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Explaining the monopoly in shell-bead production on the Channel Islands: drilling experiments with four lithic raw materials

Benjamin T. Nigra [a,*], Jeanne E. Arnold [b,1]

[a] University of California Los Angeles, Cotsen Institute of Archaeology. Box 951510, A210 Fowler Los Angeles, CA 90095-1510, USA
[b] University of California Los Angeles, Department of Anthropology and Cotsen Institute of Archaeology, 341 Haines, Box 951553 University of California Los Angeles, CA 90095-1553, USA

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ABSTRACT

Significant political and economic developments among the Chumash of southern California were catalyzed in part by the emergence of an intensive, specialist-driven shell-bead industry during the second millennium CE on the Santa Barbara Channel Islands. The production of millions of beads depended in turn on the availability of lithic microdrills of standardized form and materials. Channel Islanders quarried a particular stone type, a blocky Monterey Formation chert, from multiple outcrops situated close to the eastern shores of Santa Cruz Island. Rich archaeological assemblages document the lithic and shell byproducts of these intertwined production systems, each of which endured for several centuries (CE 1150–1819). Islanders invariably chose Island chert for making microdrills: hundreds of thousands of specimens recorded to date are of this material. Furthermore, nearly every microlith in all of Chumash territory (post CE 1150) was produced on the islands; the large populations on the mainland did not participate in microlith making or bead making after CE 1150–1200. We argue that this pattern had its roots not only in the patchiness of key resources and shifting regional social relationships, but also in the *physical properties* of available raw materials. Here we experimentally assess the properties of Santa Cruz Island chert alongside three important mainland raw materials—Grimes Canyon fused shale, Coso obsidian, and Vandenberg chert—that potentially could have been tapped to make microliths. We test the proposition that Island chert outperforms other lithic materials in drilling efficiency and drill use life. Our experimental results from 108 drilling trials reveal sharp distinctions in performance characteristics across the four materials. We infer that the process by which Islanders became the more-or-less exclusive manufacturers of shell-bead currency in southern California was facilitated by both the efficacy and physical properties of the Island cherts and the propitious locations of the outcrops.

1. Introduction

The indigenous maritime Chumash peoples of southern California were among the world's most complex hunter–gatherers. Archaeological advances in California, together with considerable research on coastal societies elsewhere, have exploded the myth that agriculture is a prerequisite for the development of social and political complexity (Arnold, 1993, 1996, 2001, 2009; Kennett, 2005; Moseley, 1975; Rick, 2007). We can point to evidence of organizational complexity and intensive craft production industries, advanced boating technology, intra-regional trade, and genealogies of chiefly lineages in the historical and archaeological records of certain hunter–gatherer groups, particularly those with access to a rich array of marine or riverine food resources. Substantial populations and intricate social networks and social exchange practices suggest quite complex economic relationships. The entire length of the Pacific coast, in particular, provides a dynamic arena in which anthropologists are continually reassessing our understanding of human cooperation and the development of complex political and economic institutions.

The famed non-farming societies of the Pacific Northwest and Plateau, for example, organized elaborate and costly ritual potlatches and maintained social stratification through a carefully guarded system of rank (Ames, 1994; Coupland, 2004; Hayden, 1995; Masco, 1995; Prentiss and Kuijt, 2004; Sassaman, 2004: 240–243; Sobel et al., 2006). Leaders of populous, early ranked groups on the north coast of Peru organized labor for the construction of massive earthworks and public spaces with limited reliance on agricultural subsistence. Today our debates center not

* Corresponding author. Tel.: +1 724 396 7345; fax: +1 310 206 4723.
E-mail address: bnigra@ucla.edu (B.T. Nigra).
[1] Fax: +1 310 206 7833.

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on whether these groups were complex, but on the degree to which they relied on domesticates for primary subsistence (Haas et al., 2004; Moseley, 1975, 2001; Shady Solis, 2000; see Haas et al., 2013 for the latest instantiation of the contest). Collecting/foraging groups in Florida, as well as ancient Natufian and Jomon cultures, also attract scholarly attention to processes of political evolution among non-farmers (Habu, 2002; Marquardt, 2001; Matsui and Kanehara, 2006; Milanich, 1998).

Here we investigate an important cornerstone in the foundation of Chumash complexity: the large-scale production of beads from the shells of *Olivella biplicata*, a small marine snail native to the California coast. Strings of Olivella callus beads, which first appeared in quantities during a period of rapid political and economic transformation in the early second millennium CE, served as standardized measures of value in local and interregional trade. As currency, the millions of these beads made by the islanders were key to broader developments in the Chumash political economy. Understanding the scale and organization of this shell-bead production industry—perhaps the largest of its kind in indigenous North America—is important in addressing basic anthropological questions of global interest about labor organization, specialization, complexity, resource exploitation, performance characteristics, and currency.

Thus we need a clearer understanding of the bead production process itself, particularly the choice of the lithic drilling materials necessary to manufacture the beads. Whereas the geographical distribution of the quarries and diachronic morphological shifts in the microlithic production industry on the Channel Islands have been reported at length (Arnold, 1987; Arnold et al., 2001; Perry, 2004), the comparative *efficacy* of the stone raw material selected for this task has not been examined. We propose that Chumash lithic specialists chose Island chert owing to its availability near shell-rich beaches *and* because it demonstrated superior material properties for shell drilling.

1.1. Experimental archaeology

We devised a series of experimental trials to compare the stone material that Channel Islanders used for drilling tasks for some 900 years—Santa Cruz Island chert (hereafter, Island chert)—to three alternative lithic materials. All four lithic types were available at prominent, defined outcrop localities in the southern California region, and all were potentially suitable for making drilling tools. Large-grained quartzites and igneous rocks, locally occurring in cobble form, were less preferred by the Chumash for knapping than cryptocrystalline rock, and they were less predictably available (and thus not tested here).

These trials test lithic performance characteristics for shell-drilling tasks. Superior mechanical performance of Island cherts would have been instrumental in the emergence of the Channel Islands as the center of shell-bead currency production. It appears that the close spatial juxtaposition of the two raw materials essential for bead making—chert and shells—allowed for the emergence of an economy of scale that could not have been duplicated on the mainland and would have facilitated control over the quarry zone, thus promoting the monopolization of drill and bead production (see Arnold, 1987).

Experimental archaeology is a powerful tool for hypothesis testing, inference building, and understanding the context of past human activities (Ascher, 1961; Mathieu and Meyer, 2002; Saraydar and Shimada, 1973; Schiffer et al., 1994; Schiffer and Skibo, 1987). Experiments provide an empirical basis for understanding choices made by toolmakers with regard to raw materials, techniques, and the spatiality of activities. The lithic materials employed for a given task are often chosen for particular, desirable qualities, including suitability for the task at hand, availability, risk reduction, finding solutions to problems, and securing advantages (Andrefsky, 1994; Bamforth, 1986; Beck and Jones, 1990; Bertrando and Harro, 1997; Goodyear, 1979; Torrence, 1989a,b). Human choices govern fundamental considerations, such as the need to match core morphology and tool size (Clark, 1987; Collins, 2008) and the maximization of the use of raw material by making blades from well-prepared cores (Clark, 1987: 260). A second important consideration addressed by experimental archaeology is the role of specialized knowledge and the acquisition of technical skills by novices (Bamforth and Findlay, 2008; Ferguson, 2008; Milne, 2005; Tehrani and Riedi, 2008).

Since microlithic tools functioned in different capacities, including cutting, sawing, drilling, and incising, archaeologists often employ experiments to test suppositions about local production sequences and uses. Flenniken (1981), for instance, conducted experimental tests with replicated Hoko River (WA) vein quartz microlithic tools. His experiments and use-wear studies showed that vein quartz blocks were not suitable for formal microblade production from prepared cores. The microliths were instead fashioned by snapping and retouching narrow flakes of that material and functioned as an effective fish-processing toolkit. Yerkes (1983, 1993) analyzed the production and use of microliths in the U.S. midcontinent, verifying that Mississippian-era chert microdrills were well suited for shell drilling. And a related study by Lindner and Foelb (1998) established that the types of materials drilled (shell, bone) in certain eastern U.S. assemblages could be determined via use-wear experiments. The experiments we report here take the analysis of microlith assemblages in a different direction, comparing the performance characteristics—drilling efficacy—of four lithic material types.

2. Chumash complexity and shell-bead production

Multiple Chumash subgroups who spoke related but mutually unintelligible languages inhabited the arid coastal plains and mountainous back country extending from Malibu in the south to San Luis Obispo in the north and including the four northern Channel Islands (Fig. 1). We denote several of the coastal subgroups as independent simple chiefdoms, following Arnold (2009). Contact-period reports describe a handful of high-ranking hereditary chiefs who controlled swaths of territory encompassing multiple villages within the Barbareño, Ventureño, and Island Chumash territories along the Santa Barbara Channel.

An important corollary to emerging Chumash social complexity was the codification of standards of value that could bridge the economies of these several groups, as manifest in a quite dramatic expansion of the production of shell beads (Arnold and Graesch, 2001; Kennett, 2005). The first appearance of shell-bead currency followed upon other important economic innovations that began late in the first millennium CE. Among these, the most notable was the development of the proto-*tomol* (plank canoe), beginning by 600 CE and culminating in the full 2-ton-capacity watercraft by about 1000 CE (Arnold, 1995, 2007). Before the tomol, Chumash peoples engaged in middle-distance trade among the Channel Islands and between the islands and the coast, employing much smaller tule-reed watercraft. Such boats were adequate for essential trips, but they were comparatively unstable and became easily waterlogged, restricting the frequency with which people and cargo crossed the channel.

The local development of the tomol was the beginning of a significant intensification of Chumash open-ocean activities and cross-channel exchange. It facilitated pelagic fishing for swordfish and tuna, broadened the range of trade, and served as a reliable form of intercommunity transport (Arnold and Bernard, 2006). Both cross-channel commerce (Island Chumash – mainland