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Asphaltum (bitumen) production in everyday life on the California Channel Islands

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ABSTRACT

Sequential models can be used to connect raw material culture to broader social, economic, and religious processes. The present study explores an asphaltum (bitumen) production sequence at Tule Creek Village, CA-SNI-25, a large Late Holocene site on San Nicolas Island, California. Three conclusions have been drawn from this investigation: (1) island populations used asphaltum for a variety of activities that supported everyday needs, (2) male and female tasks were spatially unsegregated, and (3) everyday asphaltum use appears in the same space as ceremonial activities, suggesting spiritual and secular realms were intricately linked. The asphaltum production sequence model built and applied here can be used to address a variety of broad anthropological questions and is applicable in regions that contain naturally occurring seeps across the globe.

1. Introduction

Material residues left behind by peoples of the past are the primary means by which archaeologists access information on social and economic organization in antiquity. The ways people made and interacted with things offers insight into past technologies, techniques of production, and broader socio-political processes. Each technological act holds valuable clues to the social production, reproduction, and organization of daily life (Appadurai, 1986; Dobres and Hoffman, 1994; Heidegger, 1977; Ingold, 1993; Lechtman, 1977; Schlanger, 1990). Following Bourdieu (1977:80), insignificant and taken-for-granted practices have more meaning to us then we are aware, forming an "orchestration of habitus" that creates our understanding of how the world works. It is through reconstructing the sequence of craft production that theoretical implications concerning unseen structures governing everyday lives can be better understood (Lemonnier, 1986, 1992, 2012).

Middle range interpretive methodologies such as the *chaîne opératoire* (Leroi-Gourhan, 1964) provide a direct link between empirical observations of material culture and the social relations of production (Dobres and Robb, 2005). The *chaîne opératoire* traces the production sequence—beginning with the acquisition of the raw material—following its transformation (i.e. pyrotechnology), application, use, and final disposal. The step-by-step reconstruction of events is not only helpful in understanding human relationships with their physical environment, but yields evidence regarding cognitive aspects of technology as well. The *chaîne opératoire* along with other theories arising from the French structural school access emic dimensions of daily life by identifying the internal logic of production techniques (Bleed, 2001:105–108; Lemonnier, 1992; Leroi-Gourhan, 1964; Mauss, 1973). Technical gestures expressed over the course of many generations form a habitual and learned course of social practice, which on the one hand has aided in analyzing material practice, embodiment, agency, and identity (Dobres and Hoffman, 1994; Dobres and Robb, 2005; Dietler and Herbich, 1998; Peelo, 2011; Sinclair, 2000), and on the other hand has allowed archaeologists to interpret socio-economic organization through fine-grained intrasite analyses (Dufraisse, 2011; Van Peer et al., 2008; Wilson, 2011).

The present study does not focus on the production sequence of any one particular craft item, but instead is concerned with the organization of an asphaltum (bitumen) industry in which many crafts were produced. Because asphaltum was applied to a variety of primary and secondary technologies (i.e. watercraft construction, everyday adhesive, waterproofing agent, and as a masonry element) archaeologists around the world have been able to address a broad array of theoretical issues. In the Old World, asphaltum sourcing has helped determine changing trade routes that coincided with major cultural and political shifts (Connan,

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1999, 2012; Connan and Deschesne, 1992; Connan and Van de Velde, 2010; Schwartz and Hollander, 2008; Schwartz and Stein, 2000). Geochemical analysis has been especially advantageous for the identification of bituminous mixtures utilized in the construction of reed and wooden boats, embalming mummies, as well as smaller scale applications such as making beads for necklaces and gluing flint to wooden handles (Connan, 1999, 2012; Connan et al., 2005). Asphaltum studies taking place in the New World—especially in the Olmec region of Mesoamerica—have focused on examining regional systems of exchange, ancient building techniques, and even assessing the presence of specialized processing activity areas (Kita et al., 2014; Wendt, 2009; Wendt and Cyphers, 2008; Wendt and Lu, 2006).

Within California's Channel Islands and mainland coast, asphaltum use and exchange has been brought to the forefront in debates regarding emergent socio-political complexity (Gill and Erlandson, 2014; Fauvelle, 2013, 2014). Fauvelle (2011, 2012, 2013, 2014) has argued that "high grade" asphaltum, only available from mainland terrestrial seeps, was essential to island populations for the construction and maintenance of the Chumash sea-going plank canoe, the *tomol*. Fauvelle (2012:150) asserts that island Chumash did not have direct access to mainland seeps for *tomol* construction, causing a "lopsided trade network with significant implications for regional sociopolitical development." Gill and Erlandson (2014), however, reject the notion that asphaltum was a major commodity in mainland-island trade systems; rather, they suggest the relative abundance of asphaltum is a part of the islands' natural resources, as large quantities of tarballs wash up on the shore from submarine seeps. Indeed, this natural substance was utilized by the Chumash and their southern neighbors, the Gabrieliño, in numerous technologies, including skirt weights, baskets, fishhooks, knives, pendants, and whistles (Hudson and Blackburn, 1982, 1983, 1985, 1986, 1987). These artifacts are found in archaeological contexts throughout the Santa Barbara Channel area, more specifically on the Northern and Southern Channel Islands, around the modern-day Los Angeles region, and also in the southern San Joaquin Valley (Erlandson et al., 2008; Hodgson, 2004; McCawley, 1996; Salwen, 2011; Reinman and Townsend, 1960). Across this macroregion, frequently occurring artifact types illustrate that multiple groups utilized asphaltum in similar ways across the landscape. Microscale analysis, at the level of the village or household, also features diverse ways in which the substance was utilized, detailing the variety of activities that occurred within a village space.

Asphaltum is a well-preserved artifact class and leaves behind a distinctive archaeological signature, allowing for its typological classification and placement in a sequence of production. This study utilizes an asphaltum artifact typology, in conjunction with gas chromatography/mass spectrometry (GC/MS) and spatial distributions, to elucidate the social and economic organization of people living on the California Channel Islands, more specifically on San Nicolas Island. San Nicolas Island offers an ideal opportunity to study asphaltum use relative to the other Channel Islands because it is the farthest and most remote of the eight islands off the California coast (Fig. 1). The island is situated approximately 122 km (75.8 mi) southwest of Los Angeles and 110 km (68.4 mi) from the nearest point on the mainland. It is one of three other

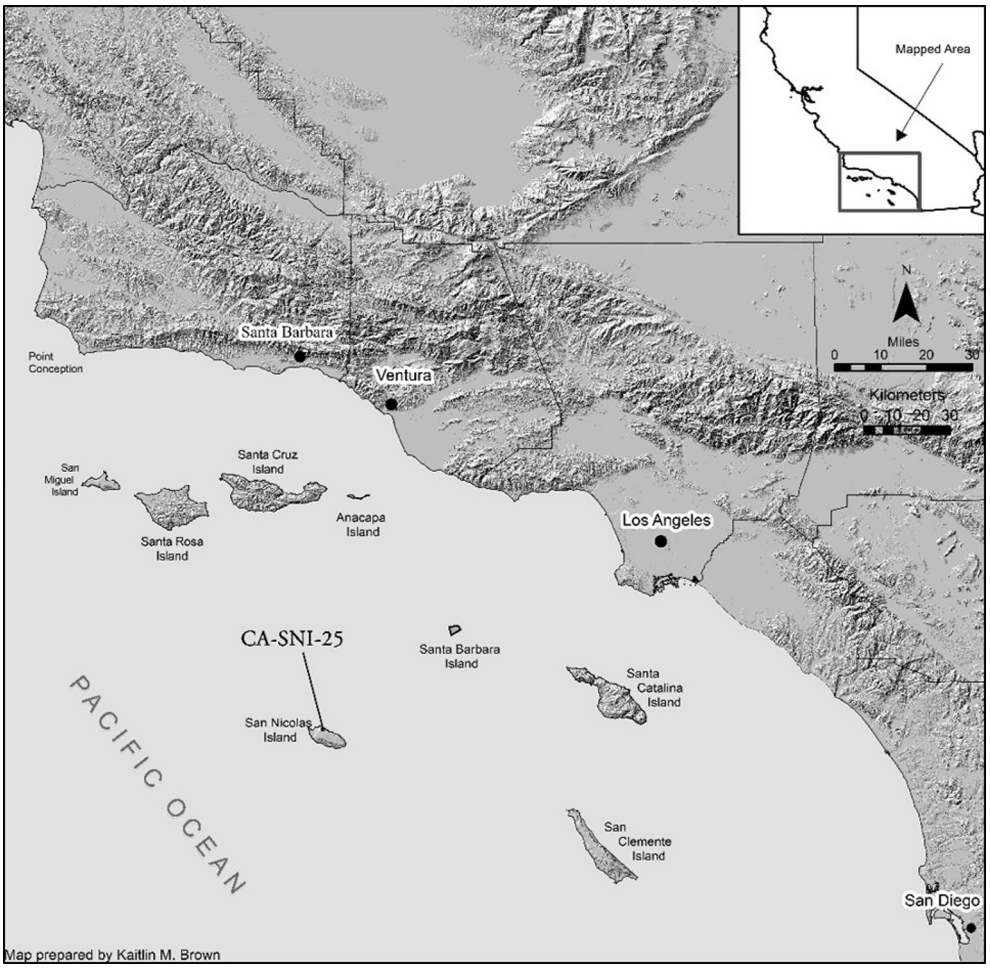

Fig. 1. Southern California Bight showing the location of CA-SNI-25.

islands that make up the Southern Channel Islands including Santa Barbara, San Clemente, and Santa Catalina; these islands were occupied by the Gabrieliño who spoke a Takic language of the Uto-Aztecan language stock (Bean and Smith, 1978). The Northern Channel Islands are more geographically concentrated than their southern neighbors; this group of islands includes San Miguel, Santa Rosa, Santa Cruz, and three small islands referred to collectively as Anacapa. These islanders were speakers of one of six Chumashan languages referred to as Island Chumash (Grant, 1978).

Intrasite analysis of a large Late Holocene village on San Nicolas Island reveals that asphaltum was acquired and processed using locally available resources, supporting a variety of necessary technologies that sustained a largely autonomous island community. The reconstruction of the asphaltum production sequence additionally demonstrates that male and female gender roles were spatially unsegregated, and little separation existed between spiritual and secular realms. Artifacts analyzed in this study are found widely dispersed throughout California Channel Island archaeological deposits, suggesting that islanders sustained self-supporting lifeways for thousands of years. These findings dovetail with other emerging lines of evidence that demonstrate the islands were home to productive communities that were economically independent of mainland groups.

2. Asphaltum use in antiquity

Ancient cultures around the globe used asphaltum for a variety of symbolic, decorative, and practical purposes. In California, indigenous groups applied the substance as body paint during curing, mourning, and burial ceremonies (Gutman, 1979, 1983; Hodgson, 2004:6–7; Hull et al., 2013; McCawley, 1996:158). Regarding decoration, Chumash used asphaltum to appliqué shell beads onto objects such as mortars and pestles, steatite pipes, and effigies. For more practical uses, the substance fostered many complex technologies, such as hafting projectile points to shafts and knife blades to handles, as well as gluing fish-hooks to cordage. Moreover, the water resistant characteristics of asphaltum made it ideal for waterproofing basketry and caulking sea-going canoes, such as the *tomol*—a hallmark of Chumash craft specialization that transported people and prestige goods to the Channel Islands (Arnold, 2007; Gamble, 2008; Hudson et al., 1978).

2.1. Acquisition

Asphaltum deposits occur naturally throughout the world, but vary in chemical composition and consistency (Connan, 2012; Forbes, 1936). It can be found extruding from terrestrial sources, appearing in liquid pools that eventually harden into mounds, and also oozes from submarine seeps, subsequently washing up as tarballs along sandy beaches and rocky shorelines. In Southern California, asphaltum seeps occur mostly along the coast of Santa Barbara, Ventura, Los Angeles, and are also present inland in the Central San Joaquin Valley and Kern County. The Santa Barbara Channel is home to one of the most prolific submarine seep fields in the world, which is responsible for amassing numerous tarballs on the mainland coast and Channel Island beaches (Landes, 1973). Recent geochemical analysis of archaeological asphaltum on San Nicolas Island and San Miguel Island has demonstrated that these tarballs were used for a wide variety of routine manufacturing and repair processes for thousands of years (Brown et al., 2014).

Native Californians traded asphaltum in two ways: liquid form and hand-molded pads. The liquid would be brought to trade in baskets, while asphaltum pads were uniformly shaped in the palm of a hand and wrapped in grass and rabbit skins to prevent from sticking (Hodgson, 2004:5). Ethnographic evidence suggests that asphaltum gathered from terrestrial seeps was formed into cakes and traded to the Channel Islands where there were no terrestrial sources (Hudson et al., 1978:52). These mainland, terrestrial seeps were believed to produce a better quality adhesive and caulking component for the manufacturing of the *tomol*, while asphaltum from submarine seeps was considered inferior for this purpose (Hudson et al., 1978:51–52).

2.2. Processing

After asphaltum was acquired, it would be condensed and refined in an essential heating process well documented in different culture areas worldwide, including the Near East (Connan, 2012; Forbes, 1936; Schwartz and Hollander, 2001), Mesoamerica (Wendt and Cyphers, 2008), Japan (Habu, 2004) and California (Hudson et al., 1978). The process of heating hardens the substance by condensing the gasses within, ultimately creating a stronger adhesive (Connan, 2012; Hudson et al., 1978; Forbes, 1936; Schwartz and Hollander, 2001; Wendt, 2009:34–42). A variety of tempers would be added during the heating stage such as minerals to make it thicker, vegetal material to give it greater stability, and waxy/oily elements to make it more viscous.

During the early 20th century in California, a detailed account of asphaltum processing was documented by John P. Harrington in the construction of the *tomol* (Hudson et al., 1978). Harrington's principal informant, Fernando Librado, stated that asphaltum collected from terrestrial seeps (*woqo*) was pounded up and heated in a large olla. Once in a liquid state, two double handfuls of pine-pitch were stirred into the liquid mixture (Hudson et al., 1978:52). This mixture, referred to as *yop*, varied in quantity and composition. For instance, ochre was occasionally added into the mix, and the quantity of pine pitch varied or was excluded altogether. Once the right recipe was attained, the *yop* would be quickly applied to the planks of the *tomol* and continuously reheated until the job was complete (Hudson et al., 1978:80–124).

Large sandstone melting palettes, split cobbles, steatite bowls and crucibles, as well as asphaltum stained mollusk dishes collectively referred to as "mixing dishes" (Fig. 2a), contain evidence of asphaltum heating and processing. Archaeologically, shell containers with residue on their interior cavity are found widely dispersed across the Channel Islands (Heye, 1921; Hudson and Blackburn, 1987; Reinman and Townsend, 1960; Salwen, 2011). Hudson and Blackburn (1987:171) proposed that "mixing dishes" were used to mix and/or store melted asphaltum and pine resin. In a later study, Salwen (2011) distinguished different types of shell dishes that were used for mixing and those that were used as storage containers. Using replicative studies, Brown et al. (2013) demonstrated that the primary function of a "mixing dish" was not to mix but to melt and refine asphaltum in an essential heating stage of the asphaltum production sequence.

2.3. Application

Applicators were made from easily accessible local materials such as bone, shell, and stone, and were used to administer processed asphaltum onto a final object. These applicators display distinctive patterns on their surfaces, such as a small amount of residue or staining on their distal end, which allows them to be placed in a typological sequence. Stone applicators comprise some of the better-preserved artifacts in the archaeological record and provide clues to a variety of different functions. Asphaltum coated pebbles, referred to as tarring pebbles, are one type of stone applicator ethnographically known to have been used for coating the interior of basketry water bottles (Fig. 2b) (Brown and Vellanoweth, 2014; Craig, 1966; Hudson and Blackburn, 1987:174–175). Once the pebbles were heated, they were placed

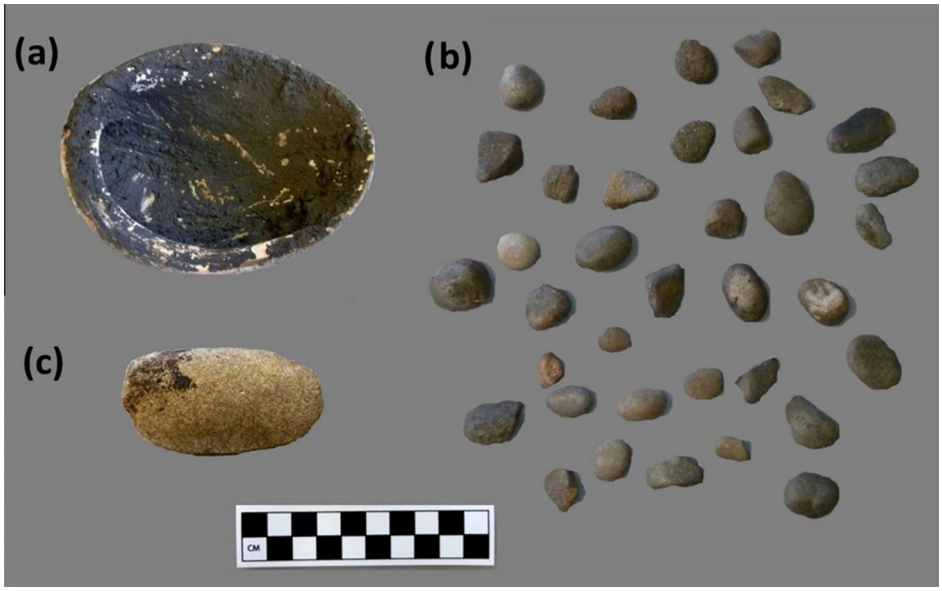

Fig. 2. Top left: (a) interior-stained abalone dish; Right: (b) tarring pebble cluster; Bottom left: (c) asphaltum-stained sandstone saw with residue on the proximal, lateral margin of the dorsal surface. After Brown (2013:56).

inside a woven basket along with chunks of asphaltum and rolled around to press the interior of the weave. After this process was complete, the tarred pebbles were discarded, creating an event visible in archaeological contexts on the mainland and Channel Islands. Brown and Vellanoweth's (2014) classification of tarring pebble sizes illustrates the similarity of sizes within clusters, and also discusses the differences between them, providing evidence for the many different functions tarring pebbles served. Additionally, Kendig et al. (2010) analysis of sandstone saws, a tool associated with the manufacturing of the circular shell fishhook, shows that asphaltum residue appears most often on the proximal, lateral margin (Fig. 2c), suggesting that these artifacts most likely served as applicators as well.

3. Materials and methods

The dataset, on which this paper is based, consists of asphaltum artifacts excavated under the direction of Dr. René Vellanoweth (2003–2009) from Tule Creek Village, CA-SNI-25, on San Nicolas Island, California. The village is located on the north-western side of the island and is situated on top of the island's central plateau. Below Tule Creek Village lies Corral Harbor, a small, protected cove where drift asphaltum frequently washes up on the rocky shoreline. Malcolm J. Rogers first excavated the site in 1930 and recorded numerous house depressions, communal structures, and at least two cemeteries. Recent investigations have focused on a special use area designated as East Locus that was primarily occupied between 800 and 500 cal BP (Table 1) (Bartelle et al., 2010; Cannon, 2006; Guttenberg et al., 2013; Knierim et al., 2013; Vellanoweth et al., 2008). Excavations have revealed pit features filled with subsistence remains (possibly representing feasting events) and formal dog and fox burials. A variety of exotic materials as well as a broad assortment of bone, shell, and stone artifacts—both utilitarian and ritual in nature—testify to villagers' participation in inter-island and mainland exchange.

Approximately 1500 asphaltum artifacts from Tule Creek Village were identified from East Locus. Two of these artifacts were sampled for their source origin based on their proximity and association to other artifacts used for asphaltum processing and application. The artifacts include a sample of detritus (#2830) excavated from Unit 7A1, Stratum II, which was found in contexts that date between 590 and 500 cal BP. Another sample was taken from the interior of an asphaltum-stained abalone (*Haliotis cracherodii*) shell (#2833) in Unit 8 K, Stratum II, dating between 520 and 450 cal BP. The samples were sent to GeoMark Research Ltd. to determine the source origin, and the methods are thoroughly described in Brown et al. (2014).

Within the entire asphaltum assemblage, each artifact displayed distinctive signs that allowed for its placement in a particular stage of production. The artifacts were classified based on the typology developed by Salwen (2011) that includes: technological, smeared, cached, and detritus/waste. However, changes were made to this initial typology that aid in a more accurate placement of asphaltum artifacts in a sequence of production (Table 2).

The *technological* category consists of artifacts overtly employed in the construction of a final object. There are three subgroups within the technological category: constructive, reconstructive, and decorative. The constructive subgroup includes objects used as waterproofing and gluing agents in the production of composite artifacts. The reconstructive subgroup consists of artifacts that were glued back together, and the decorative subgroup includes asphaltum coated objects used for ornamentation.

The *processing and application* category consists of artifacts used for heating, mixing, and application. In California, these artifacts can include tarring pebbles, which are ethnographically known to melt and apply asphaltum, as previously discussed. Artifacts used specifically for heating were placed in the processing subgroup, while the application subgroup contained applicators that contained residue on their distal ends, suggesting that their primary function was to apply asphaltum onto another artifact.

The *detritus* category contains two subgroups: fragments and incidental. Artifacts placed in the fragments subgroup are less than 2 cm in size and display signs of having been processed, such as degassed holes. The other artifacts in the incidental subgroup consist of objects unintentionally smeared with asphaltum at some point during the production process.

The *cached* category consists of three sub-categories: cakes, chunks, and asphaltum filled mollusk shells (Salwen, 2011:16). Cakes are circular to semi-circular molded pads that typically

Table 1
Radiocarbon dates from East Locus.

Sample #	Unit and context	Stratum/level	Depth (cm)	Material	Uncalibrated ^{14}C age (BP)	Calibrated range (1 σ) years BP	Calibrated age range (2 σ) years BP	Reference
OS-54562	Unit 7, Feature 9 (hearth)	V/1	60–70	Charcoal	395 ± 70	510–320	530–310	Cannon (2006)
OS-54355	Unit 7H, Fishing Tackle Kit Feature	II/1	18	*H. cracherodii*	1090 ± 35	500–430	530–370	Cannon (2006)
OS-54397	Unit 7L, Feature A (pit)	IIB/1	63	*M. californianus*	5700 ± 35	5870–5760	5910–5710	Cannon (2006)
OS-66789	Pit 7Q	II/8	125	*H. cracherodii*	900 ± 30	320–250	410–220	Guttenberg et al. (2013)
OS-54411	Unit 8, Feature 6 (hearth)	IV/2	70	Charcoal	175 ± 30	280–140	290–170	Cannon (2006)
OS-55465	Unit 8A, saddle bead	I/1	–	*Olivella biplicata*	1180 ± 35	550–490	610–470	Guttenberg et al. (2013)
OS-55336	Unit 8E2, left-handed fishhook	II/4	–	*Norrisia norrisi*	1180 ± 35	550–490	610–470	Guttenberg et al. (2013)
OS-54400	Unit 8T, Rock Cairn Feature	II/2	108	*H. cracherodii*	1000 ± 30	430–330	460–300	Cannon (2006)
OS-66910	Dog burial	–	–	*Canis familiaris*	680 ± 25	450–330	470–310	Guttenberg et al. (2013)

[a] All dates were calibrated using Calib 7.0.4 (Reimer et al., 2009) and applying a ΔR of 261 ± 21 for all shell samples.
[b] Dates provided by Dr. René Vellanoweth, Department of Anthropology, California State University, Los Angeles.

Table 2
Asphaltum artifacts from East Locus.

Asphaltum category	Examples
(I) Technological	
(A) Constructive	Skirt weights, plugged abalone shells, bone gorges, basketry impressions, hafted points
(B) Reconstructive	Repaired bowls, pestles, mortars, baskets, and ollas
(C) Decorative	Shell inlay, painted objects
(II) Processing and Application	Tarring pebbles
(A) Processing	Steatite ollas, interior-stained abalone shells, asphaltum stained sandstone slabs
(B) Application	Applicators of bone, shell, stone, or wood
(III) Detritus	
(A) Fragments	Processed fragments less than 2 cm; non-recyclable
(B) Incidental	Asphaltum smudges on artifacts and ecofacts with no function
(IV) Cached	
(A) Cakes	Hand molded asphaltum pads, typically around 15–45 cm[a] in diameter
(B) Filled Shells	Shells with inner cavity filled with asphaltum
(C) Chunks	Unmodified or modified fragments between 2 and 15 cm; recyclable

[a] Cakes do not necessarily depend on their size but shaped or molded, and processed characteristics.

measure between 15 and 45 cm. Chunks are irregular in shape and measure between 2 and 15 cm. Conversely, asphaltum filled mollusk shells contain large masses of asphaltum stuffed inside the shell's interior cavity.

All the artifacts placed in the typological sequence were summarized, digitized, and spatially mapped in Arc GIS 9.3. These data were displayed within their grid units in distribution maps across the entire excavated area at East Locus. Statistical operations were performed in the Arc GIS 9.3 spatial statistics toolbox, including Moran's *I* spatial autocorrelation and Getis-Ord Gi* hot spot analysis to identify discrete areas of asphaltum production.

4. Results

The results of the asphaltum sourcing study are thoroughly described in Brown et al. (2014). These data show that archaeological samples from Tule Creek Village match the geochemical fingerprint of a modern tarball collected from Corral Harbor. The archaeological samples and modern tarball were compared to a chemometric database published by the United States Geological Survey (USGS) and exhibit the same chemical composition of other tarballs originating from submarine seep fields located in the general vicinity of Point Conception (see Fig. 1)—a natural headland in southwestern Santa Barbara County (Brown et al., 2014:72–73; Lorenson et al., 2009). The asphaltum was likely brought to the shores of San Nicolas Island by the California Current, which passes Point Conception, flows west of San Miguel Island, and then passes the windward shore of San Nicolas Island.

4.1. Asphaltum production sequence

Artifacts representing every stage of asphaltum production are present at East Locus (Table 3). The majority of asphaltum encrusted artifacts belong to the *processing and application* and *detritus* categories, demonstrating that asphaltum production was occurring within the village space. Numerous other artifacts belonging to the *technological* category attest to the range of everyday activities in which the substance was involved. Furthermore, the lack of artifacts in the *cached* category speaks to the expedient and small-scale nature of asphaltum use by peoples at Tule Creek Village.

Table 3
Asphaltum artifact typology.

Asphaltum category	Count	Count % (category)	Count % (total)	Weight (g)	Weight % (category)	Weight % (total)
(I) Technological						
(A) Constructive						
Skirt weight	7	25.0	0.3	2.9	1.4	0.0
Basketry impression	9	32.1	0.4	39.3	19.4	0.3
Abalone dish	2	7.1	0.1	49.1	24.2	0.4
Projectile point	5	17.9	0.2	11.9	5.9	0.1
Mytilus blade	1	3.6	0.0	0.5	0.3	0.0
Donut stone	1	3.6	0.0	51.2	25.2	0.5
Glued sea mammal tibia	1	3.6	0.0	25.9	12.8	0.2
(B) Reconstructive						
Steatite bowl fragment	1	3.6	0.0	22.0	10.9	0.2
(C) Decorative						
Cut shell	1	3.6	0.0	0.0	0.0	0.0
Total	28	100.0	1.2	202.8	100.0	1.8
(II) Processing and application						
Tarring pebbles	664	93.5	27.9	4249.9	55.8	37.7
(A) Processing						
H. cracherodii (MNI)	18	2.5	0.8	976.5	12.8	8.7
H. rufescens (MNI)	5	0.7	0.2	433.3	5.7	3.8
Haliotis spp. *(MNI)*	1	0.1	0.0	112.5	1.5	1.0
M. californianus (MNI)	2	0.3	0.1	30.2	0.4	0.3
(B) Application						
Sandstone saw	14	2.0	0.6	1501.0	19.7	13.3
Pestle	1	0.1	0.0	264.4	3.5	2.3
Bone	2	0.3	0.1	24.5	0.3	0.2
Shell	2	0.3	0.1	23.1	0.3	0.2
Wood	1	0.1	0.0	2.2	0.0	0.0
Total	710	100.0	29.9	7617.7	100.0	67.6
(III) Detritus						
(A) Fragments	1574	97.6	66.2	804.9	25.6	7.1
(B) Incidental						
H. cracherodii	16	1.0	0.7	126.0	4.0	1.1
H. rufescens	7	0.4	0.3	53.7	1.7	0.5
Haliotis spp.	6	0.4	0.3	8.5	0.3	0.1
Olivella	4	0.2	0.2	0.8	0.0	0.0
M. californianus	1	0.1	0.0	0.8	0.0	0.0
Chlorostoma sp.	1	0.1	0.0	0.3	0.0	0.0
Canine	1	0.1	0.0	n/a	0.0	0.0
Pestle	2	0.1	0.1	2143.9	68.3	19.0
Total	1612	100.0	67.8	3139.0	100.0	27.8
(IV) Cached						
(A) Cakes	0	0.0	0.0	0	0.0	0.0
(B) Filled Shells	0	0.0	0.0	0	0.0	0.0
(C) Chunks	26	100.0	1.1	316.7	100.0	2.8
Total	26	100.0	1.1	16.7	100.0	2.8

After the asphaltum had been acquired from the island's shores, it was processed in shell containers or heated by tarring pebbles for the waterproofing of basketry (Fig. 3). A total of 144 (MNI = 26) interior-stained mollusk dish fragments and whole shells representing at least three different shellfish species (*H. cracherodii*, *H. rufescens*, and *M. californianus*) were identified in the East Locus dataset (Fig. 4). The method by which the asphaltum was heated in these shell containers was difficult to distinguish due to their fragmented and deteriorated nature. It is possible that multiple techniques were used to heat the asphaltum inside the shell; one such method might have been placing the shell directly on a hearth or heating the shell at a low temperature by placing it over warm coals or on a hot rock. Another possibility is that tarring pebbles were used to heat the asphaltum inside the shell container (Brown and Vellanoweth, 2014:15–16).

Interior-stained mollusk dishes, asphaltum chunks, basketry impressions, and detritus fragments all contain vegetal debris, fragmented shell, and quartz grains adhered to their surfaces. It remains undetermined whether these materials were intentionally added during the heating stage or if they were picked up from the soil matrix in which they were deposited. Experiments demonstrate that mixing asphaltum with small quantities of additives, such as pine resin or ochre, changed some of the physical properties but did not affect the quality of asphaltum as an adhesive (Brown et al., 2013). When used as a gluing agent for small-scale applications, adding temper may not have been necessary, and any debris adhering to archaeological asphaltum samples from East Locus may be inadvertent. Supplementary geochemical testing on the interior-stained abalone dish from East Locus (#2833) shows that no conifer resins were added to the asphaltum in the shell container (Brown et al., 2014; Connan and Zumberge, 2012:5).

Asphaltum applicators in the dataset consist primarily of sandstone saws and tarring pebbles. A total of 14 sandstone saws had asphaltum adhered to their surfaces, and 11 of the total 14 (79%) had residues on their right, proximal, lateral margin. Only five other applicators comprised of shell, bone, and wood were identified with asphaltum on their distal ends (Fig. 4). Conversely, tarring pebbles were widely dispersed throughout the village and made up the majority (n = 664) of artifacts in the *processing and application* category. Of the lot, 578 (87%) tarring pebbles—measuring between 15 and 30 mm—fell within the medium size category in the Brown and Vellanoweth (2014) classification scheme, whereas 58 pebbles were classified as "small" (4–15 mm) and 28 pebbles were

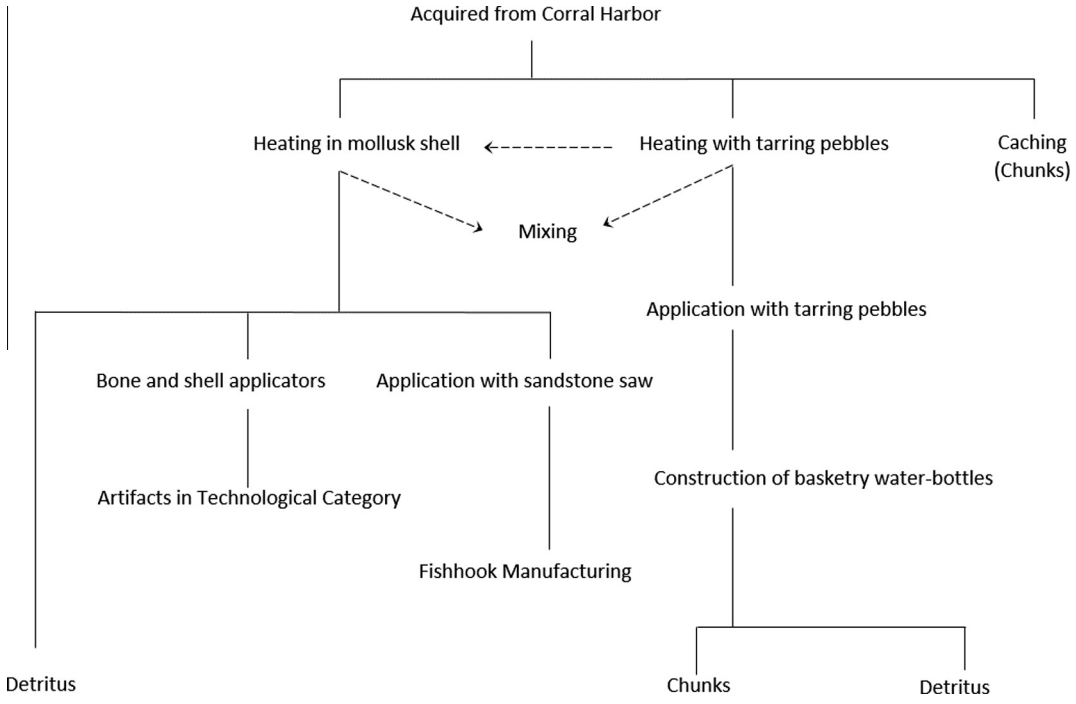

Fig. 3. The asphaltum production sequence at East Locus. Dashed arrows indicate alternative possibilities.

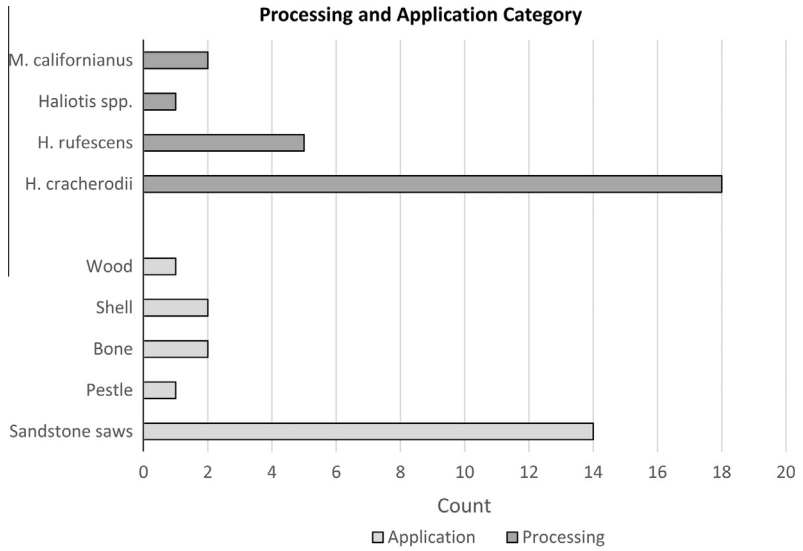

Fig. 4. Artifacts placed in the processing and application sub-categories.

classified as "large" (30–45 mm). Of the tarring pebbles that classified as either large or small, 98% of them fell within 5 mm of the medium range (Fig. 5).

The presences of finalized crafts in the *technological* category demonstrate that villagers utilized tools with asphaltum residues for harvesting subsistence resources (Fig. 6). Water bottle basketry impressions indicate that villagers were able to obtain water from a local source and store it within the village. Projectile points with asphaltum residue on their dorsal surfaces provide evidence of having once been hafted to a shaft that was likely utilized for hunting activities. The use of asphaltum for plugging, repairing, and mending is also visible at East Locus. For instance, fragments of abalone with their siphon holes plugged show use of the shells for containers, cups, and dishes (Hudson and Blackburn, 1983:278, 1987:171). Asphaltum residue found on the fractured surfaces of a steatite bowl fragment additionally illustrates asphaltum use as glue and sealant. A cut shell (*Haliotis* sp.) with asphaltum adhered to one side likely served an ornamental function, providing probable evidence for artistic use. Skirt weights, identifiable by their small ovular shape and holes in their outer edges, were attached to the ends of grass skirts to hold the fibers down against the wind, further attesting to the various functions asphaltum served for the peoples of Tule Creek Village.

The dearth of artifacts found in the *cached* category also yields information about the asphaltum industry at East Locus. Cakes and asphaltum filled mollusk shells were not identified at the site, indicating that large quantities of asphaltum were not being stored for later use. Only small (3–4 cm), modified asphaltum chunks

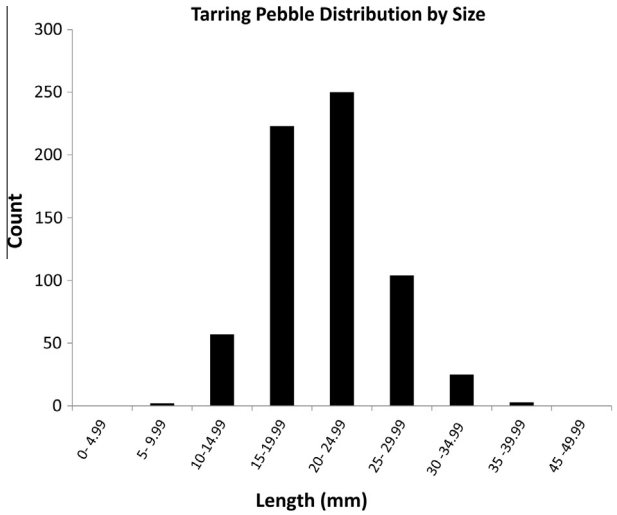

Fig. 5. Tarring pebble distribution by size at East Locus.

were found widely dispersed within the village space and may likely represent the average quantity cached for future use. These data and other artifacts identified in the *technological* and *processing and application* categories express the small-scale nature of asphaltum use at East Locus.

4.2. Spatial distributions

Although evidence for asphaltum use is widespread at East Locus, Brown (2013:60–63) identified a primary area of asphaltum production in the southwest section of the village that Arc GIS 9.3 Getis-Ord Gi* hot spot analysis clarified (Fig. 7). The categories of asphaltum use in this designated space include *technological* (construction), *processing and application* (medium-sized tarring pebbles), and *detritus* (fragments). This zone of production is located near hearth features, a triple dog burial, and fishhook production locales. Conversely, artifacts placed in the *cached* category were more sporadically situated within the village space.

Two discrete activity areas are evident within the primary asphaltum production zone, including asphaltum artifacts identified near the Fishing Tackle Kit feature in Unit 7H and a large cluster of 94 tarring pebbles in Units 7V, 7Y, and 7Z (Brown 2013:61–62). The Fishing Tackle Kit feature contains a cache of shell fishhooks, fishhook blanks, stone drills, abraders, and other materials used in the production of circular shell fishhooks (Cannon, 2006). Guttenberg et al. (2013:103–105) found a statistically significant clustering of fishhooks and sandstone saws precisely where this feature is located. Other artifacts included within this study occur in close proximity to the Fishing Tackle Kit feature as well and are detailed in Table 4. Another discrete activity area consists of a large cluster ($n = 94$) of tarring pebbles, approximately 3 m southwest of the Fishing Tackle Kit feature. This tarring pebble cluster is made up of 95% ($n = 89$) medium-sized (15–30 mm) tarring pebbles, and 5% ($n = 5$) small (4–15 mm) tarring pebbles. The five tarring pebbles classified in the "small" category were within 5 mm of the medium category size range.

Moreover, spatial distributions enabled the examination of asphaltum use relative to specific features at East Locus (Fig. 8). Medium-sized tarring pebbles, located within pit features, occur in the northeastern and southwestern sections of the site and illustrate discrete tarring pebble dumping zones. A total of 18 tarring pebbles were found within a large pit feature that straddles Unit 8T and 8R (Brown 2013:120–121). This pit feature had three ritually associated stacked elements: an inverted sandstone mortar, a piece of basalt breccia, and a serpentine pestle (Guttenberg, 2014; Knierim et al., 2013). Approximately one meter to the northeast, adjacent to a double dog burial, a tarring pebble and asphaltum detritus were found within another pit feature located in Unit 8 W (Brown 2013:122,134). The pit had an associated fishing tackle kit comprised of modified shell, ground and flaked stone, as well as an additional stacked stone feature that included a phallic-shaped sandstone pestle, a worked piece of granite, and a chunk of red ochre (Guttenberg, 2014; Knierim et al., 2013). Similarly, in the southwestern section of the site, medium-sized tarring pebbles were found within and between several other pit features that were organized in close proximity to fishhook production locales, discrete pits, and a double dog burial.

5. Discussion

Tracing the *chaîne opératoire* of asphaltum production is a convincing method by which to understand social and economic organization at East Locus. The analysis of these step-by-step activities illustrates that villagers acquired, processed, and applied

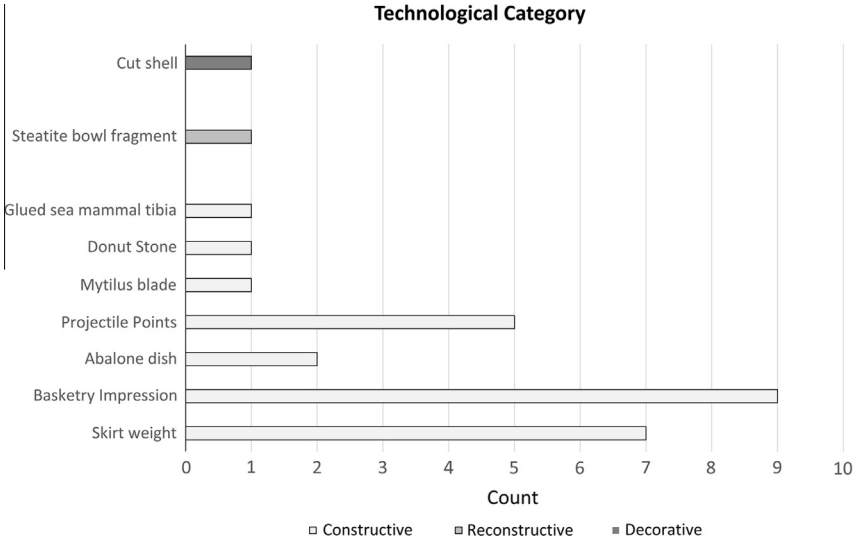

Fig. 6. Artifacts placed in the *technological* category.

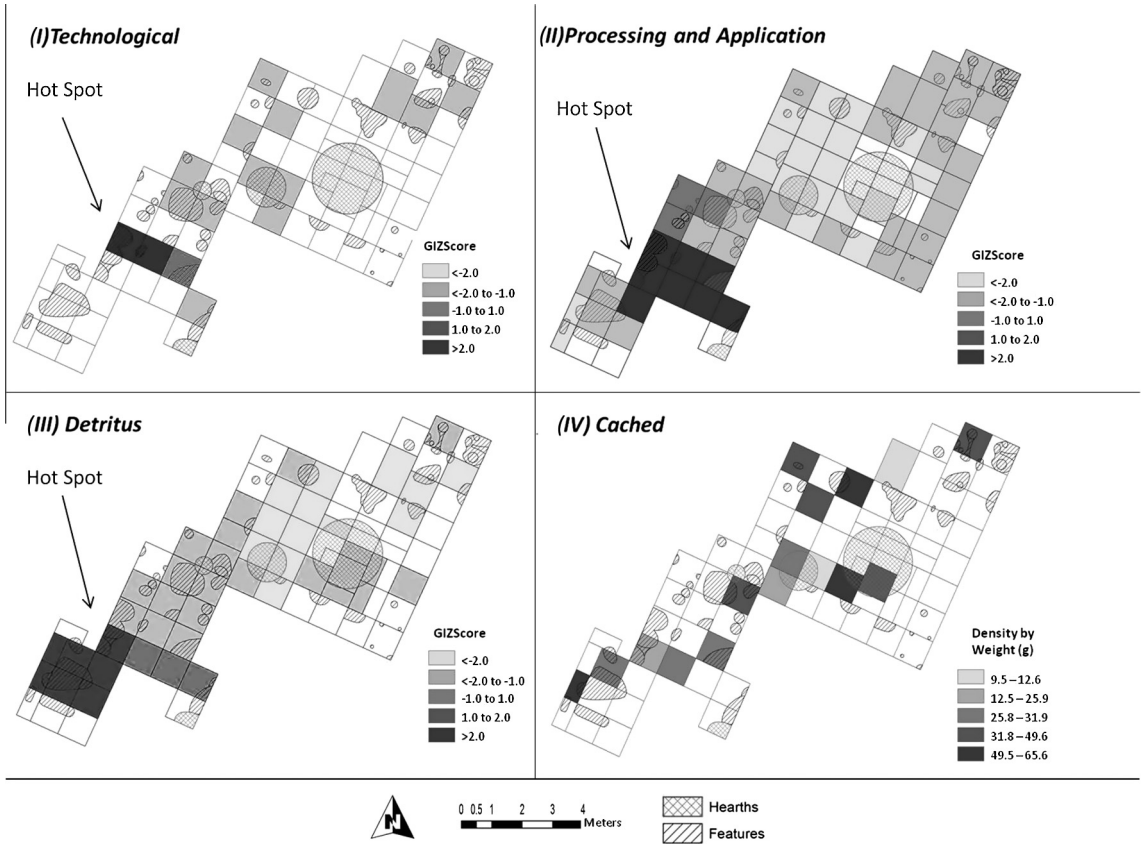

Fig. 7. Hot spots of asphaltum production activities at East Locus. Top left: (I) technological (constructive); Top right: (II) processing and application (medium tarring pebbles); Bottom left (III) detritus (fragments); Bottom right: (IV) cached (no hot spots). After Brown et al. (2014).

asphaltum using locally available resources for a variety of necessary and routine activities. Behavioral aspects of asphaltum use are present in the orientation of physical space as well. Spatial distributions of processing activity areas reveal that the organization of production occurred in concentrated areas, and routine activities took place near ceremonial spaces. These data merge with a larger suite of archaeological data that indicate islanders utilized their local environment to sustain vibrant and dynamic communities for thousands of years.

5.1. Life on an Island home

The discovery of exotic artifacts throughout the Santa Barbara Channel region has long indicated an interlaced series of social networks that connects the islands and mainland coast. Steatite from Santa Catalina Island and shell beads manufactured on Santa Cruz Island are widely distributed across Southern California, attesting to island participation in and access to extensive trade networks. Artifacts moving from the mainland to the islands, such as obsidian, acquired primarily from the Coso Range (Rick et al., 2001), deer bone (Glassow and Perry, 2015), and ethnographic accounts of bows, arrows, and furs (Davis, 1961) additionally demonstrate the types of objects that were traded across the Channel. Ongoing dialogue among scholars continues to elucidate the role exotic artifacts would have played in the cross-channel exchange system. Arnold (1995, 2001) and Kennett (2005) argue that the elite controlled bead production industry on the Channel Islands resulted from a demand to acquire and redistribute acorns and other terrestrial resources to the islands. Conversely, Fauvelle (2011, 2013) asserts that mainland elites controlled islanders' ability to construct sea-going canoes due to the lack of high-grade asphaltum, pine pitch, and milkweed needed for *tomol* construction. Others suggest that trade across the Santa Barbara Channel benefited numerous groups by uniting different ecological zones, which was especially valuable during times of resource depression (King, 1974, 1990; Gamble, 2008).

Asphaltum use and exchange has been used to strengthen arguments regarding the dependency of island peoples on mainland resources (Arnold, 1993, 2007, 2012; Arnold and Bernard, 2005; Arnold et al., 2001; Fauvelle, 2011, 2012, 2013, 2014; Salwen, 2011). According to Fernando Librado, high-quality asphaltum mined from mainland terrestrial seeps, referred to as *woqo*, was the only source utilized in the construction of the *tomol*. In fact, this statement is often extended to all asphaltum production industries on the Channel Islands that required its use for everyday activities. For instance, Hudson and Blackburn (1987:163–166) rely on Librado's ethnographic description when they describe Chumash use of "glue," which they argue was only procured from mainland sources and utilized for a variety of everyday adhesive purposes. Recent studies share the same bias toward mainland seeps as a primary source for everyday activities. For example, Salwen's (2011) study is set on the premise that cached asphaltum is indicative of collection from mainland terrestrial seeps; she links the increase of asphaltum caching in the Middle period (600 B.C.–A.D. 1150) to an escalation of a variety of other new asphaltum-based technologies that are not associated with *tomol* manufacturing (Salwen, 2011:35–39). Asphaltum production systems located within mainland archaeological contexts have also been used to suggest islanders' lack of basic materials for their everyday needs. In explaining the presence of 651 tarring pebbles at Pitas Point on the mainland, Gamble (2005:100) suggests they are there "possibly because its inhabitants were making water

Table 4
Asphaltum artifacts identified in proximity to the Fishing Tackle Kit feature identified in Cannon (2006).

Type	Unit(s)	Strat	Level	Description
Fishing Tackle Kit	7H	II	1	Shell fishhooks, fishhook blanks, trash pits containing burned fishbone, stone drills, abraders (Cannon, 2006)
(I) Technological				
(A) Constructive	7I, 7P, 7Q	II	2, 3, 8	*M. californianus* worked blade, basketry impressions, projectile points, sea-mammal bone glued together
(B) Reconstructive	7Q	II	7	Steatite bowl fragment with asphaltum adhered post fracture
(C) Decorative	7P	II	3, 8	Cut shell with asphaltum on one side
(II) Processing and Application	7H, 7P, 7Q, 7I	I, II	1, 2, 3, 6, 7	Tarring pebbles, clusters range from 1 to 30 per unit
(A) Processing	7H, 7P, 7Q, 7I	II	1, 2, 3	Interior-stained abalone dishes: *M. californianus*, *H. cracherodii*, *H. rufescens*, *Haliotis* spp.
(B) Application	7S, 7B	I, II	1, 2	Sandstone Saw, worked shell applicator
(III) Detritus				
(A) Fragments	7H, 7I 7P, 7Q	I,II	1,2,3	Small fragments of detritus scattered throughout
(B) Incidental	7H, 7I, 7P, 7Q	II	1, 2, 3	*H. cracherodii*, *H. rufescens*, *Haliotis* spp.
(III) Cached				
(C) Chunks	7I	II	1	Large chunk of asphaltum

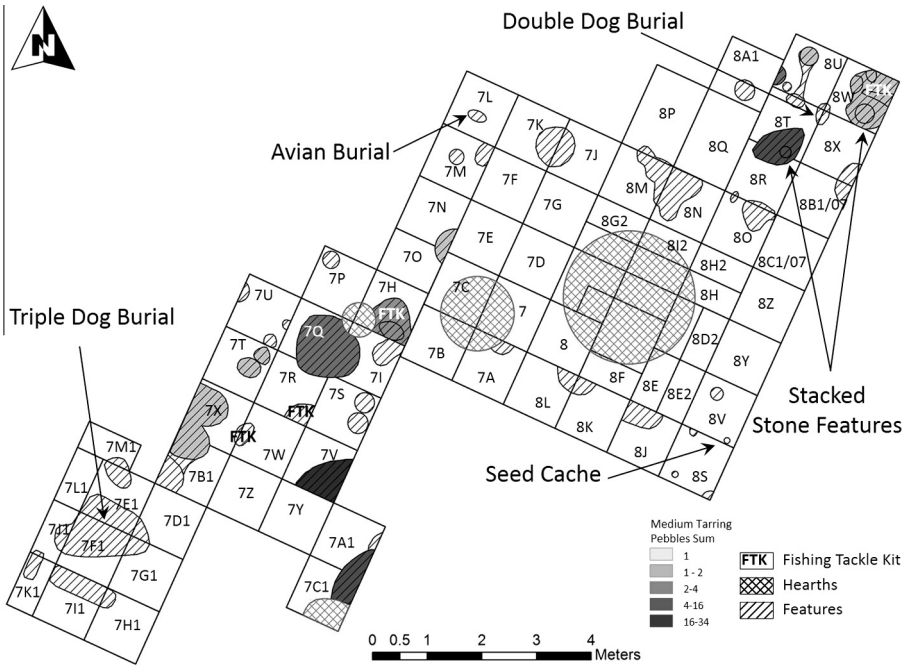

Fig. 8. Distribution of tarring pebbles within pit features and their association with fishing tackle kits [after Cannon (2006) and Guttenberg (2014)] and ceremonial features. Following Brown et al. (2014), Guttenberg (2014:46), and Knierim et al. (2013:43).

bottles for export to the islands," implying that islanders did not have sufficient asphaltum sources necessary to construct water storage containers and thus required mainland resources to do so.

Emerging archaeological evidence offers new interpretations concerning daily life from an island perspective. Analysis of subsistence remains not only demonstrates that island diets were heavily dependent on the marine environment, but also shows that islanders had access to local terrestrial foodstuffs such as blue dicks (*Dichelostemma capitatum*) and other geophytes, as well as a variety of seeds and nuts (Gill, 2013; Gill and Hoppa, 2015). Raw materials for tool manufacturing were available from naturally occurring geological features (Erlandson et al., 2015), as well as locally available terrestrial and marine flora and fauna (Rick et al., 2005). On the islands, evidence for tool production appears in the form of mortar and pestle production refuse (Rozaire, 1983), as well as fishhook and bone tool manufacturing (Kendig et al., 2010; Wake, 2001); this evidence of tool production indicates that peoples who lived on the Channel Islands could sustain economically independent lifestyles, as opposed to the idea that islanders had to rely on their mainland counterparts to meet their everyday needs.

When comparing asphaltum artifacts from East Locus to Pitas Point—a site where asphaltum use was thoroughly analyzed on the mainland—not only are similar types of crafts produced, but the comparison of asphaltum assemblages also illustrates that asphaltum systems on the islands were highly productive. For example, the number of tarring pebbles excavated from East Locus ($n = 664$) and Pitas Point ($n = 651$) are nearly equivalent, suggesting these two villages manufactured similar yields. However, when comparing the artifact density, East Locus has over 18 tarring pebbles per cubic meter of excavated soil more than Pitas Point, which has less than three tarring pebbles per cubic meter (Brown and Vellanoweth, 2014; Gamble, 1983). This evidence suggests that islanders had the materials necessary for making large quantities of asphaltum-based technologies, most notably basketry water-bottles. Furthermore, the distribution of asphaltum encrusted artifacts across the Channel Islands reveals similar patterns that speak broadly to economically self-sufficient groups. Artifacts identified

in the *technological*, *processing and application*, and *detritus* categories are found widely dispersed in island archaeological deposits, further demonstrating that islanders had the resources and technological knowledge to produce tools that utilized asphaltum for an array of everyday activities.

5.2. Gendered activities

Links between gender, tool manufacturing, and the social relations of production in California's archaeological record have been examined by numerous archaeologists. Jones (1996) examination of mortars and pestles focused on changes in diet that may be indicative of shifts in gender specific tasks, while Jackson (1991) used analogy to compare bedrock mortars and storage silos in the Sierra Nevada to ethnographically known acorn-dependent groups and showed that the location of settlements were largely determined by women. At Mission San Antonio de Paudo, Peelo (2011) found distinct and overt construction techniques that were used to identify gendered boundaries present during ceramic production—women may have hand molded the vessels whereas men may have thrown them on a wheel. Among the Chumash, Hollimon (1990) used ethnographic, archaeological, and skeletal data to demonstrate that gender roles were relatively equal for thousands of years. In another study, Gamble (1983) demonstrated that the distribution of artifacts associated with food preparation and cooking within house features may have represented a women's domain, while concentrated activity areas suggestive of butchering took place outside of the house, representing places where men may have worked.

The asphaltum production sequence and its spatial distribution at East Locus reveals organizing principles that may also reflect a gendered division of labor. In tracing the asphaltum chain of production, two distinct activities—identified from artifacts placed in the *processing and application* category—become apparent: basketry construction and fishhook manufacturing. Regarding basketry construction, tarring pebbles are found in nearly every unit at East Locus, but it is the discrete areas of tarring pebble clusters dispersed across the site that may be linked to the construction of basketry water bottles. Their uniformity in size indicates that they were gathered for a particular purpose; the historic accounts of Juana Maria provides some evidence that these could have been used for the construction of woven asphaltum lined basketry water bottles (Nidever, 1883:34). These "long-necked water bottles" were fashioned out of sea grass, lopsided in shape, and flexible in texture (Heizer, 1960; Heizer and Elsasser, 1973; Woodward, 1940, 1957). Medium-sized tarring pebbles, ranging between 15 and 30 mm, would have been used, as they were small enough to pass through their narrow necks.

Ethnographic and ethnohistoric sources from the Santa Barbara Channel region illustrate that women were the primary weavers of baskets (Crespi in Brown, 2001:391; Gamble, 1983, 2005; Priestley, 1972:34–35). One account, documented by Pedro Fages traveling up the Santa Barbara coast in 1776, observed some of the primary activities performed by women: "The women go about their seed-sowing, bringing the wood for the use of the house, the water, and other provisions. They skillfully weave trays, baskets, and pitchers for various purposes; these are made with threads of grass roots of various colors" (Priestley, 1972:34–35). While baskets are hard to identify archaeologically largely due to disintegration, tarring pebble clusters offer a means by which to detect areas where basketry construction and manufacturing likely occurred (Hector, 2006:108–109). At East Locus, the spatial distributions of tarring pebble clusters probably represent areas used by women in the manufacturing of basketry water bottles.

Fishhook production is another distinct activity that emerges when tracing the asphaltum chain of production at Tule Creek Village. Mixing dishes and sandstone saws are two of the most abundant artifacts to occur in the *processing* and *application* subcategories, and their presence suggests primary use in the construction of shell fishhooks. Previous studies at Tule Creek Village have presented the functional linkages between sandstone saws and the manufacturing of circular shell fishhooks (Kendig et al., 2010; Smith et al., 2015). The consistent occurrence of asphaltum on the right, proximal, lateral margin illustrates that sandstone saws were used in a lineal process of fishhook manufacturing. For instance, after constructing the fishhook, the sandstone saws may have been dipped into the mixing dish and then used to apply asphaltum to cordage, which would strengthen or secure the knot where it would be attached to the shank of a hook. Fishing tackle kits identified in other Channel Island archaeological deposits, such as the "tackle box" found on San Clemente Island (CA-SCLI-1215), include a variety of asphaltum encrusted artifacts such as a worked flaked tool, interior-stained *Mytilus* dishes, a bone knife, composite barbs, and miscellaneous wrapped cordage (Bleitz and Salls, 1993). Numerous artifacts placed in the *processing*, *application*, and *cached* categories at East Locus are also likely to have played a role in the fishhook production toolkit.

While both men and women have been documented hunting and fishing throughout California, men were primarily responsible for these tasks among the Chumash (Hollimon, 1990; Willoughby, 1963). Chumash men were also linked to the repair and manufacture of tools utilized for the hunt, as well as the butchering of game (Hollimon, 1990:61; Willoughby, 1963:21–25). At East Locus, numerous tools associated with fishhook manufacturing and shellfish processing were found in concentrated activity areas across the horizontally exposed space (Cannon, 2006; Guttenberg, 2014). The discovery of these assemblages reveals a space where men may have worked.

The spatial arrangement of tarring activities for basket construction and fishhook manufacturing presents compelling implications regarding social organization at Tule Creek Village. The southwestern section of the sampled area clearly served as a production zone for most asphaltum related activities, which may be due to the inherently messy nature of asphaltum processing. However, basketry dumping zones and fishing tackle kits are often paired with each other and commonly overlap across the village space. While a division of labor is evident, the performance of these gendered activities was spatially unsegregated and served equally important roles in sustaining village life on an island home. These data illustrate the substantive social and economic nature of men's and women's activities at East Locus, and more broadly speak to the daily actions of men and women across the Channel Islands.

5.3. Intermixing the sacred and profane

Components of Chumash and Gabrieliño spiritual and religious traditions have been well documented in several ethnographic accounts that mostly derive from Fernando Librado (Blackburn, 1975; Hudson, 1979; Hudson et al., 1977; Hudson and Underhay, 1978; Johnson, 1982, 2001). According to Librado, the Chumash had a powerful religious faction comprised of chiefs, their family members, and high-status individuals referred to as '*antap* (Bean and King, 1974; Hudson and Underhay, 1978:29). The '*antap* were responsible for recruiting and training shamans to preside over rituals and festivals, as well as advising high-ranking officials. The Gabrieliño had their equivalent of '*antap* called the *yovaarekam*, which originates from the word *yovaar* for "sacred enclosure" (Bean and Smith, 1978:542; Hudson and Blackburn, 1986:56–60). These sacred enclosures placed one in contact with *Chengiichngech*, or the supreme creator-god of the Gabrieliño religion (McCawley, 1996:28).

Archaeological evidence for ritual activity on the California Channel Islands has been examined through many theoretical

Fig. 9. An asphaltum lump adhered to the second metacarpal of the southernmost dog in the Triple Dog Burial feature at East Locus (Brown 2013:56).

lenses. On a regional scale, Perry's (2007) landscape perspective of rock features on Santa Cruz Island illustrates that portable ritual items were a significant part of the geographic and cultural landscape. This approach is ideal for understanding how islanders interacted with the supernatural landscape on the California Channel Islands. Intrasite levels of analysis have also been effective in the identification of ritualistic behavior. For example, the Lemon Tank site (CA-SCLI-1524) on San Clemente Island exposed ritualistically interred dogs, foxes, and raptor burials associated with caches of red maid seeds, shell beads, and mortars containing ochre, among other items (Hale, 1995). Many of these animal burials were found in a structure surrounded by 25 postholes that has been interpreted as evidence for an enclosed space used in annual mourning ceremonies and *Chengiichngech* traditions (Hale, 1995; Perry, 2013:147).

Tule Creek Village has yielded similar intrasite patterns when compared to the Lemon Tank Site. In the northeast section of the excavated area, two dog burials were found within a one meter radius of stratigraphically associated ritual paraphernalia, including an incised steatite doughnut stone, ochre, morning glory seeds, wild cucumber (*Marah macrocarpus*) seeds, iron concretions known as *toshwaat stones*, and two balancing rock features (Vellanoweth et al., 2008; Cannon, 2006; Knierim et al., 2013). On the opposite (southwest) end of the horizontal exposure, a triple dog burial was discovered in proximity to discrete pits as well as exotic artifacts, including a large steatite fishhook and a pendant representing a sunfish (*Mola mola*) (Bartelle et al., 2010; Knierim et al., 2013).

However, unlike the Lemon Tank site, ritual activities discovered at East Locus appear at opposite ends of a series of three hearths, providing a glimpse into everyday activities occurring adjacent to ceremonial spaces. On the northeastern end of the site, the basket dumping zone located in pit feature 8T/8R and the double dog burial are nearly contemporaneous; the former has been dated between 460 and 300 cal BP and the later has been dated between 470 and 310 cal BP (see Table 1). The units in which the pit features and double dog burial were interred also had in the *technological* (e.g., a projectile point with asphaltum on the dorsal surface), *processing and application* (e.g., interior-stained mollusk dishes), *cached* (chunks of asphaltum), and *waste* (incidental and detritus) categories; the presence of these artifacts in different stages of production demonstrates that a variety of everyday processing activities were occurring adjacent to ceremonial features. On the southwestern portion of the site near the asphaltum production "hotspot," a fragmented piece of asphaltum was found adhered to the second metacarpal of the southernmost dog in the Triple Dog Burial feature (Fig. 9). As this asphaltum lump served no clear function, its incidental occurrence suggests that asphaltum processing was occurring at the same times the dogs were ritualistically interred. All in all, these data illustrate that ritual features and daily site functions were mixed, and there was little separation between the secular and spiritual realms.

6. Conclusion

Archaeologists have long been skeptical about the limitations and difficulties faced in interpreting the material residues left behind by peoples of the past. As illustrated by Hawkes (1954) conceptual "ladder of inference," the notion that technical processes—the bottom rung of the ladder—is the most accessible for archaeologists, while social, political, and religious institutions—the top rungs of the ladder—are more difficult suggests a hierarchy of approachability within archaeology. However, the analysis and interpretation of data presented in this paper illustrate that the *chaîne opératoire* is an exceptional tool that can bridge the study of material culture to broader cultural phenomenon. Issues regarding economic organization, gender roles, and belief systems can be critically investigated using sequential models that paint a vibrant picture of daily life from a bottom-up perspective.

The rich dataset utilized in this study has helped flesh out what domestic economies looked like on the California Channel Islands and has provided a much more robust perspective on the realities of everyday island life. Villagers at CA-SNI-25 processed asphaltum using materials found in their local environment for a variety of necessary and routine purposes, and these technological acts were framed by their perception of spatial arrangements for where to conduct specific activities. The spatial blurring of male/female gender roles and ceremonial/secular realms suggests that daily life was bound up in a web of interconnections. Everyday asphaltum tasks were tightly integrated with social, economic, and ceremonial spheres, and these dynamic production systems were fundamental to the fabric of social life on an island home.

This multi-methodological approach can be applied comparatively to archaeological sites across Southern California. Asphaltum can aid researchers in tracing trade networks, locating specialized areas of production, comparing varying techniques of processing, and identifying specific site functions. Regional patterns of asphaltum use can aid in interpreting social boundaries, elite and domestic economies, as well as differences in gendered or ritual use of space. These methods can also be applied in other areas around the world where asphaltum deposits naturally occur. Archaeologists now have a typology that provides a standardized process when comparing asphaltum assemblages between sites and cross-culturally. In the future, the methods employed here *can be* used in major debates regarding ancient economic systems and further expand our understanding of everyday life deep in antiquity.

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