Dentalium Shell Artifacts From a 6600-Year-Old Occupation of Otter Cave, San Miguel Island

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Abstract

Dentalium shell beads were widely used by Native American peoples along the Pacific Coast of North America, but were never more than a minor ornament type along the southern California coast. Limited test excavations at a small rockshelter located on San Miguel Island produced 40 *Dentalium pretiosum* artifacts from a thin occupational stratum radiocarbon dated to approximately 6600 years ago. The density of the bead-making refuse in this Otter Cave stratum is roughly 2.8 fragments per liter (2800 per cubic meter) a very high value for shell bead-making refuse during the Middle Holocene or for *Dentalium* artifacts during any time period in the Santa Barbara Channel sequence. In this paper, we describe the context, chronology, nature, and implications of the *Dentalium* shell assemblage from Otter Cave.

The maritime peoples of the Pacific Coast of North America are well known for the antiquity and diversity of shell beads and ornaments used in a variety of cultural contexts—as objects of beauty for ornamentation and ritual, as forms of money used in local economies, as symbols of power and cultural identity, and as trade items used in long-distance exchange. The variety of utilitarian and ceremonial uses for marine shells was perhaps greatest among the maritime Chumash and *Tongva* (Gabrielino) of the southern California coast between about 1000 and 250 years ago. The south and central California coastal area has also produced some of the earliest shell beads in North America, with spire-removed *Olivella* beads well documented from several sites dated between about 10,000 and 8500 years old (Erlandson 1994:264). *Dentalium* shells, commonly known as Indian Money Tusk shells, have also been used as beads or ornaments for thousands of years—and are still used today—by many Native Americans of western North America. Although *Dentalium* shells were particularly prized by Pacific Northwest tribes, Native peoples of the southern California coast also used *Dentalium* shell beads. Unfortunately, knowledge of the chronology and context of such uses is relatively poorly documented. Small numbers of *Dentalium* beads have been found in a variety of sites along the southern California coast, however, and appear to have been used by numerous Indian tribes (see Bennyhoff and Hughes 1987; King 1990:113, 137).

In 2000, limited test excavations at a small San Miguel Island rockshelter known as Otter Cave resulted in the recovery of an unusual assemblage of 40 *Dentalium pretiosum* artifacts from a sealed stratigraphic context dated to approximately 6600 calendar years ago. Although they comprise a minute (less than 0.1 per cent) fraction of the shellfish and other faunal remains recovered at the site, they easily dominate the artifact assemblage. Although a full description of the Otter Cave collection is being prepared, aspects of our analysis are not yet complete. In this paper, we focus on describing the *Dentalium* shell artifacts from Otter Cave, which appear to have come primarily, if not

entirely, from a single thin substratum within the cave. As we show, both the number and density of *Dentalium* artifacts recovered at Otter Cave is unusual for sites of the southern California coast, especially those dating to the Middle Holocene. Before describing the chronology, nature, and significance of the Otter Cave artifacts, we provide background data on the distribution of *Dentalium* shells along the Pacific Coast, the setting of Otter Cave, and the recovery and analytical methods we used.

Use of *Dentalium* Shell Beads along the Pacific Coast

Dentalium shells, often referred to as tooth or tusk shells because of their narrow cylindrical shape, are hollow-shelled gastropods belonging to the Class Scaphopoda. Two types of *Dentalium* shells live along the Pacific Coast. The Indian money tusk (*D. pretiosum*) ranges from Alaska to southern or Baja California and is generally found subtidally, burrowing in muds or sands between about 2 m and 150 m deep (Andrews 1989:32). According to McConnaughey and McConnaughey (1994:393), the Indian money tusk grows to lengths of about 2.5 to 5.1 cm, with relatively stout, moderately curved shells and smooth white exteriors. King (1990:113) suggested, however, that *D. pretiosum* shells from the southern California coast rarely exceed about 1.25 cm (0.5 inches) long. A second species, the Six-sided tusk (*D. neohexagonum*) ranges geographically from around Monterey Bay to Baja California and grows to lengths between about 2.5 and 4.4 cm. The shells of this species are more slender and lightly built, with six "strong, rounded longitudinal ribs" (McConnaughey and McConnaughey 1994:393). Both taxa were used by Native American peoples of the Pacific Coast.

Ethnographically, *Dentalium* shell ornaments were used as far north as the Yukon River and the south-central coast of Alaska (Andrews 1989:69). In southeast Alaska, the Yakutat Tlingit also reportedly obtained *Dentalium* shells by trade (deLaguna 1972:445). Ames and Maschner (1999:171) described *Dentalium* shells as being available only along the west coast of Vancouver Island in British Columbia, from where they were traded "throughout Cascadia and the high plains of central North America." Fladmark (1986:76) suggested that this long distance trade began as much as 3500 years ago. Although the premier source of larger *Dentalium* shells in the Pacific Northwest may have been on Vancouver Island, where specialized technologies were used to collect live specimens from subtidal sand and mudflats, the shells can also be found washed up on certain beaches up and down the Pacific Coast (Moss 1993:634). *Dentalium* beads are known, in fact, from numerous archaeological sites in British Columbia, Washington, Oregon, Idaho, California, and the western Great Basin (see Andrews 1989; Bennyhoff and Hughes 1987; King 1990:113, 137; Lyman 1991:287; Wessen 1982:274). According to Bennyhoff and Hughes (1987), *Dentalium* artifacts found in archaeological sites of the western Great Basin come from northern California sources, with the earliest documented specimens dating between about 1300 and 200 BC. Largaespada (2001:42, 61) documented five *Dentalium* artifacts (four *D. pretiosum*, one undifferentiated) from Fort Rock Basin sites in Oregon's northern Great Basin, including one specimen thought to be associated with an occupation dated to about 3000 BC.

Kroeber (1925) described the widespread use and exchange of *Dentalium* shells by California Indians. *Dentalium* shells were the primary form of money in northwestern California, where they were abundant, but gradually gave way to clam disk and other types of bead money among the more southerly tribes. According to Chartkoff and Chartkoff (1984:233), the Native American tribes of northwest California obtained *Dentalium* shells from the Puget Sound area. Archaeologically, Jones and Waugh (1995:45) reported a single undifferentiated *Dentalium* bead

from the Little Pico site (SLO-175) in coastal San Luis Obispo County.

On the Channel Islands, Orr (1968) recovered *Dentalium* shell beads from several sites on Santa Rosa Island, including a cemetery at Tecolote Point (SRI-3) that he believed was more than 7000 years old. Orr also found 76 *Dentalium* beads among over 16,600 shell artifacts (0.5%) recovered from the 3500-year-old Cemetery A at Canada Verde (SRI-41), and another 182 *Dentalium* beads among 64,598 shell artifacts (0.3%) recovered from a cemetery at Skull Gulch (SRI-2) that he believed was occupied roughly 2000 years ago. Philip Mills Jones (1956:231) reported at least one *D. neohexagonum* bead excavated from a burial cave in Jolla Vieja Canyon on Santa Rosa Island in 1901. Arnold and Graesch (2001:106) also reported three *Dentalium neohexagonum* beads from Santa Cruz Island sites, two from historic levels at SCRI-240 and one from a Middle period component at SCRI-474. On San Miguel Island, Heye (1921) described eight incised *Dentalium* shells from an undated burial. More recently, two *D. pretiosum* beads were found in the 6500-year-old Stratum C at Daisy Cave (SMI-261), in a stratified context roughly the same age as the artifacts from Otter Cave. A single *D. neohexagonum* bead was also recently recovered from shell midden deposits at SMI-163 dated to ca. AD 1700 (T. Rick, personal communication, 2002).

On the mainland, Greenwood and Browne (1969:29) reported 35 *D. neohexagonum* beads from VEN-3, the historic Chumash village of Shisholop. Ranging from 0.4 cm to 2.1 cm long, some of these beads reportedly had ends that were cut and ground, while others were simply broken. Harrington (1928:148) also recovered "a number of" *Dentalium* beads from Burton Mound (SBA-28), but described these as rare in the Santa Barbara Channel area. Owen, Curtis, and Miller (1964:501) reported 19 *Dentalium* beads at the Glen Annie Canyon site (SBA-142), a multicomponent site dating to as early as 8000 cal BP (Erlandson, Colten, and Glassow 1987). Finally, Harrison (1964:273) described finding five *Dentalium* shells at SBA-78 (Dos Pueblos), four from deposits in Area A associated with the historic village of Mikiw and one from Area C, which is dated to the Middle Holocene. King (1990:137) also noted that *Dentalium* artifacts are found at least as far south as San Clemente Island.

Unfortunately, some key archaeological sources (i.e., Orr 1968) do not note the species of *Dentalium* found in archaeological sites along the southern California coast. Nonetheless, after examining many of the major cemetery collections from the Santa Barbara Channel area, King (1990) suggested that there was a temporal shift in the species of tusk shell used through time. According to King (1990:113, 137, 228), *D. pretiosum* was used prior to about 2500 years ago and *D. neohexagonum* later in time.

Otter Cave: Location, Stratigraphy, and Chronology

Otter Cave is located on a ridge overlooking Otter Point and Amphitheatre Cove on the northwest coast of San Miguel Island (Fig. 1). San Miguel, the westernmost of the Northern Channel Islands, is located approximately 40 km from the mainland coast. Roughly 17 km long and 7 km wide, the island is surrounded by a rocky coastline punctuated with stretches of sandy beach. Large parts of the island are covered with sand dunes, suggesting that sandy beaches have been an important component of the San Miguel Island landscape for millennia. At the time of European Contact (AD 1542), and probably for thousands of years prior to that, San Miguel Island was occupied by the coastal Chumash, who also occupied the other northern Channel Islands and the adjacent mainland coast. The maritime Chumash are well known for their high population densities, elaborate material culture, and sociopolitical and economic complexity (see Arnold 1992, 2001; Erlandson 1994:48-49; King 1990; Orr 1968).

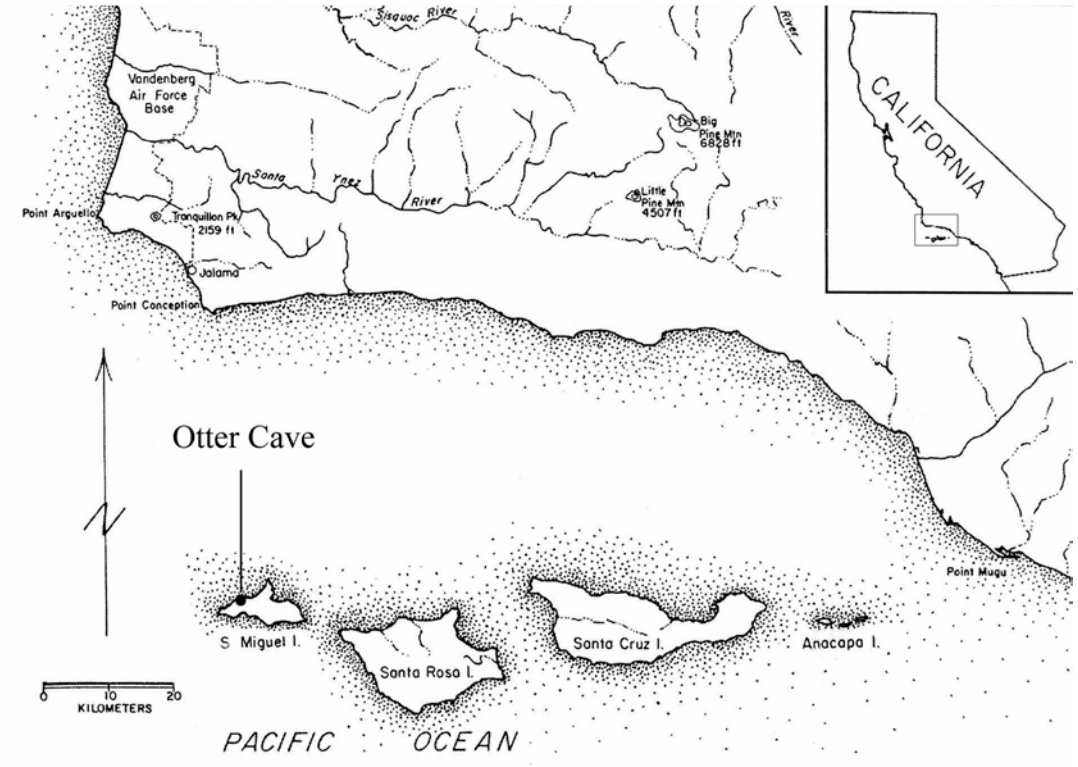

Fig. 1. Location of Otter Cave on San Miguel Island.

Otter Cave is situated at an elevation of about 35 to 40 meters (115 to 131 feet) above sea level. The cave mouth faces northwest, opening just below a prominent ridge that forms the east side of Amphitheatre Cove. Technically classified as a rockshelter, the interior of Otter Cave is about 2.4 meters wide, 2.6 meters deep, and a maximum of about 1.2 meters high. Although the cave mouth faces the prevailing winds that blow from the northwest, it still provides substantial shelter when compared to open areas in the vicinity. Formed in a relatively friable and coarse sandstone bedrock, the cave has a relatively level sandy floor that is largely unvegetated except for tendrils of ice plant that encroach from the cave mouth. Although there are no archaeological materials on the floor of the cave itself, shell midden debris litters the talus slope below. In 1999, radiocarbon dating of a large and well-preserved California mussel shell from the talus slope immediately below the cave mouth produced a ^{14}C date of 6400 ± 80 RYBP and a calibrated calendar age of approximately 6600 years (Table 1).

The apparent antiquity of the occupation of Otter Cave, the presence of well preserved faunal remains, and the fact that midden deposits outside the cave are actively eroding, led to small scale testing by Erlandson and Vellanoweth during the summer of 2000. These limited excavations, located near the center of the cave interior, revealed a sequence of finely stratified shell midden layers—between about 25 and 47 cm thick—resting on bedrock and below approximately 90-100 cm of sterile dune sand. Differences in the color, texture, and contents within the shell midden led us to define three major cultural strata (3, 4, and 5) and at least six substrata that may

Table 1. Radiocarbon Dates from Otter Cave, San Miguel Island.

Provenience	Material Dated	Lab Number	^{14}C Date	Calendar Age Range
Surface: below cave	California mussel	Beta-134838	6400 + 80	6500 (6620) 6710 BP
Unit 1: Stratum 3	California mussel	Beta-145812	6370 + 90	6460 (6590) 6700 BP
Unit 1: Stratum 4	Black abalone	Beta-145309	6150 + 60	6280 (6320) 6400 BP
Unit 1: Stratum 5a	California mussel	Beta-145310	6440 + 80	6560 (6660) 6750 BP
Unit 1: Stratum 5c	Owl limpet (*Lottia*)	Beta-145311	6390 + 40	6540 (6620) 6660 BP

Note: All dates are on single shell fragments; ^{14}C dates include adjustment for ^{13}C/^{12}C ratios. Beta-145311 was dated via AMS, all others via conventional Liquid Scintillation Counting. Calibrated age ranges, with intercepts in parentheses, were calculated using CALIB 4.3 (Stuiver and Reimer 1993) and a delta-R (reservoir correction) of 225 ± 35.

result from three or more discrete occupations. A suite of five ^{14}C dates suggests, however, that the human occupation of the cave was limited largely to a 300 year period of the Middle Holocene (Table 1), between about 6700 and 6400 years ago. During this period, Otter Cave appears to have been used as a temporary campsite for a small group of people.

The *Dentalium* artifacts described here all came from a single 40 by 80 cm wide test unit, the contents of which were dry-screened in the field over 1/16th-inch mesh. During field screening, a concentration of *Dentalium pretiosum* shells was noted from Stratum 5 in Unit 1 East and Stratum 5B in Unit 1 West. The *Dentalium* shells identified in the field were bagged separately to protect them from breakage or abrasion, then the screen residuals were bagged and returned to the University of Oregon for detailed analysis. Initially, a 40 by 40 cm "stratum test pit" (1 East) was excavated to ascertain the nature of subsurface strata. A minimum of about 25 cm of shell midden, including three discrete cultural strata (3, 4, and 5) were identified in this probe. A second 40 by 40 cm wide test unit (1 West) was excavated contiguous to and northwest of Unit 1 East. In Unit 1 West, located closer to the cave mouth, shell midden deposits increased in thickness to as much as 47 cm. The greater thickness of the shell midden, along with the greater visibility in the combined trench, allowed several microstrata to be defined, including two probable hearth features. In Unit 1 West, we also found evidence that water dripping off the ceiling had caused several localized drip features that crosscut the cultural strata. At least one *Dentalium* shell artifact was found displaced in the largest drip feature, which extended through strata 4, 5A, 5B, and 5C, and it is possible that others were, as well.

In the laboratory at the University of Oregon, all screen residuals from Unit 1 were separated into 1/8th-inch and 1/16th-inch fractions. All 1/8th-inch screen residuals were sorted into general constituent classes (shell, bone, charcoal, etc.) under controlled laboratory conditions, including *Dentalium* artifacts. These general classes were then identified to the most specific level possible and all identifications were checked by experienced personnel. Detailed analysis of the 1/16th-inch fraction has not been completed, but these materials are limited in volume and rough-sorting identified no *Dentalium* artifacts.

To understand the origin and nature of the *Dentalium* shells from Otter Cave, we examined each artifact for a variety of attributes, including: (1) the nature of any sediments inside the shell, (2) natural or cultural abrasion patterns, (3) the whole or fragmentary nature of the shell, (4) the length and weight of each artifact, (5) the nature of each break for fragmentary speci-

mens, and (6) presence or absence of other modifications such as burning or incising. Our analysis aimed to determine if the *Dentalium* artifacts served as beads or bead detritus, if they were collected alive or dead, and how they were modified by humans after being brought to Otter Cave. To determine if a *Dentalium* shell was whole or fragmentary, the ends of each shell were analyzed under low power (x10) magnification. Whole shells were defined as those with no fresh breaks that appear to be essentially intact morphologically. Weathered or rounded edges were categorized as a natural break, while fresh or unweathered breaks were considered to be cultural in origin. An incomplete shell was labeled a fragment whether it had fresh breaks or natural edges. Shell fragments with naturally abraded breaks appear to have been beach-rolled before being collected for use.

A second aspect of our analysis of the *Dentalium* artifacts was concerned with identifying what part of a whole shell each fragment represented: proximal, medial, or distal. By definition, all fragments with two fresh breaks were classified as medial. Specimens with naturally rounded ends were more difficult to categorize. Proximal fragments generally have a larger diameter and thinner edges than medial sections of the shell. However, a beach-rolled specimen could have a worn proximal edge, leaving some ambiguity with this classification. Solely focusing on the shape of the shell, a fragment that has no obvious widening at one end could be either a proximal or medial section. After measuring the length of each artifact, we unsuccessfully tried to refit any *Dentalium* fragments that exhibited fresh breaks.

Distribution and Description of the *Dentalium* Artifacts

Of the 40 *Dentalium* artifacts recovered in Test Unit 1, seven came from Stratum 5 in Unit 1E (Table 2). In Unit 1W, where the strata were roughly twice as thick and several microstrata were defined during excavation, 33 more *Dentalium* artifacts were recovered. Twenty-six of these came from a dense concentration of *Dentalium* shells in Stratum 5B, three from Stratum 5C, two from Stratum 5A, and one from a hearth feature identified in Stratum 3B. Observations made during excavation suggest, however, that most if not all of these *Dentalium* artifacts found outside of Stratum 5B in Unit 1W may have been redeposited by stratigraphic disturbance associated with the formation of intrusive drip features, or possibly during occupational disturbance of the sandy cave sediments.

Although we cannot be absolutely sure that all the *Dentalium* artifacts originated in Stratum 5B, the vast majority of them probably were originally associated with a single relatively brief occupation of the cave. At the eastern end of the unit, all of Stratum 5 is no more than about 6-7 cm thick, and Stratum 5B appears to be only 2-3 cm thick. At the west end of Unit 1, where the thickness of the midden deposits was thickest, Stratum 5B is only 6-7 cm thick. Extrapolating the density of *Dentalium* artifacts recovered in the limited volume of Stratum 5B sediments excavated in Unit 1W results in an estimated density of roughly 2800 *Dentalium* shell artifacts per cubic meter. This is the highest density of shell bead-making debris we are aware of for a Middle Holocene site on the Channel Islands and an unprecedented value for *Dentalium* artifacts outside of cemetery contexts anywhere along the southern California coast.

Of the 40 *Dentalium* artifacts recovered, six were classified as essentially whole shells and 34 as shell fragments. The essentially whole specimens ranged between 2.28 cm and 1.35 cm long, with a mean of 1.72 cm. The fact that many of the *Dentalium* shells had coarse beach sand in their interiors or had been naturally abraded in the surf zone suggests that the shells were collected from the beach, probably very near Otter Cave. The shells whose interiors were filled with this coarse consolidated beach sand—very different from the dune sand of the cave matrix—

Table 2. *Dentalium* Artifacts from Otter Cave, San Miguel Island.

Provenience Unit: Stratum	NISP	Weight	Whole Shells	Fragments	Burned	Two Fresh Breaks	One Fresh Break	No Fresh Breaks
1W: 3B Hearth	1	0.11	0	1	0	0	1	0
1E:5	7	0.59	2	5	0	2	2	1
1W: 5A	2	0.11	0	2	0	0	2	0
1W: 5B	26	1.86	4	22	5	8	8	6
1W: 5C	3	0.14	0	3	0	2	1	0
1W: 5/6	1	0.04	0	1	0	0	1	0
Totals	40	2.85	6	34	5	12	15	7

Notes: All specimens have ends that are either weathered/abraded or unweathered "fresh" breaks; the latter are assumed to be cultural in origin.

clearly were never strung and represent bead-making debris. Even the whole shells not filled with beach sand probably never were strung, however, since the distal end of these whole shells has a perforation too small to string on any reasonably strong cordage. It appears then, that whole *Dentalium* shells from Otter Cave required further processing to make useable beads from them.

To distinguish between unmodified shells left behind by the occupants of the cave, and those intentionally broken during bead manufacturing, we carefully examined both ends of every *Dentalium* shell to distinguish between abraded (culturally unmodified) and fresh breaks. Excluding the six whole shells, we classified the 34 fragments. Of these, 12 were found to contain two fresh breaks, one on each end of the shell (Fig. 2). Fifteen of the fragments had one fresh break and one eroded end, and the remaining seven contained no fresh breaks and appear to have been collected off the beach as shell fragments. Five of the *Dentalium* artifacts, all from Stratum 5B in Unit 1W, were visibly burned, ranging in color from gray to black. There is no clear evidence that this burning was intentional and the abundant evidence of charcoal, ash, and hearth features in the cave sediments suggest that the burning may have been accidental.

It appears that several steps were involved in the collection and processing of *Dentalium* shells by the residents of Otter Cave. First, numerous whole or fragmentary shells were collected from the beach, probably in the immediate site vicinity. Once the *Dentalium* shells were transported to Otter Cave, processing appears to have included the initial sorting of usable and unusable shells, removing the shelly sand matrix packed inside some usable shells, breaking off the thin distal ends from usable whole shells to facilitate stringing, and discarding the unusable or extraneous materials among the shell midden (food) debris at the site. Although we classified all the *Dentalium* artifacts from Otter Cave as bead-making debris because of the larger context of the assemblage, many of the shell fragments left behind appear to have been perfectly usable as beads and would probably be classified as such if found at other sites that lacked evidence for bead production. At present, it is unclear why these usable *Dentalium* fragments were discarded or left at Otter Cave. It is possible that the cave occupants were selecting for a particular diameter, length, color, or condition of *Dentalium* segments, discarding usable fragments that did not conform to expectations. It is also possible that usable fragments of *Dentalium* shell were simply lost or left behind at Otter Cave.

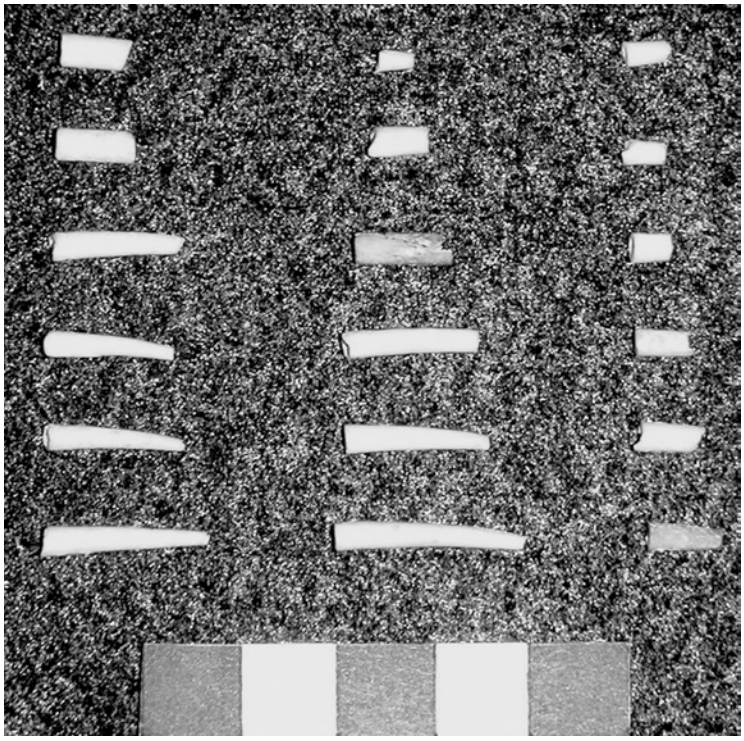

Fig. 2. Photograph of *Dentalium* artifacts from Otter Cave (left column: unmodified specimens with no fresh breaks; middle column: specimens with one fresh break; right column: specimens with two fresh breaks). Scale shows one centimeter intervals.

Summary and Conclusions

The recovery of 40 *Dentalium* shell artifacts from 6600-year-old shell midden deposits at Otter Cave on San Miguel Island provides evidence for a short-term specialized occupation focused on general maritime foraging, including an unusual emphasis on collecting and manufacturing *Dentalium* beads or other ornaments. Although 40 shell artifacts would not be unusual from many Late Holocene assemblages on the northern Channel Islands, *Dentalium* artifacts are relatively unusual finds in the area and the density of *Dentalium* artifacts at Otter Cave (ca. 2800 per cubic meter) is unprecedented for a 6600-year-old site. According to Ames and Maschner (1999:165) *Dentalium* shell collecting and production sites are not even documented on Vancouver Island—supposedly the center of *Dentalium* exchange—or apparently elsewhere along the Northwest coast.

As Chester King (1990:285) noted, *Dentalium pretiosum* beads have been reported from Early Holocene cemeteries at the Glen Annie Canyon site (Owen, Curtis, and Miller 1964) on the Goleta Slough and at Tecolote Point on Santa Rosa Island (Orr 1968). Since their excavation, however, younger components have been identified at both of these sites (Erlandson, Colten, and Glassow 1988; Erlandson 1994:188-189), raising questions about the age and association of these *Dentalium* artifacts. Although the age of the Tecolote Point specimens remains to be resolved, the close association of *Dentalium* beads with Burial 9 at Glen Annie suggests that these probably are associated with Owens' Early Holocene cemetery, dated between about 7500 and 7900 cal BP (Erlandson 1994:179). Although they are probably at least 1000 years younger than the Glen Annie specimens, the *Dentalium* artifacts from Otter Cave support the notion of an early use of *Dentalium* beads along the southern California coast and clearly document another spatial and temporal locus for their use, in this case the northwest coast of San Miguel Island approximately 6600 years ago. Although a detailed review of the geographic and temporal use of *Dentalium* beads along the southern California coast is beyond the scope of this paper, the data we have presented strongly suggest that such artifacts were used during the Early, Middle, and Late Holocene in the Santa Barbara Channel area and that, unless accompanied by additional modification (incising, etc.) or associations such beads are not temporally diagnostic. It should be noted, however, that the Otter

Cave assemblage is consistent with the temporal shift identified by King (1990:228) in the *Dentalium* taxa used through time.

Finally, unlike the vast majority of *Dentalium* beads found in cemeteries or as isolated artifacts in village sites of the southern California coast, the Otter Cave assemblage provides a rare glimpse of the collecting, processing, and discard activities associated with the early manufacture of *Dentalium* beads. At Otter Point about 6600 years ago, it appears that early maritime peoples took advantage of a fortuitous and possibly short-lived concentration of *Dentalium* shells on a nearby beach, collecting large quantities of the shells and carrying them up to the cave where they could be processed in relative comfort.

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