Coastal Brown Ware Ceramics from Camp Pendleton, San Diego County

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Abstract

This article addresses the chronology, technology, and regional distribution of brown ware ceramics in northern San Diego County, focusing specifically on 429 sherds from CA-SDI-10726 and CA-SDI-15254 at Camp Pendleton. Brown ware ceramics are characteristically lacking in readily interpretable variability and are usually resistant to classification beyond the gross level of ware. Optical petrography and neutron activation analysis (NAA), when added to the arsenal of study techniques, can help overcome the inherent limitations of standard brown ware classifications. This study of brown ware ceramics reviews previous research and adds to the efforts of many archaeologists in expanding and strengthening regional ceramic analysis.

Introduction

Prehistoric brown ware ceramics from the San Diego coastal plain have been excavated from Late Prehistoric period sites and subjected to various forms of analysis for over a century. These ceramics have contributed to our understanding of Native American culture history, technology, and economy, but unfortunately at a frustratingly slow and equivocal pace. Lacking much easily observable variability, the application of the traditional Southwestern type/variety approach to coastal brown ware ceramic typology has limited utility. More productive are newer technological approaches, including direct dating of ceramic sherds, petrographic analysis, and chemical fingerprinting of ceramics and clays. These methods were applied to ceramic samples from two sites at the mouth of Las Flores Creek overlooking the Pacific Ocean on Camp Pendleton Marine Base in northern San Diego County (Figure 1).

This area was within the traditional territory of the Luiseño. CA-SDI-10726 covers 2,007 m^2 and includes spatially discrete Late Prehistoric and post-contact components, extending to depths of 50–100 cm, with a wide range of artifacts and ecofacts. Radiocarbon dates for the earlier component range between cal AD 1015–1285 (1 sigma) and those of the later component, containing a higher frequency of milling tools and ceramics, range between cal AD 1450–1959 (1 sigma).

CA-SDI-15254 covers 15,629 m^2 and contains 5,299 m^3 of subsurface deposits extending to depths of 100 cm. The site was initially occupied in the Early Archaic period and then abandoned and reoccupied in the Late Prehistoric period. The upper component radiocarbon dates indicate an occupation between cal AD 875–1670 (1 sigma). Food and tool remains at both sites indicate Late Prehistoric subsistence practices that typify local intensification and increased diet breadth, focusing on small-package food sources such as *Donax,* rabbit, fish, legumes, and grass seeds. Multidisciplinary studies at both sites suggest that they represent marine littoral residential camps (Byrd 2003).

Ceramics and Chronology

Brown ware pottery technology was adopted by the Luiseño later and with much less intensity than the Kumeyaay, or Tipai-Ipai, to the south (Figure 1) from whom Rogers (1936:21) presumed they learned the tradition. Ceramic buff ware is estimated to have appeared as early as AD 700 on the Colorado River (Waters 1982). Efforts to assign similar early dates to the brown ware of the Peninsular Range and coastal areas have met with considerable uncertainty (Laylander 2012). Moriarty (1966:27) recovered ceramics from lower levels of the Spindrift site (CA-SDI-39) that had a radiocarbon date of 1270 ± 250 BP (cal AD 680), but this date was based on shell without calibration for the reservoir effect. There was also considerable evidence of bioturbation, which diminishes the reliability of the date (Warren 1964:142–144). One sherd was recovered from the lowest levels of the Santee Greens site, CA-SDI-5669, from which a radiocarbon date of 1220 ± 110 BP (cal AD 730) was obtained (Berryman 1981:405). This date is also extremely suspect because of bioturbation.

More credible dates for the introduction of brown ware ceramics come from the Cottonwood Creek site in the Laguna Mountains (May 1976, 1978). An early

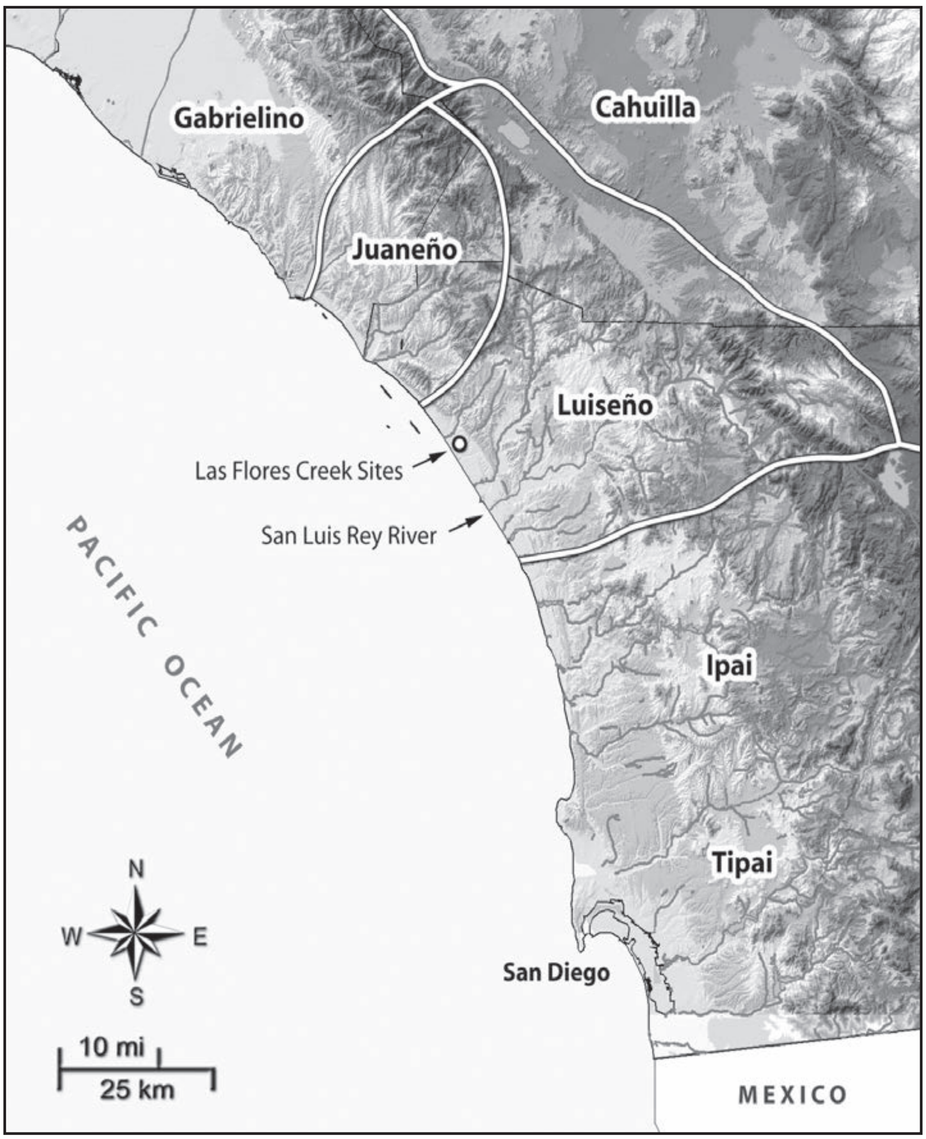


Figure 1. Map of southern California showing approximate tribal boundaries and locations of the two study sites on Las Flores Creek.

date there may suggest a gradual westward diffusion of ceramic technology. The earliest ceramics came from a level 75 to 80 cm below the surface based on a charcoal-derived radiocarbon date of 960 ± 80 BP (cal AD 990). This level is stratigraphically above a deposit with a human burial and a Late Archaic component. The date, however, may actually be more appropriately applied to a hypothesized preceramic Late Prehistoric phase, and the ceramics may actually be from several centuries later (Laylander 2012).

Confirmation that ceramics did not yet occur on the lower San Diego River in the Santee area by AD 1000 has been provided by excavations at CA-SDI-10148 (Kyle and Gallegos 1993). This site was deeply buried in alluvial deposits and had much less bioturbation and more consistent radiocarbon dates than other sites in the region. Ceramics were absent from deposits dated as late as AD 1150. Therefore, an introductory date of AD 1200–1300 appears to be warranted for south coastal San Diego County. A similar date of AD 1200–1300 for the introduction of ceramics in northern San Diego County is supported by the excavations at Molpa (CA-SDI-308). However, ceramics were not common there until about AD 1500–1600 (True et al. 1974). The assumed late prehistoric predecessors of the Luiseño, farther to the north, appear to have adopted pottery technology later in time. McCown's (1955:18) relative dating of ceramics as early as AD 1250 at Temeku was probably incorrect. The dating was based on specious assumptions concerning the accumulation of archaeological deposits.

Meighan (1954) established a sequence for the introduction of ceramics in his development of a regional culture sequence for northern San Diego County and Orange County. He defined an aceramic Late Prehistoric assemblage in the area as the San Luis Rey I Complex and provisionally dated it to AD 1400–1750. True (1966) subsequently argued for the introduction of this complex as representing the so-called "Shoshonean wedge," or intrusion of Takic peoples from the east, who were the ancestors of the ethnohistoric-period Luiseño. Meighan defined the short-lived San Luis Rey II Complex (AD 1750–1850) as virtually identical to San Luis Rey I, except for the introduction of ceramics and European items.

The introduction of ceramics would therefore have been virtually contemporary with, but historically independent of, the Spanish colonization of Alta California in 1769. True and Waugh (1983) confirmed Meighan's cultural phases with a suite of radiocarbon dates from Frey Creek; although they did find evidence for some ceramic usage as early as AD 1600, it did not become common until after the 1700s. They agreed with Meighan (1954), however, that ceramics did not become common in this area until the ethnohistoric period.

Griset (1996:70–88) prepared a comprehensive and critical review of radiocarbon dates associated with brown ware to conclude that contextual associations between ceramic manufacture and charcoal dates from related deposits were tenuous at best. These radiocarbon dates should only be used to indicate the time before which the ceramics cannot date and not as absolute dates. In an effort to resolve the dating issue, Griset obtained accelerator mass spectrometry (AMS) dates from the carbon soot on 19 brown ware sherds and two Lower Colorado Buff Ware sherds from nine prehistoric sites in San Diego County. Sites were selected to provide a wide geographical spread and deep stratigraphic contexts where early dates might be obtained.

Most of the sites in northern San Diego County and southern Riverside County produced calibrated dates ranging from cal AD 1515–1665 to cal AD 1640–1865 (1 sigma). An unusually early date of AD 625–850 came from Tomkav (CA-SDI-682) on the upper San Luis Rey River. No other radiocarbon dates were obtained during excavation in the 1950s and 1960s, and Griset cautioned against relying on the date. Early ceramic dates are more confidently derived from the Silver Crest site (CA-SDI-217) located on Palomar Mountain at the Luiseño summer/fall campsite of Pa-ku-ka. Two sherds dated between AD 800 and 1000, and two clustered between AD 1275 and 1380. In addition, aceramic levels of the site were dated between AD 690 and 1120. Intermediate dates were obtained from two sherds in prehistoric levels of Molpa, a protohistoric Luiseño lowland winter village at the southwest slope of Palomar Mountain. These dates ranged between AD 1310 and 1630.

Griset (1996) also compared AMS dates from soot with thermoluminescence (TL) dates from the same sherds and radiocarbon dates from charcoal or shell in ceramic-bearing deposits from the same sites. She found substantial disagreement between the dates. TL dates tended to be much younger, while charcoal and shell dates tended to cover much longer time ranges that included much younger dates. Her study provides unexpected indications that ceramics were used in northern San Diego County as early as, or perhaps earlier than, southern San Diego County. For sites with directly dated ceramics from Griset's study, this would appear to be the case at least in the upper San Luis Rey River and Palomar Mountain areas. Her results also indicate, however, that ceramic usage did not become widespread throughout the area until after AD 1400 and that ceramic usage remained proportionally lower in northern San Diego County when compared to the southern portion of the county.

Griset's investigations were based on recognition of the problems with dating ceramics by associated radiocarbon dates from the same levels. This is the case at SDI-10726, Locus B, Unit 5 (60–70 cm), now designated SDI-15254, that yielded ceramics with associated charcoal dates between cal AD 800 and 999 (Byrd 1996). This example probably should not have been used as an indication of early ceramic use at Camp Pendleton by Griset in her effort to demonstrate early ceramic usage in northern San Diego County. In fact, there was also a shell date of 5435–5100 BC from the same level, clearly disassociated from the sherds. The test-phase ceramic analysis specifically attributed the few sherds found in lower levels of the site as resulting from post-depositional downward movement of ceramics into the Archaic horizon as a result of bioturbation (Schaefer 1996:204). New evidence presented here directly dates sherds from SDI-10726 and conforms to the larger array of post-fifteenth century estimates now available from northern San Diego County.

Reasons proposed for the adoption of ceramics on the San Diego coast, and particulary for adoption by the Luiseño in any substantial way at a relatively late date, are the same given for hunter-gatherers in other parts of California, the Great Basin, and elsewhere. The generally repeated argument is that ceramics provide more efficient means of maximizing the nutritional yield from nuts, starchy seeds, seafood, and terrestrial animals through boiling and slow cooking (Arnold 1985:127ff). Other advantages might revolve on location of raw materials, fuel, mobility patterns, and seasonal scheduling.

What inhibited the Luiseño from adopting ceramics as intensively as the Ipai/Tipai to the south and the Cahuilla to the east? What caused more northern groups to reject ceramics in favor of basketry and stone cooking vessels? These remain questions of considerable interest. In addition to entirely materialist factors, historical and cultural factors, including cultural interaction and trade, need to be considered (Wade 2004).

Ethnohistory of Luiseño Pottery

It is not known if the changes brought about by the missions accelerated the Luiseño adoption of ceramic technology. In any case, ceramic manufacture and use was not widely described by early observers of the Luiseño, although the Luiseño themselves attest to a long-standing tradition (Sparkman 1908:201). That ceramics were used at contact can be inferred from the accounts of the Portolá expedition in 1769, when ceramics were observed to the south in Kumeyaay territory and to the north in Gabrielino territory. Father Crespí noted two well-made vessels at a pool 1.6 km (1 mi) north of Soledad Valley (Bolton 1926:112). Continuing on, he saw more ceramic pots and jugs at a village located .4 km (.25 mi) north of San Elijo Lagoon. Further north at Batiquitos Lagoon, he saw someone smoking a pipe of baked clay (Bolton 1926:114). Although the Portolá expedition passed through a village on the Santa Margarita River, no mention of ceramics was made, possibly because the novelty had worn off by then or other observations were considered more important. Upon reaching the Los Angeles area, Crespí again observed some old men smoking tobacco in clay pipes (Bolton 1926:134). On the same expedition further north, Costansó remarked on the absence of ceramics among the people of the Channel Islands and adjacent mainland (Brandes 1970:91).

Pablo Tac (1958:21), one of the few nineteenth-century Native Americans to write about his own culture, mentioned the use of ceramic “cups,” “pitchers” (ollas), and “frying pans” around 1835. These, however, may represent the expanded ceramic repertoire available to neophytes at Mission San Luis Rey (Griset 1990:187). Contemporary accounts by the Franciscan friars made no reference to ceramics.

Twentieth-century ethnographic accounts of Luiseño pottery production are varied and inconsistent, as expected for observations at the end of a declining tradition that was being influenced by Euro-American culture (Griset 1990). Traditional methods were identical to those of other southern California groups (Rogers 1936). Vessels were built up in coils that were fused together by slapping with a wooden paddle against a cobble or ceramic anvil. Clay was derived from residual sources, and only Tizon Brown Ware was locally produced. Residual clays are generally considered to be “self-tempering” because of their large quantities of angular quartz, feldspar, hornblende, and other minerals of granitic origin, as well as low to high mica content. Sparkman (1908:202) and Kroeber (1922:276) described temper additives, specifically crushed rock by Kroeber, but some researchers consider this unlikely (Rogers 1936:22). Results of the current study help to resolve this issue. After the pots were allowed to dry, they were fired in pits (Sparkman 1908:202) or open fires (Drucker 1937:22) at relatively low temperatures and for short durations.

Sparkman (1908:201) conducted his research while ceramics were still being made. His Luiseño consultants identified six vessel shapes: a water or seed storage vessel (*narungrush*); a wide-mouthed cooking pot (*wiwlish*); a small-mouthed water carrier or olla (*nadungdamal*); a canteen with two small mouths (*papakamal*); a shallow dish for serving food (*tevatvamal*); and an unnamed serving bowl. In addition, a short, tapering, tubular clay pipe (*hukapish*) was used to smoke tobacco. Kroeber (1922:276) added short-handled spoons to the list of shapes. Special bowls were also used for ceremonial occasions (Strong 1929:298, 301, 311).

Luiseño ceramic production had ceased by the time Rogers (1936:21) conducted his research in 1928. His reconstruction of the ceramic technology was therefore limited to several knowledgeable elders and to observations of pots and sherds from archaeological sites. He saw the tradition as very late in origin and decreasing in acceptance from south to north through Luiseño territory. Rogers recorded fewer basic shapes, less variability, and fewer decorative treatments than Kumeyaay pottery, with cooking pots, food bowls, and storage ollas occurring in decreasing frequencies within the assemblage.

Rogers (1936:21) and True (1966) postulated that the cylindrical pipe form characteristically used by Takic peoples, including the Luiseño, was distinguishable from the curved pipe used by Hokan peoples such as the Kumeyaay to the south. Archaeological studies have demonstrated that the types co-occur at sites in both Takic and Hokan territories (Schaefer 1992; True 1966). More rigorous research will be required to substantiate other perceived differences between Luiseño and Kumeyaay ceramics.

Ceramic Typology

Brown ware types characteristically found in San Luis Rey II sites are traditionally viewed as being manufactured from residual clays, that is, clays from argillic horizons of decomposing granitic rocks containing large amounts of quartz, feldspar, and other minerals (Rice 1987:36). Residual clays also derive from limestone, shales, and volcanics, but granitics are the source for most southern California brown wares. These primary clays are located at the parent rock. In the literature they tend automatically to be associated with ceramic production at upland or highland locations (Lyneis 1988).

Brown ware is characterized as highly micaceous, having high mineral content, with numerous angular quartz, feldspar, hornblende, and other mineral grains. This material is usually natural to the clay, resulting from the local decomposition of the rock. Residual clays are thus described as "self-tempering." Authors differ in their interpretations of brown ware content as natural inclusions or intentional tempering material (Cook 1986:90–91). Whatever the source, the high mineral content results in a characteristic brown to brick-red color after firing.

In reality, brown ware derives from clays that are found in a continuum of depositional contexts ranging from the in situ decomposing mineral source to secondarily redeposited clay beds. This is seen in the observed gradient of mineral sizes and degrees of angularity that characterize most brown ware collections. Results of the current study also support the possibility of Tizon Brown Ware production from sedimentary clays. Brown ware in the Southwest is typically referred to as Tizon Brown Ware, a term coined by Lyndon L. Hargrave (1938) in Arizona. Harold Colton (1939) subsequently described specific regional types in northwestern Arizona. These were revised by Dobyns and Euler (1958). Malcolm Rogers also attempted a typology for brown ware with special reference to California. Rogers' data were published by Ron May (1978), who added his own types from Mission Santo Tomás in Baja California, Mission San Buenaventura in Alta California, and several prehistoric sites in the Peninsular Range. He also included Meighan's (1954) definition of Palomar Brown. May divided Tizon Brown Ware into six series, within which there are 22 types. Four of the series are prehistoric but defy assignment of more specific temporal control. Several types certainly extend into the ethnohistoric period. The "Mission Series" of six types is associated with historic period sites and, in particular, the changes associated with neophyte mission residence.

Inspection of Rogers' type collection shows that Tizon Brown Ware variability is great both within and between types. A similar range of variability was found in the currently recovered collection. It is also extremely difficult to assign types to specific geographic areas or time periods. Indeed, Wilken (1986) observed that Paipai potters at Santa Catarina in northern Baja California mined their clays from different sources and produced very different brown ware even though the vessels came from the same village. Some potters added ground sherds, while others did not. Margaret Lyneis (1988) has struggled with the problem of distinguishing types within a geographically expansive Tizon Brown Ware concept. She concluded that it will be extremely difficult to isolate temporally or spatially discrete types because of the enormous distribution of granitic sources that produced residual clays throughout the Great Basin, Colorado Desert, and Peninsular Range. Conventional macroscopic methods of sherd typology, therefore, may not always be appropriate for making meaningful discriminations in Tizon Brown Ware, and other methods such as acid extraction (Burton and Simon 1993) might prove useful in distinguishing Tizon Brown Ware "types."

Recent Advances in the Analysis of Brown Wares

Efforts are currently underway to resolve the fundamental issues of southern California ceramic typology by the examination of both ceramics and clay sources throughout San Diego and Imperial counties (Hildebrand et al. 2002). In the initial study, 25 clay samples and 100 sherds were examined from locations in the coastal plain, Peninsular Range, and Colorado Desert. This study focused on the coastal and mountain habitats and addressed the most pressing concern of finding analytically meaningful discriminations within the brown wares. Sherds and fired test tiles from clay sources underwent standard field-specimen type classification, petrographic analysis of thin sections, and neutron activation analysis (NAA).

Several important conclusions were drawn from the first phase of investigations. Distinct chemical and petrographic differences were found between Tizon Brown Ware pottery, derived from the Peninsular Range (including the coast), and Salton Brown pottery, derived from the western desert. Prior to these investigations, Salton Brown ceramics had been treated as a type within the Gulf Series on the eastern base of the Peninsular Range (May 1978:26). Both Tizon Brown and Salton Brown ceramics are superficially similar to the naked eye, which has resulted in an erroneous lumping together of the two types. Both have a dark brown or red color, are micaceous and coarse-textured, and contain large amounts of angular to sub-rounded mineral grains. Applying neutron activation analysis, Salton Brown pottery matches the chemical fingerprint and petrographic characteristics of clays from the Brawley Formation on the western side of the Salton Trough. It is clearly distinguishable from Tizon Brown Ware pottery when 32 elements are analyzed using principal components analysis to reveal source-related subgroupings (Hildebrand et al. 2002).

This correlation of ceramics and clays qualifies Salton Brown as a true ware on the same typological level as Tizon Brown Ware. Two Salton Brown Ware subgroups also appear to be present but are only distinguishable at this time through NAA. As the initial sample of sherds and clays from the Salton Trough was limited, additional meaningful discriminations are expected when the sample size is increased. At present, Tizon Brown Ware sherds are found to possess a high degree of compositional variability, and their chemical profiles do not generally match with any of the 17 sampled clay deposits throughout the Peninsular Range. One suggestion is that intentional tempering of clays or other cultural modifications substantially altered the relative frequency of constituent elements in the ceramics.

The results of the NAA provide independent substantiation or refutation of the ceramic typology based on morphology. Yet they have limited use if the chemical fingerprints cannot be correlated with observations at the hand-specimen level. After all, no project can afford the time or funding to subject every sherd to NAA. Thin-section comparisons of NAA identified Tizon Brown and Salton Brown sherds show several significant differences that can be applied, although with difficulty, to the hand-specimen level. Salton Brown Ware pottery has much more quartz and mica than Tizon Brown pottery. Tizon Brown ceramics contain considerably more plagioclase feldspar and amphibole (hornblende) than Salton Brown ceramics. On a hand-specimen level, the most diagnostic attribute is the presence or absence of amphibole, characterized by black mineral grains under a hand lens or as opalescent, purple to yellow grains under a polarizing microscope.

A recent examination of ceramics from Buckman Springs by Gallucci (2001) also found that amphibole was often undetectable with a standard 10x hand lens and that 40x magnification under a microscope more consistently distinguished Tizon Brown from Salton Brown sherds based on the presence or absence of amphibole. A certain error rate still remains, but these new high-magnification typing methods have detected a much higher rate of Salton Brown Ware pottery coming from the desert into mountain assemblages. As techniques are refined for the discrimination of Salton Brown from Tizon Brown wares, the ability to characterize desert-coastal interaction spheres and mobility patterns will be greatly enhanced.

Analytic Methods

Analytic methods used in this study began with classification at the hand-specimen level, specifically the macroscopic examination of freshly broken edges under 20x magnification. The paste of each sherd was examined for variety and amount of mineral inclusions, degree of angularity (an indication of secondary sedimentary deposition of the clay source), amount of mica, and evidence of vugs or cavities indicative of fiber temper. Surface treatments and rim sherd characteristics were also examined. Because of the small sample, even the smallest fragments were examined and counted.

Eight sherds (three from SDI-10726 and five from SDI-15254) and one clay sample were selected for petrographic thin section analysis and NAA. The statistical limitations of such a small sample are obvious, but every small sample nevertheless helps expand and refine the southern California regional ceramic typology and chronology. Petrographic thin sections allow for much more accurate identification and quantification of mineral constituents and other inclusions than mere examination at the hand-specimen level. To prepare each specimen, a portion of the sherd was cast in epoxy resin, polished, cemented to a glass slide, cut, polished to a thickness of 30 µm, and sealed with a glass cover. The samples were then examined by the author with an Olympus polarizing microscope at a setting of 40x. Mineral inclusions were quantified by a point-count method until 100 grains were counted. Dr. John Hildebrand of Scripps Institute of Oceanography supervised the processing of the sherd samples, consulted on the petrographic analysis, and provided lab facilities.

NAA was conducted at the University of Missouri Research Reactor (MURR) under the supervision of Dr. Hector Neff. The sherds were prepared according to standard MURR procedures (Glascock 1992). Elemental concentrations were derived from two irradiations and three gamma spectra counts to assay a total of 33 elements. Based on results from previous studies, nickel was dropped from the data analysis, as it always fell below the level of detection. Concentration data from the 32 remaining elements were subjected to principal components analysis to distinguish source-related subgroupings of sherds and clays. This method provides a series of linear combinations of the concentration data, which can be arranged in decreasing order of variance subsumed. Hypothetical sherd groupings can then be evaluated by application of Mahalanobis distance multivariate statistics (Bishop and Neff 1989) which are then converted into probabilities of group membership for individual specimens. Each specimen is removed from its presumed group before calculating its own probability of membership (Baxter 1994; Leese and Main 1994).

The thin sections and epoxy-encased sherds from this analysis are now part of a large study collection of over 370 similarly analyzed sherds and clay samples from San Diego and Imperial counties. This collection of thin sections, now at Scripps Institute of Oceanography, is expected to have a permanent home at the San Diego Archaeological Center. NAA samples are treated as radioactive contaminated waste and are no longer available for study.

CA-SDI-10726 Ceramics

Forty-six sherds were examined from SDI-10726, and 383 sherds were examined from SDI-15254. Each collection is discussed separately. Ceramics represent the third most frequent artifact class at

SDI-10726. The 46 sherds, 3.9 percent of the total assemblage, were recovered during the testing and extended evaluation phases combined. Forty-two sherds were found in six units during the extended evaluation phase, and four sherds from Unit 1 were recovered during the testing. The majority of the ceramic assemblage was recovered from Unit 12 (41.3 percent), Unit 18 (21.7 percent), and Unit 19 (19.6 percent), and less than 5 percent was recovered from each of four units—Units 1, 13, 17, and 20. Sherds were found to a depth of 80 cm, but the vast majority (84.8 percent) were recovered from the upper 40 cm. Only two rim sherds were recovered. Both exhibit recurved rims with flat lips. Both appear to be from cooking pots, and the soot from a sherd from Unit 18, level 30–40 cm, was submitted for radiocarbon analysis. This sherd (Cat. No. 374) also underwent petrographic analysis and NAA.

The ceramics have a very high macroscopic mineral content, accounting for more than 60 percent of the fabric. Angular, unsorted quartz grains account for more than 80 percent of macroscopic mineral constituents. Feldspar and muscovite mica make up the remainder. Amphibole occurs at trace levels and appears to be finely crushed or dispersed within the clay fabric. Quartz grains are uniformly angular. Amphibole is always difficult to discern but can be seen protruding through the surface of the sherds when grains are not visible in a freshly broken section. Sue Wade (personal communication 1999) suggested that some of the grains appearing to be amphibole may actually be tourmaline, based on her examination of a sherd collection at Topomai (CA-SDI-10156). Sherd color ranges from dark gray (5YR 3/1) to brown (7.5YR 4/4). In contrast, there is a higher frequency of brown sherds in the SDI-15254 assemblage. The light brown sherds tend to have the same frequency of different mineral grains except that the grains are smaller, better sorted, and rounded to subangular. Otherwise the sherds from the two sites are indistinguishable.

CA-SDI-15254 Ceramics

Ceramics constitute 5.1 percent of the total SDI-15254 artifact assemblage. Of the 383 sherds from SDI-15254, roughly half were collected during the extended evaluation phase. Two sherds were recovered from Trench 15, while the rest came from excavated units. Ceramics were found in all units at SDI-15254, but units 24, 23, and 21 produced substantially higher ceramic counts than the other five units. Ceramics are almost exclusively confined to the upper 40 cm of deposits at SDI-15254; only 10 sherds were found below 40 cm. Dismissing the possibility that all or most of the sherds recovered are from but a single vessel, this strong vertical and spatial patterning of ceramics in SDI-15254 may have temporal and behavioral implications.

All but two sherds were typed as Tizon Brown Ware. This is typical of coastal San Diego County sites, where 99–100 percent of ceramic assemblages are Tizon Brown Ware (Schaefer 1994). This uniformity is indicative of the geographical proximity of residual clay sources in the granitic rocks of the Peninsular Range and the long distances to the Colorado Desert, the source of Colorado Buff Ware that was made from sedimentary clays. None of the sherds exhibit evidence of fiber temper or heavy carbon streak indicative of the brown wares produced at the missions.

The sherds from SDI-15254 exhibit considerable variability of mineral inclusions. There is a noticeable mix of angular, subangular, and rounded mineral grains suggestive of clay sources that derive not only from the residual source but from redeposited clays downstream from the source rock. Both upland and lower-elevation clays may have been used. Some sherds contain larger quantities of rounded grains, suggesting the addition of wash sands through either deliberate tempering or unintentional inclusion.

All the sherds are extremely small, with few other notable traits. This poor preservation is typical of pottery from deposits that have been disturbed by mechanical or biological processes. Sherds are also in relatively low frequencies, indicating low ceramic vessel usage. Sherd thicknesses vary from .4 cm to 1.0 cm. More diagnostic attributes were only found in ceramics from SDI-15254. Three rim sherds were recovered. A rim with a rounded lip and large diameter (Unit 2, 0–10 cm) may be part of a bowl or cooking pot, but it is too small to be more specific as to vessel form. Another example with a rounded lip is also too small for vessel identification (Unit 6, Feature A). A larger specimen could be conclusively identified as a cooking pot rim with a square lip and slightly recurved rim (Unit 6, Feature A). Black residue on the interior appears to be soot. This sherd contains abundant, fine (<0.2 mm) angular and subangular, rose and milky quartz grains with some feldspar and abundant muscovite mica. Exterior soot was also observed on five other sherds.

Radiocarbon Dating of Tizon Brown Ware Sherds

With the AMS radiocarbon method, small amounts of soot on ceramics can be analyzed, providing a more direct date of activities associated with the ceramics rather than the more tenuous association of ceramics with a charcoal sample in the same stratigraphic level (Griset 1996). Soot accumulates on the pottery when used in cooking. If the soot occurs as a thick deposit on the exterior base, it is also more likely to be from direct contact with fuels during cooking. Soot on the interior base can accumulate from burnt residue during cooking. Sooted broken edges indicate sherds were merely burned after the vessel ceased to be used. In some cases it may be difficult to distinguish pre- and postdepositional sooting. Given the standard variance of radiocarbon dates, and unless the period of ceramic use was extremely long at the site, the soot still represents valid directly dated cultural activities associated with either ceramic use or discard. With the two sherds from SDI-10726 that were selected, the soot was restricted to exterior surfaces and did not extend to broken edges, suggesting it accumulated during the use-life of the vessels.

The radiocarbon dates conform to expectations of ceramic use at the end of the Late Prehistoric period and the beginning of protohistoric times. Sample No. 200 from Unit 12, 20–30 cm, yielded a radiocarbon age of 180 ± 50, calibrated to AD 1645–1950 (2 sigma). Sample No. 374, a cooking pot rim sherd from the 30–40 cm level of Unit 18, yielded a radiocarbon age of 410 ± 50, calibrated to AD 1445–1655 (2 sigma). These dates conform to the cluster of dates obtained by Griset (1996:248) for sites in Luiseño territory and suggest an intensification of ceramic use at the end of the Late Prehistoric period.

Local Clays and Ceramic Manufacture

The hypothesis that potters used local clays to manufacture ceramics was tested using replicative studies, petrographic analysis, and NAA. Replicative studies conducted on local clays from the banks of Las Flores Creek indicate the potential for crafting local ceramics. Clay from the creek bank in the vicinity of CA-SDI-811, directly below SDI-10726, was collected for examination of its physical properties (Schaefer 1996, 2006). Sediment cores from SDI-811 indicate that Late Holocene silty and slightly micaceous clays were readily accessible from the surface to depths of 203 cm. Early-to-Middle Holocene pure clay deposits do not occur until depths of 665 cm but could be exposed along the stream-cut banks of Las Flores Creek (Pope 2003).

For this study clay from the banks of Las Flores Creek was ground, sifted, and cured in a manner replicating southern California Indian technology (Rogers 1936). Test tiles were then made and fired in a kiln at a maximum temperature of 700º C. This is within the range of maximum temperatures recorded for aboriginal pit-fired ceramics (Shepard 1956:83–88). Firing time was 45 minutes. The resulting tiles fired to a brown ware comparable in color, texture, and fracture to archaeological specimens. The only difference was a lower quantity of mineral inclusions. Those present were sub-rounded grains identical to many of the specimens from SDI-10726. Grain quantities were low, however, suggesting that if this clay was a local source, some temper may have been added as reported ethnographically (Rogers 1936).

During the extended evaluation phase, a clay sample was obtained from the uppermost (0–50 cm) level of a core drilled in Las Flores Creek as part of the paleoenvironmental investigations (Pope 2003). This clay was very similar in composition and was from the same geological formation as the previously investigated clay in the banks of Las Flores Creek. Both represent the nearest type of alluvial clay most readily accessible to the inhabitants of SDI-10726. We do not wish to imply that the clay was definitely a source for prehistoric potters of the area, but it was examined to see if it could be a likely match with some of the local ceramics. A 5 cm x 5 cm test square was patted out, with little need to remove larger mineral fragments or organics as the clay was naturally well levigated. The clay was found to be well suited for ceramics, with a high degree of plasticity. The square was dried and then fired to 600º C for three hours. The result was a hard and quite functional ceramic resembling Tizon Brown Ware in color and texture.

Examination of a thin section revealed in greater detail the differences between the untreated clay and actual ceramic samples that had been previously observed. Average grain size was much smaller than sherd samples and, except for a few larger quartz grains, was generally much more evenly sorted (Figure 2a). The proportion of quartz and plagioclase was similar to only one of the Tizon Brown Ware sherds, No. 304, both having significantly lower amounts of quartz and higher amounts of plagioclase than most other specimens (see Figure 2 b–d, Figure 3).

The clay sample also contained the highest frequency of biotite of any sample but with typical traces of amphibole. Based on petrographic analysis, the clay sample appears to have some of the same mineral constituents as the fired ceramics although in different frequencies and with a much smaller grain size. In general, more similarities are found between the clay sample (see Figure 2a) and sherds from SDI-15254 (see Figure 3b, d, and e). This supports the idea that the local clay may have been used for ceramic manufacture but that crushed rock or sand temper was added to condition the clay.

Brown Ware Petrographic Analysis

Eight sherds were selected for petrographic and NAA studies. Three sherds came from SDI-10726, which appears to represent a single occupation. Five sherds derive from SDI-15254, from which there was greater variability in sherd morphology at the hand-specimen level. The sample included examples that appeared representative of the variability of paste and mineral inclusions within Tizon Brown Ware plus any specimens that displayed atypical characteristics. Three sherds were found with no visible traces of amphibole and might be Salton Brown Ware candidates. One of the sooted sherds dated by radiocarbon analysis, Cat. No. 374, was also included in these studies.

Of the three sherds (Cat. Nos. 304, 364, and 1089) that appeared on the hand-specimen level to be assigned to the Salton Brown Ware category, only one appeared to meet the criteria when viewed in thin section (Figure 2b). A sample of 100 counted grains shows dominance of quartz (90 percent) with traces of plagioclase, biotite, muscovite, and composite rock (Table 1). Amphibole was largely absent, although some very small grains were noted. Muscovite appears to have been undercounted based on an overview of the thin section. NAA confirmation of the classification is pending.

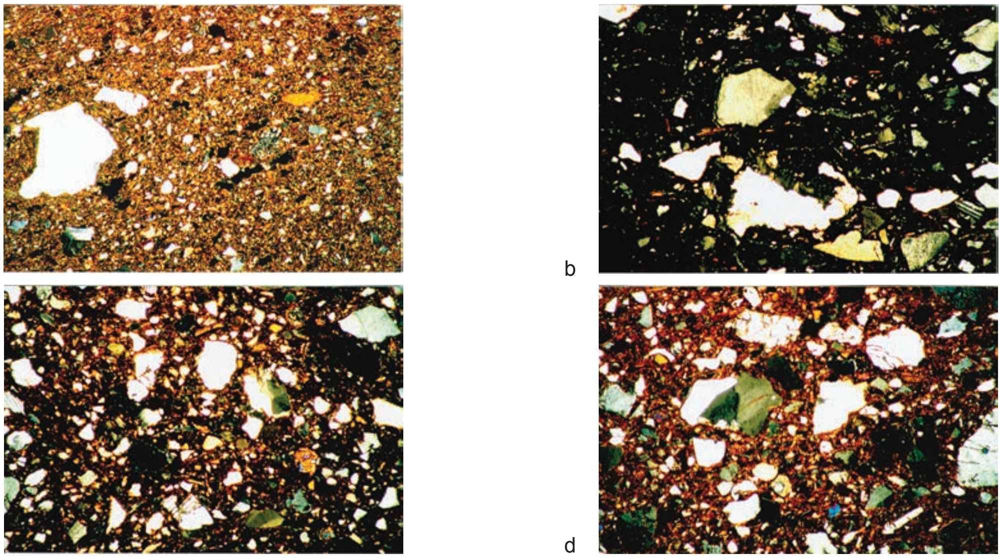
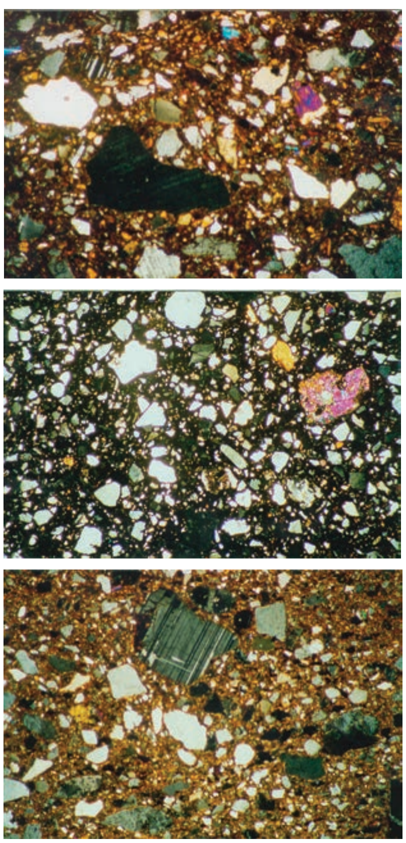


Figure 2. Photomicrographs with crossed polars of ceramic thin sections from Las Flores Creek clay and sherds from CA-SDI-10726. Left to right: (a) Las Flores Creek clay; (b) sherd No. 364; (c) sherd No. 374; (d) sherd No. 489. Under polarized light, quartz appears as white or dark gray grains. Plagioclase feldspar grains are striped. Amphibole grains are opalescent or yellow with 120 degree cleavage planes. Mica grains appear as long opalescent or yellow slivers.



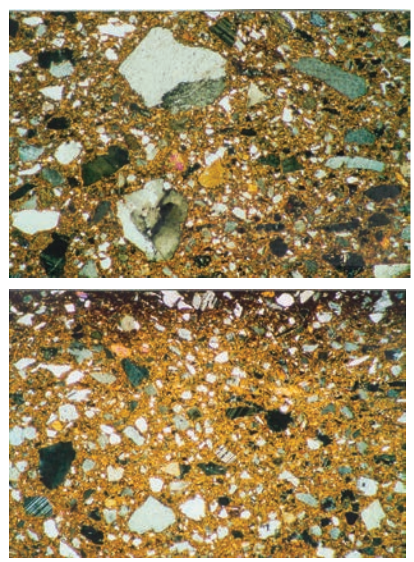


Figure 3. Photomicrographs with crossed polars of ceramic thin sections from CA-SDI-15254. (a) sherd No. 304; (b) sherd No. 781; (c) sherd No. 958; (d) sherd No. 974, (e) sherd No. 1089.

Table 1. Petrographic Analysis of Las Flores Creek Clay Sample and Sherds from CA-SDI-10726 and CA-SDI-15254.

Cat. No.	Lab No.	Type	Sorting	Quartz %	Plagioclase %	Biotite %	Muscovite %	Amphibole %	Rock %
Las Flores Creek Clay Sample									
–	SIC209	Clay	Well	60	12	18	1	5	4
CA-SDI-10726									
364	SIC211	Salton	Poor	90	4	2	2	0	1
374	SIC212	Tizon	Moderate-Good	78	11	4	6	1	–
489	SIC213	Tizon	Poor	85	6	3	1	4	1
CA-SDI-15254									
304	SIC210	Tizon	Poor	59	10	7	23	1	–
781	SIC214	Tizon	Poor	89	6	–	–	4	1
958	SIC215	Tizon	Poor-Moderate	72	4	–	2	15	7
974	SIC216	Tizon	Poor-Moderate	79	5	–	2	11	3
1089	SIC217	Tizon	Poor	81	6	–	–	10	3[a]

a. Two of the grains represent unidentified minerals.

Neutron Activation Analysis

The NAA results provided some surprises that defy easy interpretation. The one clay sample from Las Flores Creek and eight sherds from the two sites were integrated into the analysis of 59 clay samples and 311 sherds from the San Diego coast to the western Colorado Desert. The analysis produced five groupings based on principal chemical components. Two of these groupings are identified from SDI-10726 and SDI-15254. The clay sample could not be attributed to any sherd types. Three of the sherds are identifiable to the desert region, and two characterize ceramics from the Peninsular Range and coastal plain. The remaining sherds are unattributable (Table 2).

This chemical-based typology has a high degree of statistical validity, since all but one of the groups (Mountain Brown-1) are large enough in sample size to calculate non-singular variance-covariance matrices from which were calculated Mahalanobis distances and associated p-values for group membership. Those sherds that could be assigned to one of the five groups could be assigned with a greater than 1 percent probability of membership and with much less than a 1 percent probability of membership in any other group (Neff 2001). Alternatively, the possibility that multiple sherds derived from but a single vessel must be considered.

The first two principal components clearly separate the desert and mountain ceramics (Table 3 and Figure 4). The mountain wares are enriched with transition metal elements such as scandium, while desert wares are enriched with rare earth elements such as potassium, rubidium, and cesium. Desert buff wares are the most homogeneous group due to high antimony and arsenic levels and low sodium levels relative to mountain wares. The sherds conform closely to local clays deposited by the Colorado River in the Salton Basin from Plio-Pleistocene through Late Holocene times. No buff ware sherds occur in the two Camp Pendleton sites. Salton Brown is the other desert ware that exhibits a very distinctive chemical signature. It overlaps with Lower Colorado Buff Ware on virtually all bivariate projections of the chemical data but is lower

Table 2. Results of Neutron Activation Analysis.

Lab No.	Cat. No.	Material	CeramicType	Site No.	Provenience	Chem '01 Assign.
SIC209	na	Clay	–	–	Las Flores Creek-1	Unassigned Clay
SIC210	304	Pottery	Tizon	SDI-15254	Locus B, Unit 5, Level 10–20	Unassigned
SIC211	364	Pottery	Salton Brown	SDI-10726	Locus A, Unit 18, Level 0–10	Unassigned
SIC212	374	Pottery	Tizon	SDI-10726	Locus A, Unit 18, Level 30–40	Mountain Brown-2
SIC213	489	Pottery	Tizon	SDI-10726	Locus A, Unit 12, Level 10–20	Desert Brown-1
SIC214	781	Pottery	Tizon	SDI-15254	Locus B, Unit 24, Level 0–10	Desert Brown-1
SIC215	958	Pottery	Tizon	SDI-15254	Locus B, Unit 29, Level 0–10	Unassigned
SIC216	974	Pottery	Tizon	SDI-15254	Locus B, Unit 29, Level 20–30	Desert Brown-1
SIC217	407	Pottery	Tizon	SDI-15254	Unit 6, Feature A	Mountain Brown-2

Lab No.	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
SIC209	26.6905	0.3487	24.5355	5.2243	5.45	2.4985	53.7047	13.6891	69.4951	4.619	1.1475
SIC210	14.4447	0.2463	14.7376	4.0354	1.8496	1.9576	36.567	16.9347	42.2043	1.9792	1.0784
SIC211	10.2662	0.1632	10.2187	1.9963	4.5814	0.7196	44.3803	8.2678	18.441	5.2782	0.5224
SIC212	13.05	0.3424	17.1039	3.9471	1.3245	3.0615	29.0417	22.6423	52.0298	2.5117	1.0188
SIC213	26.0602	0.6382	28.9421	7.4792	4.9281	4.8251	64.8859	14.205	58.5463	6.2952	1.2411
SIC214	21.4139	0.3179	18.2073	4.4448	2.8357	2.5075	46.4944	6.8474	57.3657	2.9343	1.0248
SIC215	20.1565	0.318	20.361	3.9472	1.4797	2.1702	44.2121	6.7262	55.9737	2.7541	0.9345
SIC216	21.4971	0.3028	24.6926	4.3856	1.3242	2.318	48.8322	19.3805	51.1131	4.4674	0.998
SIC217	15.7664	0.3322	19.6577	4.4226	2.382	2.4398	34.4279	17.4951	63.9085	2.5913	1.1466

Lab No.	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th	Zn
SIC209	34645.4	5.181	0	97.72	0.9278	13.9954	351.01	0.8162	0.7517	9.4119	81.68
SIC210	53338.8	5.173	0	32.93	0.1279	21.9939	252.84	0.5902	0.7561	7.5789	81.63
SIC211	30252.6	4.004	0	88.83	0.1686	9.2425	170.58	1.9191	0.2016	11.1501	60.12
SIC212	56449.5	4.31	0	34.73	0.399	24.8861	247.99	0.3795	0.7083	5.1385	72.44
SIC213	47926.3	11.035	0	85.34	0.2272	19.7256	273.38	1.0458	1.1936	12.8282	77.2
SIC214	27646.5	7.022	0	70.07	0.5376	11.9507	230.62	0.7672	0.5852	8.1444	47.99
SIC215	25468.2	6.654	0	76.53	0.5547	11.2722	284.61	0.7389	0.5742	8.9022	44.36
SIC216	47502.8	4.127	0	86.29	0.3838	17.5885	234.94	0.667	0.5545	8.3597	81.7
SIC217	51489.2	8.973	0	36.21	0.1424	20.6359	154.82	0.7252	0.5981	5.8892	73.9

Lab No.	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
SIC209	159.32	79575.3	695.7	27231.4	4.251	22791.6	780.45	21522.2	5381.3	102.71
SIC210	101.82	92894.9	440.2	26061.2	3.034	10253.3	982.13	12990.5	5826.2	169.87

Table 2. Continued.

Lab No.	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
SIC211	99.37	92147.5	656.7	13033.3	0.95	20062.2	301.97	9196.1	3116.1	62.41
SIC212	115.25	101312.8	485.9	24775.4	4.642	7430.5	965.54	13758.9	5190.6	185.7
SIC213	241.12	86191.6	734.4	18961.3	6.954	18454.9	514.99	12602.6	5688.9	101.55
SIC214	211.84	78531.3	756	20132	3.312	18069.4	338.14	16103	3277.6	76.09
SIC215	158.66	79610.5	812.2	19440.3	2.849	17286	381.57	18045.9	3304.2	87.91
SIC216	87.94	90323.5	570.3	21024.2	3.775	16950.8	693.02	16076.8	4203.3	125.55
SIC217	199.73	101834.6	574.3	20720.8	3.893	10891.4	831.59	10300.6	6691.7	154.73

Table 3. Principal Components Analysis.

	PC01	PC02	PC03	PC04	PC05	PC06	PC07	PC07	PC08
Desert Brown-1									
SIC213	-0.14	0.14	-0.04	0.17	-0.09	0.02	0.02	-0.04	0.00
SIC214	-0.05	-0.14	-0.07	0.07	-0.11	-0.00	0.02	0.02	-0.06
SIC216	0.07	-0.02	0.00	-0.03	-0.00	-0.02	-0.00	-0.07	0.01
Mountain Brown-2									
SIC212	0.21	0.07	-0.01	0.01	-0.06	-0.00	-0.02	-0.04	-0.02
SIC217	0.12	0.04	-0.06	0.13	-0.01	0.05	0.07	-0.01	-0.02
Unassigned									
SIC209	-0.08	0.01	0.01	-0.02	-0.06	0.06	0.00	-0.03	-0.02
SIC210	0.19	-0.00	0.01	0.03	-0.00	0.02	0.03	-0.03	0.01
SIC211	0.11	-0.43	-0.18	-0.08	0.11	0.07	0.03	-0.05	0.07
SIC215	-0.00	-0.17	-0.05	0.05	-0.11	-0.03	0.03	-0.01	-0.06

in a number of elements, such as antimony. Despite some shared variability, principal components analysis clearly separates the desert buff and brown wares.

Two types or variants are chemically distinguished in the Salton Brown assemblage. Desert Brown-1, as it is currently identified by Neff (2001), has higher proportions of such elements as scandium and vanadium than Desert Brown-2. The significance of this difference has yet to be determined. Systematic examination of the Salton Brown collection is necessary before we can determine if the Desert Brown-1 and Desert Brown-2 chemical differences can be correlated with macro-mineralogy, clay source, or provenience. Three sherds from the current study exhibit Desert Brown-2 chemical signatures.

The Mountain Brown ware sherds, referred to as Tizon Brown, are statistically distinguishable from Desert Brown Ware, identified on the hand-specimen

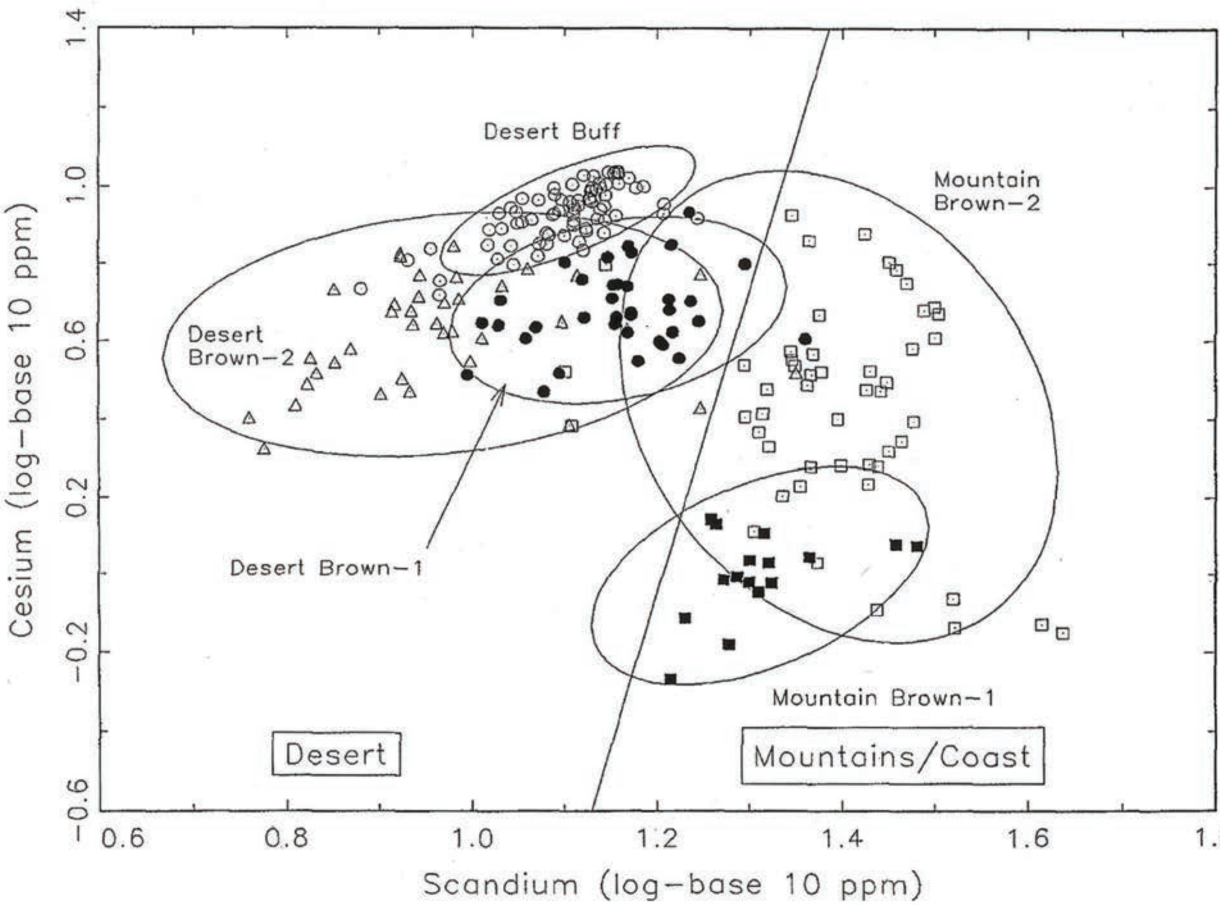


Figure 4: Comparison of five established or proposed southern California ceramic types through plotting clay and ceramic samples (N=370). Ellipses represent 90 percent confidence levels. Diagonal line through plot represents the proposed separation of desert versus mountain/coast types. From Hildebrand et al. (2002).

level as Salton Brown (Galucci 2001). Tizon Brown is distinguished by relatively higher proportions of transition metal elements such as scandium. The Tizon Brown sherds can be further divided into two groups, referred to by Neff (2001) as Mountain Brown-1 and Mountain Brown-2. Mountain Brown-1 is relatively richer in potassium but poor in heavy rare earths such as ytterbium. This is consistent with derivation from more mafic (basaltic) rocks that are found on the western edge of the Peninsular Range batholith according to Neff (2001). Mountain Brown-2 is relatively richer in ytterbium and other heavy rare earths and is consistent with derivations from the felsic rocks (granitics) that are to be found in the eastern side of the Peninsular Range. At this stage in the analysis, there does not seem to be much support in the clay or ceramic data for this geographical separation, although any ability to geographically discriminate Tizon sherds would be a step forward. Still to be resolved is the identification of specific clays from which Tizon Brown Ware derives.

The one clay sample from the uppermost level of a drilled core sample in Las Flores Creek could not be assigned to any ceramic grouping. This typifies clay deposits along the San Diego coast. Of 13 tested clay samples from the San Diego coastal plain, only two could be attributed to a source type. A clay sample from north Mission Gorge and clay samples beneath the Aguirre Adobe site in Old Town San Diego both fell into the Mountain Brown-2 category. Both clays are probably derived from San Diego River alluvium. Note that Mountain Brown-2 is expected to be associated with the eastern side of the Peninsular Range and not the coastal area according to Neff's analysis. Only three of the 26 clay samples from the mountains were attributable to a source type. Clay from McGinty Mountain was assigned to Mountain Brown-1, and clays from Guatay Mountain and one of the sources on Mt. Laguna conformed to Mountain Brown-2.

Two sherds from the current study were also attributable to Mountain Brown-2, one from SDI-10726 and one from SDI-15254. Several Tizon sherds from CA-SDI-10156B, the site of Topomai next to Rancho Santa Margarita Ranch, also conform to this chemical signature (Sue Wade, personal communication 2001). This chemical fingerprint appears to characterize much of the Tizon Brown Ware sample throughout the entire coastal and mountain area. The number of sherds in the entire collection that can be characterized as Mountain Brown-1 is actually very small. Ironically, the one sherd that was classified as Salton Brown based on a lack of observable amphibole remained unassigned. Three sherds originally classified as Tizon, however, conformed to the chemical signature for Salton Brown, specifically Desert Brown-1. Two of these sherds had only trace amounts of amphibole (4 percent), while one contained substantial amounts (11 percent). Likewise, Sue Wade identified nine sherds from Topomai as Tizon Brown, but NAA indicated two were Desert Brown-1.

The identification of desert-derived sherds on the coast has important implications for understanding patterns of mobility and cultural contact between the two regions. Lower Colorado Buff Ware, a more immediately identifiable desert ceramic type, is extremely rare (less than 1 percent) at coastal sites (Schaefer 1994:92). Salton Brown Ware should be equally rare. It therefore seems unlikely that so many sherds from both of the sites under investigation and from Topomai within Camp Pendleton would be from the desert. If this is the case, then more substantial desert-coastal interaction is going on than previously thought, and some cultural pattern is responsible for the transport of more desert brown ware than buff ware. An alternative explanation is that some clay sources used by the people of the Las Flores Creek and Santa Margarita River areas have chemical signatures similar to Salton Brown. Only additional research directed toward Camp Pendleton clay mineralogy and ceramic variability will resolve this issue.

All of the other sherds are easily identified as Tizon Brown Ware by the occurrence of large amphibole grains. They range from trace amounts of approximately 1 percent to as high as 15 percent. From 4 percent to 11 percent of counted grains are plagioclase feldspar, with no observed orthoclase. Biotite and muscovite mica occur in low frequencies, as do quartz/plasioclase rocks that might be expected from decomposing granitic sources. Most notable about all of the sherd samples is the high frequency of quartz grains, ranging from 72 to 89 percent of counted grains. This is well above the quartz counts of the Las Flores clay source and higher than the average 48 to 54 percent quartz counts of Tizon Brown Ware in the mountains (Hildebrand et al. 2002).

Sherds from the mountains also tend to have higher counts of plagioclase and amphibole but similar low mica content. Sue Wade (personal communication 1999) also found higher than expected amounts of tourmaline in sherd samples from SDI-10156, the site of Topomai on the Santa Margarita River. Tourmaline may also be present in this sample but was not distinguished from amphibole. As discussed above, the high quartz counts may be due to artificial tempering. One cannot discount the possibility that there was a cultural selection for crushed quartz or riverine quartz sand temper. Whether as a result of natural petrography or cultural practices, the higher quartz content of Tizon Brown Ware at SDI-10726 may have broader analytical implications for the identification of a localized ceramic tradition with either geographical or ethnic correlates.

Conclusions

Tizon Brown Ware from SDI-10726 and SDI-15254 in its material characteristics and dates typified San Luis II ceramics of the northern San Diego coastal plain. This occupational phase is consistent with observations of the Portolá expedition during their 1769 foray through the area and later with historical accounts associated with the Luiseño occupation of the Las Flores Estancia and Rancho Santa Margarita (Schaefer 1992).

Two directly dated sherds from SDI-10726 fall within the age range obtained from charcoal and shell samples from the site, but radiocarbon data also suggest that ceramics were used in the later phases of the occupation. One calibrated date of cal AD 1445–1655 (2 sigma) supports arguments that the San Luis Rey II Complex, as defined by Meighan (1954), must predate AD 1750. Although northern San Diego County ceramics have been directly dated to as early as AD 800–1000, the vast majority of dates are after AD 1600, for which the second directly dated sherd at SDI-10726 is an example. Although no sherds were directly dated at SDI-15254, the majority came from upper levels dated between AD 1345 and 1700. It would not be unexpected if the sherds dated to the later part of that occupation as well. Sherds found in lower levels of this multicomponent site are likely to represent downward drift from bioturbation, not an early sherd-bearing horizon (Griset 1996).

The sherd assemblage is too small and fragmentary to determine the forms and functions represented. The few rims and sooted sherds tend to support previous assumptions that Tizon Brown Ware pottery was primarily used for cooking. Clearly, additional ceramic samples from clear stratigraphic contexts with reliable absolute dates are needed to advance our knowledge of pottery use by the Native inhabitants of the Camp Pendleton area (Laylander 1983). Petrographic comparison of Las Flores Creek clays with ceramic samples suggests that some of the Tizon Brown Ware pottery could have been locally manufactured. Much higher frequencies of quartz in the sherd samples also suggest that crushed quartz or quartz sand temper was intentionally added to the local clay to improve its plasticity during manufacture and its durability after firing. Evidence therefore supports the view that Tizon Brown Ware was not necessarily self-tempering and that the mineral constituents are, in part, a result of cultural modifications. This is an important observation for making specific cultural/geographical inferences from Tizon Brown Ware variability. One sherd displayed the petrographic properties of Salton Brown Ware. If verified by NAA, it could indicate trade with or travel from the desert areas of western Imperial or Riverside counties.

The results of more detailed examination of brown ware sherds from Camp Pendleton indicate much more is to be learned from microscopic examination and chemical fingerprinting of ceramics than can possibly be achieved through traditional methods of hand-specimen classification. Substantial benefits in tracing resource use patterns, mobility, and trade are likely to derive from the application of these methods to a larger sample of natural clays and sherd samples from throughout the Camp Pendleton area.

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