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# Dating The Pinto Occupation at Rogers Ridge: A Fossil Spring Site in the Mojave Desert, California

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THE dating of the Pinto Period has long been a major issue in Mojave Desert prehistory. Competitive chronologies place it within two significantly different time intervals, and lead to quite different interpretations of the ancient desert lifeway. Projectile points from radiocarbon-dated strata at the Rogers Ridge site support the case for an early occupation dating between 6,000 and 6,400 B.P. This paper presents and discusses the implications of the evidence from Rogers Ridge.

The Pinto Period falls between the Lake Mohave and Gypsum periods of Mojave Desert prehistory. Each of these periods has been defined by the presence of one or more time-sensitive projectile points. The Lake Mohave Period is marked by the presence of Lake Mohave and Silver Lake points; the Pinto Period is marked by the presence of Pinto points; and the Gypsum Period is marked by the presence of Elko, Gypsum Cave, and Humboldt Concave-based points (Warren 1980a:19-20).

The beginning of the Pinto Period, marked by the first appearance of Pinto points, was initially dated by Campbell and Campbell (1935) at 10,000 B.C. to coincide with the end of the Pleistocene. This was the only period they thought wet enough to maintain a running stream in the Pinto Basin River channel and to account for the many Pinto campsites they had found for miles along its banks. Dating of the Lake Mohave-San Dieguito culture to this paleoclimatic period has, however, eliminated further serious consideration of Pinto in such an early time frame (Warren 1967; Warren and Ore 1978).

Currently, the most seriously considered dates for the advent of Pinto points are 5000 B.C. (Warren and Crabtree 1986), 4000 B.C. (Bettinger and Taylor 1974), and 3000 B.C. (Wallace 1962; Kowta 1969; Hester 1973). The proposed date of 2000 B.C. (Harrington 1957; Lanning 1963) is now generally considered too late and can be eliminated from further consideration. None of the proposed dates have been confirmed by radiocarbon dating of materials from sites in the Mojave Desert. Instead, authors have proposed dates by correlating the Pinto Period in the Mojave Desert with radiocarbon dates of various "Pinto" assemblages in other areas of the Great Basin (i.e., Monitor Valley [Thomas 1981] and Surprise Valley [O'Connell 1975]), or have relied on their own interpretations of human response to the desiccation of the desert after the Lake Mohave Period.

This paper examines the data recovered at Rogers Ridge (CA-SBr-5250), an open Lake Mohave and Pinto Period campsite at Fort Irwin in the central Mojave Desert of California (Fig. 1). The radiocarbon dates and stratigraphy from the site are of significance in dating the beginning of the Pinto Period, and in determining whether or not an occupational hiatus occurred between the Lake Mohave and Pinto periods, as argued by Wallace (1958, 1962, 1977), Hunt (1960), and Kowta (1969).

Radiocarbon dates from Rogers Ridge

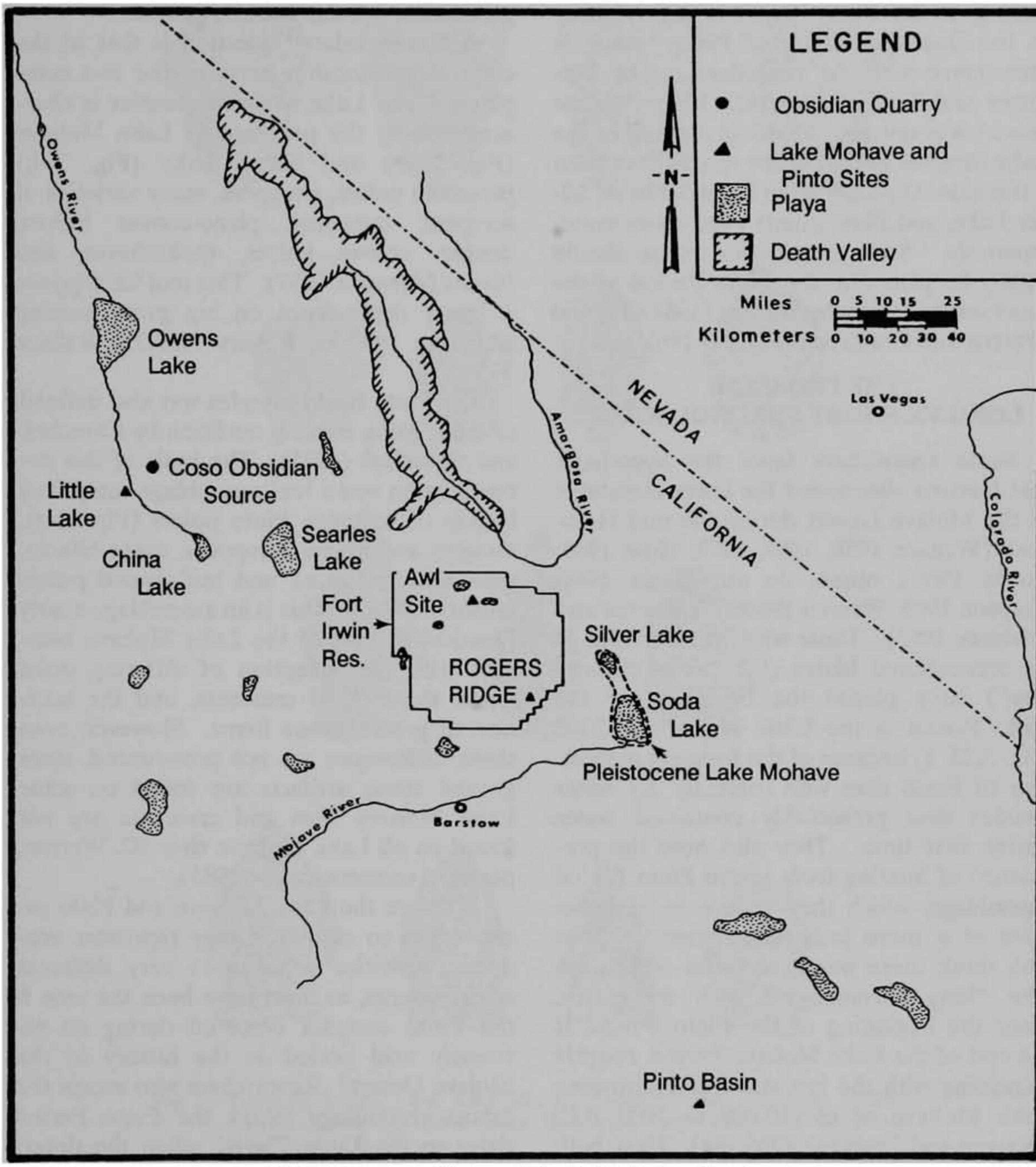


Fig. 1. Location of Rogers Ridge in the Mojave Desert.

suggest that Pinto occupation first occurred there between 6400 and 6000 B.C. The beginning of the Pinto Period is defined here as the first appearance of Pinto points, in accordance with the precedent set by Bettinger and Taylor (1974:14). If the Mojave Desert was not abandoned at the end of the Lake Mohave Period, there should have been a transitional phase when Lake Mohave, Silver Lake, and Pinto points were made simultaneously. Such a transition phase should rightly be placed in the Pinto Period as defined most recently by Warren (1984:411) and Warren and Crabtree (1986:184-186).

## THE PROBLEM: LONG VS. SHORT CHRONOLOGIES

Some researchers favor the hypothesis that humans abandoned the lower elevations of the Mojave Desert during the mid Holocene (Wallace 1958, 1962, 1977; Hunt 1960; Kowta 1969); others do not (Susia 1964; Simpson 1965; Warren 1980b:75; Warren and Crabtree 1986). Those who favor the idea of an occupational hiatus (the "short chronology") have placed the beginning of the Pinto Period in the Little Pluvial (ca. 2500 B.C.-A.D. 1) because of the frequent association of Pinto sites with currently dry water courses that presumably contained water during that time. They also note the prevalence of hunting tools in the Pinto Period assemblage, which they believe to be indicative of a more lush environment. Those who think there was continuous occupation (the "long chronology") with no hiatus, place the beginning of the Pinto Period at the end of the Lake Mohave Period, roughly coinciding with the last stand of Pleistocene Lake Mohave at ca. 10,000 to 5000 B.C. (Warren and Crabtree 1986:184). Thus, both dating hypotheses would associate Pinto sites with currently dry watercourses. To point out that a Pinto site was associated with a water source that is now dry does not resolve the question of dating. Only by dating the water source and the associated human occupation will this issue be settled.

A closely related question is that of the cultural relationship between the two complexes. The Lake Mohave complex is characterized by the presence of Lake Mohave (Fig. 2a-h) and Silver Lake (Fig. 2i-k) projectile points, choppers, many varieties of scrapers, crescents, plano-convex knives, double- convex knives, spokeshaves, and blades (Amsden 1937). This tool kit suggests a heavy dependence on big game hunting (Amsden 1937:90; Rogers 1939:27; Wallace 1958:11).

The Pinto Basin complex was also defined as a big game hunting tradition by Campbell and Campbell (1935). The basis of this determination was a tool assemblage comprised largely of scrapers, Pinto points (Fig. 2l-o), metates and manos, choppers, ovate bifaces, spokeshaves, knives, and leaf-shaped points (Amsden 1935). This is an assemblage nearly identical to that of the Lake Mohave complex with the exception of differing point types, the lack of crescents, and the addition of ground stone items. However, even these differences are not pronounced, since ground stone artifacts are found on some Lake Mohave sites and crescents are not found on all Lake Mohave sites (C. Warren, personal communication 1985).

Why are the Lake Mohave and Pinto assemblages so similar if they represent economic activities adjusted to very different environments, as must have been the case if the Pinto complex occurred during an extremely arid period in the history of the Mojave Desert? Researchers who accept the "short chronology" think the Pinto Period dates to the Little Pluvial, when the desert was considerably more moist than during the time immediately following. They believe that the similarity of Pinto and Lake Mohave assemblages is due to similar tasks being

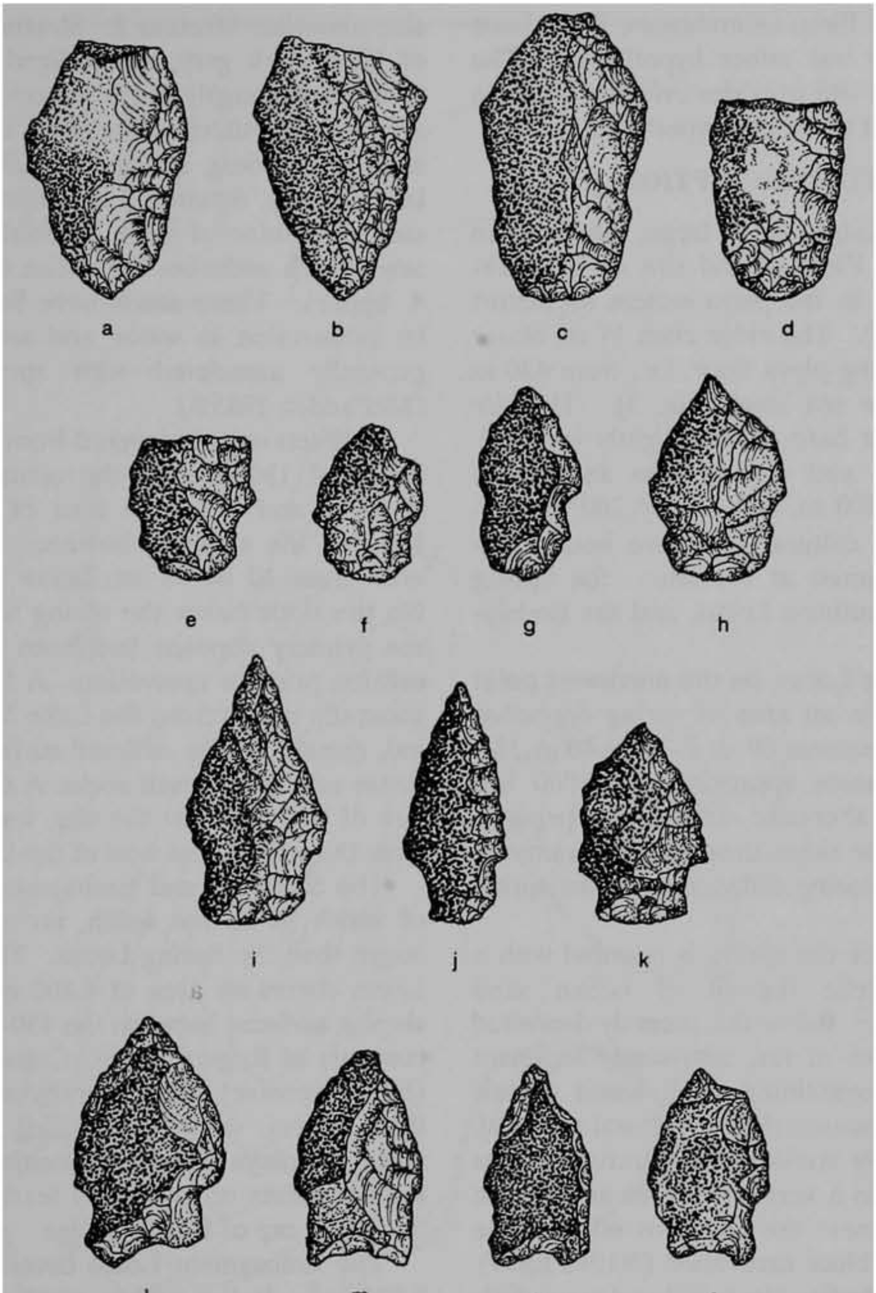


Fig. 2. Projectile points. a-d, Lake Mohave Long-stemmed; e-h, Lake Mohave Short-stemmed; i-k, Silver Lake Rectangular-stemmed; l-o, Pinto Points. Point c is 6.14 cm. in length.

performed during widely separated chronological periods, and/or that very different tasks were being performed with the same tools. Proponents of the "long chronology" simply suggest a continuation of a generalized hunting tradition from the end of the moist Lake Mohave Period into the Pinto Period (Warren 1986a). Again, without adequately dated Pinto assemblages, it has been impossible to test either hypothesis. The Rogers Ridge site provides evidence that can be used to test the above hypothesis.

## SITE DESCRIPTION

Rogers Ridge is a large, open Lake Mohave and Pinto period site on a basalt-capped ridge in the playa system of Tiefort Basin (Fig. 1). The ridge rises 17 m. above the surrounding playa floor, i.e., from 430 to 447 m. above sea level (Fig. 3). The site surrounds the base of the slightly crescent-shaped ridge and encompasses an area of 74,000 $m^2$. (400 m. NW-SE by 200 m. SW-NE). Three cultural loci have been identified and named at the site: the Spring Locus, the Southern Locus, and the Embayment Locus.[1]

The Spring Locus, on the northwest point of the ridge in an area of spring deposited sediments, measures 60 m. E-W by 40 m. N-S and encompasses approximately 2,000 $m^2$. Artifacts are abundant around the spring at the base of the ridge, dropping off dramatically with increasing distance from the spring deposits.

The area of the spring is mantled with a culturally sterile deposit of eolian sand (Stratum 1A).[2] Below this recently deposited sand is a layer of tan, silty-sandy sediment (Stratum 2) containing small basalt gravels and a rich concentration of cultural material. Fine, culturally sterile sand (Stratum 3) was encountered in a very small area at the base of the ridge near the southern edge of the Spring Locus block excavation (N1042 E939). Stratum 3 underlies Stratum 2 and apparently replaces Stratum 4 (found elsewhere at this locus) in the small area at the base of the ridge. It thus appears to be a lateral faces of Stratum 4. Stratum 3 rests on a bed of large basalt boulders underlain by Stratum 5.

North of the base of the ridge, Stratum 4, consisting of humus-stained spring deposits, underlies Stratum 2. Stratum 4 consists of hard, dark gray, mineralized sandy soils containing roughly 0.1% decomposed plant material, basalt clasts ranging in size from sand to boulders, and sparse cultural materials. Finally, Stratum 5 is a thick, culturally sterile stratum of light greenish (reduced) sand which underlies the entire deposit (Fig. 4, upper). These sands have been reduced by submersion in water and are of a type generally associated with spring activity (McFadden 1985:8).

Artifacts were recovered from a maximum depth of 130 cm., at the contact between strata 4 and 5 in the area of the spring. Most of the artifacts, however, were recovered from 10 to 70 cm. below the surface. On the slope below the spring area, most of the primary deposits had been removed by erosion prior to excavation. A few artifacts, generally dating from the Lake Mohave Period, remain on the deflated surface among a dense scatter of basalt rocks. A Clovis point, one of two found at the site, was recovered from the surface just west of the locus.

The Southern and Embayment loci, both of which lie to the south, are considerably larger than the Spring Locus. The Southern Locus covers an area of 4,800 $m^2$. of gently sloping surfaces between the 430- and 432-m. contours of Rogers Ridge. Cultural deposits (Fig. 4, center) are generally shallow, less than 50 cm. deep. Prevailing west winds scour the playa surface, depositing sand only against plants or geological features such as the basalt cap of Rogers Ridge.

The Embayment Locus covers an area of 3,800 $m^2$. It lies higher on the slope than the Southern Locus (up to the 435-m. contour) and contains cultural deposits to a depth of 70 cm. Decomposing basalt cobbles and gravels are common on the surface but occur somewhat less frequently throughout the deposit, with the exception of a cobble layer located 40 to 60 cm. below the surface

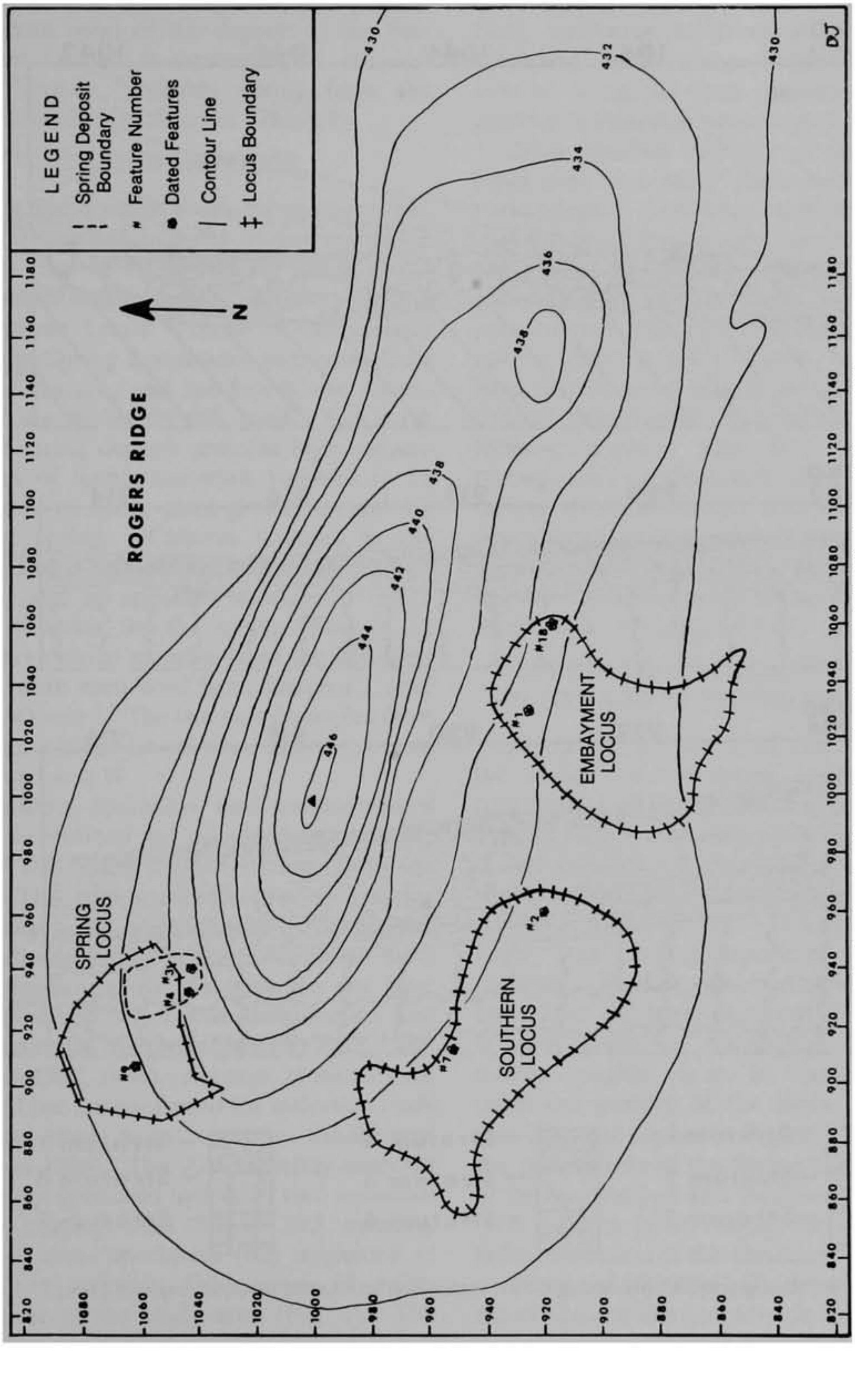


Fig. 3. Loci and locations of radiocarbon-dated features at Rogers Ridge.

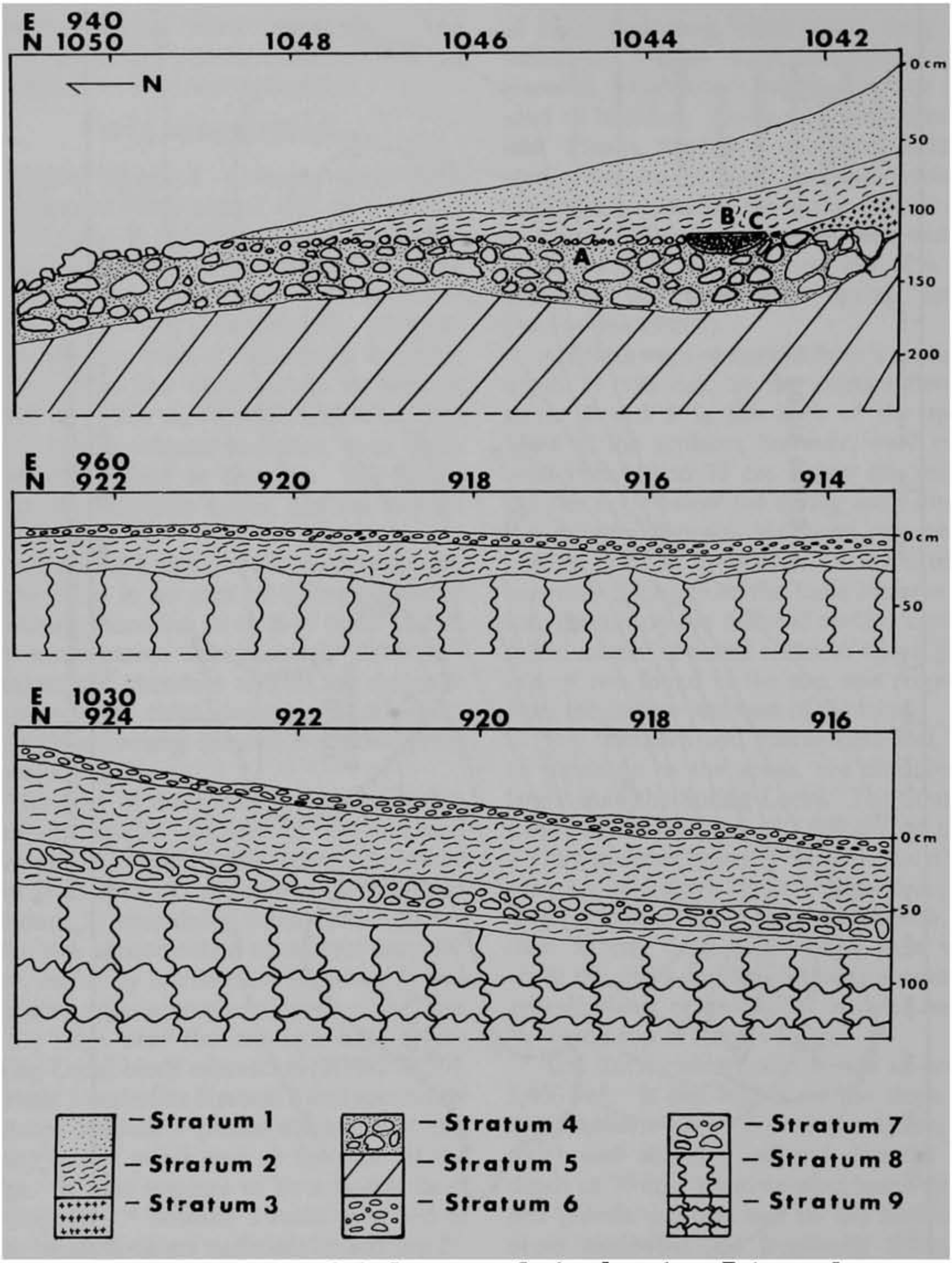


Fig. 4. Stratigraphy. Upper, Spring Locus; center, Southern Locus; lower, Embayment Locus.

(Fig. 4, lower). This cobble layer is present throughout most of the deposit in the Embayment Locus. It represents an old erosional surface, probably dating from the early Holocene (McFadden 1985:B-7).

## DATING METHODS

Nine radiocarbon dates for various deposits and cultural features at Rogers Ridge include four from the Spring Locus, three from the Southern Locus, and two from the Embayment Locus. Three of the samples from the Spring Locus were recovered from cultural features and the fourth was a sample of the spring deposit itself. The earth of the spring deposit contains high concentrations of humic materials believed to be the result of dense plant growth around the ancient spring. Cultural features in the Spring Locus include two hearths (features 3 and 9) and an apparent aboriginally developed reservoir for the spring (Feature 4). The three dated samples from the Southern Locus were recovered from features 2 (two samples) and 7. The two dated samples from the Embayment Locus were recovered from features 1 and 18.

Obsidian hydration rind measurements were determined for all obsidian projectile points and much of the debitage from the site. The measurements provide relative dates that serve as comparative evidence for the radiocarbon dates reported below. Seventy obsidian specimens from the site have been analyzed for source identification and hydration rind thickness (Jackson 1985, 1986; Hughes 1985, 1986). Another 26 items were sourced but not measured for hydration rinds because they were severely sandblasted (Hughes 1986). The 70 completely analyzed specimens produced hydration rind measurements ranging from 0.0 to 24.5 microns. Most of these specimens (62) originated at the Coso volcanic field some 85 miles northwest of the study area (Fig. 1). The other eight specimens include one from Bodie Hills, California (approximately 250 miles northwest) and seven from unidentified sources. Only the Coso specimens are here used for comparison between loci.

Coso obsidian hydrates at an unusually rapid rate and many thick hydration rind measurements have been recorded on Coso obsidian from Fort Irwin (Jenkins and Warren 1985). One of two hydration rates has generally been used for Coso obsidian: 220 years/micron (Meighan 1981) and 344 years/micron (Ericson 1977). These "linear" rates have proven unreliable in accurately dating cultural components of the Pinto and Lake Mohave periods. The dates arrived at through their application conflict with radiocarbon dates associated with later cultural assemblages of the central Mojave Desert (Jenkins and Warren 1985). Hence, obsidian hydration measurements are used here solely as indicators of relative time.

## SPRING LOCUS: RADIOCARBON DATES AND PROJECTILE POINTS

Feature 9, a stone-lined hearth visible on the surface of the Spring Locus (Fig. 3), consisted of 37 basalt stones arranged in an oval about a meter across. It contained copious amounts of charcoal, a sample of which produced a radiocarbon age of 1,280 ±50 B.P. (Beta-12839). This dates a relatively "late" surface deposit of fluvial sand (Stratum 1B) that subsequently was eroded away from the lower slopes of the locus and is now limited in distribution to a small mound roughly 15 m. in diameter in the northwest portion of the locus. This stratum does not appear in Figure 4, upper, with the other strata of the Spring Locus because of its very limited and localized distribution (see Ferraro [1986:166-68] for a more detailed discussion of this stratum).

Dissected Stratum 1B deposits form a series of dune-like geomorphic features north

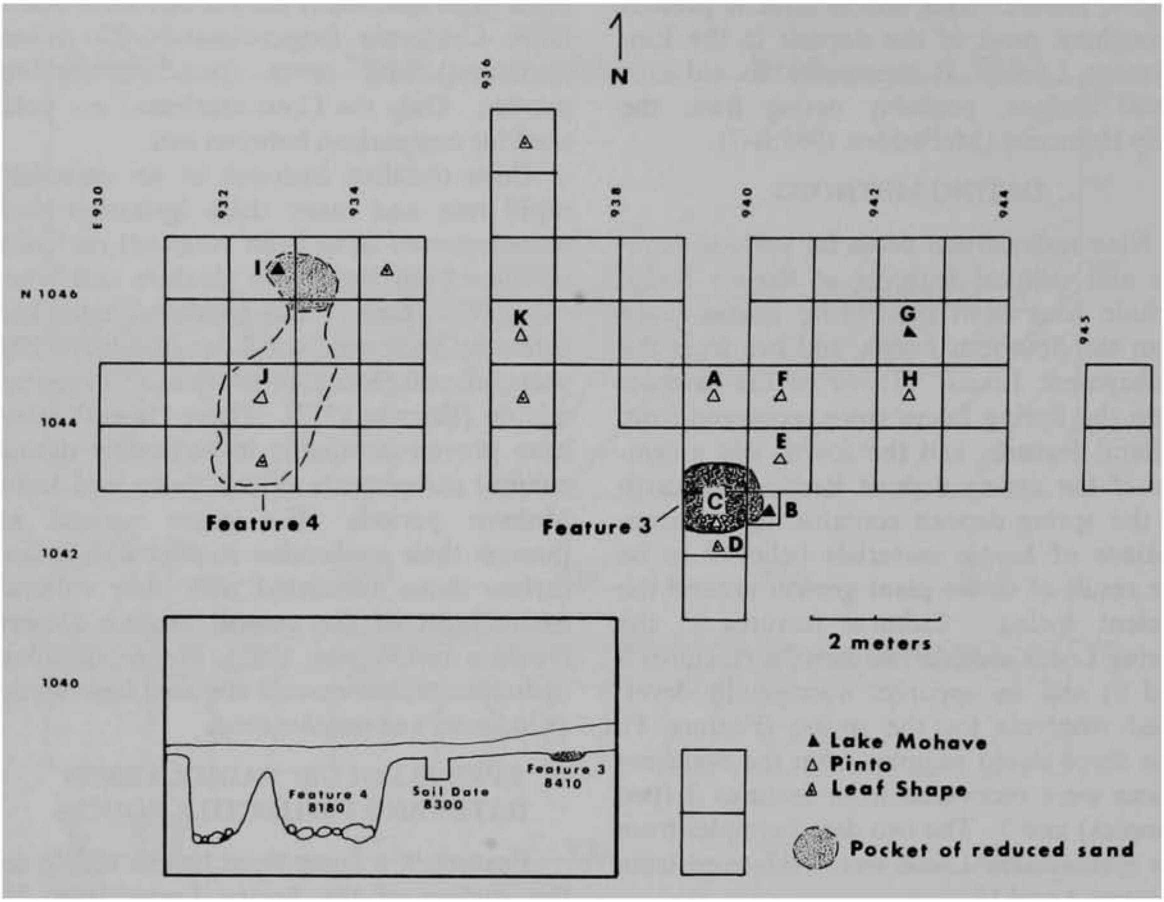


Fig. 5. Location of projectile points in relation to radiocarbon-dated features of the Spring Locus.

of the major wash that passes along the foot of Rogers Ridge. The elevation of Stratum 1B deposits on the Spring Locus (431-432 m.) is well below the maximum elevation of Stratum 1B deposits north of the wash (436 m.) and there is little doubt that both are remnants of a single major event of deposition in the basin. No culturally or chronologically diagnostic artifacts were recovered from the area of Feature 9 and, though excavation continued downward through the underlying deposits, only two small flakes were recovered. The greenish (reduced) sands of Stratum 5 that generally underlie the spring deposit (Stratum 4) were encountered just below Stratum 1B, indicating strata 2 and 4 had been eroded away before Stratum 1B was deposited. Thus, there was a major period of erosion between the development of the spring deposits and the deposition of the fluvial sands of Stratum 1B. This sequence could well represent the erosional and depositional regimes of the Altithermal and Little Pluvial periods, respectively.

Feature 3, an unlined hearth found some distance away from Feature 9 (Fig. 3), was approximately 1 m. wide by 1.5 m. long and 15 cm. deep. It was found at a depth of 50 to 65 cm. in the contact zone between strata 2 and 4. It produced a radiocarbon date of 8,410±140 B.P. (Beta-12840).

Six projectile points were found within 2 m. of Feature 3. A Pinto point (Fig. 5, item A) was recovered from the 50- to 60-cm. level, well within the compact, dark gray spring deposit (Stratum 4), 2 m. northwest of Feature 3. An unusual bipoint (Fig. 5, item D) was recovered from Stratum 4 in the 50- to 60-cm. level of the Feature 3 excavation unit. A second Pinto point (Fig. 5, item C) was recovered from Stratum 2 in the 40- to 50-cm. level near the southern rim of Feature 3. This point was fractured lengthwise, and both halves were found together within the same 10-cm. level of the excavation unit. This suggests that there was little if any post-depositional movement of artifacts within the deposits. An obsidian Lake Mohave Short-stemmed point with a hydration rind thickness of 15.3 (Fig. 5, item B; similar to the Silver Lake type [Warren 1985, 1986b]) was recovered from the 40- to 50-cm. level above Feature 3 in Stratum 2. Finally, two Pinto points (Fig. 5, items E and F) were recovered nearby at 20 to 30 cm. and 30 to 40 cm., respectively, in the artifact-rich Stratum 2.

Two additional points were recovered some distance away. One was a Coso obsidian Lake Mohave Short-stemmed point (Fig. 5, item G) with a hydration rind thickness of 16.3 microns and the other was a Pinto point (not of obsidian; Fig. 5, item H). Both were recovered at depths of 10 to 20 cm. within Stratum 2.

The proveniences of the six points recovered near Feature 3 establish an important fact: Pinto points occurred in both Stratum 2 and Stratum 4, bracketing Feature 3, which was radiocarbon-dated at 8,410±140 B.P.

An aboriginal excavation interpreted as a spring reservoir (Feature 4) was encountered 6 m. west of Feature 3. Feature 4 was a steep-sided, 100-cm. deep pit measuring 3.5 m. long (north-south), 1.5 m. wide (east-west) that originated in Stratum 2 and was cut 80 to 90 cm. into Stratum 4 (Fig. 6). This pit was filled with eolian sand containing a mixture of bone, flaked and ground stone artifacts, charcoal, a Pinto point (at a depth of 70 to 80 cm), an obsidian Lake Mohave Short-stemmed point (at a depth of 40 to 50 cm. with a hydration rind measurement of 16.8 microns), and an *Olivella* shell bead. The floor of the pit was a mixture of boulders, gravel, and sand. Lack of well-developed rounding on the gravels, and especially on artifacts within the feature, indicates that water did not flow in sufficient volume within the feature to cause these heavier items to "boil" in typical spring fashion.

A sample of charcoal was recovered at a depth of 60 to 70 cm. from the sand that filled Feature 4. Dated by accelerator mass spectrometry, it produced a determination of 8,180±150 B.P. (Beta-13463). This sample clearly does not date the initial construction of Feature 4, but rather dates to the time when it was being filled in.

The presence of both Pinto and Lake Mohave Short-stemmed points within Feature 4 suggests rough contemporaneity of these point types around 8,200 B.P. The Lake Mohave Short-stemmed point may, however, be somewhat older. It was found in a pocket of reduced sand in the north end of the paddle-shaped feature. Reduced sand did not occur in the broader, south end of the feature where the Pinto point was found (Fig. 5; see also Jenkins 1986:180). In order for the sand of this pocket to have been reduced by water submersion, the north end of the feature must have been filled in while the main feature remained open and water continued to saturate the surrounding soils. Thus, the Lake Mohave Short-stemmed point in the pocket of reduced sand at the north end of Feature 4 must be at least slightly older than the Pinto point in the unreduced, younger fill of the south end.

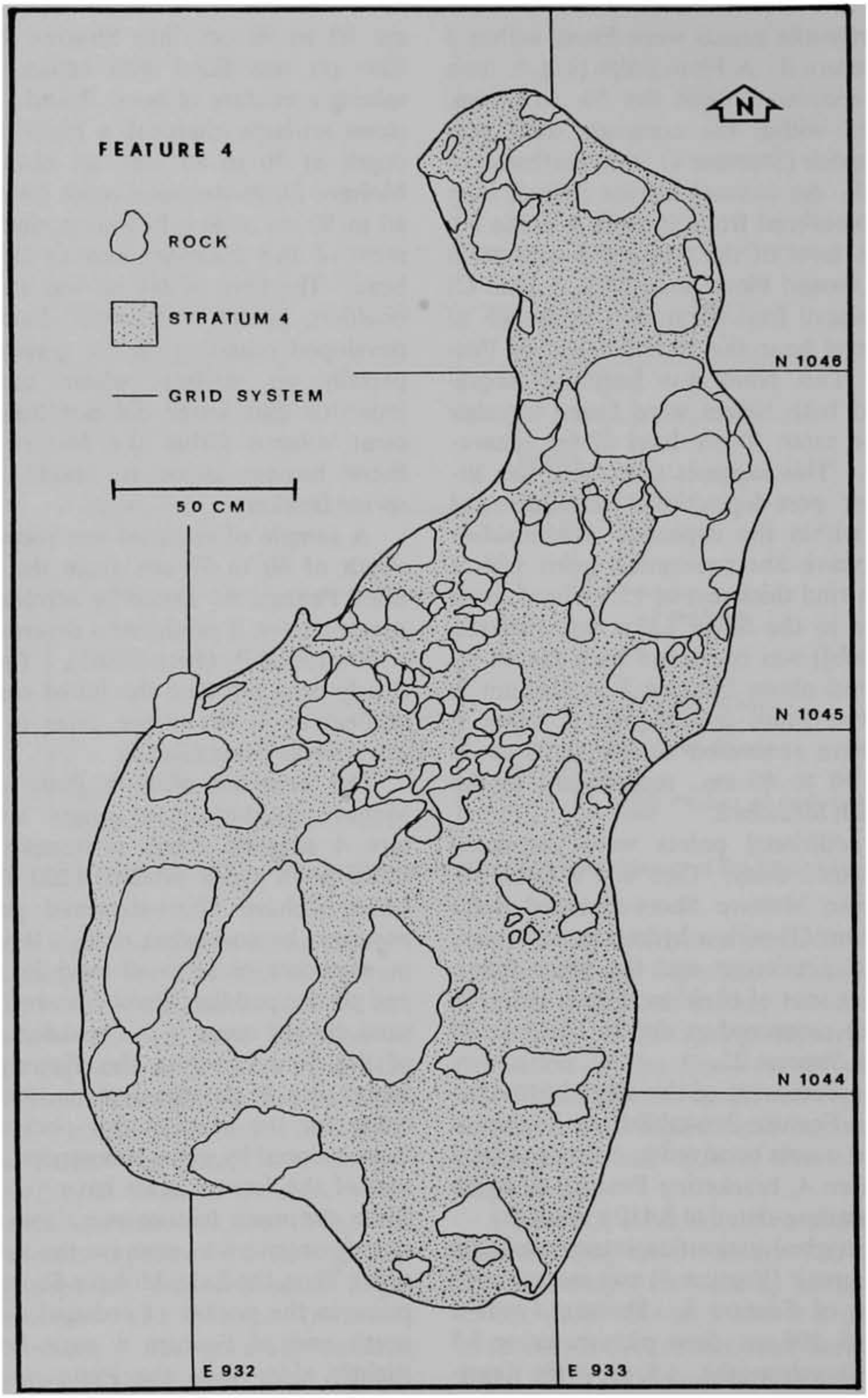


Fig. 6. Spring reservoir (Feature 4) in the Spring Locus.

The pocket of sand in which the Lake Mohave point was found dates between the determination 8,180 B.P. for the fill of Feature 4, and the 8,410 B.P. date for Feature 3 at the top of Stratum 4, into which Feature 4 was excavated.

This interpretation gains further support from the final radiocarbon date from the Spring Locus. A soil sample from the top of the spring deposit adjacent to Feature 4 dated to 8,300±110 B.P. (Beta-12843). This soil date represents humus development in the area of the spring, and as the sample was obtained from the top of the spring deposit, it represents a late period of spring flow. It would appear, as does the date from Feature 3, that the sample provides a terminal date for Stratum 4, into which Feature 4 was excavated, as does the date from Feature 3.

## DATED FEATURES OF THE SOUTHERN LOCUS

Feature 2 was a large charcoal-stained deposit in the Southern Locus at Rogers Ridge, believed to be the remains of a midden (Fig. 4, center). Two radiocarbon samples recovered between 20 and 30 cm. produced dates of 7,910±420 B.P. (Beta-10790) and 8,410±210 B.P. (Beta-12844). No projectile points were recovered from Feature 2, but two Lake Mohave Short-stemmed points, five leaf-shaped points, and two convex-based point fragments that probably represent the Lake Mohave type were recovered from the surface within 20 m. of the location of the samples from which the dates were obtained.

Feature 7, a well-defined basin-shaped hearth 15 to 20 cm. deep and 40 to 50 cm. in diameter produced a third and much later radiocarbon date of 4,020±110 B.P. (Beta-12841) for the Southern Locus. No diagnostic tools were recovered from excavations around the feature. Three Pinto points and one Clovis point were found on the surface within 20 m. of the feature, however.

## DATED FEATURES OF THE EMBAYMENT LOCUS

Feature 1 at this locus consisted of two carbon stains approximately 40 cm. wide, 70 cm. long, and 15-20 cm. thick. Encountered at 50 cm., they were situated slightly above and within the cobble layer mentioned earlier as underlying the Embayment Locus (Fig. 4; McFadden 1985:B-7). Soil samples were recovered from both stains; material from the darker of the two was radiocarbon dated to 5,050±230 B.P. (Beta-12186). A Pinto point was recovered from above the feature at the 20- to 30-cm. level.

Feature 18 of the Embayment Locus was a hearth 70 to 80 cm. in diameter and 15 cm. deep, that was covered by 14 fairly large (10 to 25 cm.) stones. These stones were first encountered at about 35 cm. below the surface, but carbon-stained soil first appeared above them in the 20- to 30-cm. level. This dispersal of soil suggests rodent disturbance, which may have contaminated the radiocarbon sample with modern carbon, and which might explain the statistically modern date it produced (Beta-12842). No diagnostic artifacts were recovered close to Feature 18.

Both Pinto and Lake Mohave points were recovered from the surface of the Embayment Locus. Pinto points are the predominant type in this area of the site, however, and a single Pinto point was the only diagnostic specimen recovered from subsurface context. The radiocarbon date of 3100 B.C. obtained from the Embayment Locus (Feature 1) suggests a mid- to late-Holocene occupation. If it is an accurate date, few people will argue that it does not refer to a Pinto occupation; and the same is true of the 2070 B.C. date of Feature 7 in the Southern Locus.

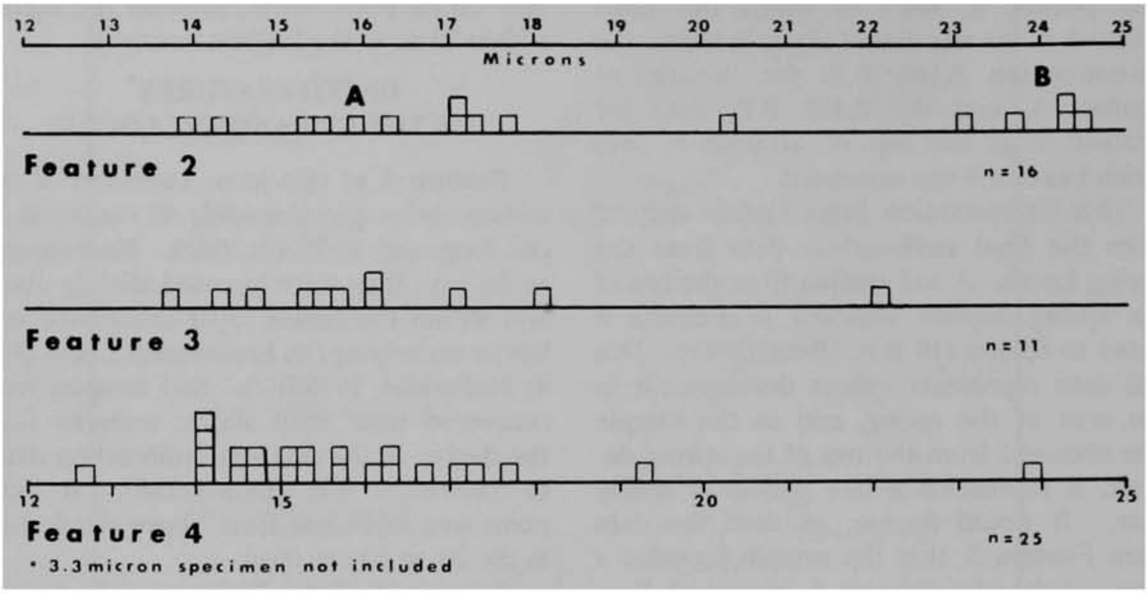


Fig. 7. Obsidian hydration rind measurements on artifacts from features 2, 3, and 4.

## OBSIDIAN HYDRATION STUDIES

Obsidian samples were selected for sourcing and hydration rind analyses based on adequate size of items for analytical manipulations, artifact form (all projectile points and intentionally modified tools of obsidian were analyzed), and proximity to radiocarbon-dated cultural features. An effort was made to select at least 10 specimens close to each radiocarbon-dated feature of the site. Features 1, 7, 9, and 18 did not yield enough obsidian specimens to provide 10 samples for analysis, however, and in these cases all available obsidian specimens of sufficient size were analyzed.

Thirteen Coso obsidian flakes from Feature 2 in the Southern Locus were recovered from a single shallow block excavation that reached a depth of 20 to 30 cm. The resulting 16 readings (three specimens were each read at two locations) form two distinct groups (Fig. 7). The 10 readings of Group A ranged from 13.9 to 17.7 microns with a mean of 15.9 microns. The six readings of Group B ranged from 20.3 to 24.5 microns with a mean of 23.4 microns. A two-tailed Student's t-test indicated that there is no significant difference between the mean of the 10 samples of Group A from the Southern Locus and the mean of the samples recovered from the Spring Locus. This correlates well with the radiocarbon dates from features 2, 3, and 4 of the Southern and Spring loci which also indicate that the dominant occupations of the two loci were roughly contemporaneous.

Thus, the 16 obsidian hydration readings of Feature 2 of the Southern Locus appear to represent two distinctive groups that should be considered separately. Group A dates to about the same period as the occupation of the Spring Locus and Group B may date to a much earlier phase of occupation.

Ten specimens of Coso obsidian recovered close to Feature 3 (Spring Locus) produced a mean hydration rind thickness of 15.7 microns with a range of 13.9 to 18.1 microns. A flake of Coso obsidian with a hydration rind thickness of 22.1 microns was recovered from within 2 m. of Feature 3 but was excluded from the group of specimens from which the mean was calculated because it fell far beyond the range of the other specimens and possibly represents an older artifact that was reused (Fig. 7).

Twenty-three specimens of Coso obsidian, recovered from within 2 m. of Feature 4 in the Spring Locus, including the Lake Mohave Short-stemmed point from the interior of Feature 4, have a mean hydration reading of 15.3 microns with a range from 12.9 to 17.7 microns. Three outlier readings of 3.3, 19.3, and 23.8 microns were eliminated from the group that produced the mean (Fig. 7).

Two Coso obsidian samples were recovered from the interior of the hearth in Feature 7 (Southern Locus). These specimens measured 11.3 and 12.6 microns.

No Coso obsidian pieces large enough to measure for hydration rind thickness were recovered in the Feature 1 excavations in the Embayment Locus. Excavation of the Feature 18 hearth, also in the Embayment Locus, produced only two obsidian specimens from above the hearth. These had widely disparate hydration rind measurements of 9.0 and 14.9 microns.

## SUMMARY AND DISCUSSION

Table 1 provides a comparison of the data by locus at Rogers Ridge. It demonstrates correlations that exist between associated radiocarbon dates, obsidian hydration measurements, and projectile point associations.

Reasons for believing that Pinto and Lake Mohave Short-stemmed points recovered in the Spring Locus were contemporaneously associated with the radiocarbon dates also obtained there include the following.

1. Artifact distributions are strongly associated with the dated (8,300±110 B.P.) spring deposits. At the Spring Locus, few artifacts occur outside of the gray spring deposits.

2. Pinto points were found both above and below the Feature 3 hearth, which was dated to 8,410 B.P. The unusual cluster of points near the feature probably reflects the focus of the hearth to the activities resulting in the presence of artifacts.

3. Rodent activity, deflation, or erosion apparently have had minimal effect on artifact distributions at the Spring Locus, as shown by the fractured Pinto point, both halves of which were recovered close to each other in the same stratigraphic level.

4. The clear separation of depositional strata also indicate that there has been no major mixing of the deposits. Mixing would have resulted in a "smearing" effect that would have been easily discernible in the boldly contrasting colors of strata 2 and 4.

5. Finally, projectile points, tools, and lithic debitage were densely concentrated within a 2-m. radius of Feature 3. This suggests that cultural activities associated with the feature resulted in a distributional pattern of cultural materials that survived both rodent activity and erosion.

It remains, then, to explain the occurrence of both Pinto and Lake Mohave Short-stemmed points in the Spring Locus and the apparent lack of such a co-occurrence in the Southern Locus, although these two loci were radiocarbon-dated to essentially the same time period.

The similar obsidian hydration measurements from the Spring Locus and Feature 2 in the Southern Locus suggest continuity of occupation between the Lake Mohave and Pinto periods at both loci, as do the radiocarbon results (Fig. 7 and Table 1). The evidence also supports the interpretation that although different point types were found in the Spring and Southern loci, there was little, if any, time difference between them. To deny this interpretation is to support the alternative hypothesis that although Pinto points comprise 70% of the diagnostic

Table 1
RADIOCARBON DATES, CULTURAL FEATURES, ASSOCIATED PROJECTILE POINTS, AND OBSIDIAN HYDRATION MEASUREMENTS FROM ROGERS RIDGE

| Locus | Feature Number | Projectile Points (Frequency)[a] | Radiocarbon Dates (B.P.) | Sample Number | Obsidian Hydration Measurements Mean | Frequency | Range |
|---|---|---|---|---|---|---|---|
| Spring | 9 | None | 1,280±50 | Beta-12839 | None | | |
| Spring | 3 | Pinto (2); LMSS (2) | 8,410±140 | Beta-12840 | 15.7 | 10 | 13.9-22.1 |
| Spring | 4 | Pinto (1); LMSS (1) | 8,180±150 | Beta-13463 | 15.3 | 23 | 12.9-17.7 |
| Spring | Spring deposit | None | 8,300±110 | Beta-12843 | None | | |
| Southern | 2 | None | 7,910±420 | Beta-10790 | 23.5 | 5 | 20.3-24.5 |
| Southern | 2 | None | 8,420±210 | Beta-12844 | 15.9 | 6 | 14.4-17.7 |
| Southern | 7 | None | 4,020±110 | Beta-12841 | 12.0 | 2 | 11.3-12.6 |
| Embayment | 1 | Pinto (1) | 5,050±230 | Beta-12186 | None | | |
| Embayment | 18 | None | Modern | Beta-12842 | 11.9 | 2 | 9.0-14.9 |

[a] Numbers in parentheses equal number of specimens. LMSS = Lake Mojave Short-stemmed (after Warren 1985, 1986a).

specimens recovered from the Spring Locus, over 94% of the obsidian specimens must date from an unrelated Lake Mohave Period occupation.

If two components, one Lake Mohave and the other Pinto, separated by an occupational hiatus of millennial magnitude, were mixed together in the Spring Locus, there should be a bimodal distribution of hydration readings separated by a distinctive break. No such break is apparent. Figure 7 demonstrates extensive overlapping of the three sample sets associated with features 2, 3, and 4. This strongly supports the radiocarbon dates, which indicate slight, if any, difference in age between these features.

## CONCLUSIONS

The data from Rogers Ridge indicate that there was no hiatus between the Lake Mohave and Pinto occupations there. Thus, they support the "long chronology" hypothesis (unbroken occupation between the Pinto and Lake Mohave periods) but place the transition period at ca. 6000-6400 B.C., rather than 5000 B.C. as advocated by Warren and Crabtree (1986:184). They also suggest the Pinto complex was a continuation of adaptations begun in the Lake Mohave Period that accommodated the changing environments of the early to mid Holocene.

The following hypothetical scenario fits the data comfortably, explaining the co-occurrence of Lake Mohave Short-stem, Pinto, and leaf-shaped points in the Spring Locus and the lack of Pinto points in the area of Feature 2. First, Rogers Ridge was sporadically occupied very early (8000 to 10,000 B.C.?), resulting in the deposition of at least two Clovis points and obsidian flakes with hydration rind thicknesses of 20 microns and greater. Second, sometime later (7000 to 8000 B.C.?) another occupation occurred, contributing Lake Mohave Long-stemmed and possibly some Short-stemmed points and obsidian flakes with hydration rind thicknesses of 17 to 19 microns to the deposits of the Spring Locus (Jenkins 1985: 179). Third, the main occupation occurred at the site between 6000 and 6400 B.C. Early in this period, Lake Mohave Short-stemmed points were predominant, and the main camp was located on the west end of Rogers Ridge in the area of the Southern Locus. Obsidian specimens deposited then would be those with hydration readings of 16 to 17 microns. By 6400 B.C., occupation had shifted a short distance to the east to an old camp location used during the initial Clovis occupation (Feature 2). More leaf-shaped than Lake Mohave Short-stemmed points were made here, and obsidian flakes deposited would be those with hydration rinds between 15 and 16.5 microns.

Within a short period of time somewhere between 6000 and 6400 B.C., occupation shifted from the south side of Rogers Ridge to the northwest point, where the spring provided water and vegetation. Pinto, Lake Mohave Short-stemmed, and leaf-shaped points were made and deposited around the cultural features at this camp. Obsidian flakes from this period have hydration rind means between 14 and 15.5 microns.

Sometime later, occupation shifted back to the south side of the ridge, to the Embayment Locus. Pinto points were then the predominant point type, although a few other types may also have been present either as innovations or as reused artifacts. Obsidian flakes from this occupation may be those with hydration rind thicknesses ranging from 9.0 to 14 microns. It is likely that the Pinto Period terminates somewhere in the lower range of these readings. Certainly, occupation ceased before Gypsum Cave, Humboldt, and Elko points became popular in the Mojave Desert.

## NOTES

1. The locus names used in this paper have been changed from those of the original site reports (Jenkins 1985, 1986) to facilitate the discussion and comprehension of the site layout and deposits. The Spring, Southern, and Embayment loci designations used here correspond respectively to the Locus 1, Silver Lake cluster, and Embayment cluster of the previous reports.

2. These strata do not correspond in name to those of Ferraro (1986:152-191) and Jenkins (1985).

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## REFERENCES

Amsden, Charles A.

1935 The Pinto Basin Artifacts. In: The Pinto Basin Site, by E. W. C. Campbell and W. H. Campbell, pp. 33-50. Southwest Museum Papers No. 9.

1937 The Lake Mohave Artifacts. In: The Archaeology of Pleistocene Lake Mohave: A Symposium, by E. W. C. Campbell, W. H. Campbell, E. Antevs, C. A. Amsden, J. A. Barbeiri, and F. A. Bade, pp. 51-98. Southwest Museum Papers No. 11.

Bettinger, Robert, and R. E. Taylor

1974 Suggested Revisions in Archaeological Sequences of the Great Basin in Interior Southern California. Nevada Archeological Survey Research Papers No. 5:1-26.

Campbell, Elizabeth W. C., and William H. Campbell

1935 The Pinto Basin Site. Southwest Museum Papers No. 9.

Ericson, Jonathan E.

1977 Prehistoric Exchange Systems in California: the Results of Obsidian Dating and Tracing. Ph.D. dissertation, University of California, Los Angeles.

Ferraro, David D.

1986 Stratigraphy and Environmental History of Tiefort Basin. In: Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by Dennis L. Jenkins, pp. 152-191. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 17.

Harrington, Mark R.

1957 A Pinto Site at Little Lake, California. Southwest Museum Papers No. 17.

Hester, Thomas R.

1973 Chronological Ordering of Great Basin

Prehistory. Berkeley: University of California Archaeological Research Facility Contributions No. 17.

Hughes, Richard E.
1985 Obsidian Sourcing Studies. In: Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mohave and Pinto Periods --Phase 2 Test Excavations and Site Evaluation, by Dennis L. Jenkins, Appendix E. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 18.

1986 Obsidian Sourcing Studies. In: Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by Dennis L. Jenkins, Appendix F. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 17.

Hunt, Alice P.
1960 Archeology of the Death Valley Salt Pan, California. University of Utah Anthropological Papers No. 27.

Jackson, Robert J.
1985 Analysis of Obsidian Hydration on Archaeological Specimens from CA-SBr-5250. In: Rogers Ridge (4-SBr-5250): a Fossil Spring Site of the Lake Mohave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation, by Dennis L. Jenkins, Appendix D. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 18.

1986 Analysis of Obsidian Hydration on Archaeological Specimens From Fort Irwin. In: Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California by Dennis L. Jenkins, Appendix D. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 17.

Jenkins, Dennis L.
1985 Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mohave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report Number 18.

1986 Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 17.

Jenkins, Dennis L., and Claude N. Warren
1985 Obsidian Hydration and the Pinto Chronology in the Mojave Desert. Journal of California and Great Basin Anthropology 6:44-60.

Kowta, Makoto
1969 The Sayles Complex: A Late Milling Stone Assemblage from Cajon Pass and the Ecological Implications of Its Scraper Planes. University of California Publications in Anthropology No. 6.

Lanning, Edward P.
1963 Archaeology of the Rose Spring Site, INY-372. University of California Publications in American Archaeology and Ethnology 49(3).

McFadden, Leslie D.
1985 Soil Geomorphic Study of Roger's Ridge, Tiefort Basin, Southern California. In: Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mohave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation, by Dennis L. Jenkins, Appendix B. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 18.

Meighan, Clement
1981 The Little Lake Site, Pinto Points, and Obsidian Dating in the Great Basin. Journal of California and Great Basin Anthropology 3:200-214.

O'Connell, James F.
1975 The Prehistory of Surprise Valley. Ballena Press Anthropological Papers No. 4.

Rogers, Malcolm J.
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum of Man Papers No. 3.

Simpson, Ruth D.
1965 An Archaeological Survey of Troy Lake, San Bernardino County: A Preliminary Report. San Bernardino County Museum Association Quarterly 12(3).

Susia, Margaret L.
1964 Tule Springs Archaeological Surface Survey. Nevada State Museum Anthropological Papers No. 12.

Thomas, David Hurst
1981 How to Classify the Projectile Points from Monitor Valley, Nevada. Journal of California and Great Basin Anthropology 3:7-43.

Wallace, William J.
1958 Archaeological Investigations in Death Valley National Monument 1952-1957. Berkeley: University of California Archaeological Survey Reports No. 42: 7-22.

1962 Prehistoric Cultural Developments in the Southern California Deserts. American Antiquity 28:172-180.

1977 A Half Century of Death Valley Archaeology. The Journal of California Anthropology 4:249-258.

Warren, Claude N.
1967 The San Dieguito Complex: A Review and Hypothesis. American Antiquity 32: 168-185.

1980a The Archaeology and Archaeological Resources of the Amargosa-Mojave Basin Planning Units. In: A Cultural Resource Overview for the Amargosa-Mojave Basin Planning Units, by Claude N. Warren, Martha Knack, and Elizabeth von Till Warren, pp. 1-134. Riverside: U.S. Bureau of Land Management Cultural Resources Publications, Anthropology-History.

1980b Pinto Points and Problems in Mojave Desert Archaeology. In: Anthropological Papers in Memory of Earl H. Swanson, Jr., Lucille B. Harten, Claude N. Warren, and Donald R. Tuohy, eds, pp. 67-76. Pocatello: Idaho State Museum of Natural History.

1984 The Desert Region. In: California Archaeology, by Michael J. Moratto, pp. 339-430. Orlando: Academic Press.

1985 Projectile Points. In: Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mohave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation, by Dennis L. Jenkins, pp. 103-116. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 18.

1986a Observations on the Settlement Patterns of Early Times Occupation in the Central Mojave Desert. Paper presented at the biennial meeting of the Great Basin Anthropological Conference, Las Vegas.

1986b Projectile Points. In: Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by Dennis L. Jenkins, pp. 195-217. Salinas, CA: Coyote Press Fort Irwin Archaeological Project Research Report No. 17.

Warren, Claude N., and Robert H. Crabtree
1986 The Prehistory of the Southwestern Great Basin. In: Handbook of North American Indians, Vol. 11, Great Basin, W. L. d'Azevedo, ed., pp. 183-193. Washington: Smithsonian Institution.

Warren, Claude N., and H. Thomas Ore
1978 Approach and Process of Dating Lake Mohave Artifacts. The Journal of California Anthropology 5:179-187.