Stratigraphic Integrity and High-Resolution Reconstructions from Buried Archaeological Sites of the Santa Barbara Coast

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Along the California Coast, the stratigraphic integrity of most archaeological sites is limited by stratigraphic mixing caused by gophers, ground squirrels, earthworms, and other burrowing animals. Such bioturbation limits the resolution with which we can reconstruct the past, especially in multi-component sites where archaeological materials from discrete occupations are commingled. An exception to this general pattern is found in sites buried by alluvium or other sediments, which protect them from further animal burrowing. Buried sites are found in a variety of geological contexts, but most examples from the California Coast have been identified in canyon fills or dune fields, where they range in age from the early Holocene to historic times. In this paper I review some examples of buried sites found along the western Santa Barbara Coast, where I directed a successful search for such sites in the 1980s and 1990s. We found numerous archaeological sites buried in the alluvium in the bottom of coastal canyons, sites that ranged in age from about 8200 to 150 cal BP.

Due to the variety of animals that burrow in the soils of their state, California archaeologists regularly struggle with interpretive problems associated with stratigraphic mixing of archaeological site soils. This problem is particularly intense along the southern and central coast, where soils are mixed by a variety of animals, including humans, badgers, ground squirrels, gophers, moles, crickets, earthworms, ants, and more. In most areas, the most ubiquitous and problematic of these burrowing animals is the pocket gopher (*Thomomys bottae*), a prolific burrower that thoroughly and rapidly churns many soils, redepositing smaller materials (<6-8 cm wide) throughout the soil, and generally causing larger objects to sink towards the base of the A-horizon (Erlandson 1984; Erlandson and Rockwell 1987; Johnson 1989). Except for the Channel Islands, where burrowing animals are rare, this stratigraphic mixing limits the resolution with which California archaeologists can reconstruct the past—especially in the multi-component sites that are common in many coastal areas.

In 1980, a team of geographers hired to help us reconstruct the landscape history of the Tecolote Canyon area on the western Santa Barbara Coast identified an "estuarine shell deposit" deeply buried in the banks of Tecolote Creek. On closer inspection we found this deposit, consisting almost entirely of Pismo clam (*Tivela stultorum*) and California mussel (*Mytilus californianus*) shells embedded in a paleosol, to be an archaeological rather than a geological deposit. At the time, we had little time or justification to evaluate this shell midden, but John Johnson and I collected a sample of the shells, one of which later was radiocarbon dated to about 5,500 years ago (Erlandson et al. 2005). This discovery inspired me to study the geological evolution of canyons along the Santa Barbara Coast and led my colleagues and me to identify numerous buried sites in the area during subsequent archaeological projects.

In this paper, I summarize what we learned in our search for buried sites along the western Santa Barbara Coast, especially during the Chevron oil pipeline project that trenched across numerous coastal canyons between the Gaviota and Point Conception areas (Erlandson et al. 1993). The buried sites we discovered ranged in age from the Historic period (ca. 150 cal BP) to about 8200 cal BP, and included examples dating to the early, middle, and late Holocene. The preservation and stratigraphic integrity of these sites were often extraordinary compared to surface sites in the same area, providing the opportunity to examine human behavior and environmental changes on a scale of resolution rarely found in archaeological sites of California's mainland coast.

Environmental Background

Along the western Santa Barbara Coast the Santa Ynez Mountains rise relatively rapidly from the sea, reaching elevations of 1,000 meters or more within 10 km of the coast. The shoreline is oriented roughly east-to-west, and coastal plain and foothill landforms are dissected by numerous coastal streams and canyons that run from north to south. Even the larger of these coastal canyons are relatively short, however, extending only about 8 km from the coast, and the coastal plain is much narrower. This topographic relief, when combined with the long maritime focus of the Chumash and their predecessors, tended to concentrate human settlement on the narrow coastal plain for millennia (Erlandson 1994, 1997; Erlandson and Rick 2002).

During the last glacial, many coastal drainages were deeply incised as rivers and streams cut downward to flow into lower and more distant shorelines. With sea levels rising about 120 meters in the past 20,000 years, however, the geography of the California Coast changed dramatically. Large tracts of coastal lowlands were flooded, creating estuaries in the drowned mouths of many coastal rivers and streams. With sea level rise, the base levels of coastal streams also changed, leading to the deposition of alluvial or estuarine sediments in the lower reaches of many coastal canyons. As these canyons filled with sediments, stream terraces were formed during periodic flood episodes. As a result, thick sequences of alluvial sediments are punctuated by paleosols formed during periods of relative stability.

These paleosols represent surfaces that were available for

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occupation or use by humans in the past. The formation of canyon fill sequences, prone to alternating cycles of sedimentation and erosion, can be very complex. Our experience along the Santa Barbara Coast suggests that buried archaeological sites are relatively common in the lower reaches of coastal canyons. Because paleosols in canyon fills were often buried rapidly beneath alluvial sediments, stratigraphic mixing caused by burrowing animals was limited. Consequently, buried sites often provide an opportunity to identify and explore relatively intact cultural features or activity areas, to examine single cultural components (sometimes of short duration) without worry of contamination from earlier or later occupations, and to study temporal changes in artifacts or ecofacts at a level of resolution rarely possible in surface sites.

BURIED SITES OF THE WESTERN SANTA BARBARA COAST

During the 1980s and 1990s, we identified and dated at least ten archaeological sites buried in canyon fill sequences along the western Santa Barbara Coast (Table 1), including several that contained multiple components. Several of these have been described in previous publications and are only briefly described below to illustrate the variability inherent in their context, age, and contents.

CA-SBA-2067/H

About a kilometer from the coast in Gaviota Canyon, archaeologists working in a pipeline right-of-way identified the stone foundations of two historic adobe buildings buried beneath roughly a meter of alluvium on the west bank of Gaviota Creek. These structures appear to have been associated with a ranch and stagecoach stop dating to the mid-1800s. Due to their outstanding preservation and research potential, California State Park officials required pipeline companies to drill under the structures, and only limited exploration took place (see Erlandson et al. 1993). Along with the structural remains, however, faunal remains and other archaeological materials were also recovered from the historic component.

While drilling under these 19th-century structures, a much older archaeological component containing a shell midden and numerous

Table 1: Radiocarbon Dates from Buried Archaeological Sites of the Western Santa Barbara Coast

Notes: dates calibrated with Calib 4.3 (Stuiver & Reimer 1993), using a ΔR of 225 ± 35 years for shell samples. $^{13}C/^{12}C$ ratios determined by ^{14}C labs or 430 years was added (Erlandson 1988a). Age ranges at 1 sigma. Dates compiled from Breschini et al. (2004); Erlandson (1994); Erlandson and Gerber (1993); Erlandson et al. (2005).

Site # (SBA-)	Lab Number	Dated Material	Sample Provenience	Measured 14C Age (BP)	Adjusted 13C/12C Age	Calendar Age Range (cal BP)
2067/H	Beta-23028	CA mussel	Historic adobe	400 ± 40	820 ± 40	300-145
1731	Beta-4934	Mixed shell	Sea cliff: -120 cm	560 ± 70	--	480-310
	Beta-5058	*Tivela* shell	Unit 112: 140-160 cm	560 ± 80	--	490-300
	Beta-33549	Marine shell	Sea cliff: Stratum 3	800 ± 80	--	650-520
	Beta-4391	*Haliotis* shell	Sea cliff: -50 cm	820 ± 60	--	650-540
	Beta-4935	*Tivela* shell	Sea cliff: -20 cm	965 ± 65	--	770-650
	Beta-33821	Marine shell	Unit 6: Stratum 7	990 ± 90	--	840-650
	Beta-33822	Marine shell	Unit 8: Stratum 8+	1060 ± 60	--	900-720
	Beta-4390	*Tivela* shell	Sea cliff: -100 cm	1720 ± 70	--	1550-1380
2253	QL-4463	Shell	Creek bank	1690 ± 80	--	1530-1340
	QL-4462	Shell	Creek bank	2010 ± 40	--	1880-1740
1881	Beta-18532	CA mussel	Stratum A-13:150 cm	1320 ± 70	1750 ± 70	1165-985
	Beta-20408	CA mussel	Stratum A-7: 300 cm	2550 ± 80	2980 ± 80	2600-2350
	Beta-20407	*Hinnites* shell	Stratum A-2: 160 cm	2340 ± 80	2770 ± 80	2320-2110
2028	Beta-21072	Wood charcoal	30S/35E:180-200 cm	2750 ± 80	--	2930-2770
	Beta-21073	CA mussel	30S/35E:180-200 cm	3050 ± 120	--	3240-2920
2067	Beta-20410	*Septifer* shell	Pipe trench: -260 cm.	3820 ± 100	4250 ± 110	4210-3890
	Beta-18608	Wood charcoal	Rock oven: Feature 1	4280 ± 80	4300 ± 80	5040-4710
2255	QL-4464	Marine shell	Stream bank: -4.5 m	4310 ± 70	4740 ± 70	4810-4610
72N	Beta-28032	CA mussel	Creek bank: -2.5 m	4920 ± 70	5350 ± 70	5580-5430
	Beta-111649	Pismo clam	Unit 97-4: 40-50 cm	5040 ± 80	5470 ± 80	5680-5550
	UCR-1116	Pismo clam	-290 cm	5270 ± 120	5700 ± 120	5979-5710
	Beta-111648	Pismo clam	Unit 97-4: 20-30 cm	5400 ± 80	5810 ± 80	6090-5890
2058	Beta-26293	*Saxidomus* valve	Stream bank: -700 cm	5940 ± 120	--	6720-6430
	USGS-?	Estuarine shell?	Stream bank: -700 cm	6065 ± 305	--	7080-6400
2057	Beta-17753	*Saxidomus* valve	A3 midden soil	7550 ± 100	7960 ± 100	8320-8100
	UM-1464	Chione shell	A3 midden soil	7630 ± 95	8040 ± 95	8370-8170
	USGS-535	Chione shell	A3 midden soil	7990 ± 100	8400 ± 100	8850-8540

burned rock features was identified between two and three meters below the historic component (Erlandson et al. 2004). Portions of this lower component, between about 5,000 and 3,900 years old, had been bioturbated to some extent, but others extended down to the water table and contained articulated mussel shells and outstanding faunal preservation.

CA-SBA-1731

This multi-component shell midden, located at the mouth of Las Flores Canyon (Erlandson and Gerber 1993; Erlandson and Rick 2002:175-177), was inhabited from about 1,500 years ago into historic times, but mostly between about AD 1150 and 1550. The western site area is located on a low stream terrace where repeated flood events sealed a series of discrete and finely stratified occupational strata. To the east these strata rise onto a gently sloping canyon wall landform, however, where they grade into a single well-developed soil heavily mixed by bioturbation. While the midden deposits in the eastern site area offer a general view of Chumash lifeways and local environments during a millennia or more, careful excavations in the western area provided a detailed view of changes in human subsistence, site function, and local environments through the Middle-to-Late Period Transition, a key time in Chumash history.

CA-SBA-1881

One of the more complex cultural and natural sequences identified along the western Santa Barbara Coast came from SBA-1881, located just behind the beach at the mouth of Agua Caliente Canyon. In a pipeline trench cut to a depth of approximately five meters across the canyon mouth, we identified at least 10 discrete occupation layers dating between about 2,700 years ago and historic times (Erlandson et al. 1993). These archaeological strata were interdigitated with a complex sequence of alluvial gravels, marsh and beach sediments, and thin paleosols—representing an extremely dynamic depositional environment. Despite the use of mechanical pumps and shoring, groundwater intrusion and the collapse of trench walls limited data recovery operations at SBA-1881. Nonetheless, we were able to record much of the complex stratigraphy in the trench walls, collect radiocarbon samples, and excavate portions of several features. In the process, we found discrete shell dumps, numerous midden lenses containing articulated mussel shells, well-preserved hearth features, and a butchered deer carcass—all sealed by the episodic accumulation of sediments in a low-energy depositional environment.

CA-SBA-2028

Situated on a stream terrace in the bottom of Cementerio Canyon about 200 meters from the coast (Cooley 1992; Erlandson et al. 1993), this site was first identified as a low-density scatter of chipped stone artifacts in disturbed surface soils. Limited subsurface testing encountered a few artifacts in disturbed soils overlying a dense layer of stream cobbles and gravel located about 60-80 cm below surface. This buried stream deposit was initially believed to be the base of the site, but our discovery of sites deeply buried in alluvium in nearby canyons led me to order a reluctant crew to dig through the cobble layer. An intact archaeological soil was identified below the cobbles, 100-200 cm below the ground surface. This paleosol produced thousands of chipped stone artifacts, numerous fragments of burned bone, scattered charcoal and burned rock, and occasional marine shells. Samples of charcoal and California mussel shell from near the base of this archaeological paleosol were dated to between about 2,500 and 3,000 years ago. Our sample from this buried site was small, but artifacts recovered included two pestle fragments; several dart-point, biface, or biface preform fragments; numerous flake tools and cores; and abundant debitage. Bones from land and sea mammals, fish, birds, and reptiles were also identified.

CA-SBA-2255

During a survey of Santa Anita Canyon in 1989, we found this low-density shell midden exposed in a stream meander about 0.8 km from the coast. Encased in a paleosol buried under 4-5 meters of alluvium on the west side of Santa Anita Creek, the midden was dominated by the remains of California mussels, chitons, turban snails, and other rocky shore shellfish (Erlandson 1997:103). The site has not been tested, but a marine shell sample from the midden was dated to about 4,700 years ago, and the site appears to represent a small camp. Unlike some rapidly buried paleosols along the western Santa Barbara Coast, the midden soil at SBA-2255 appears to have been a relatively stable surface for a considerable time, leading to considerable bioturbation and stratigraphic mixing of the shell midden deposit.

CA-SBA-72N

First identified in 1980, this Tecolote Canyon site was excavated in the 1980s and 1990s during a CRM study related to hotel construction (Erlandson et al. 2005). These investigations showed that it extended for at least 60 meters along the east bank of Tecolote Creek and contained two middle Holocene components dated between about 6,100 and 5,400 years ago. During its occupation, the site was located on the west bank of the creek, which later migrated across the site, leaving a thick bed of fluvial gravels overlying the buried midden in the northern site area. Vellanoweth and Erlandson (2004) demonstrated that the two buried middle Holocene components at SBA-72N contained very different shellfish assemblages, the earlier dominated by Pismo clams and the later by California mussels. They suggested that this was evidence for human adjustments to relatively rapid shoreline changes from sandy beach to rocky shore habitats. These changes appear to have been obscured by stratigraphic mixing in contemporary midden deposits at the residential base of SBA-75, situated on the adjacent canyon rim (see Erlandson 1988b).

CA-SBA-2058

Located about a kilometer from the coast in Agua Caliente Canyon, this small, low-density shell midden is embedded in a 20-cm-thick paleosol buried beneath 6-7 meters of alluvium (Figure 1). Based on what is known about the site, it appears to be a campsite briefly occupied by a small group of people about 6,600 years ago. It contains

Figure 1: Madonna Moss pointing to buried hearth and shell midden soil at CA-SBA-2058 (photo by J. Erlandson)

a cluster of burned rock—probably the remnants of a hearth or a rock oven—and a sparse scatter of charcoal and estuarine shell (Erlandson 1997:103).

CA-SBA-2057

Located just downstream from SBA-2058 in Agua Caliente Canyon, this 8,200-year-old shell midden was rapidly buried after occupation and sealed below 2-3 meters of alluvium. Subsequent stream erosion has destroyed portions of the site, but the remnants are extremely well preserved. A few krotovina were found running through the 10-15-cm-thick midden, but most of it was beautifully preserved beneath muds deposited by low-energy stream flow. In excavating samples of the midden, we found numerous articulated shellfish valves and sardine vertebral columns preserved in situ—a situation unheard of in surface sites in the area, even those dating to the historic period. High-

resolution data from this site provided a unique window on local environments and human subsistence along the western Santa Barbara Coast during the early Holocene (see Erlandson 1991, 1994; Rick and Erlandson 2000).

Discussion and Conclusions

Overall, we identified ten buried archaeological sites (and at least 25 discrete components) along a 50-km stretch of the western Santa Barbara Coast, sites ranging in age from about 8,200 years ago to historic times. Many of these buried sites featured preservation and stratigraphic integrity that were extraordinary compared to surface sites in the same area. They were found primarily in the lower reaches of coastal canyons, within about a kilometer of the modern coastline, buried beneath anywhere from a meter to seven meters of sediment. Elsewhere along the California Coast (and interior regions), however, buried sites have been found considerably farther from the shoreline (e.g., Lebow et al. 2005) and buried by as much as 70 meters of sediment.

Although buried sites have played an important role in California archaeology, their abundance is not fully appreciated, their research potential has not been fully realized, and all too often the possibility of presence is not fully considered in CRM studies. As I have shown, California's coastal canyons are highly dynamic geological features that contain numerous buried archaeological sites. Sites found in such settings—as well as those found buried beneath accumulations of dune sand, landslides or mudflows, and other sediments—often retain a degree of stratigraphic integrity unusual in California. When well preserved, buried archaeological sites provide an invaluable opportunity to refine California's complex cultural chronologies and typologies. With careful investigation and dating, they can help control for the stratigraphic disturbance and mixing common in many multi-component sites and help us reach higher levels of resolution in our reconstructions of cultural and environmental change in California's long human history.

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