Using Pottery Collections with Limited Provenience to Explore Pre-Contact Ceramic Traditions: An Example from the Anza-Borrego Desert

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Pottery collections from defined geographic regions can be used to explore questions related to pre-contact ceramic traditions even without site-specific provenience. As an example, this paper presents the results of typological analysis of a surface collection of pottery sherds from the Anza-Borrego desert. Type frequencies are compared to a published site assemblage to identify possible biases in the data set. Correlation of typological attribute data is used to reexamine previous classification schemes for regional pre-contact ceramics. The results suggest that the research potential of archaeological collections with limited provenience should be assessed on a case-by-case basis.

Time, Space, and Curation Decisions

Time and space are crucial parameters for archaeologists who seek to reconstruct past lifeways, cultural trajectories, and patterns of population movement. Therefore, archaeological collections or individual artifacts that have been removed from their chrono-spatial context and lack documentation as to precise find spot are often regarded as lacking research value. Although modern professional ethics and methods of archaeological recovery and curation now operate to minimize such occurrences, in fact there exist many private and museum collections and assemblages from early archaeological projects that might be deemed "useless" if very strict standards of provenience are applied. Such assessments can have far-reaching impacts because provenience and research potential may be important considerations for curation facilities in making decisions to accession or deaccession objects, or in assigning objects to research, education, or exhibit collections (Malaro 1985:53-55, 139-140) which may have different standards for care, access, and use. Ultimately, such decisions determine whether a collection will be properly curated and maintained and thus have significant ramifications for the corpus of material heritage that is passed on to future generations. This paper presents an example of a private collection of pottery sherds from the Anza-Borrego desert to show that the research potential of collections with limited provenience should be carefully evaluated on a case-by-case basis. Such evaluations should take into account the level of spatial and cultural specificity that can be assigned, the presence of "diagnostic" artifacts and materials amenable to analytical techniques, the existence of similar or related cultural objects, and biases inherent in the material sample.

SDAC 206, a Pottery Collection with Limited Provenience

Collection History

A private collection of pottery sherds from what is today the area of Anza-Borrego Desert State Park in San Diego County was donated to the San Diego Archaeological Center (SDAC) in April 2005. Initially, this collection, designated SDAC 206, was accepted for curation for public educational purposes due to the lack of accompanying provenience documentation. However, the nature of the material and information obtained during interviews with the donor suggested that the collection had the potential to offer data bearing on research issues related to the prehistory of the Anza-Borrego region and surrounding areas. These issues include questions concerning early ceramic function and the spread of pottery technology from the Colorado desert westward (Rogers 1945) or from Baja California northward around A.D. 800 (Griset 1996:263, 264, 273) as well as the validity of chronological schemes for Colorado desert buff ware ceramic types (Rogers 1945; Waters 1982) that have been questioned by more recent research by D. Laylander and others (Laylander 1997:83-84).

According to information provided by the donor, sherds were collected from the surface during off-road jeep exploration of desert areas, centered around the town of Borrego Springs, California. Collecting began in the 1940s and lasted until the early 1960s, with most collecting activity taking place during the 1950s. The geographic area traversed, as indicated on a map by the donor, was mainly south of Borrego Springs, bounded by Highway 86 on the east, Agua Caliente Hot Spring on the south, and Scissors Crossing on the west (Figure 1). Some trips were also made northwest of the town, into Collins Valley, Shelter Valley, and Coyote Canyon. Collection of sherds was reportedly done in a random manner. However, the sherds donated to

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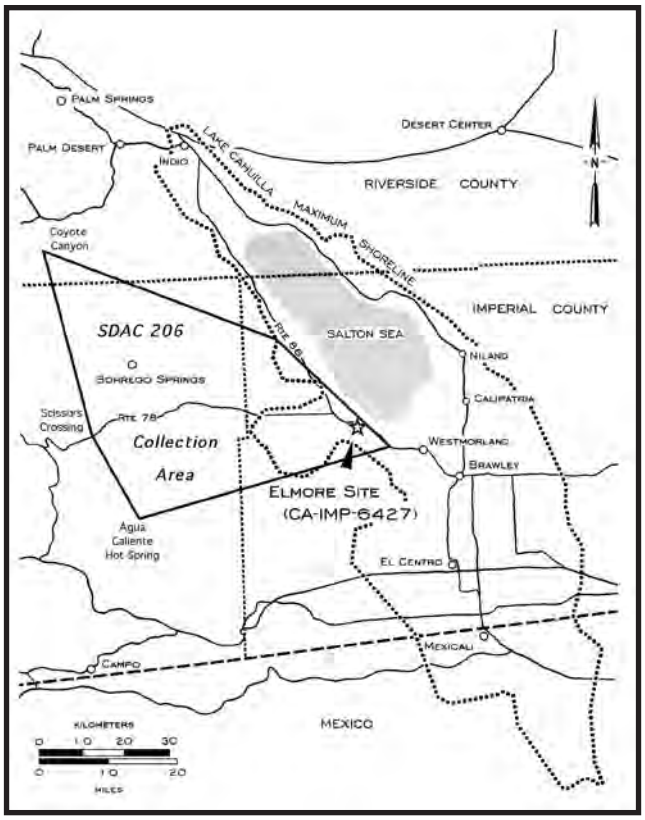

Figure 1. Map of the Anza-Borrego desert region showing boundaries of SDAC 206 collection area and location of the Elmore site (IMP-6427). Map modified from Laylander 1997 with permission.

SDAC are only a portion of the total private collection and are not necessarily representative of the entire collection. In particular, the donated sherds included a large number of rim sherds and sherds with post-firing drilled holes.

A systematic analysis of the pottery sherds was conducted at SDAC in May-August 2005 in order to create a catalogue and a database of ceramic attributes. Attributes recorded were sherd type, general vessel form type, rim form and lip shape, decoration, surface color, core color, manufacture marks, inclusion type/size, post-firing modification, rim radius (cm), circumference percentage, wall thickness (mm) measured 1 cm below the lip and wall thickness (mm) measured 3 cm below the lip. Other observations were recorded in a "Comments" field. A Munsell Soil Color Chart (1994 edition) was used to evaluate surface and core color of dry specimens under indoor lighting.

Results, Comparison, and Discussion

Results of the analysis of SDAC 206 are presented below in comparison with a published Late Prehistoric period ceramic assemblage from the "Elmore site" (CA-IMP-6427). The Elmore site is located on the western side of the Salton basin, at the southeastern extremity of the geographical range of SDAC 206. A habitation site excavated by Caltrans in 1990 (Laylander 1997), the Elmore site has been radiocarbon-dated to post-A.D. 1500. Further analysis of the dates by D. Laylander (1997:44) indicates that the site most likely represents a single short-term occupation between A.D. 1660 and 1680. Material assemblages from the Elmore site have been published in detail (Laylander 1997), allowing quantitative comparison. The purpose of this comparison is to show regional-level similarities in ceramics but also biases that may be present in collections like SDAC 206 which represent uncontrolled surface sampling over large areas. As discussed below, these biases preclude some kinds of hypothesis testing, but may be weighted in favor of material that is otherwise rare in site assemblages, affording opportunities for future study of aspects of pre-contact ceramic technology and function.

Vessel Form Types

Site assemblages typically consist of many non-diagnostic body sherds and few rim sherds. For example, only 67 of 727 pottery sherds recovered at the Elmore site were rim sherds, of which 63 were identifiable as to vessel form type (9 percent of the total assemblage) (Laylander 1997:34). In contrast, SDAC 206 included many rim sherds, comprising 71 percent of the collection (133 rim sherds of a total of 187 pottery sherds). A number of factors may have contributed to the unusually high percentage of rim sherds in this surface collection. These include cognitive processes in human perception which may favor discrimination of a smooth rim edge against a random background, influencing a searcher's collection of scattered surface objects. In addition, although the donor stated that "everything" was picked up, the possibility of preferential selection of certain kinds of objects and of post-collection sorting and preferential saving cannot be ruled out and is likely to have affected the donated set of objects.

Results of the diagnostic sherd (rim and shoulder sherds, handles, and body sherds with form-diagnostic attributes or post-firing treatments) analysis revealed a diversity of form types (Table 1, Figure 2), consistent with Rogers' (1973:24-28) early reports of "Kamia" or Kumeyaay vessel types. The congruence of SDAC 206 form types with previously published examples from the Anza-Borrego region, especially types such as rattles and scoops with reportedly geographically restricted distributions (Rogers 1973), helps to confirm the donor's definition of the collection area. Though not always explicitly carried out or acknowledged, a comparison of this kind is necessary to validate any provenience information provided for a private collection and will be most convincing if a collection includes objects known to be associated exclusively or predominantly with specific source areas.

Compared to the Elmore site assemblage, SDAC 206 has the same rank ordering of general vessel form types; i.e.,

Table 1. Vessel Form Percentages Based on Diagnostic Sherd Count for SDAC 206

General Vessel Form Type	Percent of Total Diagnostic Sherds (N = 138)
Bowls	49.3
Neckless jars	19.6
Necked jars	18.1
Rattles	1.4
Scoops or spoons	2.2
Tokens or palettes	1.4
Not discernible	8.0
Total	100.0

Table 2. Vessel Form Percentages Based on Diagnostic Sherd Count for SDAC 206 and the Elmore Site (IMP-6427)

General vessel form type	SDAC 206 (N = 138)	Elmore Site (N = 69)[1]
Bowls	49.3	62.3
Jars	37.7	29.0
Other	5.0	2.9
Unidentified	8.0	5.8
Total	100.0	100.0

[1] Laylander 1997: 33-35

bowls are the most common vessel form, followed by jars (Table 2). However, SDAC 206 has a higher proportion of jars than the Elmore site assemblage. Miscellaneous ceramic items including scoops, rattles, and tokens (Figure 2:4-6) are relatively rare in SDAC 206, but they occurred even less frequently at the Elmore site. Due to the only regional-level provenience information available for SDAC 206, it is not possible to discriminate among a number of variables that may contribute to these differences. These include, in addition to factors related to human perception and selectivity that may have affected the composition of SDAC 206, shifts through time in production of bowls versus jars, differences in spatial distributions of form types related to vessel function and site type (e.g., a habitation site versus a trail-side vessel cache), and the effects of accumulation through time of vessels with different use-lives (cf. Orton et al. 1993:207-209). Investigation of research questions requiring control over such variables will generally need a site-specific (and in some cases intra-site) level of spatial and chronological resolution. However, the form-diagnostic sherds in SDAC 206 are still useful objects for technological studies that may potentially demonstrate form/fabric correlations (e.g. Rice 1987:227, 237-238; Rye 1981:26-27) within the Anza-Borrego desert region as well as for organic residue studies that examine form/function associations (e.g. Heron and Evershed 1993). Rare items such as rattles in SDAC 206 are important as examples of little-known forms.

Decoration

Decoration within southern California indigenous ceramic traditions is relatively uncommon and appears more arbitrary than in other parts of the southwestern United States (Van Camp 1979:61-62). Eleven percent of the SDAC 206 sherds were decorated (Table 3). The most frequent mode of decoration was incising, and this was most commonly observed as short transverse lines or "notches" on rim sherd lips (Figure 3). One jar rim sherd was burnished with an incised lip and fine etched lines in zigzag and crosshatched motifs (Figure 3:5; cf. Van Camp 1979:63). The Elmore site assemblage had fewer decorated sherds (0.4 percent of the total assemblage of 727 sherds) with only three examples of incised lips (Laylander 1997:35). The chronological schemes put forth by Rogers (1945) and Waters (1982) rely in part on decorative attributes including incising, "rim notching", and burnishing to distinguish their proposed Yuman/Patayan I, II, and III phases of the Late Prehistoric period in southern California. It is possible that incising, which is considered an "early" trait by Rogers and Waters, is observed less frequently in the Elmore site assemblage because this material is from a late-stage context of the pre-contact ceramic sequence (cf. Laylander 1997:83) while SDAC 206 represents an uncontrolled and probably longer time frame. However, a collector's preference for decorated or "interesting" pieces would also tend to impose a bias toward decorated sherds, and therefore the data cannot be interpreted as unequivocally supporting the Rogers/Waters chronological framework. Correspondences among "early" and "late" decorative and

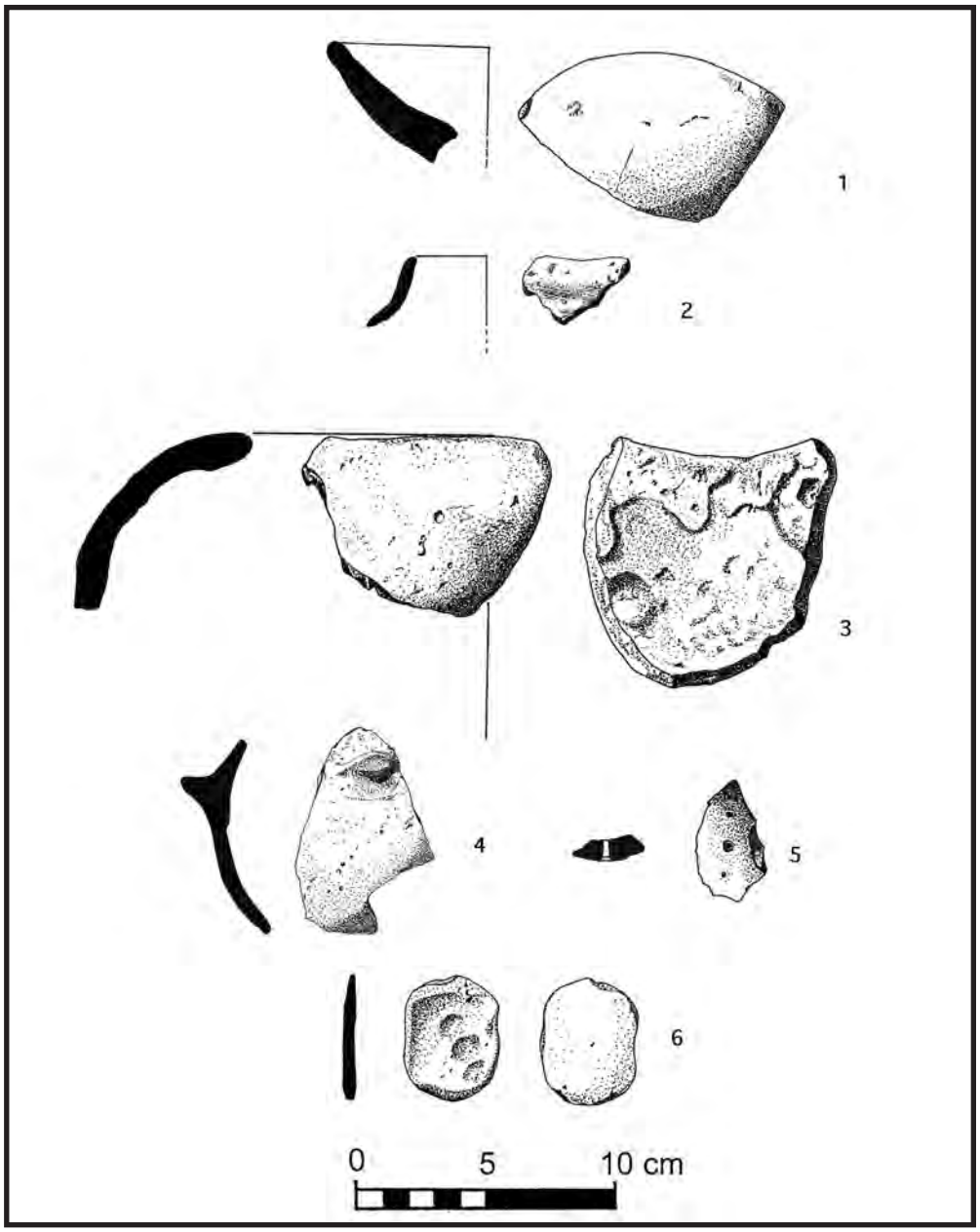

Figure 2. Diagnostic sherds. 1: AB-78, bowl rim; 2: AB-164, necked jar rim; 3: AB-60, neckless jar rim; 4: AB-138, scoop fragment with tab handle; 5: AB-23, rattle fragment with pre-firing pierced holes; 6: AB-147, sherd "token" with worked edges.

Table 3. Decoration Percentages for SDAC 206 and the Elmore Site (IMP-6427)[1]

Decoration	SDAC 206 (N = 186)	Elmore Site (N = 727) [2]
None	89.2	99.6
Incised treatments	5.4	0.4
Paint or burnish	3.8	-
Prefiring perforations	1.6	-
Slip	1.1	-
Small tab handle	0.5	-
"Stucco" treatment	0.5	-

[1] Percents may sum to more than 100 percent because some sherds show multiple decoration modes

[2] Laylander 1997:33-35

formal attributes within individual artifacts, on the other hand, may be examined using SDAC 206 material. This is discussed in more detail below.

Post-Firing Modifications

The relatively large number of sherds with post-firing modifications observed in SDAC 206 is consistent with previous reports that ceramic vessels were frequently repaired or recycled (e.g. Rogers 1973:18-19; Van Camp 1979:54-55, 60). Fifty-two percent of all sherds in SDAC 206 exhibited some kind of post-firing modification (Table 4). In contrast, the Elmore site assemblage included no sherds with post-firing modifications (Laylander, personal communication 2007).

The vast majority of post-firing modifications in SDAC 206 were biconical drilled holes (Figure 4). Examination of sherd profile sections and some incomplete perforations indicates that the drilling was almost always begun from the exterior surface and then finished from the interior. This may suggest that the vessel was intact or largely intact when the drilling was carried out since in this case the exterior would have been easier to access. Drilled perforations occurred on both rim sherds (80 percent) and body sherds (20 percent) and on both bowls (64 percent) and jars (36 percent). G. Van Camp (1979:55) writes that small-necked jars served as water canteens in the desert, carried " . . . by a thong threaded through a hole in the neck of the vessel" (see also Rogers 1973:25-26). However, neither Van Camp (1979) nor Rogers (1973) specify whether such transport-related holes were made before or after the vessel was fired, or both.

Two sherds in SDAC 206 had been worked into flat oblong shapes by grinding and smoothing the edges (e.g., Figure 2:6; cf. Van Camp 1979:60). Similar objects have been found in small numbers in some site assemblages in San Diego County (e.g. "Santee Greens" SDI-5669 west of the Peninsular mountain range, Berryman 1981; Collins Valley site SDI-2336 in the Anza-Borrego desert, Seidel 1973) and may have been game pieces or tokens.

It is likely that biases related to human perception and collector's selection are the major determinant of the very high frequency of sherds with post-firing drilled holes in SDAC 206, just as similar biases probably contributed to the large numbers of rim sherds and decorated sherds in this collection. Unfortunately, little quantitative data has been published on sherds with post-firing modifications in site assemblages so there is insufficient background information to assess the degree of exaggeration in this material. A factor in the absence of modified sherds from the Elmore Site might be that the site was probably inhabited only briefly during a single occupation event (Laylander, personal communication 2007). It may be possible to correlate the frequency of sherds with post-firing modifications in site assemblages with the relative duration (e.g. short-term or long-term) of site occupation. In addition, future studies of collections like SDAC 206, with large numbers of form-diagnostic drilled sherds, have the potential to yield useful information concerning vessel repair and transport technologies within the Anza-Borrego desert region. These are research topics that are yet to be explored in southern California.

Aperture Size

Vessel size is generally associated with vessel function and social contexts of use (Hayden 2001:40, 49; Rice 1987:236-240, 299). The large number of measurable rim sherds in SDAC 206 allows for an examination of patterns in vessel size based on rim diameter. Specifically, it is the vessel aperture that is being measured and not necessarily overall vessel size. Vessel capacity will typically vary directly with aperture diameter within vessel form categories (cf. Burton 2004:524) so that, for example, smaller rim diameters indicate the presence of smaller vessels. However, positive correlations between aperture size and overall vessel shape and capacity have not been tested for San Diego area pre-

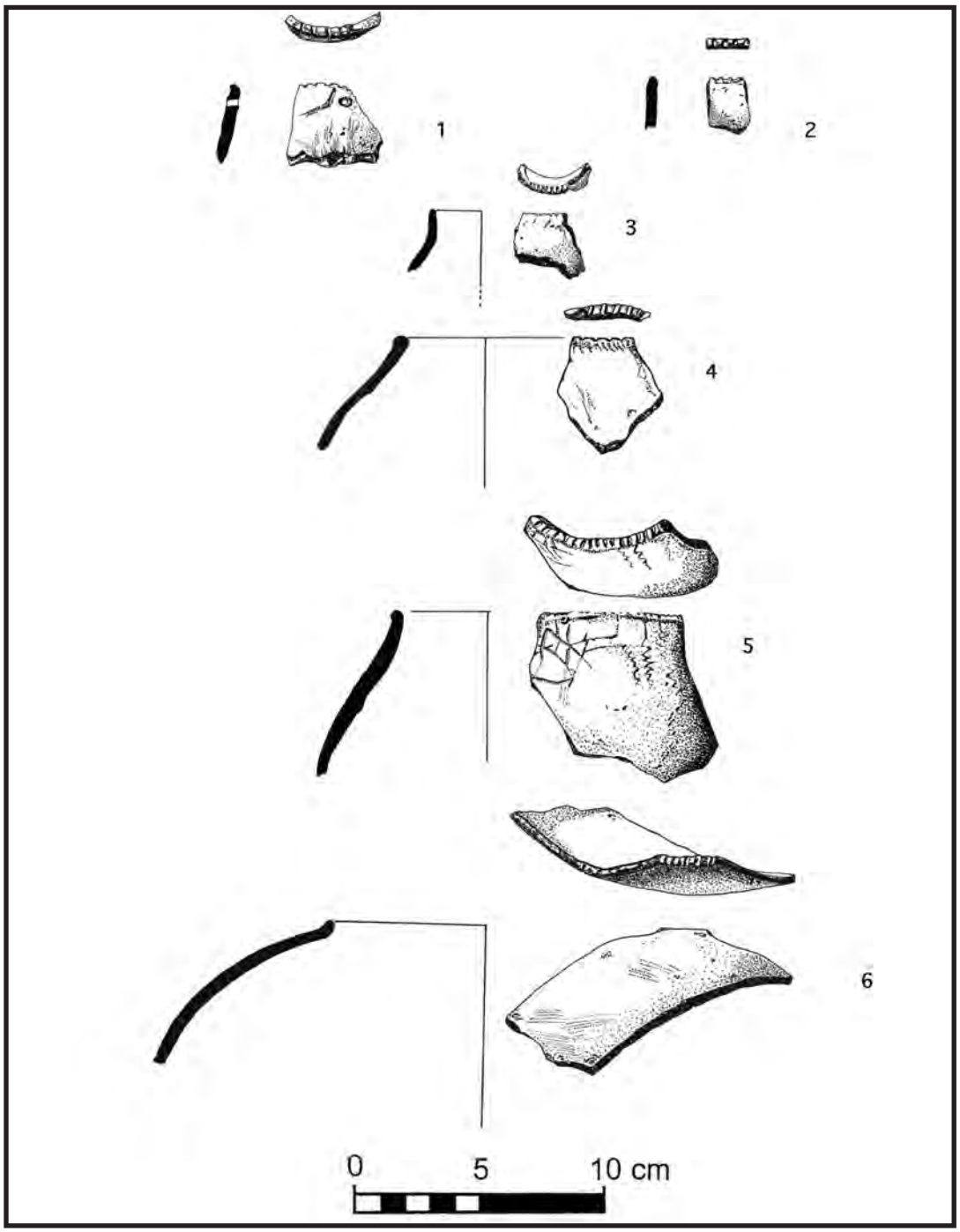

Figure 3. Decorated sherds. 1: AB-25, rim with incised lip and pre-firing pierced hole; 2: AB-185, rim with incised lip; 3: AB-182, necked jar rim with incised lip and beige slip on exterior surface; 4: AB-171, jar rim with incised lip; 5: AB-141, jar rim with incised lip, incised geometric designs, and burnishing on exterior surface; 6: AB-162, jar with incised lip.

Table 4. Post-firing Modification Percentages for SDAC 206

Post-firing Modification	Percent of Total Sherds N=187
Biconical perforation	44.9 %

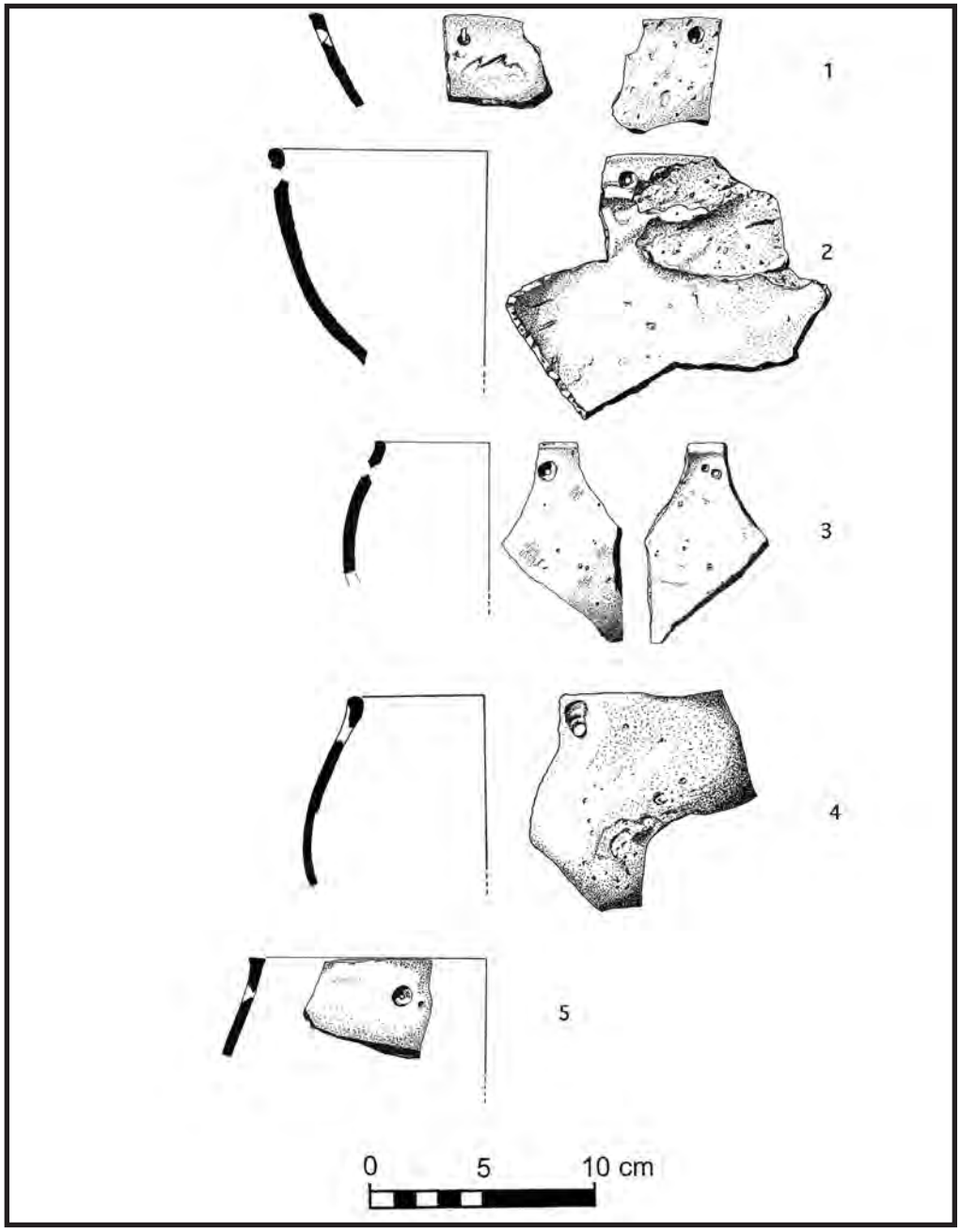

Figure 4. Sherds with post-firing drilled holes. 1: AB-20, rim, biconical post-firing drilled hole, interior view (left), exterior view (right); 2: AB-57, bowl rim, biconical post-firing drilled hole; 3: AB-68, jar rim, biconical post-firing drilled hole, incomplete perforation on interior surface (right); 4: AB-101, jar rim, biconical post-firing drilled hole; 5: AB-8, jar rim, biconical post-firing drilled hole, incomplete perforation on exterior surface.

Table 5. Aperture Diameter (cm) Statistics for SDAC 206 and the Elmore Site (IMP-6427)

	Bowls SDAC 206 N=55	Bowls Elmore Site N=37	Jars SDAC 206 N=48	Jars Elmore Site N=15
Mean	21.09	22.38	13.90	16.40
Mode	18	30	6	12
Range	42	22	30	24
Coefficient of Variation	41.75	32.56	56.30	45.68
Skewness	0.80	-0.77	0.64	0.47

contact ceramic traditions and therefore interpretations should be approached cautiously.

Mean aperture diameter measurements for bowls and jars from SDAC 206 and the Elmore site (Table 5) are similar, demonstrating a consistent central tendency despite the larger ranges and Coefficients of Variation for the SDAC 206 material. It is likely that the uncontrolled spatial and temporal collection of artifacts represented by SDAC 206 results in greater metric variability than shorter time period accumulations from well-defined loci even in non-standardized ceramics (cf. Sinopoli 1988; Stein and Blackman 1993:40). It is also possible that extreme ends of the size range are not present in the Elmore site assemblage simply due to the smaller sample size (cf. Orton et al. 1993:166). For both bowls and jars, the aperture diameter mode is smaller in SDAC 206 than in the Elmore site assemblage. Pronounced skewness toward smaller sizes in SDAC 206 may be another indication that this collection represents a longer time frame of deposition. Ethnographic studies (DeBoer and Lathrap 1979:127-128) suggest that smaller vessels, which are more portable and subject to breakage than large stationary vessels, have shorter use-lives and need to be replaced more often. Assuming constant replacement of broken and discarded vessels and that all broken vessels remain within the spatial unit under analysis, the proportion of small vessels represented in an archaeological assemblage will increase through time (Orton et al. 1993:Fig. 16.1; e.g., if small vessel Type A has a use-life of two years and large vessel Type B has a use-life of 10 years and they are present in a 1:1 ratio at the beginning of Year 1, after 20 years have elapsed the ratio of Type A to Type B in the accumulated assemblage will be 5:1). Therefore, smaller vessels will tend to be overrepresented in long-term regional accumulations of ceramics compared to shorter-term site accumulations

Although differences in the aperture size distributions can be interpreted as consistent with differences in chronological range—with the Elmore site assemblage being deposited during a very short-term occupation and SDAC 206 being of uncontrolled, probably longer, temporal duration—it is also likely that vessel function, which is related to vessel size, is an important variable that contributes to the observed patterning. For example, small, portable, narrow-necked water "canteens" may have been more commonly dropped and deposited along trails crossing the desert floor than within the boundaries of habitation sites (cf. DeBoer and Lathrap 1979:133). In contrast, large cooking and storage vessels may be expected to predominate in habitation site assemblages. Without site-specific, or at least sub-regional, provenience, it is not possible to evaluate the significance of microenvironment, resource zone, or site type in affecting the vessel sizes or shapes recovered. In the case of SDAC 206, it is unknown whether collecting was equally intensive throughout the defined geographical range so that, even as a regional sample, it may not accurately reflect the relative quantities of pottery shapes and sizes across the entire desert landscape. Generally, the most useful quantitative assemblage comparisons will require consistency in collection strategy as well as spatial and temporal units of analysis (see Bradley et al. 1994; Clarke 1978 for cautionary tales). That is, region-to-region comparisons may be valid while region-to-site comparisons may not, but even the former must take into account biases introduced by different collection methodologies.

Chronological Indicators

One of the most important applications of ceramic typologies worldwide is their use in constructing relative chronological sequences. In the San Diego area, Rogers (1945) proposed a tripartite chronological scheme of Yuman I, II, and III for the Late Prehistoric period that was linked to changes in pottery production. Waters (1982) later slightly reworked Rogers' typology and renamed the three phases Patayan I, II, and III. Their work suggested that pottery might provide a means of resolving the 1,000-plus years of the Late Prehistoric period into shorter temporal segments. Among their proposed chronologically diagnostic ceramic attributes, incised decoration and burnishing were considered by Rogers and Waters as associated exclusively with an "early" phase (ca. pre-A.D. 1000) of pottery production and direct rims were thought to chronologically precede recurved rims, which may not have appeared until post-A.D. 1000. Likewise, rounded lips and incised or "notched" lips were designated by both Rogers and Waters as occurring from the inception of pottery production (pre-A.D. 1000). Flattened lips, especially ones with finely finished edges, were thought

to be associated with a later production phase (ca. post-A.D. 1000) (Waters 1982:Figure 7.1), replacing rounded lips between A.D. 1000 and 1500.

Considerable difficulty in the subsequent verification and application of the Rogers/Waters chronological scheme has resulted in large part from its heavy emphasis on typological criteria in a region where rim sherds and especially decorated sherds are rare in pottery assemblages. However, SDAC 206, with its many diagnostic sherds, offers an opportunity to examine the intra-artifact correspondences among proposed "early" and "late" ceramic attributes. This collection supports a correlation between the "early" traits of direct rims and incised and burnished decoration (all 10 examples of incising and burnishing occurred on sherds with direct rims), but suggests that the relationship between incised lips and lip form is problematic. Incising or "notching" on lips, an exclusively "early" attribute according to Rogers (1945; see also Waters 1982:Table 7.1), occurred equally often on "early" rounded lips and "late" flattened lips, implying that these particular ceramic traits lack chronological significance (cf. Laylander 2005). Similarly, Laylander (1997:83) noted one example of incising on a rounded lip and two examples on flattened or slightly flattened lips at the Elmore site. The presence of "early" ceramic attributes such as direct rims, incising, and rounded lips at this radiocarbon-dated late-stage site further calls into question the effectiveness of Rogers' and Waters' proposed chronological diagnostics for discriminating temporal sequencing in this desert region. Thus, SDAC 206 adds to an accumulating body of data that suggests these ceramic typological attributes are unreliable for purposes of subphasing the San Diego area Late Prehistoric period.

Summary

The results reported here for SDAC 206, a surface collection of pottery sherds from the Anza-Borrego desert, highlight a number of considerations in the evaluation of research potential in cases of limited provenience. These include:

1. Level of spatial specificity that can be attributed based on oral testimony or written documentation. SDAC 206 consisted of archaeological material collected decades earlier and donated by a private individual. Although there was no accompanying written documentation, the donor was able to recall and outline geographic boundaries for the collection so that regional-level provenience could be established. It is critical for any curating institution to record and preserve oral testimony as well as to maintain any paper reports related to collections in order to maximize research potential.

2. Level of chronological and/or cultural specificity that can be assigned through comparison with well-provenienced assemblages. For SDAC 206, it was possible to confirm that the material was consistent with previously published Late Prehistoric (ca. A.D. 800-1769) ceramic collections from the Anza-Borrego desert region. This evaluative step, although often carried out only implicitly, is necessary to substantiate any reported provenience and is prerequisite for further analyses.

3. Presence of formally or temporally diagnostic artifacts. SDAC 206 included a relatively large number of diagnostic sherds compared to many Late Prehistoric ceramic assemblages from the San Diego region. These diagnostic sherds, in addition to being important for corroborating the geographical range indicated by the donor, contribute to our knowledge of formal, decorative, and metric variation within Anza-Borrego desert pre-contact ceramics and allow for regional-level investigation of vessel function in this arid climatic zone.

4. Presence of residues or material that could be used for compositional analysis. With form-diagnostic sherds such as those found in SDAC 206, surface or absorbed organic residues may be extracted and chemically analyzed to obtain direct evidence of vessel use for different form types. Petrographic and chemical compositional analysis of form-diagnostic ceramic sherds may be used to examine technological choices that may be conditioned by vessel form/function requirements. These kinds of studies based on regional collections may be supplemented with more specifically provenienced material in order to evaluate intra-regional geographic variables in vessel function and composition.

5. Unique or rare material. Some artifacts and archaeological materials may have intrinsic importance as singular or unusual items despite issues related to provenience. SDAC 206 included some examples of relatively rare pottery forms such as rattles, tokens, and drilled sherds that are not always found in site assemblages, such as the Elmore site. The large number of form diagnostic sherds with drilled holes provides evidence of pre-contact technologies of post-firing modification and the considerable level of effort invested to extend ceramic vessel use-life across all vessel form types. In addition, correspondences between some formal and relatively rare decorative attributes that occurred in this collection indicated

problems with ceramic chronological indicators proposed by Rogers (1945) and Waters (1982) and recently questioned by researchers (e.g., Laylander 1997:83-84). Even without site-specific provenience, such artifacts can be understood as having significant research potential as well as interpretive value.

When considering the use of collections like SDAC 206 for research purposes, it is important to be aware of biases that may be present in archaeological material that represents uncontrolled surface collection and generally unknown degrees of selective culling prior to curation. Some of these biases, expressed in the present example as exceptionally large numbers of rim sherds, decorated sherds, and "unusual" items, may be systematically anticipated and may even present advantages for certain kinds of technological or functional studies as discussed above. Other research questions, especially ones requiring refined degrees of chronological or spatial resolution (e.g., intra- or inter-site), cannot be approached through the use of collections with only regional provenience. With respect to the evaluation of bias, and hence research value, in archaeological datasets generally, it is worth remembering that even material recorded and recovered by trained archaeologists is subject to myriad kinds of bias, including variable sets of expectations, degrees of experience, and levels of motivation and interest (Bradley et al. 1994; Clarke 1978). This does not mean that "real" trends and patterns cannot be discerned. Improved knowledge of the past depends on continued diligent preservation, study, and comparison of all the archaeological material available to us.

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