A GEOARCHAEOLOGICAL APPROACH FOR INVESTIGATIONS IN THE CACHE CREEK PRIMITIVE AREA, BUREAU OF LAND MANAGEMENT, UKIAH FIELD OFFICE

ALEX DEGEORGEY
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Chico, CA 95928In the Cache Creek Primitive Area, Paleo-Archaic archaeological remains are expected to exhibit a spatial and temporal patterning as provided by late Pleistocene and early Holocene erosional surfaces. Detailed knowledge of soils information and geomorphology in the project area will allow better prediction and evaluation of archaeological sites during survey and testing phases of research. Until such a study is conducted at a regional scale, inferences with regard to settlement pattern, mobility, or subsistence strategy cannot fully be developed.

INTRODUCTION

The following paper offers a research design for identifying sites of significant antiquity within the Cache Creek Primitive Area (CCPA) by implementing principles of geomorphology. Soils are integral parts of the landscape and reflect the passage of time for stable surfaces. This consideration of soils as intimate components of the landscape is an approach less commonly employed or understood in archaeological contexts. Archaeological research in alluvial settings must be a fully interdisciplinary effort to maximize our understanding of archaeological records and their contexts.

The antiquity and potential for the presence of single-component assemblages within the Cache Creek Primitive Area is quite remarkable. Single-component sites are critical to defining artifact assemblages and for chronology building. The Paleo-Indian Period is of particular interest to archaeologists, in California and internationally. Although there are controversial sites and theories suggesting older human activites, the earliest, widely accepted dates for human entrance into western North America are 11,500-11,000 years before present (Willig and Aikens 1998). Traces of this age are rare, amounting to a handful of isolated artifacts and a few sites statewide. Identification of sites from this age will enable seminal investigations into Paleo/Archaic Period settlement systems, mobility patterns, subsistence economies, material culture, chronology, or assemblage composition.

ARCHAEOLOGICAL CONTEXT

The Paleo-Archaic prehistory of the central North Coast Ranges shows that there are very few archaeological traces of this age and no sites with well-defined single components. The Borax Lake site, CA-LAK-36, was originally recorded by M. R. Harrington (1948). Subsequent limited analysis was conducted by Clement W. Meighan and C. Vance Haynes (1968, 1970). The body of our knowledge concerning Paleo-Archaic adaptations and lifeways in this region is derived primarily from this site.

Chester Post, an avocational archaeologist, discovered the Borax Lake site in 1935. Post collected 18 fluted projectile points from the surface of the site and conveyed his findings to Harrington of the Southwest Museum, Los Angeles. Harrington recognized the fluted points as similar to ones found in association with extinct Pleistocene animals elsewhere in North America. Harrington immediately mounted an investigation at Borax Lake, beginning in 1936 and ending ten years later. Although Harrington failed to recover additional fluted points, other diagnostic artifacts were recovered, including chipped stone crescents, large stemmed projectile points which were designated as "wide-stemmed Borax Lake" points, and a variety of other stylistic and functional artifact types (Harrington 1938). Subsequent field seasons and extensive trenching revealed just two more fluted projectile point fragments and a variety of other artifact forms representing different temporal components of the deposit (Harrington 1938, 1948).

Alex DeGeorgey, California State University, Chico
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Meighan and Haynes (1969, 1970) conducted an obsidian hydration study coupled with geoarchaeological investigations to better understand the stratigraphic integrity of the archaeological record at LAK-36. Excavation with backhoe revealed that the deposit was situated on an alluvial fan that may have created a secondary deposit of Paleo-Indian artifacts via a mudslide. No satisfactory soil stratigraphy was observed in the trenches, suggesting the deposit to be mixed—i.e., lacking any definitive stratigraphic integrity (Meigan and Haynes 1969, 1970). The Borax Lake site has yet to produce horizontal or vertical stratigraphic contexts for these materials, and therefore no additional artifact types (such as ground stone) may be safely assigned to the assemblage.

Obsidian hydration testing of a substantial potion of chipped stone artifacts produced a relative dating sequence for the site. Fluted points and chipped stone crescents had thick rim values (8.3-9.7 microns), followed by the Borax Lake wide-stems (7.0-7.4 microns) and then by dart-sized, unfluted, concave-based points (6.5-3.7 microns) (Meigan and Haynes 1969, 1970).

The Meighan and Haynes analysis marked the beginning of an extensive local serration using the obsidian hydration method. The Clear Lake Basin hydration data set presently boasts more than 4,000 rim readings (White 1999b). Presently no absolute dates have been established for this or other Paleo-Indian finds from northern California; however, age estimates that range between 9,000 and 11,500 years B.P. are widely accepted (Fredrickson and White 1988; Moratto 1984; White 1999b). In his synthesis of North Coast Range prehistory, Fredrickson (1974, 1984) recognized three successive occupation phases at the Borax Lake site. The Clovis-like pattern is termed the "Post Pattern," after site discoverer Chester Post, and is dated to 10,050-9050 B.C. (12,000-11,000 years B.P.). The next occupation phase is the Borax Lake Pattern, generally dated to 6050-4050 B.C. (8000-6000 B.P.) The last component dates to 3050-1050 B.C. (5000-3000 B.P.) and is similar to the archaic "Middle Central California Complex." Studies by Fredrickson and White (1988:81) and Fredrickson and Origer (1996) ***not in bibliography*** have demonstrated the appearance of cultural activity in the basin at 10.0 microns, inferring a time span of 12,000 to 9000 years B.P.

CACHE CREEK PRIMITIVE AREA

The Cache Creek watershed and surrounding areas have long been known to be rich in archaeological resources. Marlene Greenway (BLM, Ukiah District) first discovered and recorded sites CA-LAK-1580 and -1581 as light lithic scatters of obsidian with ground stone. She proposed that either LAK-1581 was an activity area associated with LAK-1580, or they were two loci of the same site. Greenway also noted that the sites occurred on a landform with potentially significant antiquity and distinctive reddish clay soils (1988:89). She was the first to note the connection between terrace elevation and archaeological site antiquity within the Cache Creek Primitive Area.

Elaine-Maryse Solari (1994) conducted a regional study of the Cache Creek area in order to identify prehistoric sites for nomination to the National Register of Historic Places. This work resulted in the nomination of 35 sites to the National Register, including three sites that are thought to have components that date to the Paleo-Indian Period. Upon revisiting LAK-1580/1581, Solari described these sites as light to moderate lithic scatters comprised of flakes and tool fragments, and including at least two obsidian source materials. A total of 28 obsidian artifacts were surface collected for hydration testing. Twenty of these specimens produced rim values in the 8.2-13.7 micron rang,e with a mean 9.33 microns (sd = 1.25). These values imply extraordinary antiquity for LAK-1580 /1581. Solari suggested that these sites may represent deposits as old as 9000-7000 years B.P. (1994:115-116).

A geoarchaeological survey conducted by Jack Meyer (1994) provided a model for local landform development. A basic alluvial landform pattern of lateral erosion and valley formation was noted. Entrenchment and down-cutting of the creek corridor resulted in creation and isolation of landscapes, including terraces, uplifted benches, and truncated alluvial fans. These landform features provided potential locations for human occupation during the late Pleistocene and early Holocene (Meyer 1994). Many of these landforms today bear evidence of prehistoric human occupation.

Together, the chronological distribution of sites provided by Solari and the landform evolution data generated by Meyer provide a model of the relationship between archaeological site formation and landform evolution. Meyer's findings demonstrated the inevitable relationship between baseline erosion, deposition, and archaeological age in the canyon in relation to the creek's capacity to impact deposits at or near its flow.

LAK-1580/1581 are situated on a high terrace overlooking the confluence of the Main and North forks of Cache Creek. These two drainages constitute the heart of the Cache Creek Primitive Area. Recent excavations at LAK-1580 were conducted, by the author and Greg White of the CSU, Chico Archaeological Research Program, to understand the nature and extent of the archaeological deposit. Surface Transect Units (STUs) were situated every five meters across the site in order to identify discrete artifact concentrations. Investigations revealed higher relative frequencies of artifacts along the western portions. A series of 12 conjoining units was opened to intensively expose this area. High frequencies of flaked stone artifacts and numerous ground stone artifacts were observed in concentrations suggestive of a living area. Obsidian hydration analysis was conducted by the Northwest Research Obsidian Studies Laboratory, on 124 artifacts visually sourced to the Borax Lake locality. The resulting hydration profile shows a relatively normal distribution, with a mean 7.02 microns. The hydration evidence along with the artifact assemblage suggests LAK-1580 to be a mostly Lower Archaic deposit. However, an estimated 15% of the sample may be of Paleo-Indian age.

The geomorphologic position of LAK-1580/1581 is significant for the forthcoming investigation. Meyer's previous findings described these sediments as highly weathered, reddish soils developed on the terrace, as an apparent Alfisol with a well-developed Bk horizon (1994:244). These are old soils that have undergone weathering and other processes that result in the translocation of clays and silts to form an argillic "Bk" (carbonate-rich or "caliche-layer") horizon. Meyer defined this as a clear paleosol that would indicate a minimum of 4,000 years of development or perhaps significantly more. The correlation of the paleosol and obsidian hydration readings indicates that this landform likely would have been available throughout the late Pleistocene-Holocene.

GEOLOGICAL CONTEXT

The bedrock geology of the Cache Creek area consists mainly of extremely unconsolidated, friable Plio-Pleistocene lucustrian sediments. These lakebed deposits are likely from an ancestral Clear Lake (Brice 1953). The Cache Creek drainage has been subject to consistent down-cutting and persistent baseline erosion. These conditions have left a number of heavily weathered terraces as "landscape artifacts" suspended on the heavily-sculpted canyon walls of Cache Creek.

Rymer divided these ancient sediments into spatial and temporal units. The oldest, the Cache Formation, is comprised of ultramafic and silica carbonate gravels and sands primarily of fluvial origin. Cache Formation sediments range in age up to 1.8 – 3.0 million years and can be 1,500 meters thick (Rymer 1981; Rymer et. al. 1988). The Cache Formation is a sequence of transported freshwater sediments that were subsequently uplifted and dissected to form the hills of the Clear Lake highlands. Subsequent Plio-Pleistocene alluvial and colluvial landforms were derived from this highly weatherable, unconsolidated sediment assemblage of poorly sorted cobbles, gravels, sand, and silt (Manson 1989).

There is evidence to suggest that significant changes occurred in the main fork of the Cache Creek drainage basin during the late Pleistocene or early Holocene. Historically, the Main Fork of Cache Creek has been Clear Lake's sole outlet; however, geomorphic and paleo-biological evidence indicate that through much of the Pleistocene, the lake's outlet flowed west through Cold Creek Canyon to the upper Russian River (Brice 1953; Sims et al. 1988). Current evidence suggests the shift occurred around 11,000 B.P.

There are two arguments for this change. The first, by Davis (1933), postulates that during the late Quaternary the main basin of Clear Lake primarily drained west along Cold Creek, with secondary drainages at Cache Creek. At some point a "lava flow " at Red Banks blocked the

Cache Creek drainage, causing the eastern arms to pond and thereby diverting all water to the main drainage to the west. Following this change, perhaps as recent as a few hundred years ago, a massive landslide in Cold Creek near Blue Lakes blocked the western drainage entirely. Subsequent lake levels rose sufficiently to breech the eastern blockage. The breech created the deeply cut and steep-walled Red Bank Gorge of Cache Creek and modeled the contemporary shape of Clear Lake and the Cache Creek basin (Davis 1933).

The second argument cites a combination of tectonic uplift and rapid down-cutting resulting in the reversal of outlets. In her study of the geomorphic history of Clear Lake, C. Hodges (1966) examined the development of the North and Main Forks of Cache Creek. Hodges suggested that tectonic uplift induced the rapid down-cutting and headward migration of the North Fork of Cache Creek through poorly consolidated Cache Formation sediments. The progressive upstream sediment removal continued until intersecting Clear Lake. This essentially reversed the outtake flow to the eastern end of the lake and generated the North Fork of Cache Creek (Hodges 1966).

Research by Hodges (1966) and others has further documented landform history in the Cold Creek drainage (Rymer et al. 1988). Hodges argues that the erosional maturity of the Cold Creek landslide indicates several thousand years of disturbance, suggesting an age of 10,000-5000 B.P. for the original event (Hodges 1966:155). This work has not fully supported Davis's proposal of a more recent antiquity for the Cold Creek landslide. Further, additional geological mapping has determined that the Red Bank Gorge outcrop is in fact not lava, but limonite-stained marl and sediments attributable to the Lower Lake Formation (Brice 1953; Rymer 1981). Consistent with other Lower Lake Formation deposits, the Red Bank outcrop is uplifted and titled. Thus, this formation must have been in existent for a considerable time, and tectonics, rather than a "lava flow," was a more likely cause for the blockage of the eastern drainage of Clear Lake.

Extensive studies of the late Quaternary climate, tectonics, and sedimentation in the Clear Lake basin have clarified some issues concerning the geomorphology and paleoenvironment. Based on sediment cores taken from the lake bottom, it was determined that the lake did not reach its present configuration until about 3,500 years ago (Sims et al. 1988). This information can be applied to the understanding of Holocene geomorphology and terrace sequence development in the CCPA.

METHODS

We propose to implement a survey strategy that will incorporate existing regional soil survey maps, aerial photography, and geomorphological techniques with archaeological field methods. Late Quaternary soil-stratigraphic frameworks will be used to prioritize the survey area. The relationship between archaeological site antiquity and landform evolution processes has been noted elsewhere (Greenway 1988; Meyer 1994; Solari 1994; White 1999b). This investigation will identify especially sensitive landforms, such as alluvial terraces, that would have been available for late Pleistocene and early Holocene occupation.

The initial landscape setting and resource distribution play a critical role in human behavioral systems. Where humans will live and what forms of behavior will occur is in many circumstances a result of the landscape context. These conditions made a particular functional activity possible and provided the circumstances, which later transformed or preserved the artifactual evidence of human behavior (Rapp and Hill 1998: 50). Therefore, the character and spatial distribution of particular activities as reflected in the archaeological record is largely dependent upon the original site setting. This setting also influences the visibility and preservation of the human record.

A set of geoarchaeological principles is incorporated into the proposed multidisciplinary research. Archaeological deposits on landforms may contain materials of relative age to the landform in which they are embedded. Landforms that have remained stable since the late Pleistocene have been available for human occupation throughout the entire span of human prehistory in the CCPA. Certain colluvial and alluvial landforms were generated during the Holocene Epoch and therefore were available only for a limited span of time. Thus, landforms of too recent an age can effectively be eliminated from the survey area.

Alluvial terraces are formed when a flood plain is abandoned through stream incision, thereby isolating terrace surfaces from continued flooding. In general, soils on successively higher terraces should exhibit increasingly stronger profile development and well-developed Bk or Bt horizons. Field recognition of age-related soil properties plays a potentially important role in assessing formation processes. Archaeological sites associated with alluvial terraces can be classified into two broad categories: buried terrace sites and surface terrace sites. A buried terrace site is clearly covered with alluvial fill. These sites were occupied and buried under the antecedent floodplain prior to terrace genesis. Surface terrace sites occur on or near the ground surface and are divided into those that were occupied on an active floodplain before terrace genesis, and those that were occupied after terrace genesis, on a stable surface (Ferring 1992:24). These are "Antecedent" and "Subsequent" sites, respectively.

Generally, prehistoric peoples located their flood-plain settlements based upon the prevailing locations of habitats. Flood-plain settlements, wich are surface antecedent sites, may have sediments, soils, or depositional geomorphic features that should yield information about the original site setting. In contrast, when settlements were located on existing terraces, the occupants may have considered habitats on the terraces and the adjacent flood plain. For the purposes of regional settlement-pattern studies, the difference between antecedent and subsequent terrace sites are significant. However, antecedent and subsequent surface sites may be difficult to distinguish without independent control over the age of the archaeological assemblage, the age of the terrace, or both (Ferring 1992: 25).

Landforms do not always remain stable. Large-scale erosion in the valley may have removed the more sensitive portions of landforms available for late Pleistocene and early Holocene human occupation. Therefore, identification of landforms of appropriate age may represent the less-sensitive portion or fragment of the original landform. The structure and completeness of the archaeological record are determined in part by the inherent stability of certain landforms and the larger geological processes responsible for the evolution of these landforms. Any given landform may have been occupied continuously, intermittently, or not at all through the course of human prehistory. Absence of deposits from particular periods may be the result of cultural changes, geologic changes, or both. Until a regional study is conducted that establishes a chronology of differential landform preservation in a region, it will be difficult to determine to what extent natural or cultural processes have structured the archaeological record (Meyer 1994: 247-248).

Prior mapping of soils, sequences of terrace development, and knowledge of differential landform preservation will provide the best means for modification of site discovery strategies, analysis of archaeological deposits, and interpretation of regional site- settlement patterns.

RESEARCH PROBLEMS

PROBLEM 1: FLAKED STONE TOOLKITS AND MOBILITY PATTERNS

We propose a method of investigation designed to correlate flaked stone technologies in archaeological contexts to past economic behaviors. This analysis will focus on issues of settlement, subsistence, and exchange activities. Flaked stone reduction strategies are assumed to represent patterns in the archaeological record to the extent that the organization of technology and settlement was also patterned. Patterns formed by the transportation of lithic materials will be especially evident in the reduction trajectories and the economics of production and discard of individual tool types. Clearly the pattern of flaked stone use and discard would shift most radically in relation to mobility patterns (Binford 1979; Schiffer 1972; White 1989, 1999b).

The present dominant paradigm for Paleo-Archaic settlement-subsistence patterns assumes high residential mobility and long-distance travel (Fredrickson and White 1988; Kelly and Todd 1988; Moratto 1984). This settlement system should result in distinctive toolkits designed for travel, with tools and materials carried along for use at sites en route. Therefore toolstone procurement, manufacture, use, maintenance and discard should express a response to contingencies including: rate of use, intensity of use, tool configuration, anticipated activity, toolstone quality, and availability of lithic resources (Binford 1979; Kelly 1988; White 1984, 1989). Sites in the Cache Creek drainage within the proximity of obsidian quarries (11 air miles) should yield an assemblage more heavily configured by local toolstone materials. In general, tools are discarded when they are broken beyond utility or when opportunities to replace them are present. An analysis of regional mobility patterns in reference to the importance of local lithic resources can yield evidence indicative of relative mobility over time and, potentially, directionality or pattern of movement (Gramly 1980; Kelly 1988; White 1989, 1999b).

We expect that non-local materials will be transported to a site in functional or final form. Thus, non-local toolstone should be dominated by late-stage reduction debris; e.g., late biface thinning flakes, pressure flakes, and broken, discarded formed tools. Conversely, materials from local sources (Borax Lake) are expected to be indicative of manufacturing and early-stages of reduction. Higher frequencies of cortex, late core reduction and early biface thinning flakes are expected.

Data Needs: Investigation of flaked stone toolkits and mobility patterns will require collection of the following data from the site vicinity.

- Flaked stone samples representative of the extent and variability of tool production, use, and discard at the site.
- Chronological indicators such as stylistically diagnostic artifacts or obsidian artifacts suitable for hydration analysis.

PROBLEM 2: HUMAN OCCUPATION AND LANDSCAPE EVOLUTION

One way that terraces can form is by erosion of the stream-valley fill. Erosion or incision into the fill during a new cutting episode results in a new, lower stream course. Archaeologists have applied the concept of stream cut-and-fill episodes to help determine the age of artifacts. Although this is not always the case, generally the highest terrace surfaces are the oldest; the lower and closer to the present-day stream channel, the younger they are. Thus, artifact forms and features found exclusively on a particular terrace surface have value as chronological markers. In addition, the presence or absence of certain artifact types may be explained as the result of the dynamics of terrace formation rather than of past human behavior (Rapp and Hill 1998: 61).

Meyer's (1994) investigation attempted to correlate contemporary landform surfaces based upon type, geomorphic position, and soil development. His methods and results provided a preliminary means of relative dating, lacking the time resolution needed by most archaeologists. Meyer made the following recommendations for future research, designed to improve our understanding of the relationship between landscape evolution and the structure of archaeological deposits within the Cache Creek Primitive Area (1994:247).

1) Since existing maps of the late Quaternary geology of the CCPA do not adequately distinguish among Holocene deposits of different ages, further work is required to map, date, and correlate the distribution of these deposits.
2) Subsurface testing at selected locations should be conducted to determine the vertical distribution of the late Quaternary deposits.
3) Future investigation should combine relative dating techniques such as obsidian hydration and soil development with absolute dating techniques such as Carbon 14 to establish relationships and landscape-evolution chronologies.
4) Future studies should consider the combined influences of paleoclimate, soil formation, and landscape evolutions on the structure of the archaeological record within the Cache Creek Primitive Area (Meyer 1994:247).

Interpretation of archaeological remains associated with specific depositional settings relies mainly on an evaluation of the destructive and preservative processes prevalent in particular sedimentary contexts and how they affected the archaeological record (Rapp and Hill 1998:54). It is essential that studies of formation process come to be conducted at a regional scale, for unless the genesis of sedimentary deposits is understood, one cannot infer the behaviors of interest from the artifact patterns represented by those deposits. Regardless of how much evidence is present, the archaeologist cannot read behavior and organization directly from the patterns discovered in the archaeological record (Schiffer 1983).

However, because the formation processes themselves exhibit patterning, the distortions can be understood using appropriate analytic and inferential tools built upon our knowledge of the laws governing these processes.

Data Needs: Investigations of landscape evolution and site-formation processes within the Cache Creek Primitive Area require collection of the following data.

Recording of soil profile development on terraces should be conducted to determine the horizontal and vertical distribution of late Quaternary deposits. This will require inspection of cut-banks and subsurface testing on specific landforms.

Identification and assessment of nonarchaeological deposits with the potential to yield datable geologic deposits and/or evidence of paleoenvironmental changes or events.

Collection of datable archaeological objects from particular landforms to establish stratigraphic relationships and landscape evolution chronologies. Surface collection of obsidian, stylistically diagnostic artifacts, or radiocarbon C14 samples appropriate for assigning temporal designations to landforms.

CONCLUSION

In the Cache Creek Primitive Area, Paleo-Archaic archaeological remains are expected to exhibit a spatial and temporal patterning as provided by late Pleistocene and early Holocene erosional surfaces. Detailed knowledge of soils information and geomorphology in the project area will enable better prediction and evaluation of archaeological sites during survey and testing phases of research. Until such a study is conducted at a regional scale, inferences with regard to settlement pattern, mobility, or subsistence strategy cannot fully be developed. The development of regional data potentially allows archaeologists to alter the scale of analysis, zooming in on a particular locality, or pulling back to take in the entire region.

The development of these data sets also allows the quantitative and qualitative comparison of archaeological manifestations in a wide variety of areas. Archaeological endeavors should be fully interdisciplinary, in order to maximize our interpretations of the archaeological record and their contexts. This research will lead to new discoveries that ultimately will broaden our understanding of this important but little known period of human prehistory.

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