The Clear Lake Basin and Early Complexes in California's North Coast Ranges

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INTRODUCTION

The early cultures of California's North Coast Ranges, which include most of the mountainous coastal strip between San Francisco Bay and the Oregon border, have been of interest for almost 50 years, since investigations by M. R. Harrington (1948) at the Borax Lake site in Lake County revealed the presence of Clovis-like fluted projectile points, bifacially flaked crescents and other flaked tool forms believed then to have an antiquity of 10,000 years or more. More recently, the Mostin site, located in the Clear Lake Basin just 12 kilometers west of the Borax Lake site, has stimulated interest because of age determinations that range between about 7,000 and 11,000 years before the present coupled with midden deposits, fire hearths, numerous chipped stone and bone implements, and many human graves (Moratto 1984:100-101).

In the present paper, we briefly summarize the archaeological finds within the Clear Lake Basin that suggest human occupation during the Paleoindian and Lower Archaic periods. We focus on the Borax Lake and Mostin sites and emphasize recent findings. Figure 1 depicts the locations of the archaeological sites discussed here in relation to Clear Lake and the two local obsidian sources, Borax Lake and Mt. Konocti. We also discuss dating difficulties and suggest that obsidian hydration may have fewer problems than the radiometric method when attempting to place the cultural manifestations of the Clear Lake region into a temporal sequence. Our argument in favor of obsidian hydration is based upon its archaeological ubiquity in the region, which allows the accumulation of large samples, and upon its occurrence in the form of cultural objects that in themselves are temporally or culturally diagnostic. We suggest that, when used in conjunction with typological and stratigraphic studies, obsidian hydration has considerable potential to place sites and assemblages into relative sequences. In conclusion, we briefly summarize paleo-environmental reconstructions for the region insofar as they relate to early human settlement and resource use.

THE BORAX LAKE SITE

The Borax Lake site (CA-LAK-36) is located within Lake County's Clear Lake Basin about 150 air kilometers north of San Francisco. The site was first called to the attention of archaeologists in 1938 by avocationalist Chester Post and subsequently excavated and reported by M.R. Harrington (1938, 1948), who proposed in 1948 that the Borax Lake cultural deposits were laid down within the span of only a few centuries, probably no later than 10,000 years ago. The obsidian hydration and geologic studies reported by

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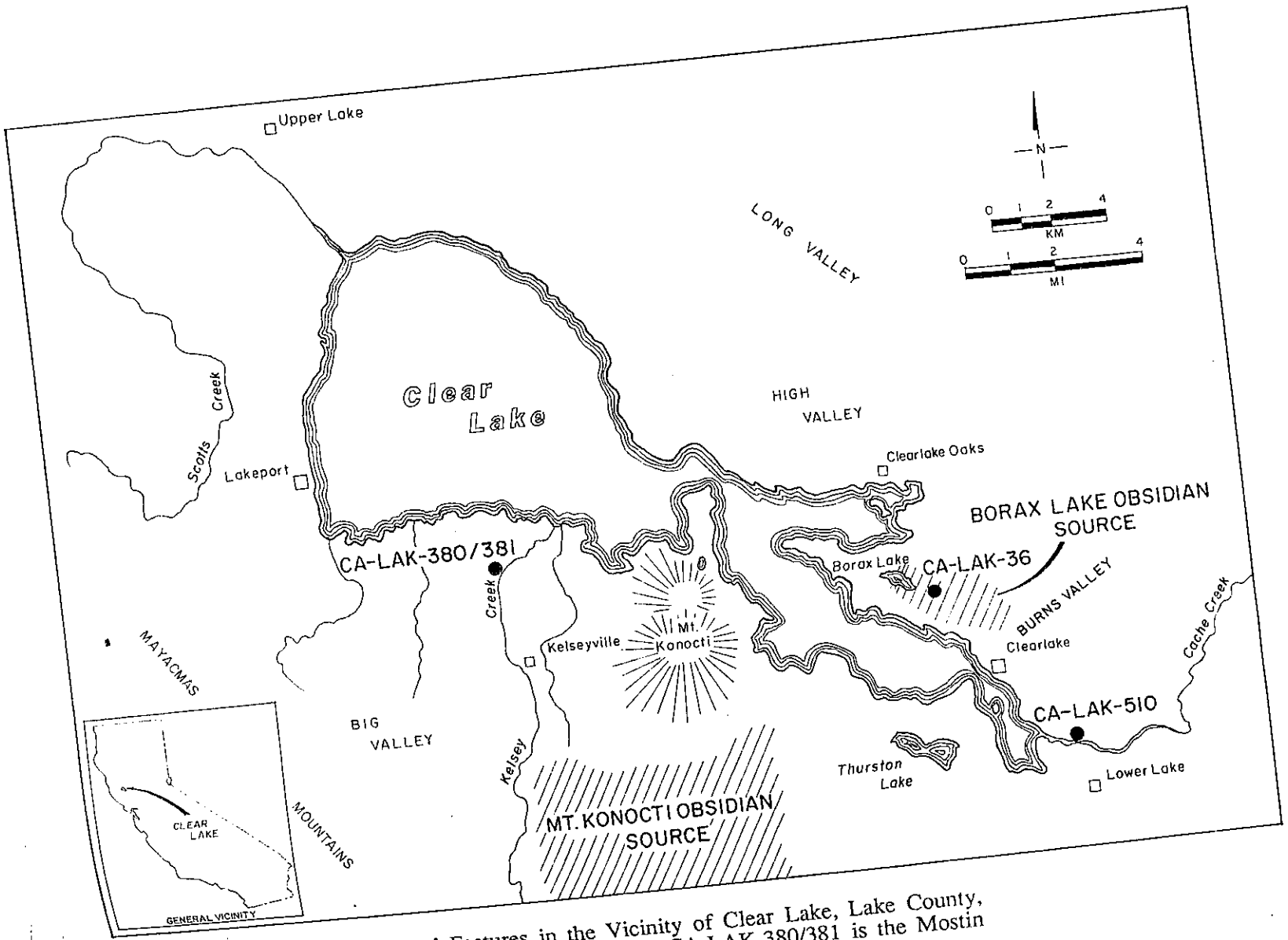

Archaeological Sites and Features in the Vicinity of Clear Lake, Lake County, ... Borax Lake site; CA-LAK-380/381 is the Mostin

Meighan and Haynes (1968,1970) in 1970 showed that the site deposits were laid down over a span of many thousands of years and supported an age assignment between 10,000 and 12,000 years ago for the fluted points and crescents. The vast majority of the site materials, however, were assigned to later time periods. In 1973, Fredrickson (1973, 1974) assumed the fluted points and crescents under the provisional Post Pattern (named after Chester Post), proposing a lacustrine (rather than a big game hunting) economy, and accepting the probability that relationships existed between the Post Pattern assemblage and early materials from other western sites, such as Tulare and Buena Vista lakes in the southern San Joaquin Valley (Fredrickson and Grossman 1977;Meighan and Haynes 1970: 1220; Riddell and Olsen 1969). The relationship between the Post Pattern and the subsequent Borax Lake Pattern could not be defined at that time. This continues to be the case.

The diagnostic implement of the early Borax Lake Pattern is the wide-stem point (Fredrickson 1973:216), also found at the Borax Lake site, which is morphologically similar to Pinto style points of Southern California and the Great Basin but which otherwise lacks demonstrable historic connections with Pinto. This point form, in association with handstone and milling slab, occurs over a wide area in northwestern California, and at present appears to be the marker of initial human use of the mountains north of the Clear Lake Basin (Hildebrandt and Hayes 1984, 1985).

Although Meighan and Haynes were successful in sorting obsidian artifact types by hydration rim thickness, the conversion of hydration readings to calendric dates was tentative, primarily because there was no series of radiometric dates that could be reliably linked with the obsidian readings to allow a rate determination for the Borax Lake source (Meighan and Haynes 1970:1217). At present, several different rates exist for this source, some based upon a lineal hydration model (such as the one employed by Meighan and Haynes), others based upon the exponential diffusion model. Table 1 shows differences in calendar years produced by two published rates for Borax Lake obsidian for hydration values between 1.0 and 12.0 microns. Several alternative models for the hydration process have been discussed in detail by Ericson (1977) and Kaufman (1980) in their UCLA doctoral dissertations and the arguments need not be repeated here.

A word about obsidian hydration findings is in order, however. There are now available more than 2,000 obsidian hydration readings from about 50 Lake County sites. Although attempts to use the published rates to obtain calendric values have generally led to inconsistent and contradictory results, the use of source-specific obsidian hydration readings to place sites, assemblages, and specific tool types into a relative time series has yielded excellent results. Although obsidian hydration continues to support the distinctions made by Meighan and Haynes at the Borax Lake site, we must be aware that the calendric dates proposed for Paleoindian and Lower Archaic assemblages in the North Coast Ranges are based for the most part upon obsidian hydration rates and radiocarbon dates that are open to serious question.

THE MOSTIN SITE

The Mostin site (CA-LAK-380/381), located in the Clear Lake Basin only a few kilometers west of the Borax Lake site, was called to the attention of archaeologists by landowner Julian Mostin, who observed numerous artifacts and human graves being eroded by Kelsey Creek as the creek went through a period of down-cutting following extensive gravel extraction. Cultural deposits as deep as five meters below the valley floor yielded human graves, obsidian tools and flakes, fish, bird and mammal bone, freshwater clam shell and fire-hearths. Although no comprehensive report has yet been published on the site, initial dating results based upon materials recovered through salvage efforts prompted considerable excitement as well as a follow-up investigation by a UCLA team lead by Thomas Kaufman (1980).

Table 1. Alternative Values in Years Before the Present for Hydration Readings on Borax Lake Obsidian

microns	*Findlow et al. (1978)*	*Ericson (1977)*
1.0	890	181
1.5	1335	406
2.0	1780	722
2.5	2225	1129
3.0	2670	1625
3.5	3115	2212
4.0	3560	2890
4.5	4005	3657
5.0	4450	4515
5.5	4895	5463
6.0	5340	6502
6.5	5785	7631
7.0	6230	8850
7.5	6675	10159
8.0	7120	11559
8.5	7565	13049
9.0	8010	14629
9.5	8455	16300
10.0	8900	18061
10.5	9345	19912
11.0	9790	21853
11.5	10235	23885
12.0	10680	26007

Values do not reflect effects of temperature variation during total time span.

A radiocarbon date on charcoal from a fire hearth produced a date of more than 11,000 years before the present, and radiometric dating of bone collagen from human burials produced four dates ranging between 7,000 and 11,000 years before the present. Amino acid racemization also yielded early dates. These age determinations stimulated published suggestions that the site represented some of the earliest examples of obsidian use in North America (Ericson and Berger 1974:824), that it contained one of the oldest known cemeteries in North America (Moratto 1984:101), and that it implied a degree of sedentism not usually associated with this early time period (Moratto 1984:101).

The Mostin site is clearly important. A manuscript reporting salvage work done at the site has recently been completed by the junior author and Ron King, the latter being one of the principal field directors of the original salvage operations. Their most striking conclusion is that the site, although of reasonable antiquity, is not as ancient as previously believed. Rather than being a direct derivative (or even a co-tradition) of the Fluted Point tradition as tentatively suggested by Moratto (1984:101), cross comparisons of key elements of the Mostin assemblage and of the obsidian hydration readings place the site considerably later in time, and support its derivation from the Lower Archaic wide-stemmed point tradition (White and King n.d.).

White and King (n.d.) point out a discrepancy between the radiometric dating results and obsidian hydration results. Although radiometric dating places Mostin at a time depth equivalent to that postulated for the fluted points and crescents at Borax Lake, numerous source specific obsidian hydration readings place Mostin obsidian considerably later in time, post-dating not only the fluted points and crescents, but also the Borax Lake wide-stem points. White and King (n.d.) also point out that formal seriation studies of projectile points from the Clear Lake vicinity place the distinctive Mostin point intermediate between the wide-stem point and the even later shouldered lanceolate point of the region.

An explanation for the discrepancy between obsidian hydration and seriation findings and the radiometric results may possibly be found in recent findings of the U.S. Geological Survey, summarized by White and King (n.d.). The USGS has found that fossil carbonates are continuously fed into Clear Lake waters by means of lake bottom geothermal springs (Sims and Rymer 1976). These carbonates are introduced into the metabolic cycle of living organisms to produce an apparent age that averages 4,200 years older than the actual age (Robinson *et al.* 1985:13). Kaufman (1980:90 ff) was aware that old carbon was entering Clear Lake through subaqueous gaseous springs and conducted experiments which demonstrated that there was "some potential for contamination of Clear Lake radiocarbon samples by fossil carbon" (Kaufman 1980:95). He further suggested that this old carbon effect varied spatially within Clear Lake, being greatest in areas of high geothermal activity. Finally, he concluded, "Extremely high quantities of magmatic carbon would be required to significantly alter the radiocarbon dates reported from the Mostin site" (Kaufman 1980:378).

In contrast, White and King (n.d.) argue that the location of the Mostin site near the shore of Clear Lake, the occurrence of nearby lake bottom geothermal springs, and the dietary intake suggested by this location (as well as by the surviving faunal assemblage at the site) would have resulted in the intake of sufficient fossil carbonates to skew the radiocarbon dates obtained from bone collagen. Other sources of skewing, such as through ground water contamination of the buried remains, are also possible. Wood charcoal provides radiocarbon ages at both ends of the time scale, possibly reflecting differential contamination by processes not yet determined, such as ground water contamination. However, when the USGS correction factor is applied to the Mostin bone collagen radiocarbon dates, the site moves clearly into an Archaic temporal context, with the dates falling between about 3,500 and 6,300 years ago. White and King (n.d.) have shown that this corrected radiocarbon age, as well as the associated obsidian hydration readings and artifact types, are congruent with the radiocarbon age, hydration readings, and artifact types found at nearby site components that do not appear to have been influenced by the contaminated waters of Clear Lake.

In the summer of 1986, through the good offices of Alan Bryan, Steve Robinson of the USGS radiocarbon laboratory visited the Mostin site with Bryan, the present authors and others, and obtained two charcoal samples for additional radiometric study that could possibly shed more light on the problems outlined above. The one sample for which results are presently available yielded a date of 7,700 $\pm$ 90 years before the present. However, until possible sources of contamination by ancient carbonates are examined further, we withhold judgement as to its validity.

If we were to accept the premised contamination of the Mostin site age determinations, it would make explicable why at least some of the published hydration rates for the local obsidian consistently fail to match archaeological expectations. These rates were partially based upon archaeological associations between obsidian and radiometrically dated materials from the Mostin site (Ericson 1977). Local workers are in the process of developing a rate for Borax Lake obsidian that does not depend upon the

Mostin data in its formulation and that leads to age assignments more fully in keeping with expectations based on other lines of evidence. We repeat, however, that obsidian hydration continues to place the various tool assemblages into a credible relative sequence.

OTHER PALEOINDIAN FINDS

Several other sites in the Clear Lake Basin have yielded data which suggest ancient cultural activity. Most significant is a buried component at Lak-510 (White 1984), located at the outlet of Clear Lake, five kilometers south of the Borax Lake site (Figure 1). Hydration measurements from Borax Lake obsidian flakes found in a submidden matrix at the site yielded consistent readings that ranged from 8.4 to 10.2 microns, well within the hydration range of the fluted points and crescents from the Borax Lake site. Unfortunately, excavation within this buried component was limited and no artifacts were recovered. Subsequent use of Lak-510 occurred after apparent abandonment for perhaps several thousand years (White 1984). The Lak-510 finds add some credibility to hydration-based claims of antiquity for two sites from Burns Valley, located less than two kilometers east of the Borax Lake site (Weber 1978) (Figure 1). Vance Haynes (1978) identified the stratigraphic position, lithology and pedogenic development of the artifact-bearing soil at the two sites as distinctly similar to the Paleoindian deposit at Borax Lake (Moratto 1984:101-103). No distinctive artifacts were found, however, and obsidian hydration results, ranging from 2.7 to 10.2 microns, indicated considerable mixing (Weber 1978).

Other, somewhat enigmatic hints of Paleoindian occupation of the North Coast Ranges emerge from time to time. Recently a large, well-made Clovis-like point was discovered in disturbed soils at an archaeological site in western Mendocino County (Simons *et al.* 1985). No other materials found at the site showed any indication of antiquity. Similarly, chipped stone zoomorphic crescents have been found at two localities in Sonoma County, about 50 miles north of San Francisco. One zoomorphic crescent without archaeological context was found by a local rancher at Bodega Head (Moratto 1984:516) and two others were recovered from an archaeological site at the Laguna de Santa Rosa near the city of Sebastopol. Although the Laguna site shared marshland environmental characteristics with the Clear Lake locality, and the finds are thus compatible with the postulated lacustrine orientation of the culture represented by the fluted points and crescents at Borax Lake, no other early materials were found at the site (Origer and Fredrickson 1980:21). Although lacking good archaeological contexts, these enigmatic finds are similar to others found throughout northern California, suggesting that a wide spread pattern is represented whose nature is not yet defined (cf. Moratto 1984:110 ff.).

Finally, a recent obsidian hydration study of the Borax Lake obsidian flow, conducted by the senior author in association with Jay Flaherty and Thomas Origer, allows some comment regarding the temporal patterning of obsidian use at the quarry (Fredrickson *et al.* n.d.). Obsidian samples were collected from seven loci at dispersed locations within the Borax Lake obsidian flow, with the choice of loci determined by street improvements that were underway at the time (Flaherty n.d.). A total of 151 hydration readings from these seven loci suggest that cultural use of the sampled locations did not occur until the time represented by about 11 microns. These hydration results are compatible with those of earlier studies that focused upon obsidian from the Borax Lake basin (Clark 1964: n=27; Findlow *et al.* 1978: n=46; Kaufman 1978: n=13). Figure 2 is a histogram depicting the frequency distribution of all obsidian hydration values from the Borax Lake basin. To place the 11 micron datum into a context, we point out that the fluted points and crescents average about 9 microns, Borax Lake wide-stem points average about 7.2 microns, and Borax Lake obsidian from the Mostin site averages about 6

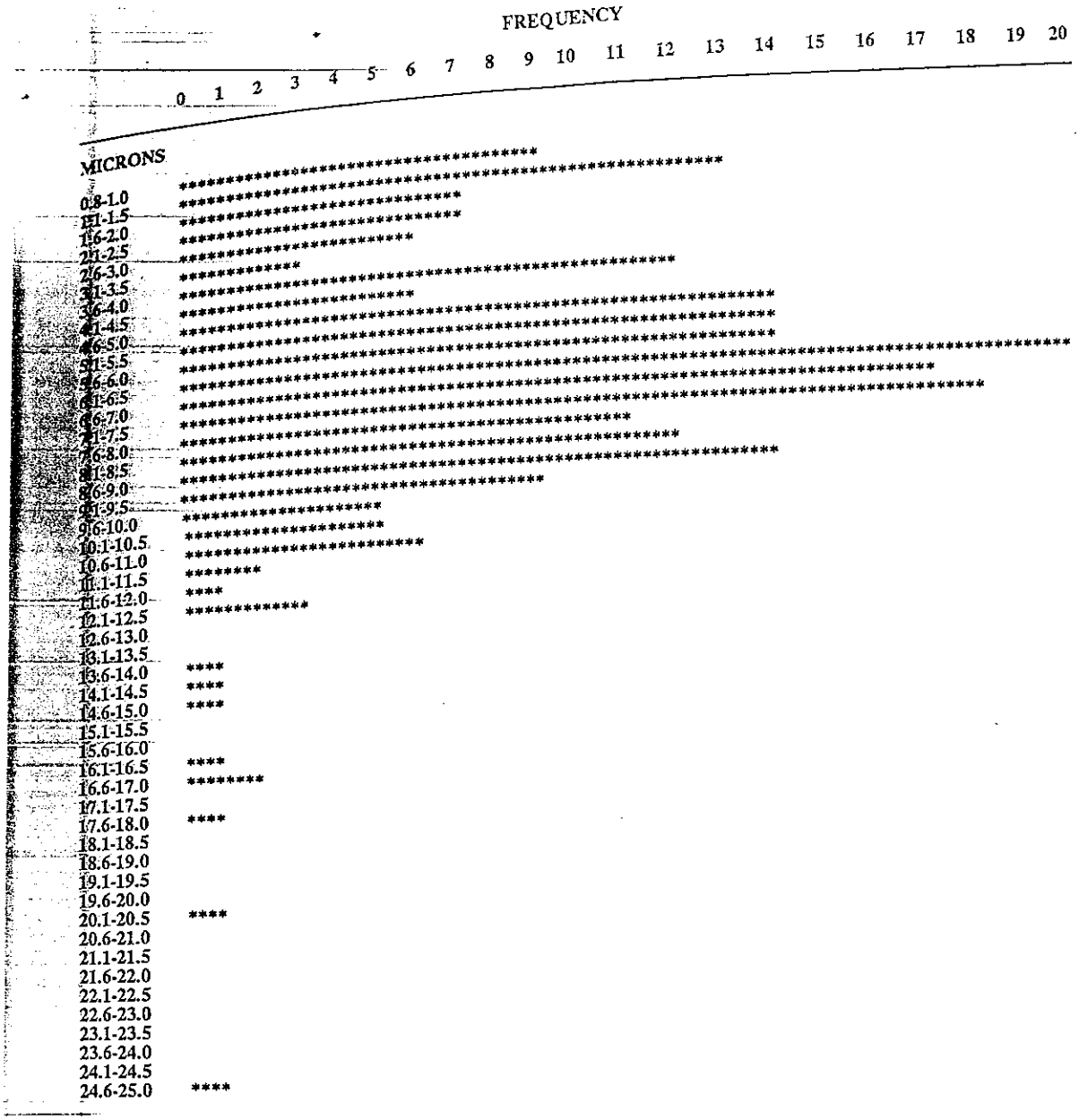

Figure 2. Frequency Distribution of All obsidian Hydration Values from the Borax Lake Basin including both archaeological and geological/quarry sites (n=237).

microns. The data also show a continuous series of readings that fill the vacancy between the wide-stem points and the crescents. Table 2 depicts the relationship between mean hydration readings from the Mostin site compared with other cultural phenomena in the Clear Lake Basin. Figure 3 illustrates the tool forms referred to in Table 2. In sum, these data suggest that only chance may be keeping us from finding other sites in the Clear Lake Basin that contain Paleoindian and Lower Archaic components, as well as components that may shed light on the interface between the two.

Table 2. Culture/Hydration Correlations
Borax Lake Obsidian

Mean Microns	*Cultural Description*
	Arrow Points - Lak-510
1.7	Beginning of Late Period
3.5	Concave Base Points - Lak-510
4.7	Shouldered-Lanceolate Points - Lak-510
5.0	Large Stemmed Points - Lak-510
5.0	MOSTIN SITE
6.5	Widestem Points
7.2	Fluted Points/Crescents
9.0	Maximum Age for Post Pattern
11.0	

Two other factors must be considered when we search for archaeological evidence representing Paleoindian and Lower Archaic cultures in California's North Coast Ranges. These are, first, the environmental conditions that likely prevailed at that time depth, and, second, the social organization postulated for such early communities. The environmental consideration assists in identifying constraints regarding early land use, while the social consideration helps in understanding the nature and distribution of cultural residues that may have been left behind.

During the past decade or more, the USGS has conducted numerous studies of cores recovered from various locations on the floor of Clear Lake. One of the results of these studies has been the identification of the fossil carbon effect that we now postulate as being the cause behind inconsistently large radiometric ages for dated samples from the Mostin site. Another set of findings relates to early Holocene climatic regimes. We provide the following summary, which Dwight Simons (1984) of Sonoma State University has suggested is congruent with independent findings based upon North Coast Ranges glacial geology, analyses of relict plant and animal distributions, and fossil pollen analyses (including work of James West, U.S. Bureau of Reclamation).

The early Holocene, between 6,000-7,000 years before the present to more than 10,000 years ago, was marked by temperatures as much as 3 degrees C cooler than at present. It is likely that relatively dense coniferous forest covered much of the North Coast Ranges, especially the northern portions, most likely to the extent that much of the region was poorly suited for human use. This, of course, covers the time period attributed to the fluted points and crescents.

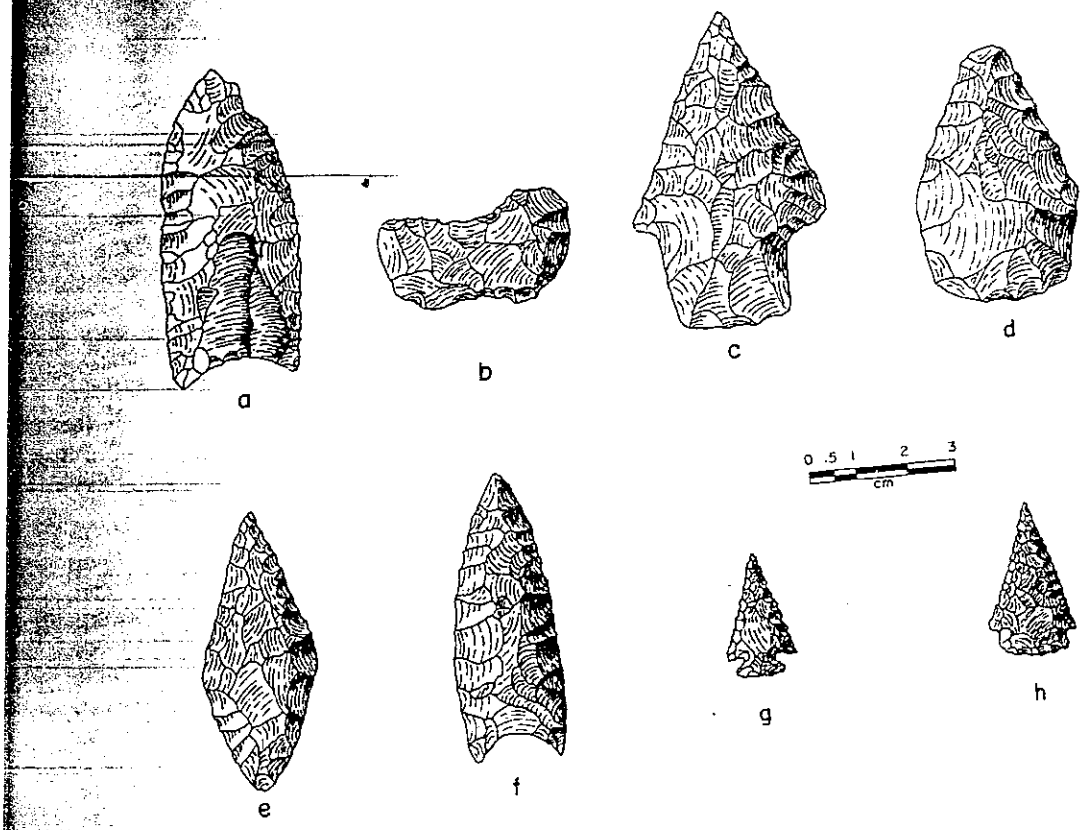

Figure 3. Projectile Points found in the Clear Lake Basin, Lake County, California. a) Borax Lake fluted point, b) Borax Lake crescent, c) Borax Lake widestem point, d) Mostin point, e) shouldered lanceolate point, f) nonfluted concave base point, g) arrow point, h) arrow point.

Wide-stem points first appear toward the end of this period at the Borax Lake site in the southern North Coast Ranges. This point form occurs later in strikingly large numbers in the mountainous region to the north of the Clear Lake Basin during the next climatic period between 6,000-7,000 years ago and about 2,500-3,300 years ago. This mid-Holocene xerothermic period was marked by temperatures that may have been 1 to 2 degrees C warmer than at present, with effective precipitation possibly less than today. Coniferous forests shrank in size, with ecotones displaced as much as 300 meters upward in elevation, creating an environment much more favorable for human use.

With the Mostin site now unlikely as a Paleoindian contender, the social organization postulated for Paleoindian cultures in the North Coast Ranges (and for many of the Archaic cultures as well) is the extended family, marked by low geographic density and relatively high mobility. Given this form of organization, we would expect cultural residues to be generally ephemeral - with their discovery mostly by happenstance - except for specific locations visited frequently because associated resources tend to be concentrated, either spatially (such as at quarry sites) or periodically (such as in marshland areas characteristic of lake basins). Thus identification of such locations and systematic hydration testing of obsidian cultural residues could help expedite the discovery of early Archaic and Paleoindian materials and perhaps gain understanding of the interface.

SUMMARY

Obsidian hydration and artifactual cross-dating data continue to support the findings of Meighan and Haynes (1968, 1970) regarding the antiquity of CA-LAK-36, the Borax Lake site, excavated by M.R. Harrington in the late 1930's and early 1940's. Geologic work by Haynes showed that site soils were deposited over a period of several thousand years, with a maximum age of 10,000 to 12,000 years before the present for cultural materials, most notably the fluted points and crescents. Contrary to Harrington's (1948) view that cultural materials were probably deposited within a time frame lasting only a few centuries, Meighan's obsidian data demonstrated that the site was used for thousands of years. Recently obtained obsidian hydration data from the Borax Lake quarry adjacent to CA-LAK-36 parallel those generated by Meighan and show that cultural use of the locality began no earlier than the time represented by about 11 microns. Although as yet there is no satisfactory hydration rate for Borax Lake obsidian, there is no reason to doubt approximate concordance between 11 microns and an age of 10,000 to 12,000 years.

On the other hand, obsidian hydration and artifactual cross-dating data fail to support radiocarbon dates between 7,000 and 11,000 years for CA-LAK-380/381, the Mostin site, located near the edge of Clear Lake 12 kilometers west of the Borax Lake site (Ericson and Berger 1974; Moratto 1984:101). Analyses carried out by White and King (n.d.) place the site later in time and suggest its origins reside in the Lower Archaic with its lithic assemblage derived from the wide-stem point tradition. The discrepancy between radiometric results and these latter findings may be due to contamination of the radiocarbon samples by fossil carbon that enters Clear Lake through subaqueous gaseous springs (Sims and Rymer 1976). This ancient carbon produces an apparent age for contemporary organisms that averages 4,200 years more than the actual age. Although the mechanisms of contamination have not yet been determined, application of the correction factor places the radiocarbon dates from the site between about 3,500 and 6,300 years ago.

If the Mostin radiometric samples were contaminated by fossil carbon, the consistent failure of some published hydration rates for local obsidian to meet archaeological expectations becomes explicable. Because the Mostin data contributed to the calculation of these rates for the two local obsidian sources (Ericson 1977), it would follow that the rates would produce ages greater than expected on the basis of other evidence.

Several other sites in California's North Coast Ranges have produced obsidian hydration readings (e.g., Weber 1978; White 1984) and single artifacts suggestive of Paleoindian occupation but without good archaeological associations--including a fluted point (Simons *et al.* 1985) and zoomorphic crescents (Moratto 1984:516; Origer and Fredrickson 1980:21). The search for Paleoindian and early Archaic cultures in the North Coast Ranges must take two additional factors into account--the environmental conditions that characterized the region at this time depth and the social organization postulated for the early cultures.

Recent paleoenvironmental studies, summarized by Simons (1984), have demonstrated that the period between 6,000-7,000 and 10,000 years ago was characterized by temperatures as much as 3 degrees C cooler than those of today. During this time period (identical to that attributed to fluted points and crescents) much of the North Coast Ranges, especially its northern portions, was covered by dense coniferous forests poorly suited for human use. The relatively warm period that followed, with temperatures that were perhaps 1 to 2 degrees C warmer than today, was accompanied by shrinking of the coniferous forests and the creation of environments much more favorable for human use. Wide-stem points first appear at the Borax Lake site about 6,000-7,000 years ago and later occur in remarkably large numbers in the mountains north of Clear Lake. Given the

later occur in remarkably large numbers in the mountains north of Clear Lake. Given the postulated extended family organization, with low population density and high mobility, most cultural residues would be somewhat ephemeral except for locations, such as marshlands associated with lake basins and important quarries, where resources tend to be spatially or periodically concentrated. Systematic identification and investigation of such locations could facilitate discovery of evidence for early Archaic and Paleoindian occupation.

ENDNOTES

This paper is a slightly revised and updated version of two earlier renditions:

(1) "The Borax Lake Basin and Early Cultures in California's North Coast Ranges," prepared for Symposium, "The Clovis-Archaic Interface in Western North America," C. Melvin Aikens and Judith Willig, Organizers, 51st Annual Meeting, Society for American Archaeology, New Orleans, Louisiana, April 23-26, 1986.

(2) "The Clear Lake Basin and Early Complexes in California's North Coast Ranges," prepared for Symposium, "Early Human Occupation in the Arid West: 12,000-7,000 B.P.," Judith A. Willig, Organizer, 20th Biennial Meeting, Great Basin Anthropological Conference, Las Vegas, Nevada, October 9-11, 1986.

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