Quartz Crystals and Other Sparkling Minerals from the Bolsa Chica Archaeological Project

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Abstract

This study documents quartz crystals and other sparkling minerals (i.e., corundum, calcite, dolomite, muscovite, and iron pyrite) curated during recent archaeological investigations at CA-ORA-83 (the Cogged Stone Site), CA-ORA-82, CA-ORA-85, CA-ORA-88, and CA-ORA-365. These sites are located either in or near the Bolsa Chica area, coastal Orange County. Ethnographic and archaeological notes are provided covering Native employments of several kinds of crystals. Geologic source information is also offered.

Introduction

Rock crystals with magico-religious connotations have near world-wide distribution (Heizer 1949:31). In aboriginal Alta and Baja California, crystal potency embraced a variety of supernatural effects, its purview falling largely to shamanic practice (e.g., DuBois 1908:97; Heizer and Treganza 1944:331-332, Map 4; Heizer 1949:19, 1978: passim; Hohenthal 1950:10; Beals and Hester 1974:136; Hoover 1975; Bean 1976: 414; Levi 1978:44-45; see also Singer 1986:Map 1).

Archaeological science records long term quartz crystal use for much of California (e.g., Moratto 1984: passim). In coastal southern California, the mineral is documented for Early Holocene (e.g., Gallegos 1991; Koerper et al. 1991), Middle Holocene (e.g., Gamble and King 1997; Mason et al. 1997), and Late Holocene contexts (e.g., L. King 1969). This study presents data from the Bolsa Chica Archaeological Project (BCAP) (Fig. 1) that helps affirm the long and continuous regional employment of the mineral, and it adds employment of other sparkling minerals–dolomite, corundum, and muscovite–to the record of prehistoric Orange County culture history. The project area is situated at two tablelands (Bolsa Chica Mesa and Huntington Beach Mesa) which overlook Bolsa Bay from opposite directions. This study focuses on five sites: CA-ORA-83; CA-ORA-82; CA-ORA-85; CA-ORA-88; and CA-ORA-365.

Clear Quartz Crystals: Cultural Background

We draw on the ethnographic/ethnohistoric record as well as the regional archaeological record to suggest the strong probability that most if not all of the 27 BCAP quartz crystal specimens had once connected to the magical arts and/or ceremonial behavior. None of the 27 BCAP rock crystals, however, was directly associated with either a burial, ceremonial feature, or ritual artifact.

Colonial Spaniards quickly recognized Native valuation of quartz crystals (e.g., Simpson 1938:52-53,

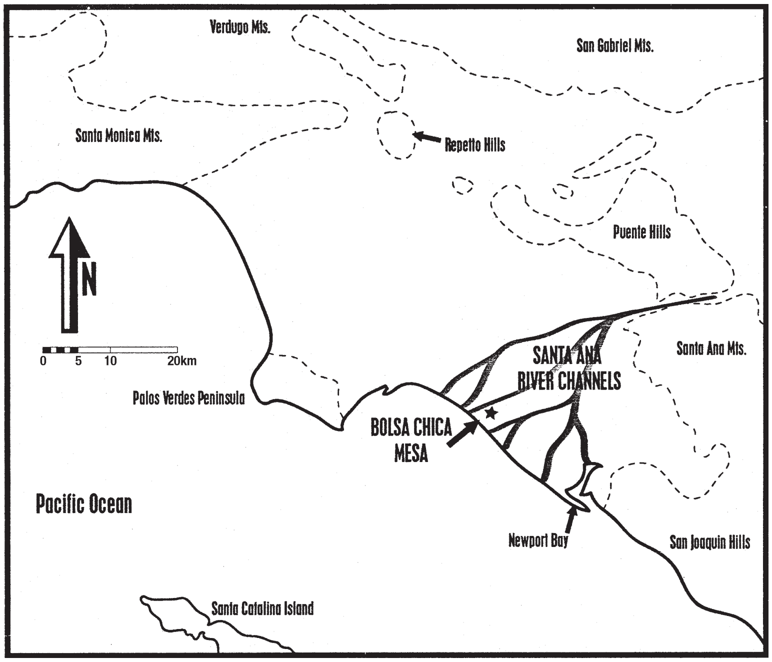
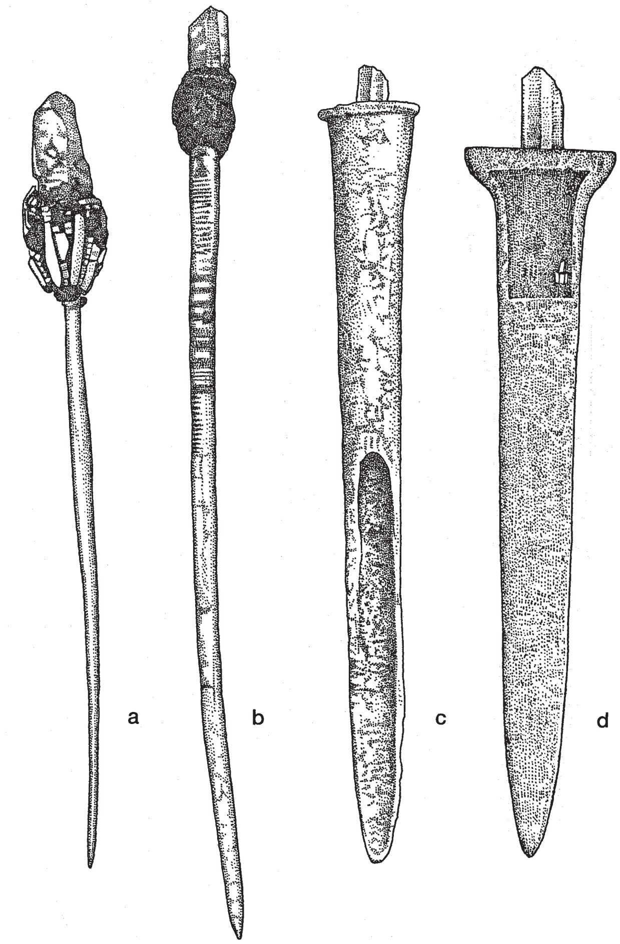


Fig. 1. Location of Bolsa Chica Mesa, with diachronic scheme showing channels cut by the Santa Ana River.

1961:60; Vizcaíno 1959:14), owing in part, one must imagine, to the multitude of sacred venues in which they appeared. For instance, in Alta and Baja California, quartz crystal talismans were causally linked to weather control and might be associated with thunder, lightning, or rainbows (e.g., Driver 1937:104; Voegelin 1938:64; Gayton 1948; Hudson and Underhay 1978:49; Levi 1978; Hudson and Blackburn 1985:262, 1986:154, 1987:33; see also Fenenga and Riddell 1978). Others carried the imprimatur of good fortune for such pursuits as love and game play (e.g., Sapir 1908; Gifford and Klimek 1936:85; Sapir and Spier 1943:282; Garth 1953:193; Levi 1978:50; Hudson and Blackburn 1985:261-262). There were varied applications of quartz crystals to healing and harming (e.g., DuBois 1908:97; Hohenthal 1950:10; Walker and Hudson 1993:53) as well as to divination, clairvoyance, miraculous feats of travel, protection, and change from human into animal form (e.g., Alliot 1916:129-130; Levi 1978:44-45, 50). Further, for coastal Shoshoneans, the mineral was sacred to god Chinigchinich (Harrington 1978:133-135; see also Sparkman 1908:219), and crystal imagery was writ large in especially Chumash mythology/cosmology (Blackburn 1975:36, 37; Hoover 1975:109; Hudson and Underhay 1978:52, 117, 121; Applegate 1978:107).

From Chumash through Kumeyaay territory quartz crystals were set atop ceremonial wands or other kinds of baton-like artifacts (Fig. 2), some of which were occasionally used to both injure or cure (Putnam et al. 1879; Sparkman 1908:211; DuBois 1908:passim; Waterman 1910:300-301; Strong 1929:21; Heye 1921:60; Kroeber 1925:567, 665; Rogers 1929:416; Olson 1930:19; Gifford 1940:173, 214, 1947:27-28, 113; M. R. Harrington 1952:135; Alliot 1969:129; True et al. 1974:Hoover 1975; Thomas 1976:129; Bean and Shipek 1978:13; Nicholson 1906, cited in Moser 1983:15; Hudson and Blackburn 1986:254-259). Batons with quartz crystals were sometimes included in shamans' bundles (Olson 1930:19), and some unmounted crystals were kept in medicine bags (e.g., Abbott 1879b:214; see also Winterbourne 1967:44; Fenenga and Riddell 1978).



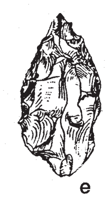


Fig. 2. Crystals and staffs:
a) Bone wand or hairpin from Santa Cruz Island, 255mm (after Orr 1947:131, AH2 and Hoover 1975:106);
b) Bone wand or hairpin from Santa Cruz Island, 295mm (after Orr 1947:131, AH1a and Hoover 1975:106);
c) Bone wand found in hand of Skeleton 20, Santa Rosa Island, 428 mm (after Jones 1956:245, Plate 96 a);
d) Artist's reconstruction of wood paviut/kotat stick with quartz crystal (after an approximately 520 mm long specimen shown in Bean and Shipek 1978:554, Fig. 5);
e) Chipped crystal biface, possibly from paviut/kotat stick, SDi-5353, 30 mm.

"Large quartz crystals" were among the items placed in a huge basket set before Luiseño girls undergoing a puberty initiation (DuBois 1908:93-94; see also Oxendine 1980:44). Perhaps the 2.5 pound specimen recovered from the San Joaquin Home Ranch site (Anonymous 1938:130) and pictured in Figure 3c was one such ritual object.

The archaeological literature attests to a regional practice of contributing crystals to graves - in coastal Shoshonean territory (e.g., DuBois 1908:92; Anonymous 1938:130; Winterbourne 1967:155; Bates 1972:44; Koerper and Drover 1983:23 [see also Koerper and Fouste 1977]), in Chumash territory (e.g., Schumacher 1875:349; Abbott 1879b:214; Ford 1887:13; Yates 1891:376, 1957:38; Jones 1956:227, 230; L. King 1969; Hudson and Blackburn 1986:155), and in coastal Yuman territory (e.g., Moriarty 1982:85-87, 90-92) - and also including rarely the graves of animals (Hale 1995:25, 70, 119, 193). The crystal of Figure 3b was recently discovered with a five year old child buried at ORA-1587, Shady Canyon, Irvine (Koerper 2001).

Crystals were coveted for aesthetic reasons. Chumash, for instance, admired quartz crystals "for their beauty" (Yates 1891:376, 1957:38), and further afield there is data to indicate their possible employment as decorative musical bangles, or tinklers, worn about the neck, at least in central California Windmiller Culture (Ragir

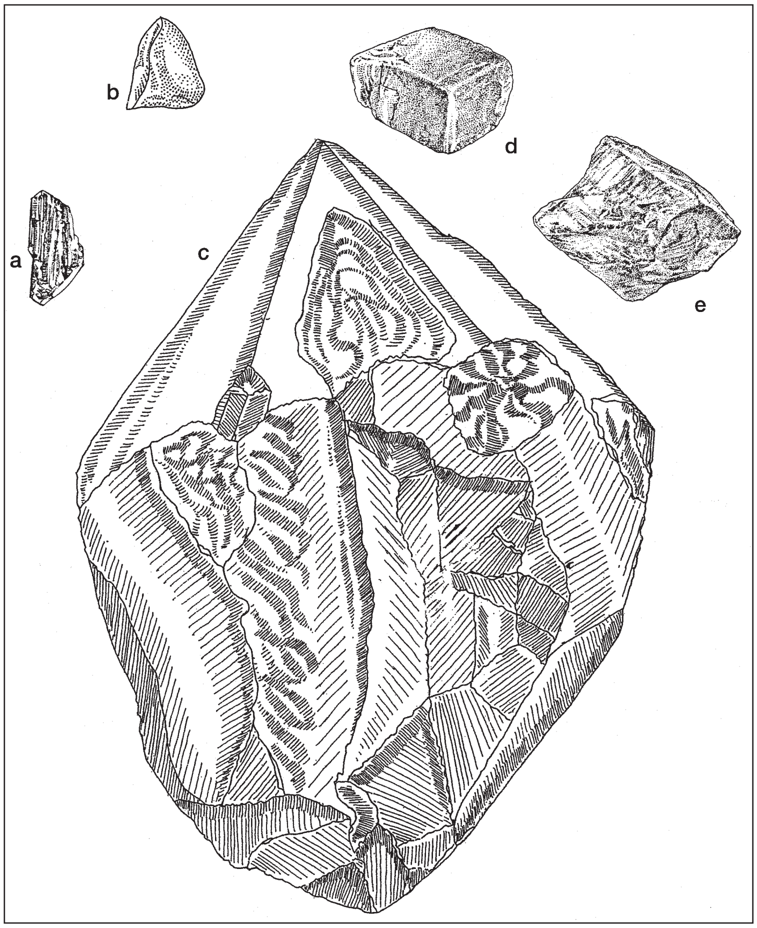


Fig. 3. Orange County crystals:
a) Spodumene, ORA-855, 21 by 10 mm;
b) Burial quartz crystal, ORA-1587, 16 by 13 mm;
c) Burial associated quartz crystal, San Joaquin Home Ranch site, 135 by 103 mm (after WPA artist, Anonymous1938:130);
d) Calcite crystal, ORA-855, 16 by 13 mm;
e) Chipped quartz crystal, ORA-855, 25 by 20 mm.
(Note that the illustrations of d and e are enlarged relative to the others.)

1972:102), and as insets for decorative items, including hairpins (cf., Gifford 1940:214; Orr 1947:118, 119, 128, 131).

Other Sparkling Minerals: Cultural Notes

Tourmaline crystals, in many ways, played functional equivalent to clear quartz crystals in many regional life-ways. Like the quartz crystal, tourmaline could serve as a mortuary offering. A specimen of schorl (black tourmaline) was likely associated with a cremation at the San Joaquin Home Ranch Site (Anonymous 1938:61, 135, 162). Highly colored tourmaline crystals have been found in Indian graves in northern San Diego County (Murdock and Webb 1948:27, 1966:49). Among other parallels, lithia-tourmaline too was sacred to Chinigchinich (Harrington 1978:133-135) as was amethyst, spodumene (specifically kunzite) (Fig. 3a) and garnet (see also Bolton 1926:125; Hinton 1994:213).

Tourmaline has been noted in conjunction with puberty rites, for girls (DuBois 1908:94) as well as for boys (DuBois 1908:92; Harrington 1978:134). The use of tourmaline is reported to have provided varied magical/medicinal effects involving healing (DuBois 1908:97), gambling luck (Hohenthal 1950:10; Levi 1978:40), luck in love (Levi 1978:40), safe travel (Hohenthal 1950:10; Levi 1978:50), divination, mind reading, transmogrification into animal forms, achieving invisibility, and warning of danger (Levi 1978:50).

No tourmaline manuport has ever been scientifically documented for the area of the BCAP investigations.

Parenthetically, certain metallic sparkling minerals carried special meanings. Spanish accounts attest to the desirability of galena (lead sulfide), which conferred valor and bravery (Simpson 1938:52, 110, note 29, 1961:60, also note 16; Vizcaíno 1959:14; see also Koerper and Strudwick 2002.). Galena was not recovered in the BCAP investigations.

Iron pyrite (iron sulfide) reportedly functioned as a "medicine stone" (Yates 1889:300, 1890:19). The iron pyrite specimen attributed to Bolsa Chica Mesa (see below) is likely, however, to have been a 20th century manuport.

BCAP Quartz Crystals

Twenty-seven quartz crystals were recovered from ORA-82, -83, -85, -88, and -365. Other crystals, two calcite (ORA-83 and ORA-365), one corundum (ORA-83), and one dolomite (ORA-83), were also excavated. Five holed muscovite specimens (ORA-83) are among the sparkling minerals in the BCAP collection. No BCAP crystal occurred in a ceremonial/ritual venue. No lithia-tourmaline, "schorl," spodumene, fluorite, amethyst, garnet, or galena specimens were excavated during the BCAP investigations. In fact, no archaeological recognition of amethyst, fluorite or garnet has been published in the Orange County literature.

Of the 27 BCAP quartz crystals (Table 1), only one possibly exhibits asphaltum. Six or seven exhibit some amount of modification or use wear. The largest sample (N=15) by site comes from ORA-83, and includes

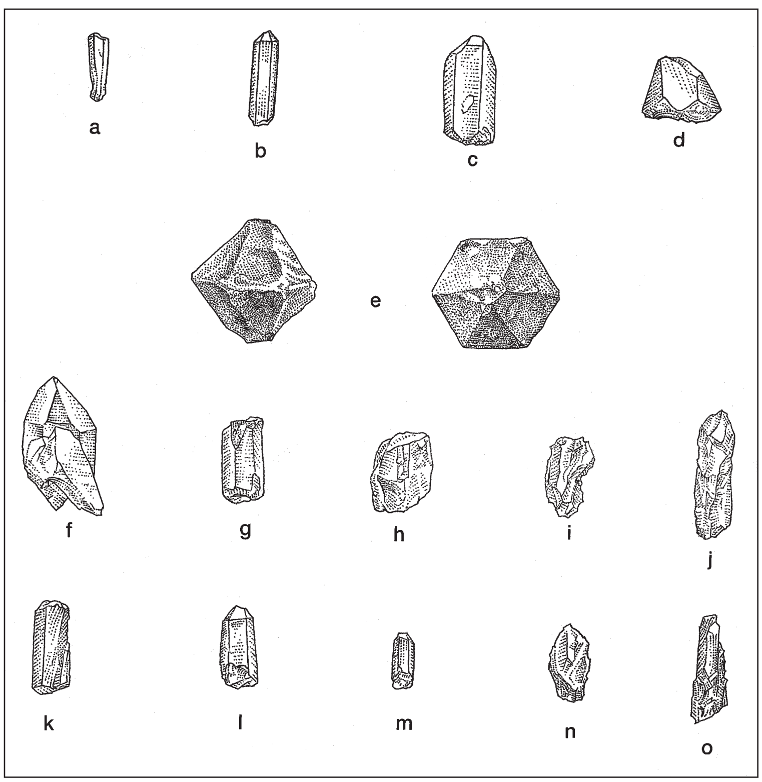


Fig. 4. Bolsa Chica Archaeological Project crystals:
a-d) Quartz crystals from ORA-85 (a-12.3 mm long, b-17.3 mm, c- 20.8 mm, d-13.6 mm);
e) Corundum crystal, ORA-83, 7.2 mm;
f-j) Quartz crystals from ORA-83 (f-27.4 mm, g-16.5 mm, h-15.8 mm, i-15.3 mm, j-24.5 mm);
k) Quartz crystal from ORA-365, 17.6 mm;
l-n) Quartz crystals from ORA-82 (l-15.4 mm, m-10.6 mm, n-14.6 mm);
o) Quartz crystal from ORA-88, 20.3 mm.
(Note that the illustration of e is enlarged relative to the others.)

the largest specimen (Fig. 4f) (Cat. #70105) which weighs in at 5.51 grams. All ORA-83 crystals are free of asphaltum. Only two show worked surfaces. One is the artifact of Figure 4g (Cat. #70106). Its basal end was intentionally chipped, and the basal edges show ground surfaces on the high points. At the opposite end there is some chipping, but it may not have been intentional. Yet it is ground around the edges at this end, and consequently it is classified as utilized. It is unlikely to have had a utilitarian (tool) function. The other worked specimen (Cat. #70110) has grinding at one tiny edge, and perhaps it had been part of a larger crystal that suffered damage. Its appearance is that of a classic piece of shatter material. The crystal of Figure 4h (Cat #70107) had once been part of the mass that lay beneath a bed of small quartz crystals.

Fifteen radiocarbon assays from the Cogged Stone Site (ORA-83) are relevant to efforts at temporal placement of 12 of the 17 quartz crystal specimens and the single corundum crystal (Fig. 4e). These radiometric values range from around 5900-7500 years B.P., or within the late Early Holocene to the early Middle Holocene, and solidly fit within the first half of the Milling Stone Period.

Of the three quartz crystals cataloged for the Borchard Site (ORA-365) (Table 1), only one (Cat. #10009) (Fig. 4k) was utilized. It appears to have been slightly ground at the basal end, blunting the edges. The tip of this crystal is missing. It has been worn off or scratched off by a kind of tapping action. Since it does not show rotary damage, it is ruled out as some kind of drill. The edges are dulled and slightly rounded three quarters of the way down the crystal.

Four radiocarbon dates help place in time all three ORA-365 quartz crystals. They range from around 2300-4000 years B.P., thus falling within the Intermediate Period.

The only BCAP quartz crystal exhibiting asphaltum is one of three found at ORA-82. This specimen (Cat. #10007) (Fig. 4l) shows tiny bits of asphaltum, top to bottom. Also, top to bottom, all edges exhibit very slight grinding. The tip has grinding, and very small microflakes are missing from the tip which could have become detached during the grinding action. This artifact was obviously utilized, but not necessarily in a utilitarian task. The four radiocarbon dates relevant to estimating temporal placement of the three ORA-82 crystals fall to around 3300 to 3500 years B.P., a tight clustering denoting the interface between Middle and Late Holocene. Culturally, this is also the Intermediate Period.

Six quartz crystals were unearthed at ORA-85 (Table 1). Two, and perhaps three, display use wear. The basal end of the largest specimen (Cat. #10042) (Fig. 4c) has been slightly blunted by grinding. All arrises (ridges between two surfaces), especially near the tip, are ground; however, this was not a drill, for there is no rotary damage. A long thin crystal (Cat. #10043) displaying a broken tip (Fig. 4b) had perhaps been tapped against something hard. The broken tip may or may not indicate utilization. Another (Cat. #10044) (Fig. 4d) is the tip of a good sized crystal. The end of the tip has chipping that looks quite deliberate, most likely, from a tapping action. Five radiocarbon assays indicate temporal placement of all ORA-85 crystals in the Intermediate Period. The dates fall roughly to 2600 to 3700 years B.P., or from the late Middle Holocene into the early Late Holocene.

A single quartz crystal (Cat. #10007) (Fig. 4o) appears quite weathered, as if it had lain exposed on the ground surface for a long period of time. There is no evidence to suggest any sort of utilization.

There are two radiometric determinations from ORA-88 useful for assessing the cultural usage of the single rock crystal recovered from the site (Table 1).

Table 1. BCAP sparkling minerals (possible talismans).

Catalog number	Mineral	Site	Unit	Level (cm)	Length (mm)	Width (mm)
83.70104	Corundum	83	D48NW	130-140	7.1	7.2
365.10008	Calcite	365	22SE	60-70	6.2	3.3
83.55789	Calcite	83	Alpha 2 NW	80-90	5.5	3.9
83.55791	Dolomite	83	Victor 9 SE	0-10	14.1	8.4
83.70099	Muscovite	83	L6 NE	70-80	33.0	25.8
83.70100	Muscovite	83	-	-	37.4 (max. dim.)	
83.70101	Muscovite	83	D8 SW	60-70	23.7 (max. dim.)	
83.70102	Muscovite	83	D7 NE	110-120	18.5 (max. dim.)	
83.70103	Muscovite	83	D8 SW	120-130	17.3 (max. dim.)	
83.29297	Iron Pyrite	83	Surface	Surface	98	65
83.70105	Q. Crystal	83	N4 SE	30-40	27.4	19.1
83.70106	Q. Crystal	83	D48 NW	40-50	16.5	7.4
83.70107	Q. Crystal	83	D40 NE	0-10	15.8	10.9
83.70108	Q. Crystal	83	D22 SW	20-30	15.3	7.7
83.70109	Q. Crystal	83	N7 SE	60-70	24.5	7.2
83.7011	Q. Crystal	83	A NE	70-80	5.1	4.9
83.70111	Q. Crystal	83	HH2 NW	10-20	7.8	6.7
83.55792	Q. Crystal	83	Echo 8 (SW)	60-70	7.4 (max. dim.)	
83.52725	Q. Crystal	83	Echo 1 (NW)	80-90	14.1 (max. dim.)	
83.55799	Q. Crystal	83	Romeo 61	north wall	20.8 (max. dim.)	
83.55801	Q. Crystal	83	TR 2	31-33 m S	11.1 (max. dim.)	
83.558	Q. Crystal	83	TR 2	31-33 m S	6.9 (max. dim.)	
83.70112	Q. Crystal	83	JJ (NE)	10-20	11.1	8.4
83.70113	Q. Crystal	83	Z2 (NE)	20-30	6.1 (max. dim.)	
83.56282	Q. Crystal	83	Romeo 23 (NW)	10-20	21.4 (max. dim.)	
365.10009	Q. Crystal	365	56 (NW)	60-70	17.6	6.1
365.1001	Q. Crystal	365	45 (SE)	10-20	9.1	6.1
365.10011	Q. Crystal	365	46 (NW)	80-90	9.2	4.4
82.10007	Q. Crystal	82	10 (NE)	0-10	15.4	6.5
82.10008	Q. Crystal	82	17 (NW)	40-50	10.6	3.2
82.10009	Q. Crystal	82	12 (NE)	10-20	14.6	7.8
85.10042	Q. Crystal	85	15 (NE)	50-60	20.8	9.3
85.10043	Q. Crystal	85	ERC-5N10W	10-20	17.3	4.2
85.10044	Q. Crystal	85	28 (NE)	40-50	13.6	14.8
85.10045	Q. Crystal	85	14 (SW)	60-70	12.3	3.3
85.10046	Q. Crystal	85	12 (NW)	30-40	5.6 (max. dim.)	
85.10047	Q. Crystal	85	12 (NW)	30-40	6.8 (max. dim.)	
88.10007	Q. Crystal	88	12 (NW)	30-40	20.3	6.6

The earlier is 4530 ± 60 years B.P., and the later is 2660 ± 120 years B.P. We feel the quartz crystal was used sometime within this approximately two millennium time range.

ORA-83 Corundum Crystal

The whitish grey, virtually opaque pyramidal corundum crystal (Cat. # 70104) (Fig.4e, Table 1) from ORA-83 exhibits neither evidence of asphaltum nor of use wear. Had it been collected merely as an oddity? Did it function in the capacity of a talisman? Was its relative hardness apparent to those persons who might have possessed it? Cultural and radiocarbon evidence support an early Milling Stone Period placement. To our knowledge, this is the only documented archaeological recovery of a corundum crystal in California.

Corundum crystals occur naturally in Los Angeles, Riverside, and San Diego counties. Opaque grey crystals are noted for the north slope of the San Miguel Mountains, 26 miles east of San Diego (Kunz 1905:45; Eakle 1922:100). Large corundum crystals occur at a location in the San Jacinto Mountains, Riverside County (Murdock and Webb 1942:328), and there are bluish corundum crystals larger than one cm from near Winchester, Riverside County (Webb 1943:581). In 1866, W. P. Blake noted the presence in Los Angeles County of sapphire-blue corundum, this in a State Board of Agriculture report, the first mention of this oxide of aluminum mineral for California (Eakle 1922:100), and on the Angeles Crest Highway there occur light green-grey corundum crystals, some five mm in maximum dimension (Sharp 1959:38).

BCAP Calcite Crystals

Site ORA-365 yielded a colorless prism shaped crystal of calcite (Cat #10,008) (Fig. 5b) (Table 1). Perhaps it was collected only as an oddity, or perhaps it was a “poor man’s magical crystal.” A complete calcite crystal (Cat. #55789) (Fig. 5a) was found at ORA-83. Calcite specimens as possible talismans have previously been reported from other Orange County sites, including ORA-855 (Koerper et al. 1988:245) (Fig. 3d). A large calcite crystal was found within the rock

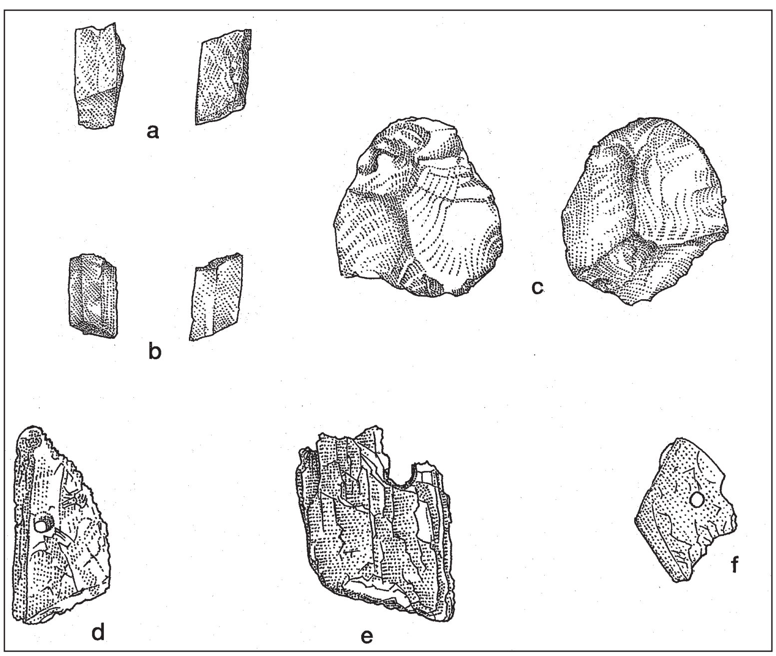


Fig. 5. Bolsa Chica Archaeological Project minerals:
a) Calcite crystal, ORA-83, 5.5 mm;
b) Calcite crystal, ORA-365, 6.2 mm;
c) Dolomite crystal, ORA-83, two views, 14.1 mm;
d-f) Drilled muscovite specimens, ORA-83 (d-33.0 mm, e-37.4 mm, f-23.7 mm).
(Note that the illustrations of a, b, and c are enlarged relative to the others.)

shelter at ORA-1080 in the San Joaquin Hills, near the Transportation Corridor, and it was associated with a feature of seven *Haliotis cracherodii* valves "stacked on their sides, end to end" (Macko and Weil 1986:378).

Calcite crystals are common in coastal southern California geology. The listings of such are especially numerous for Los Angeles County (e.g., Eakle 1911:189; Neuerberg 1951:59; Sharp 1959:46, 91; Masimer 1966:22; and Pemberton 1968:9).

Parenthetically, gypsum is another clear hazy crystal that might have served as a quartz crystal substitute. Two specimens of gypsum were recovered from a burial cave in Baja California (Massey and Osborne 1961:342, 358).

ORA-83 Dolomite Crystal

A nearly complete dolomite crystal from ORA-83 (Cat #55791) (Fig 5c, Table 1) is hazy clear without color. This specimen has a hardness (Mohs scale) between 7 and 8, a fact seemingly at variance with its identification as a dolomite crystal. A contaminant, magnesium perhaps, might account for its uncharacteristic Mohs value. Was this collected as raw material for bead manufacture? Two dolomite beads are described for the ORA-83 collection, as well as a dolomite specimen that apparently broke as it was being worked into an ornament (Koerper et al. n.d.).

Dolomite crystals are found in cracks in the basalts around Palos Verdes (Fig. 1). The Palos Verde area has substantial vesicular basalts and, to our knowledge, is the only geologic locality in the region where one could find large showy crystals of dolomite (Sharp 1959:3-4; Carnahan 1967:29; Pemberton 1983:219-220; see also Koerper et al. n.d.).

ORA-83 Muscovite Specimens

Sheet mica (muscovite, sheet muscovite) artifacts are rarely encountered at Orange County sites, yet five holed specimens were recovered from ORA-83 (Table 1). The specimen of Figure 5d (Cat. #70099) is perhaps biconically drilled, with maximum hole diameters measuring 3.3 mm and 4.2 mm on opposite faces. No clear wear appears around the drilled hole. The largest specimen (Cat. # 70100) (Fig. 5e) may also have been biconically drilled. The perforation is about 4.7 mm on one face and 7.7 mm on the opposite face. Another specimen (Cat # 70101) (Fig. 5f) has a small drilled hole, about 2.6 mm at the surface of each face. It is so thin as to suggest it broke off of a larger artifact. It is not possible to ascertain whether drilling was bifacial or unifacial. A fourth specimen (Cat. #70102) is also so thin (0.09mm) as to preclude a determination of how it was drilled. The hole is 4.0 mm on one face, and 4.1 mm on the other. The last specimen (Cat. #70103) is the smallest. Its perforation is roughly 1.9 mm on each face.

One special appeal of muscovite in local prehistory was undoubtedly its aesthetically pleasing glittery surface, a possible recommendation for magico-religious use. However, we have encountered neither ethnographic nor ethnohistoric sources to specifically identify sheet mica in any talismanic capacity. It is uncertain whether this is one of those "rare sparkling minerals" collected by local Indians that Hoffman (1885:31) found intriguing.

Material for the five ORA-83 perforate muscovite specimens could have derived from pegmatites in the Pala District (Fig. 6) (Jahns and Wright 1951:34; Brock 1974:1242; see also Stevens and Schaller 1942:525-537). Since tourmaline crystals and the single spodumene crystal documented for Orange County (Fig. 3a) likely originated in northern San Diego County, perhaps along with some of the quartz crystals, the muscovite may well have been mined

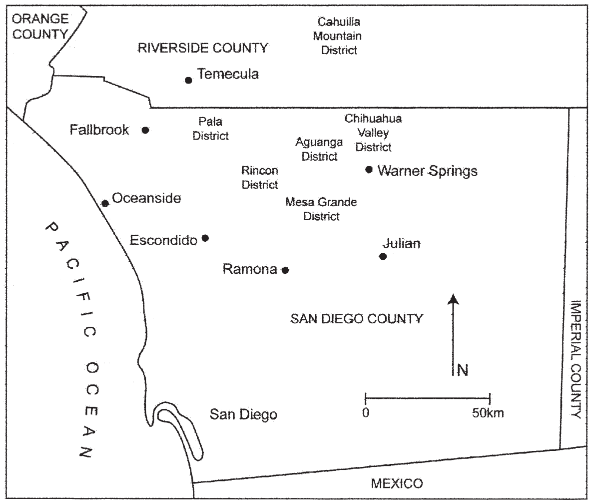


Fig. 6. Map indicating pegmatite districts mentioned in text.

and traded from a southerly location. Muscovite also occurs in significant quantity in the Mesa Grande District (Fig. 6), roughly 30 km southeast of Pala (Weber 1963:89, 91, 96, 100, 110, 113; Foord 1977:467).

The provenienced specimens from ORA-83 were discovered at significant depths dating perhaps to a time before crystals from northern San Diego County were traded up the coast. Muscovite is to be found at Cahuilla in Riverside County (Fig. 6), occurring with gem quality tourmaline (Eakle 1922:197). There are fuchsite (chromian muscovite) deposits in Los Angeles County, including on Santa Catalina Island (Bailey 1941:73) and in the San Gabriel Mountains (Gay and Hoffman 1954:676). Fuchsite is reported from Arch Beach in Orange County (Eakle 1922:197).

The ORA-83 muscovite may have originated, rather, well to the north since when one reads of muscovite ornaments in the California literature, the provenance is likely to be the Great Central Valley or in and around the larger San Francisco Bay area (e.g., Nelson 1910a, b, c: 399, 1911; Schenck 1926:266; Schenck and Dawson 1929:402-403; Lillard et al. 1939:7; Heizer and Treganza 1944:340-341, 342; Contreras 1957:31, Figs. 5,6; Gerow 1968; Ragir 1972:88; Moratto 1984:178, 182, 233, 265). Parenthetically, at least five mica ornaments from the Emeryville Shellmound were grave associated (Schenck 1926:266). Abbott (1879b: 210-211) does mention mica for ornaments in southern California.

A Questionable Iron Pyrite Specimen from ORA-83

A 443.4 gram rock (Cat #29297), supposedly found on the surface of ORA-83 by a relic collector, is conspicuous for the amount of sparkling iron pyrite (iron disulfide or "fool's gold") embedded on all surfaces of the specimen. The mineral is not present in its pyrite cubic crystal form. There is no evidence of modification to the stone. The glittery gold colored concentrations, interspersed through the white quartz and chlorite schist rock, undoubtedly made it attractive to its collector. It is not a chunk of float material, since the stone is angular, with absolutely no evidence of it having been tumbled. Locally, the Santa Ana Mountains offer a possible procurement source.

The ethnographic record attests to the value in which iron pyrite was held in at least the Late Prehistoric Period (Yates 1889:300; 1890:19), but it is uncertain whether this particular manuport has any prehistoric significance. Historically, ORA-83 was once the site of oil production facilities, concentrating persons with amateur to professional geologic interests and with, one might reasonably suspect, personal rock collections.

Quartz Crystals: Questions of Geologic Source

It is often assumed by Orange County prehistorians that clear quartz crystals were exchanged from south of the county. For instance, the San Joaquin Home Ranch Site Excavation Report (Anonymous 1938b:130) in describing the largest crystal (Fig. 3c) ever reported locally (approximately 135 mm long, weighing about 2.5 lbs.) offers the thought that the huge crystal, hexagonal at the top but rough and pitted at the bottom, had been brought from San Diego County. It appeared "similar to specimens from the Pala mine."

Indeed, the Pala District (Fig. 6) is an excellent source of fine quality quartz crystals (Jahns and Wright 1951:32-33; Jahns et al. 1974:197-198; Sinkankas 1976:240), with some specimens measuring nearly a meter in length (Pemberton 1983:348). Quartz crystals, often clear, but some ranging from "pale rose" to "dark smoky," may be found in the Mesa Grande District (Fig. 6) (see Weber 1963:passim; Foord 1977:466). Pemberton (1983:348) mentions a 145 pound specimen and several 40 pound crystals from the Esmeralda Mine in the Mesa Grande District. Other San Diego County quartz crystal sources, including the Rincon District (Fig. 6) between Pala and Mesa Grande, are documented in the geological literature (e.g., Sinkankas 1957:371; Weber 1963:passim; Masimer 1965:32).

Kunz (1905:66) notes that many fine quartz crystal specimens can be procured from pegmatite veins in Riverside County mines, and that these same veins are worked for tourmaline and beryl. Saul et al. (1970:246-248, 253-255, 263-264) document quartz crystal locations in Riverside County.

A focus on northern San Diego County and southern Riverside County as likely sources of quartz crystals in Orange County sites stems partly from the fact of rare occurrences of tourmaline in Orange County prehistoric villages. For instance, State Employment Relief Administration (SERA) and Works Progress Administration (WPA) excavators of the Depression era unearthed tourmaline crystals at the Banning Estate Excavation, Norris Property (Anonymous 1935), and at the San Joaquin Home Ranch site (Anonymous 1938:130). A vast literature identifies and discusses tourmaline sources in San Diego County (e.g., Fairbanks 1893:35-36; Kunz 1903:264, 1905:23, 54-63, 121-153; Sterrett 1904; DuBois 1908:97, 99; Rogers 1910:208; Eakle 1922:193-194; Heizer and Treganza 1944; Hohenthal 1950:10; Hanley 1951; Jahns and Wright 1951:35-36; Bradley and Bradley 1955:26; Pough 1957:280; Weber 1963; Murdock and Webb 1948:24-27, 1966:46-49; Evans and Mathews 1967; Sinkankas 1967; Jahns et al. 1974; Kampf et al. 2003). Tourmaline used as sacred objects in Baja California was possibly traded from the Pala and Mesa Grande areas (Hohenthal 1950:10; see also DuBois 1908:97, 99 and Levi 1978:44), which also implicates the Rincon area. One or all of these places are presently assumed to be sources for tourmaline arriving into Orange County. Parenthetically, the greatest yield of gem quality tourmaline in historic times in California is the Himilaya Mine in the Mesa Grande District (Evans and Mathews 1967), however, the Chihuahua Valley District (Fig. 6) has been receiving much attention of late (Kampf et al. 2003).

WPA archaeologists were also aware that Riverside County possessed an abundance of tourmaline (Anonymous 1938:135). The mineral occurs not far from the Hemet area at the Cahuilla Mountain (Fig. 6) and Thomas Mountain locales (Kunz 1905:122-123; Evans and Mathews 1967; Saul et al. 1970:245-249; see also Murdock and Webb 1948:25, 1966:47). Indeed, the Belo Horizonte gem mine (Thomas Mountain) is the oldest historic tourmaline mine in California (Kunz 1905:122-123). Less colorful tourmalines (schorl [black] and brown tourmaline) are well documented for the Crestmore area at Sky Blue Hill (Eakle 1917:350, 1922:193; Woodford 1943:360). Further, scattered locations in the granites of the batholith running from northern Orange County, through San Diego County, to Mexico, contain tourmaline (Schroth 1994: G.75). Eakle (1922:193) has noted black tourmaline in the Santa Ana Mountains, Orange County, specifically at the Santa Ana tin mine.

Parenthetically, Aden E. Treganza, A.O. Treganza, and William Hohenthal discovered a source of quartz crystals and black tourmaline north of Cantú Grade in northern Baja California. This was perhaps one Tipai source (Hohenthal 1950:10).

The northern San Diego County/southern Riverside County focus is reinforced by the discovery of a single example of light amber or greenish yellow colored spodumene (Fig. 3a) at ORA-855, the village of Putuidem, in the San Juan Capistrano Valley (Koerper et al. 1988:252-253; Koerper and Mason 2000:15-17).

Spodumene is a pegmatite mineral characterized by striated prism and pinacoid faces and steep terminations (see Pough 1976:258-259). It is commonly associated with other lithia minerals such as colored tourmalines, and therefore is often associated with the Pala District, where the mineral occurs in a variety of colors, including examples grey to white, but also in green for some gem quality specimens and in lilac in other often gem quality material (see Baskerville 1903; Kunz 1903, 1905:81-87; Schaller 1903:265-266; Baskerville and Kunz 1904; Davis 1904:29; Eakle 1922:160; Gabriel et al. 1942:119; Jahns and Wright 1951:36-37; Sinkankas 1955:50, 1957:83-85, 1959:160-166; Murdoch and Webb 1966:47; Jahns et al. 1974:197-198).

The lilac or amethystine variety was named by Baskerville (1903) after the well known geologist, George Frederick Kunz, and was once referred to as "California iris" (see Eakle 1922:159-160). Kunzite is also found to the southeast in the Rincon District (Fig. 6) (Rogers 1910:210; see also Murdoch 1946:198; Hanley 1951:23; Weber 1963:100, 114). Spodumene occurs a bit further southeast in the Mesa Grande District (Weber 1963:89, 96). Aguanga Mountain (Fig. 6) offers yet another source of kunzite (Kunz 1905:25, 62). Riverside County is not without kunzite, specifically, at Cahuilla Mountain (Fig. 6) in the San Jacinto Mountains (Schaller 1903; Kunz 1905:25, 59, 87; Eakle 1922:160; Saul et al. 1970:253-255; see also Papish 1929:477).

In this discussion, one must consider the fact that several other trade items to Orange County originated in the county to the south – Piedre de Lumbre "chert" (Pigniolo 1992), ceramic smoking pipes (see Koerper et al. 1988:244), and possibly some Tizon Brown pottery. Some of the Obsidian Butte obsidian from the southern Salton Sea region likely passed through San Diego County on its way to Orange County (Koerper et al. 1986; Ericson et al. 1989). From the foregoing discussion, it is understandable why Orange County archaeology should embrace northern San Diego County, especially the Pala region, and southern Riverside County, as probable sources of clear quartz crystals (e.g., Koerper 1986:28; Koerper and Mason 2000:15) traded into Orange County..

However, to uncritically attribute the Bolsa Chica finds to the northern San Diego County/southern Riverside County area ignores the fact that numerous locations in the state supplied shamans and others with precious quartz crystals. Also, numerous trade items came into Orange County from several other directions (Koerper and Whitney-Desautels 1999:87), places where quartz crystals may have been available for exchange. Besides San Diego County and Riverside County, several other southern California counties are listed by Singer (1986:2, Map 1) as having natural surficial deposits of quartz crystals. These are San Luis Obispo, Santa Barbara, Ventura, Kern, Los Angeles, and San Bernardino. Orange County is conspicuously absent from his list (Singer 1986:Map 1). Schroth (1994:G.75), however, writes that quartz crystals occur in granites of the batholith running from northern Orange County down to Mexico.

With regard to Los Angeles County, some crystals from local archaeology sites might have come from Santa Catalina Island. When Longinos Martínez (Simpson 1938:52, 1961:60), in 1792, dispatched two Indians to collect products of that island, they returned to the mainland with a small inventory of things regarded as valuable by an island chief. These included several stones of "quartz, sardonyx, and jasper." The "quartz" in question possibly refers to quartz crystal. Modern geology reports amethystine, citrine and smoky quartz crystals at interior island outcrops (Carnahan 1967). Some quartz crystals from Santa Catalina are described as large (Bailey 1941:55, 64, 77).

The Palos Verdes area, Los Angeles County, offers potential sources of quartz crystal (Sharp 1959:3,4) at the Livingston quarry and at certain sea cliffs (Sharp 1959:3,4), areas also featuring large, showy crystals of dolomite (e.g., Carnahan 1967:29). A variety of other quartz crystal locations are documented in Los Angeles County (Oakeshott 1958:128; Sharp 1959:22, 47, 49). Treganza and Bierman (1958:68) noted "six clusters of quartz crystals, apparently segments of geodes" from the Topanga Culture, (a phenomenon seen elsewhere in the state-see Wallace and Lathrap 1975:27), leading us to wonder whether some Orange County specimens might likewise have been from geodes, and consequently, from a desert location.

Summary and Concluding Thoughts

Ethnographic and ethnohistoric data exist to synthesize a detailed exposition of crystal use and crystal lore in coastal southern California. There is also much that might be learned from the regional archaeological record regarding quartz crystals and other "rare sparkling minerals." BCAP research demonstrates the long and continuous use of clear quartz crystals in the Bolsa Chica Mesa area, a match to the larger region, and, we suppose, for most of the state generally. The BCAP assemblage could not, however, establish unequivocal use of quartz crystals in ceremonial/ritual venues at either ORA-83, -82, -85, -88, or -365. Dolomite, corundum, and muscovite are now documented for Orange County aboriginal culture.

Presently, it is not possible to determine source location for any of the crystals or other sparkling minerals curated during BCAP operations. We are inclined to believe that the iron pyrite specimen is an historic manuport. We favor a Palos Verdes materials origin for the dolomite crystal and the ORA-83 dolomite beads (see Koerper et al. n.d.). Geologic provenances for the calcite, corundum, and muscovite objects remain enigmas. We suspect that the BCAP quartz crystals did not share a single origin.

Given that tourmaline and spodumene from northern San Diego and/or southern Riverside County most likely account for those kinds of minerals in Orange County sites, and given that several kinds of exchange objects arrived via San Diego County, we would not be surprised to learn that at least some quartz crystals originated from that area stretching from the Pala District to the Mesa Grande District. Propinquity favors Pala above other districts. Riverside County sources are not being ruled out.

If a program were undertaken to chemically and/or physically characterize quartz crystal specimens from known geologic sources, then comparative analysis to detect matches between the archaeological specimens and the knowns might provide strong tests of hypotheses regarding trade routes. One such program might involve fluid inclusion analysis to reveal the nature of the physical environments within which quartz crystals had grown. Such data could be applied to at least rule out particular locations for any crystal specimen. Such a program might serve as the heart and soul of, say, a master's thesis, one that would actually be useful.

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