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# Prehistoric Turquoise Mining in the Halloran Springs District, San Bernardino County, California

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PREHISTORIC turquoise mining in California has been treated in a cursory fashion, and the papers which address this industry are based upon field work prior to 1930. The intensity of mining and its relationship to cultural development in the Southwest suggests this activity warrants detailed analysis. This article addresses the tools, techniques, and antiquity of aboriginal turquoise mining in the Halloran Springs district of San Bernardino County, California.

## HISTORICAL BACKGROUND

Claims filed between 1895 and 1898 and mineral specimens submitted to the California State Mining Bureau marked the European discovery of the Halloran Springs turquoise district (Pogue 1915:46). Further discoveries and reports of extensive mineral deposits and evidence of prehistoric mining prompted the San Francisco *Call* newspaper to organize a small expedition headed by Gustav Eisen of the California Academy of Sciences to explore the region (Walcott 1898:582-584; Eisen 1898). Eisen observed prehistoric mines and petroglyphs, and collected Southern Paiute oral traditions. While providing interesting speculation for readers of the *Call,* the expedition accomplished little to further scientific understanding of the region. Commercial mining interests continued into the second decade of the twentieth century.

Malcolm Rogers' work in the 1920's was the earliest archaeological research and the only systematic study of prehistoric mining in this region until the present. Rogers, stimulated by accounts in geologic reports and journals, conducted a cursory field review in 1926 and a more extensive nine-day reconnaissance during October, 1928. During the latter expedition, surface collections at East Camp[1] and a survey of local springs and rockshelters were conducted. Several mines and rockshelters were excavated. Rogers believed that the material culture he observed resulted from sporadic but intensive use of the area during early Puebloan times (Basketmaker III and Pueblo I) and more recently by Chemehuevi (Rogers n.d., 1929).

In 1944, Robert Heizer and Adan Treganza (1944) reviewed prehistoric mines and quarries in California. They abstracted data from

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Rogers' field work and concluded, as did Rogers, that these mines were the result of use by Southwestern populations. Heizer, interested in evidence of Southwestern culture contact in California, visited one site at the north end of East Cronise Lake (SBr-202) and West Camp (SBr-207) in 1949.

## PROCEDURES

During April, 1978, the senior author visited the Halloran Springs region in the company of Robert Reynolds, Curator of Earth Sciences, San Bernardino County Museum. Mr. Reynolds had been monitoring modern-day mining operations and advising miners of the scientific value of the prehistoric tools they discovered in working prehistoric sites. Current mining practice is to identify the site of prehistoric mines, remove the fill (muck) from these mines, and work exposed veins by hand. During this visit to the West Camp vicinity (SBr-207), we found the miners had set aside all foreign materials—cultural remains—encountered during their mucking operations. As all work was accomplished by hand, it appeared the miners were able to recover a high percentage of prehistoric remains. These were stacked directly adjacent to the mines.

Because of the large quantity of tools and tool spalls retained and our wish to excavate a mine using archaeological methods, a second field trip was planned. In May, 1978, the authors and a crew of four spent two days examining the area within the Apache Canyon Mining Company claims, collecting a large sample of prehistoric artifacts, and excavating a small prehistoric mine.

After reviewing cultural remains assembled about the numerous active mines, materials from one mine, the Bonnie Blue, were selected for study. This mine was the farthest from the mine headquarters and was the most recently excavated. These factors suggested that it was unlikely that many of the artifacts had been removed by rockhounds. Contemporary miners had also obtained two radiocarbon samples from the Bonnie Blue.

All remains about the mine were collected, boxed, and labeled for transport. The two radiocarbon samples, which had been wrapped in aluminum foil and stored in a glass jar, were also packed.

An undisturbed prehistoric mine directly adjacent to the Bonnie Blue was selected for excavation. A one-meter-wide trench, oriented north/south, and including the total areal extent of the mine was laid out. The trench was excavated in cultural levels, and excavation continued until bedrock was encountered. The trench was excavated with trowel and shovel; all soil was passed through 1/8-inch-mesh. A second trench, oriented east/west and intersecting the first at the center of the mine, was also excavated. All materials were located three dimensionally while *in situ*. Observations were recorded by notes and photographs.

Preliminary processing, washing, cataloguing, and analysis of cultural remains took place at the San Bernardino County Museum. Tools were described by the following attributes: material, weight, dimensions, shape of utilized surface, type of wear, and presence of purposeful shaping. All remains have been stored at the San Bernardino County Museum, and are referenced by accession number SBCM-387. Prior to and during analysis, the collections of the museum were reviewed as were the collections and field notes of Malcolm Rogers, which are housed at the San Diego Museum of Man. Radiocarbon samples were analyzed by the Archeometry Laboratory, University of California, Riverside.

## MINING DISTRICT AND MINES

The Halloran Springs District, Manvel District (Kuntz 1899, 1905; Pogue 1915), or Turquoise Mountain region (Rogers 1929), is situated 25 km. northeast of Baker, California (Fig. 1). The district is characterized by two distinct topographic regions. The west and

central portions of the district are dominated by rugged, weathered ridges and hills rising to a maximum of some 250 m. above surrounding alluvial deposits. The eastern region is dominated by small mesas capped by Pleistocene basalt lava flows. The southern portion is deeply eroded, forming step-walled canyons; the northern aspect features gently sloping alluvial valleys and fans.

Fig. 1. Location of the Halloran Springs district.

Historically, mining claims have clustered in three areas: West Camp, Middle Camp, and East Camp (Kuntz 1899; Pogue 1915). These clusters also reflect aboriginal patterns of mining. West Camp is located on the rugged western slopes of Turquoise Mountain. This was probably the most heavily mined region prehistorically (Rogers 1929:5). Many of the mines have been obliterated by modern mining activity or obscured by erosion. Middle Camp is located 5 km. to the east on the eastern slopes of Turquoise Mountain. Aboriginal mines are located about the base of the rocky slopes. There is little evidence of aboriginal mining at this location (Rogers n.d.). Seven kilometers farther east is East Camp where aboriginal mines are situated in shallow alluvium near low rock outcrops. In 1928, Rogers found this to be the best preserved grouping of aboriginal mines.

Prehistoric turquoise mines in the Halloran Springs District are of a open pit type. Today they are marked by shallow, roughly circular depressions. The actual mine is usually irregular, with its shape and size dictated by the occurrence of turquoise deposits. The mines range in size from prospects 2.5 m. by 2.0 m. by 0.7 m. to large mines 9.0 m. by 4.0 m. by 4.0 m. in extent. Mines on the scale of the latter are not unusual. Rogers (1929:4) describes the mucking of a large mine at East Camp; comparable mines have been uncovered in the West Camp group (E. Nazelrod, 1978, personal communication).

The following characterization of mine fill has been drawn from the excavation of a small open pit mine at West Camp. The surface surrounding the mine exhibited a thin layer (0 to 10 cm.) of light yellow-brown sandy soil mixed with angular rock. The upper (0 to 30 cm.) level in the mine was a light gray-brown compact sandy soil with angular rock. No cultural remains occurred in the soil surrounding the mine or on the upper level within the mine. Below 30 cm. the soil became loose and rocky; a calcium carbonate cement coated many of the rocks. This soil persisted to bedrock; all cultural remains occurred in this level.

## DESCRIPTION OF TOOLS

The only published description of tools from the Halloran Springs District is Rogers' 1929 account. He describes stone mauls, picks, and axes. These groupings are based upon the shape of the utilized surface: "blunt-nose hammer, a sharp-nose pick, and a chopping type similar to the double-bitted axe" (Rogers 1929:5). Tool forms are further divided into two classes: tools "crudely" shaped and made from local basalt and those "carefully" shaped specimens of non-local materials.

While the forms described by Rogers have been recognized by subsequent researchers, they represent the unusual rather than the commonplace tool forms. The current sample of 184 hammers contains 24 grooved or notched specimens, Rogers' "crudely shaped"

category. No specimens comparable to those described as "carefully shaped" have been recovered, although one three-quarter grooved axe, exhibiting extensive pecking and grinding, was recently recovered from a mine at West Camp.

Hammers are blocks or large flakes of stone showing evidence of battering, crushing, and pitting. A variety of raw material was selected: basalt (82), quartz (45), quartz breccia (24), meta-quartzite (23), quartzite (7), gneiss (2), and chalcedony breccia (1). All but quartzite are available within 10 km. of the mines. Quartzite occurs in the Clark and Mescal Mountains to the east, the Old Dad Mountains to the south, and the Soda Mountains to the west. Tool mass varies greatly; weights range from 60 gm. to 3.56 kg. Despite this range, 85% of the tools weigh 1 kg. or less. Eighteen of the smaller hammers are reused spalls from large hammers.

Tools exhibit one or more utilized surfaces. The shape of these surfaces, the cross-section at a right angle to the long axis of the edge, varies from acutely angular (17) to angular (126) to rounded (171) to flat (7). Acutely angular edges are limited to smaller tools, tools with a mean weight of 250 gm.

The majority of tools are irregular in outline exhibiting no modifications other than through use (Fig. 2*c-f*). Twenty-four specimens exhibit notching (19) or grooving (5). Notches occur medially (Fig. 2*b*); two or three may be present, depending on the size and thickness of the tool. Shaping ranges from a single blow to pecking of a deep, broad notch. Grooves are pecked medially (Fig. 2*a*); at least 30% of the tools' circumference displays modification. Notches are present in cases where the groove did not extend to a protruding edge.

As a group, hammers which exhibit shaping differ in other aspects from the more numerous unshaped hammers. All grooved or notched hammers are made of basalt. The weight range is not as great, and varies from 250 to 1700 gm. Thirty-three percent of these hammers are over 1000 gm. There is also a tendency for utilized edges to be less acute.

Notches and grooved tools were presumably hafted. Comparable forms have been recovered elsewhere with handles in place. Hammers from salt mines in southeastern Nevada (Harrington 1927; Shutler 1961:Plate 102a) exhibit a split branch encircling the hammer head tied with twine about the base of the head. Similar branch handles without twine lashing have been found in turquoise mines in Zacatecas, Mexico (Weignad 1968: fig. 8).

Seven of the twenty-four notched and grooved hammers exhibit abraded areas on lateral surfaces. These areas are polished and exhibit striations visible without magnification. These areas range in size from surfaces measuring 1 cm. by 4 cm. to surfaces 12.7 cm. by 7.6 cm. Rogers (1929:5) noted the presence of polish on specimens and cites this as evidence of wedges associated with hafting. This may be the case in some instances; however, it is also likely that hammers functioned as lapping stones (a grinding or polishing tool). Three hammers, lacking notches or grooves, exhibit polished surfaces. In addition, a single piece of quartz breccia has been recovered which exhibits a polished surface measuring 9.5 cm. by 11.4 cm. and no evidence of battering.

The only other cultural remains collected are a possible wedge and hammer spalls. The wedge is a large flake of basalt exhibiting battering about the striking platform and edge opposite the platform, with polishing and striations over 40% of the dorsal surface. Twenty-seven spalls were recovered. These are unmodified fragments of hammers; they range in weight from 6 to 72 gm.

## TURQUOISE MINING

Turquoise is a secondary mineral, forming veins in fragmented igneous rock or irregular

nodules in highly altered rock. It forms veinlets, filling joint planes and fracture zones in the granitic porphyry at West Camp. The hardness of turquoise is between 5 and 6 on the Mohs scale; the surrounding granitic porphyry is approximately 6. Veins of turquoise may be found exposed in rock outcrops; good quality specimens may be found within a few feet of the surface.

Current turquoise mining operations include a sequence of tasks comparable to the aboriginal mining process: location of a potential mineral source, exposure of a productive vein by removal of the surrounding rock, ex-

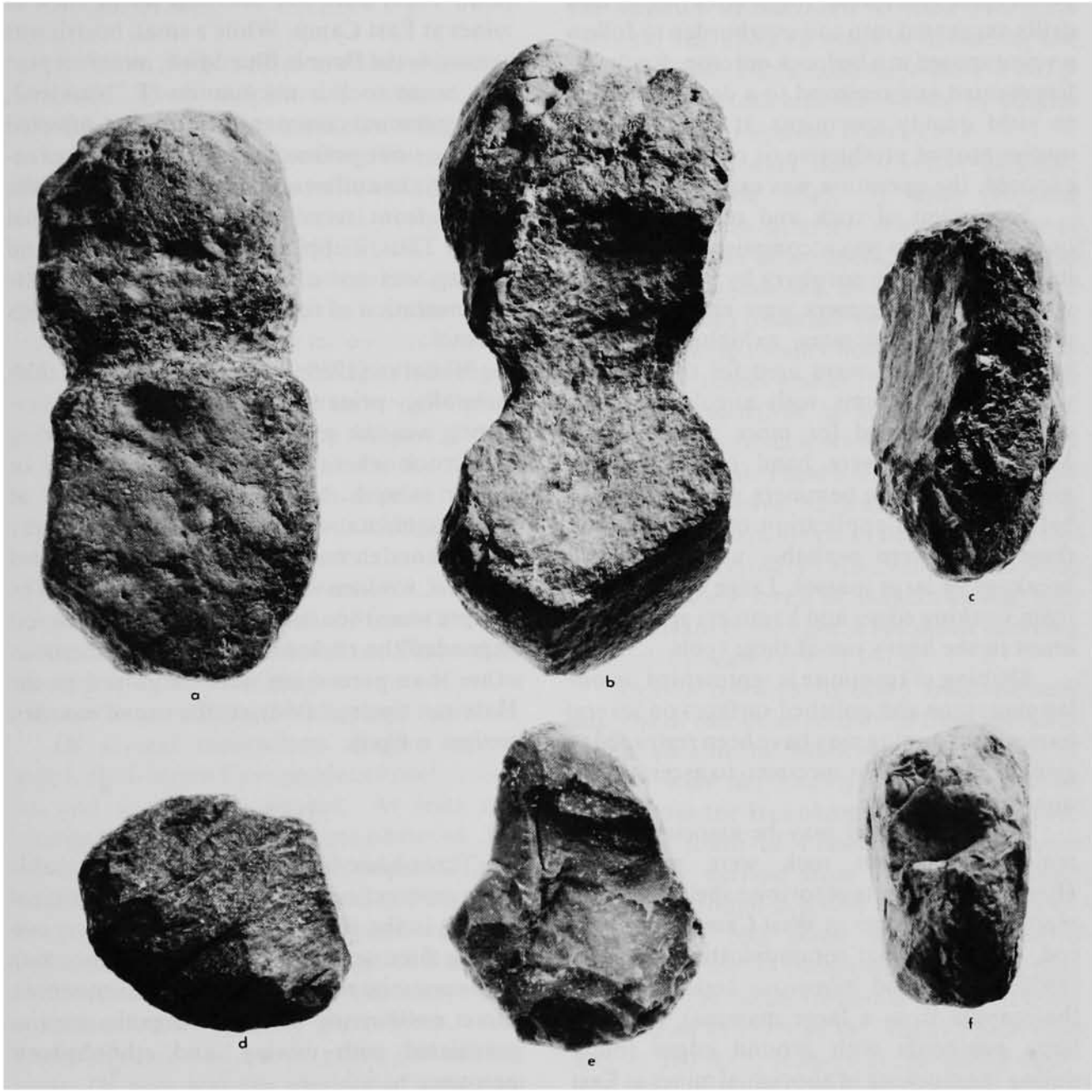


Fig. 2. Common hammer forms from Halloran Springs district: *a:* grooved hammer; *b:* notched hammer; *c-f:* unshaped hammers. Length of *a*: 21.5 cm. Photo by R. A. Hicks.

traction of turquoise specimens, and reduction of specimens by removal of matrix. Throughout the extraction process, it is necessary to have a relatively clear working area; thus removal of waste rock is an integral part of mining.

Aboriginal miners located turquoise deposits by surface traces. Rogers (n.d.) described drifts excavated into soil overburden to follow a vein exposed in a bedrock outcrop. Rock was fragmented and removed to a depth sufficient to yield quality specimens. If a vein of turquoise proved productive or other veins were exposed, the operation was expanded.

Extraction of rock and removal of turquoise specimens was accomplished by fracturing of the granitic porphyry by percussion. A wide range of hammers were employed. The more massive hammers, exhibiting broader working surfaces, were used for the heaviest work. Lighter forms with angular working surfaces were used for more precise work. Most hammers were hand held. Approximately 15% of the hammers were hafted. As hafting allowed application of greater force, these tools were probably associated with breakage of large masses. Large spalls driven from working edges and hammers split in half attest to the heavy use of these tools.

Shaping of turquoise is represented by one lapping stone and polished surfaces on several hammers. Lapping may have been restricted to grinding a facet on a specimen to ascertain the quality of the stone.

No artifacts that may be associated with removal of waste rock were recovered. However, fragments of tortoise shell have been reported from mines at West Camp (E. Naxelrod, 1978, personal communication). Rogers (1929:4) described numerous tortoise shells, the scapula from a large mammal, and two large potsherds with ground edges found during the mucking of aboriginal mines at East Camp. These tools were probably used as scoops to collect and remove broken rock from the mines.

The use of fire or combination of fire and water to fracture rock was a method employed to mine turquoise in Nevada, Arizona, and New Mexico. Reference has been made to numerous concentrations of burnt rock in mine fill (Bartlett 1935; Shutler 1961). Rogers (n.d., 1929) does not mention burnt rock in mines at East Camp. While a small hearth was present in the Bonnie Blue Mine, miners report that burnt rock is uncommon (E. Nazelrod, 1978, personal communication). Fire-affected rock was not present in the small mine excavated by the authors, nor was it observed in the dumps from recent mucking of aboriginal mines. Thus, it appears that rapid heating and cooling was not a primary technique in the fragmentation of rock in the Halloran Springs District.

Nasiatka (1969:3), in discussing tunneling technology prior to blasting, stated that fire-setting was the primary method of breaking hard rock wherever an adequate supply of timber existed. Another common method of rock fragmentation cited by Nasiatka was the use of wooden wedges. Stone tools were used to drive wooden wedges into fractures. The wedges were then moistened and as the wood expanded the rock was loosened. If methods other than percussion were employed in the Halloran Springs District, the use of wooden wedges is likely.

## DATING

Three basic lines of evidence are available in reconstructing the periodicity of aboriginal mining in the Halloran Springs region: cross-dating time sensitive artifacts in association with turquoise mining to established sequences, direct radiometric assays of organic remains associated with mining, and ethnohistoric accounts.

A number of time-sensitive artifacts have been found in association with turquoise

mines, turquoise mining tools, and turquoise. Southwestern pottery is the most diagnostic. At East Camp Rogers noted the occurrence of

> . . . twenty-five Puebloan-type sherds . . . consisting of two different pastes . . . a white paste almost free of inclusions, and a gray paste, thick with coarse inclusions [Rogers 1929:6].

Notably, Rogers observed the absence of "Mohave" (buff and brown) wares at East Camp (1929:6). The gray wares would appear to be Lino Gray (Tusayan Gray Ware—Tsegi Series), and Pyramid Gray (Lower Colorado Buff Ware—Barstow Series), respectively (Colton and Hargrave 1937:191-192; Colton 1958). The occurrence of the coarse tempered Pyramid Gray in association with the more finely tempered Lino Gray in contexts in which brown and buff wares were absent led Rogers to suggest a sporadic Basketmaker III-Pueblo I occupation of the eastern Mojave Desert (1929, 1939:61, 65; 1945:176). From a Southwestern context Lino Gray dates prior to A.D. 750 (Colton and Hargrave 1937:191-192), while Pyramid Gray is suggested to range from A.D. 900 to A.D. 1150 (Colton 1958:Ware 16, Type 31). One gray ware sherd from the West Camp collection at the San Bernardino County Museum exhibited olivine temper, a characteristic of Moapa Valley gray ware.

Of several rockshelters Rogers investigated, Half-Moon Cave produced both ceramics and a stratified deposit. At least two stratigraphic components were observed. The lower level exhibited turquoise chips, hammers and hammer spalls, pottery, and milling tools. Rogers (n.d.) noted that the potsherds were Pyramid Gray, Deadman's Fugitive Red, and Verde Black-on-Gray. The upper component contained arrow points, glass beads, beds made of yucca and bunch grass, and milling tools. Of note was the absence of turquoise chips and mining tools. The projectile points were described as Chemehuevi (Rogers n.d.). In a later article, Rogers (1945) equated Cottonwood series projectile points with Chemehuevi type.

During much of Rogers' initial work, Southwestern ceramic typologies simply were not available (see Rogers 1929:7). Later, Rogers sent type collections to Lyndon Hargrave at the Museum of Northern Arizona (Hargrave 1932:14) and updated many of his earlier site records. Table 1 illustrates the variety of intrusive Southwestern ceramics found by Rogers in the Halloran Springs District.

Regarding other time sensitive artifacts, Rogers (1929:6, Plate 2) also recorded ". . . one three-quarter grooved hammer similar to those of southern Arizona." Other similar, highly polished, three-quarter grooved axes have been observed by the authors from the West Camp locality both in the possession of modern miners and at the San Bernardino County Museum (SBCM-387). Rogers' contention that this artifact was intrusive is supported by Heizer (1946). These axes lack raised ridges around the grooves. Such axes are found only in pre A.D. 500 contexts at the Hohokam site of Snaketown (Haury 1976:291). The temporal context of these forms at Snaketown may also be significant in the light of turquoise sourcing research by Sigleo (1970, 1975).

Sigleo's research involved trace element analysis of turquoise recovered from archaeological sites in the Southwest. Specifically of interest were her findings that 13 turquoise beads from the Hohokam site of Snaketown, 30 miles south of Phoenix, Arizona, were apparently derived from Halloran Springs. The beads, found in a Gila Butte Phase (A.D. 500 to A.D. 700) house, were compared to turquoise from 23 turquoise mining districts (Sigleo 1975). Since turquoise is known from Snaketown as early as the Vahki Phase (300 B.C. to 100 B.C.) Haury has speculated that:

> The random selection from the collection as a whole suggest that the area known as

**Table 1**
**SOUTHWESTERN POTTERY FOUND IN ASSOCIATION WITH TURQUOISE MINING ACTIVITY[2]**

| | Himalaya Mines | | | Half-Moon Cave | Halloran Wash |
|---|---|---|---|---|---|
| | M-20 | M-20a | M-21 | M-23 | M-70 |
| Lino Gray (Before A.D. 750) | xx | xx | | | |
| Deadman's Fugitive Red (A.D. 700-1050) | | | | xx | xx |
| Deadman's Gray (A.D. 700-1150) | | | | | xx |
| Pyramid Gray (A.D. 900-1150) | xx | | | xx | |
| Aquarius Orange (A.D. 1000-1100) | | | | | xx |
| Aquarius Black-on-Orange (A.D. 1000-1100) | | | | | xx |
| Verde Black-on-Gray (A.D. 1050-1300) | | | | xx | |

> East Camp group of mines in California was the main supplier of turquoise in the later stages of Hohokam prehistory. Follow-up studies in this region to detect direct evidence of Indian activity, and further testing of Pioneer Period [Vahki Phase] turquoise samples to see if early stones came from there as well, could lead to helpful information about Hohokam commercial and mining efforts [Haury 1976:278].

Two radiocarbon determinations were obtained from charcoal and bone specimens recovered from the Bonnie Blue Mine at West Camp by contemporary miners. The wood charcoal specimen yielded a date of 880 ± 100 radiocarbon years: A.D. 1070 (UCR 844a); correction for secular variation results in a range of A.D. 1090 to A.D. 1120 (Ralph *et al.* 1973). An unburnt bone fragment of a large mammal from a separate context yielded a second date (acid insoluble organic fraction) of 1520 ± 180 radiocarbon years: A.D. 430 (UCR 844b); corrected to A.D. 510 to A.D. 530 (Ralph *et al.* 1973).

Ethnographic literature (Kroeber 1959; Euler 1966; Laird 1976) indicates both the knowledge of the Halloran Springs turquoise district and the actual acquisition of turquoise from this source by Chemehuevi and possibly Mohave groups. The reader may refer to the paper by Drover immediately following this paper for relevant excerpts.

The earliest known period of mining activity in the Halloran Springs District dates between A.D. 400 and A.D. 750. This period is marked by a radiocarbon date of A.D. 510 to A.D. 530 from West Camp, the presence of three-quarter grooved axes at several locations in the district, Sigleo's identification of Halloran Springs turquoise in a Gila Butte Phase house at Snaketown, and Lino Gray pottery from East Camp.

The second period dates between A.D. 750

and A.D. 1200. This period is defined by a radiocarbon date of A.D. 1090 to A.D. 1120, from West Camp, sherds of Pyramid Gray from East Camp, sherds of Deadman's Fugitive Red, Pyramid Gray, and Verde Black-on-Gray from the lower level of Half-Moon Cave, and sherds from the Halloran Wash site.

The third period dates between A.D. 1200 and A.D. 1900. Mining during this period is suggested by the presence of Panamint Brown pottery (May 1978:38) at East Camp and ethnohistoric accounts.

## CONCLUSIONS

The infrequent occurrence of turquoise in habitation sites in California and the presence of intrusive Southwestern ceramics in the turquoise mining vicinity have been used to argue that mining was not conducted by local populations (Rogers 1929, 1939:65; Heizer and Treganza 1944). However, at least one author has concluded that people living in the region mined turquoise and traded both rough and finished goods to the south and east (King 1976:30).

The general lack of finished turquoise products in California, the scarcity of lapping tools and partially complete turquoise artifacts within the mining district and the absence of this assemblage outside the immediate vicinity of mines, and the demand for turquoise in the Southwest suggest mining during the first and second periods at Halloran Springs was by Southwestern populations. Artifacts used to describe the phases of mining also reflect the source of miners and/or consumers or possible redistribution centers for turquoise goods.

The initial mining period was prior to local ceramic manufacture. While no Hohokam ceramics have been reported from this area, the three-quarter grooved axes are manifestations of Hohokam culture. Sigleo's trace element identification of Halloran Springs turquoise at Snaketown is a definite tie between this turquoise source and southcentral Arizona. Lino Gray, the earliest pottery present at Halloran Springs, represents a second area located in the Virgin River region and/or the Colorado Plateau. This ware is likely of the Virgin or Kayenta Branch, since it is not known to have been manufactured southeast of the Colorado River.

The second period of mining is marked by ceramic types manufactured south of the Colorado River between Needles and Flagstaff. Deadman's Gray, Deadman's Fugitive Red, Aquarius Orange, Aquarius Black-on-Orange, and Verde Black-on-Gray are all indicative of the Cohonina and Prescott Branches of the Patayan Culture. Rogers (1945:175) felt that these types represented trade wares and predated local pottery manufacture. This ceramic assemblage shares similarities with assemblages from other areas of the Mojave Desert: the Providence Mountains (Davis 1962; Donnan 1964; True *et al.* 1966) and Cronise Lakes (Drover 1979). If there is a pattern of ceramic similarity over the eastern Mojave, then it may indicate cultural similarities between the Amacava (desert and northern Riverine Yumans) Branch of the Patayan Culture with the Cerbat and Cohonina and Prescott Branches of northern Arizona (Drover 1979:137).

In other words, the prehistoric occupants of the northeastern Mojave Desert from about A.D. 900 to A.D. 1500 may have been the same cultural-linguistic group as the Patayan of northwestern Arizona. Schroeder (1952) uses the term Amacava to describe this phase of activity both at Willow Beach and in the Mojave Desert. Upland Patayan groups may have been involved in turquoise mining and distribution with the Hohokam. An isolated Hohokam burial near Kingman (True and Reinman 1970) and a site near Prescott, Arizona, in which both raw and shaped turquoise occurred as well as turquoise mosaics and *Conus* sp. tinklers (Spicer and Caywood 1936) may suggest such culture contact.

The Shoshonean presence during the third period of mining is indicated by Panamint Brown Ware. This period corresponds to the occupation of the region by the Chemehuevi.

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## NOTES

1. Rogers often used the names of mines to describe the location of cultural remains. The terms he adopted are either incorrect or misleading (Murdock and Webb 1966). Thus, this paper limits locational references to general areas: West, Middle, or East Camp.

2. Data presented in Table 1 are drawn from the notes of Malcolm Rogers and Jay W. Ruby's Ph.D. dissertation (1970: Appendix II).

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