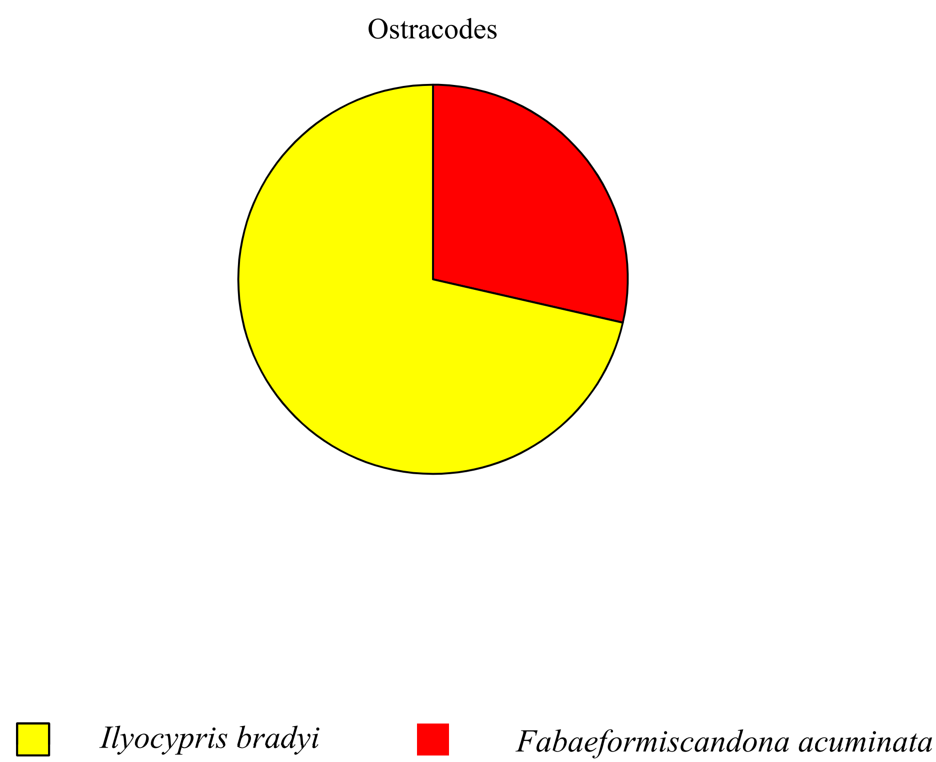

FIGURE 2a.
Micro-invertebrate relative abundance of: Rose Valley, North Caltrans Pit

China Lake, California

DSW-L# 5771 (Dove Springs Wash)

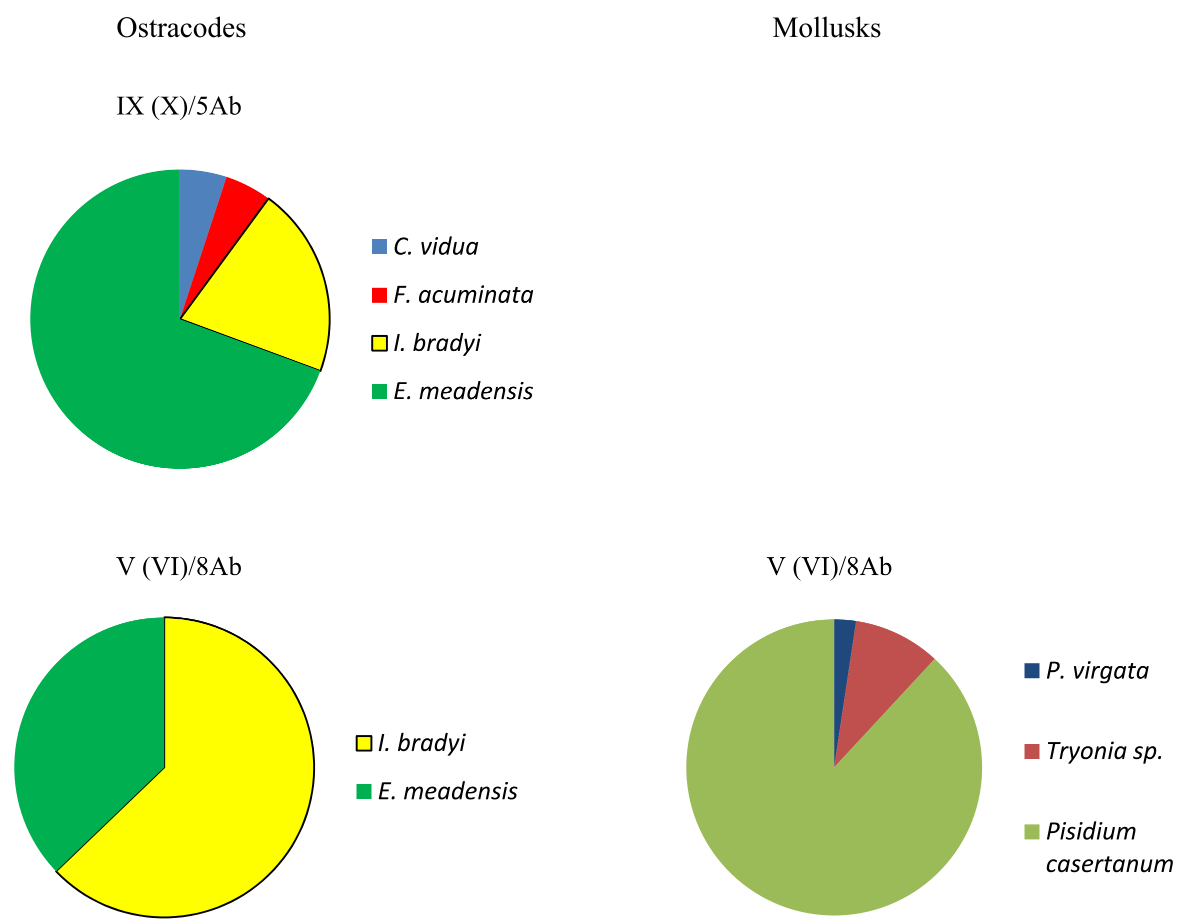

FIGURE 2b.
Micro-invertebrate relative abundance of: Dove Springs Wash Locality #5771

China Lake, California

LDW-L# 3 (Little Dixie Wash)

Horizon 4Ab

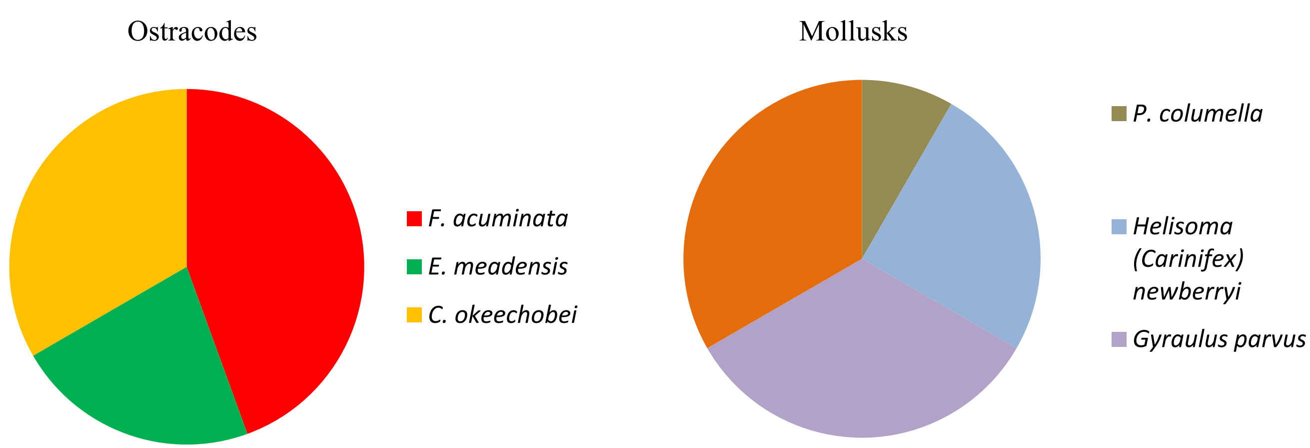

FIGURE 2c.
Micro-invertebrate relative abundance of: Little Dixie Wash, Locality #3

China Lake, California

TTIWV-SB05

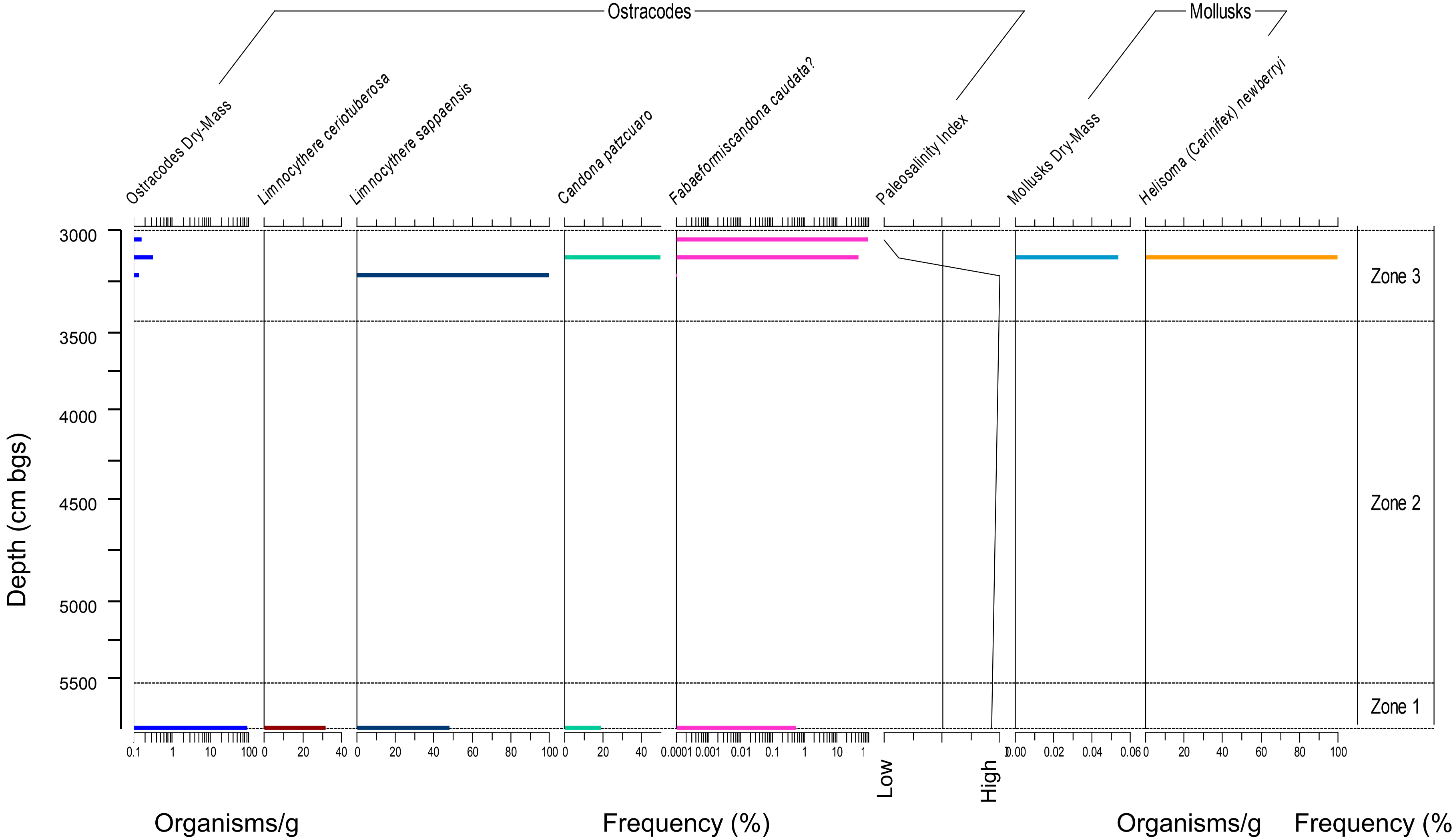

FIGURE 2d.
Micro-invertebrate relative abundance of: Bore hole TTIWV-SB05

China Lake, California

TTIWV-SB08

FW718o-05

Ostracodes

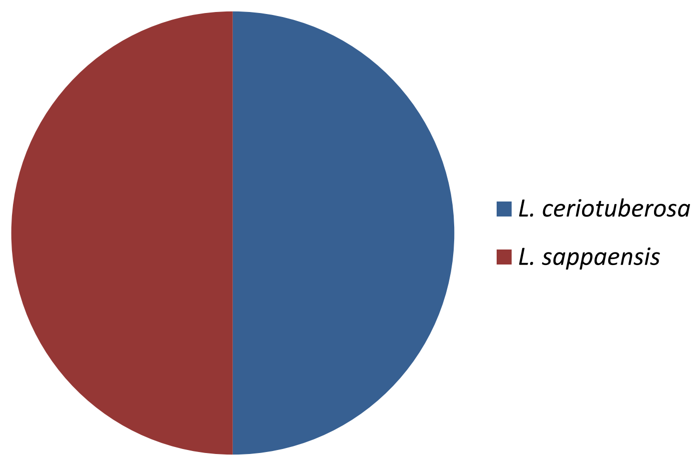

FIGURE 2e.
Micro-invertebrate relative abundance of: Bore hole TTIWV-SB08

China Lake, California

TTIWV-SB10

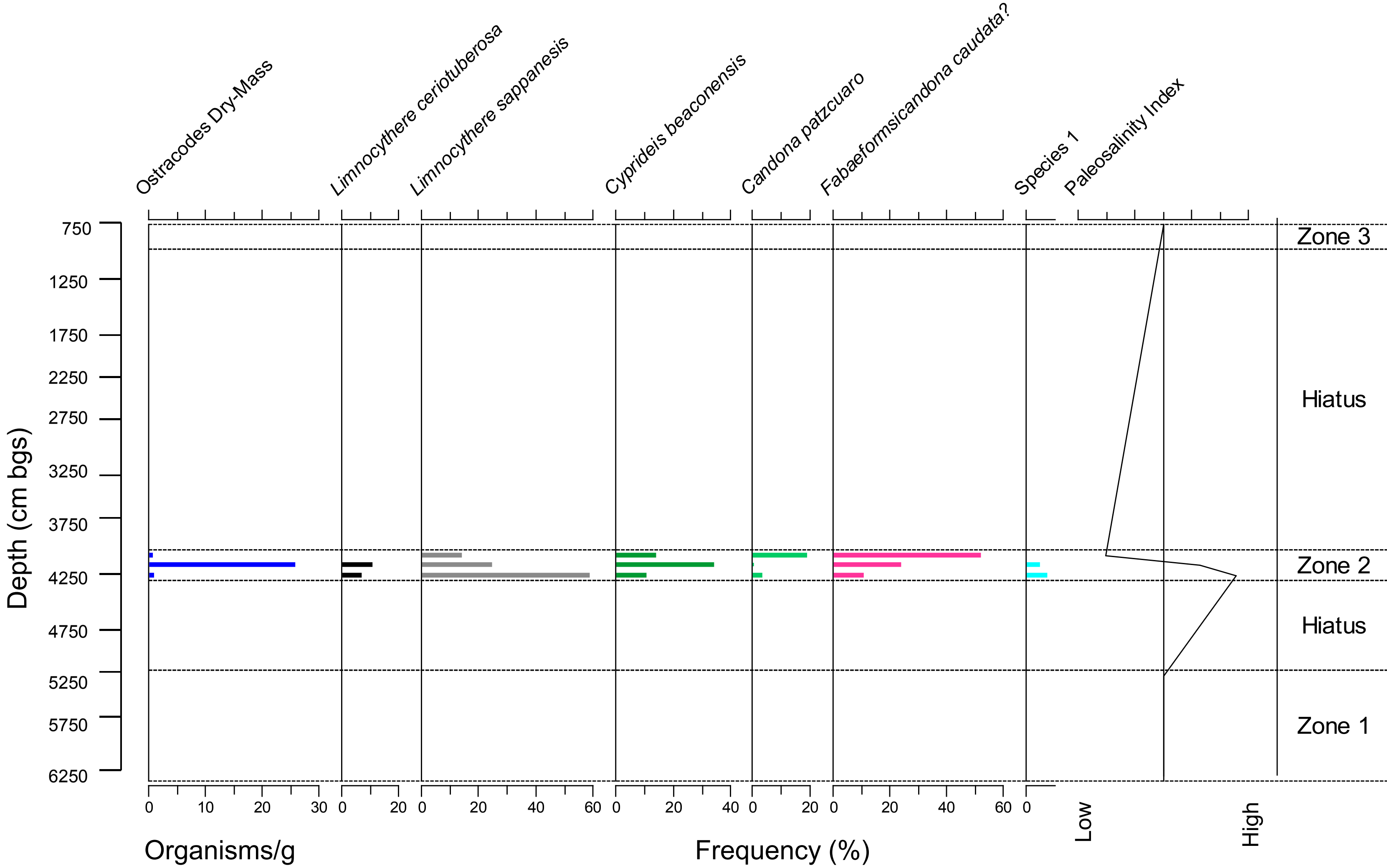

FIGURE 2f.
Micro-invertebrate relative abundance of: Bore hole TTIWV-SB10.