

Typologies and Classification of Great Basin Pottery

A New Look at Death Valley Brown Wares

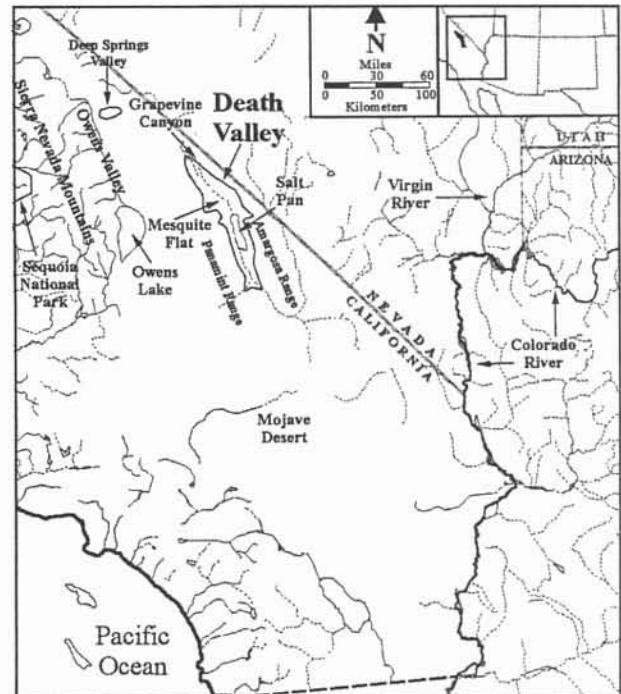
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MOST CERAMIC RESEARCH in the Greater Southwest has been concerned with the pottery of sedentary and agricultural groups. Little is known about the ceramic technology of the hunting and gathering populations in the western and southwestern extents of the Southwest and beyond. Around six hundred to one thousand years ago, and in many areas, these mobile Numic speakers seem to have replaced Anasazi cultures (Baldwin 1950; Larson 1990; Lyneis 1992). Although the Paiute and Shoshone that lived (and still live) in these areas did not leave behind as many pots and sherds as their Southwestern neighbors or Anasazi predecessors, ceramics are still common in residential sites dating to this period. Ceramics in the Southwest proper play an essential role in the reconstruction of prehistoric lifeways. Unfortunately, they are often ignored in hunter-gatherer settings (for exceptions, see Baldwin 1950; Griset, ed. 1986; A. Hunt 1960; Lyneis 1988; and J.M. Mack, ed. 1990).

The reasons for this bias are many, and include historical factors, in which archaeologists have stressed stone tools and earlier prepottery phases of prehistory, but also probably stems from the fact that the brown wares in this area are extremely variable with respect to such elements as rim form, size, shape, color, surface finish, and firing properties, and are usually undecorated. Ceramic studies in other areas, such as the Southwest core, often emphasize decoration as means for addressing topics such as interaction, exchange, and worldview, and for creating finer chronologies. Hence, many of the theories and methods successfully applied elsewhere do not readily lend themselves to brown wares. As a result, studies of hunter-gatherer pottery in the Great Basin are rarely more than descriptive accounts of the number, and occasionally variety, of sherds recovered. Analytically and interpretatively,

these studies rarely contribute more than a rough temporal designation of the site as "late prehistoric."

Here, late prehistoric hunter-gatherer pottery from one small region in the Great Basin, Death Valley (see figure 11.1) is revisited. From the large numbers of sherds collected by previous archaeologists and housed at the Death Valley National Park Museum Archives, a small sample was selected for instrumental neutron activation analysis (INAA) in an



11.1 Map of study area showing location of Death Valley and places mentioned in text. *Illustration prepared by Jelmer Eerkens*

attempt to extract more interpretive value from this class of artifacts and to learn about the ceramic technology of prehistoric hunter-gatherers in the area.

DEATH VALLEY BROWN WARE

Although outside the Southwest proper, Death Valley is at the crossroads of several traditionally defined North American culture areas, including the Southwest to the east, the Great Basin to the north and northeast, California to the west, and the Mojave Desert to the south. The Timbisha Shoshone, who currently occupy the region and were present at European contact, speak a Numic language and are part of the Great Basin culture area. The presence of modest numbers of turquoise artifacts and black-on-white or black-on-gray Anasazi ceramics in Death Valley, attest to the fact that earlier Death Valley inhabitants (AD 500 to 1200) had regular contact with Southwestern pueblo peoples to the east. Many of these artifacts probably derive from the Virgin River area (80 km east) or the Colorado River (130 km southeast). Similarly, the Timbisha Shoshone share many cultural characteristics with their Southwestern Southern Paiute neighbors to the east. By focusing on the Death Valley case in particular, much can be learned by extension and analogy about late prehistoric hunter-gatherer ceramic technology in the desert west in general.

Pottery was clearly an important part of prehistoric living in Death Valley. Late prehistoric inhabitants used and left behind significant numbers of broken pots. For example, in a survey of the Mesquite Flat area pot sherds were the most numerous find (W.J. Wallace 1986). Similarly, well over 50% of all prehistoric sites that have been recorded in the valley contain pottery (Barton 1983; Deal and D'Ascenzo 1987; A. Hunt 1960; Tagg 1984; W.J. Wallace 1957, 1958, 1968, 1988; W.J. Wallace and Taylor 1955, 1956). Pottery is not, however, ubiquitously distributed across the region (Eerkens 2001). In some places, such as along the margins of salt pans and within dunal areas, almost every site contains at least some, and often hundreds, of sherds (A. Hunt 1960; W.J. Wallace 1986). Yet, in other areas, such as higher elevation localities and more remote side valleys, few ceramics have been found (W.J. Wallace 1957; W.J. Wallace and Taylor 1955, 1956).

Little is known about ceramics from Death Valley, despite more than sixty years of archaeological research. One of the main problems thwarting advance is a lack of an agreed upon and reproducible typology that can be used to subdivide sherds into meaningful spatial, temporal, and/or functional categories. Early typological work by Alice Hunt (1960) has

not been adopted by others, probably because it is complex and she did not provide adequate detail on the criteria used to define her types. Most archaeologists continue to classify all brown ware found in Death Valley as Owens Valley Brown Ware, despite convincing evidence that most sherds do not display temper and clay characteristics consistent with the geology of that area (C. Hunt 1960). Furthermore, no systematic comparison has been carried out to demonstrate that sherds from the two areas are similar. Although just a name, the Owens Valley Brown Ware misnomer actually misleads archaeologists and other interested parties about the origins of Death Valley pottery, serves to gloss over possible differences between the two areas, and masks the potential for discovering movement of pots between the valleys (though see Colton [1953] for a discussion of using geographic place names). Moreover, a lack of chronological control (that is, radiocarbon dates) in excavated sites has not allowed researchers to investigate change in ceramics through time. Little is known about when brown wares make their first appearance, other than it occurs sometime after AD 1000. Nor do archaeologists know if brown wares undergo any visible changes during the ceramic period. Because they are assumed to be of a single type, brown wares, and by default sites containing brown ware, are lumped into a single temporal phase, Death Valley IV, or approximately AD 1000 to historic times. In short, grouping pottery from Death Valley into a single all-inclusive and highly variable category called Owens Valley Brown Ware has weakened the value of ceramic analysis (Bettinger 1986; Pippin 1986; see also Lyneis 1988 for similar sentiments regarding Mojave Desert pottery). Being all the same type and time period, there is little to compare or contrast between assemblages, other than the number or density of sherds.

This study reports results of INAA of forty-one different brown-ware vessels collected in Death Valley, including one ethnographic pot and forty archaeological sherds. Like Charles Hunt (1960) almost forty years ago, we hope to show that brown wares are not all alike and pattern in meaningful ways. Four main issues are explored: (1) where Death Valley pottery was made, (2) how chemical characterization compares with formal variability in Death Valley pottery, (3) how chemical characterization compares with previous classifications, and (4) how dividing Death Valley pottery into distinct groups can deepen our understanding of prehistoric behavior. Also briefly considered here is how ethnographic pottery compares compositionally with archaeologically collected pottery.

ENVIRONMENT AND PREHISTORY

Death Valley is a 250-km trough on the southern margin of the Basin and Range geographic province, just east of the Colorado River and north of the Mojave Desert, in eastern California. Active block-faulting, caused by a slow spreading of the Basin and Range, continues to deepen the valley, despite continuous input of sediment from surrounding mountains. A stretched and thinned upper crust also gives rise to volcanic activity. Several basalt flows and rhyolite domes are visible on the valley floor, and the surrounding hills are made up of numerous ash flows, exposed in strata.

Elevations within the valley bottom range from minus 86 m at Badwater, the lowest point in North America, to approximately 900 m above sea level in the northern end. The valley is bordered by the Panamint Range (2500 to 3300 m) on the west and the Amargosa Range (2000 to 2700 m) on the east, creating extreme topographic relief. For example, within 25 km, one can travel from sea level to over 10,000 feet. The area is also witness to extremes in temperature and precipitation: Historically, precipitation within the valley bottom has averaged less than 5 cm per year, with some years registering no measurable rainfall. Precipitation rises with elevation, and rainfall reaches over 30 cm per year in the higher mountain ranges. While winters are generally mild, summer temperatures in the valley bottom may reach 50°C or more. At the same time, snow can be found in the surrounding mountains for much of the year, and summer temperatures in montane environments rarely reach 25°C.

High topographic relief coupled with differential rainfall and temperature by elevation gives rise to a diverse ecology within the Death Valley area. Many plant and animal communities can be found within short distances of one another, varying from Desert Scrub and Salt Flat communities in the valley bottom, to piñon/juniper woodland in mid-elevations, to subalpine and bristlecone-pine forest in higher elevations. The inverse correlation between temperature and altitude causes plants to bloom first in the warmer and lower regions, and gradually, over the course of several weeks, at higher elevations.

Despite these extremes, people did quite well in prehistoric Death Valley. Although probably never boasting a large or dense population, occupants made the most of the biodiversity within the region (Steward 1938). Major plant food resources of the late prehistoric inhabitants included mesquite, piñon, seeds from several species of grass, and cactus. In addition, various roots, tubers, berries, and greens were exploited. Animal products, although probably of less dietary impor-

tance than vegetable items, included rabbits, mountain sheep, deer, and small rodents, as well as the collection of lizards, tortoise, and some insect species. Seasonal transhumance between ecological zones to take advantage of locally abundant resources was probably the rule rather than the exception in Death Valley (that is, in opposition to the transport of food resources to a central base), and may have included travel to and between different Great Basin valley systems.

POTTERY IN DEATH VALLEY

Pottery became an important part of the cultural adaptation to Death Valley only during the later part of prehistory. The earliest dated ceramics recovered from the area include sherds decorated in Southwest Anasazi styles. Whether these items were locally made or imported is not known, although the latter it is often assumed, and was not investigated as part of the current research. However, the presence of these items suggests at least a latent knowledge of the usefulness of pottery for desert living, and may have paved the way for the later development of Owens Valley Brown Ware ceramic technology, the more common and well-known Death Valley type.

Few absolute dates exist from the Death Valley area to help date the introduction of brown ware to the region. Reports commonly suggest a date around AD 1000 to 1200, but these figures are based more on conventional wisdom or analogies to nearby areas than direct evidence. An emphasis on survey rather than excavation and an ethic of preservation and protection over exploration within the National Park have contributed to this situation, and it is unlikely we will learn more about when brown-ware pottery was first used in Death Valley in the near future. In nearby Owens Valley where radiocarbon dates do exist, pottery seems to make its appearance around AD 1400. In short, pottery seems to have been introduced to Death Valley *sometime* during the late prehistoric period or Death Valley IV (between AD 1000 to 1750). Even less is known about possible changes in ceramic technology, if any, during the ensuing years in which pottery was made.

As is the case for other parts of the Great Basin and Southwest (Pippin 1986), there is disagreement over what these pot sherds should be called, whether Owens Valley Brown, Death Valley Brown, Intermountain Brown, Shoshone Brown, or some other term, though the first term is most often used. Because they are typed under a single all-inclusive term, there is an implicit assumption that all sherds are alike. Using petrographic analysis of pottery thin sections,

Charles Hunt (1960) long ago showed this not to be the case. He found pottery tempers grouped into several distinct types, indicative of the original location of pot manufacture. However, the typology he developed with Alice Hunt, as well as this technique of analysis, has not been adopted by subsequent researchers, and recent investigations tend to lump pottery into a single spacio-temporal and functional group.

There also seems to be disagreement over the location of production of Death Valley brown wares. Based on thin section studies and stylistic characteristics, some have suggested that nearly all pottery was imported to the Death Valley region (A. Hunt 1960; C. Hunt 1960), while others, based on ethnographic data and the widespread availability of clay, believe brown wares to be locally produced (Deal and D'Ascenzo 1987: 19; Tagg 1984: 24; W.J. Wallace 1986).

Clay would have been available in both upland locations, as residual or decomposing parent bedrock (such as granite or basalt), and lowland locations, as both decomposing alluvium and sedimentary clay in playa lake beds. Charles Hunt (1960) felt the latter would not have been suitable for ceramic production due to the presence of calcium carbonates, salts, and other evaporite minerals. His convictions were substantiated by the near-absence of salt minerals in more than seventy-five thin sections from Death Valley. The possibility of removing such minerals through leaching, washing, or souring clay, was not considered, and, as a result, the issue of local versus nonlocal pottery production has not been resolved.

INAA SAMPLING

OF DEATH VALLEY BROWN WARE

In order to help resolve these questions, a sample of Death Valley sherds and clay sources was submitted for INAA. Analysis was undertaken on forty-one distinct sherds collected within the valley. Included was one ethnographic pot and forty archaeological sherds collected during surface survey. To investigate variability within individual ceramic vessels and to verify replicability of the analyses, two additional samples were taken from different locations on sherds already included among the forty archaeological samples, giving a total of forty-three samples analyzed. Compositional data were compared to analogous data collected from brown-ware assemblages from other parts of California (see Eerkens, Neff, and Glascock 1998; chapter 10). In addition, five clay samples from Death Valley were analyzed for comparative purposes, representing lowland (four) and upland (one) locations. These clays were collected from central Death Valley near the findspots of most ceramics included in the study.

The INAA pottery sample represents sherds collected from two main areas (figure 11.1), Mesquite Flat (twenty samples), and the margins of the Death Valley Salt Pan (sixteen samples). Two additional samples come from Strozzi Ranch in the Grapevine mountains, while the final two samples represent unknown localities within Death Valley. In an effort to maximize the number of individual vessels sampled, only one sherd was analyzed per site, except in cases where sherds from the same site were obviously from distinct pots. Moreover, to investigate how chemical data relates to vessel shape and size, only rim sherds were sampled. In this manner, chemical composition could be compared to attributes such as vessel thickness (measured 1 cm below the lip), estimated mouth diameter, wall shape (straight versus bowled or rounded), lip shape (rounded, squared or flat, or pointy), lip lateralization (sloped to the exterior, interior, or symmetrical), rim form (direct versus recurved or outflaring), mode of surface finish (whether wiped with a tool such as a small stone [encoded "tooled"], wiped with the fingers or brushed with a narrow item such as a bundle of twigs [encoded "brushed"], or not wiped and left smooth [encoded "smooth"]), and the presence or absence of decoration, which is often limited to the vessel rim and/or neck. The method of welding or blending coils together was also recorded. As seen in wall profiles, some sherds seemed to have coils which overlapped on the interior, where clay from the upper coil was pushed or extended down onto the lower coil on the interior side of the pot only. Other pots seemed to have coils that overlapped on the exterior, and some pots displayed coils that were not overlapped and were neatly stacked vertically on top of one another. These three-coil welding styles were encoded as interior, exterior, and even, respectively.

A fresh break on each sherd was also observed under low-power magnification (30x) to determine firing properties as seen in the core (whether an oxidizing or reducing atmosphere) and to examine the types, density, and average size of temper particles within each sample. The latter two attributes are largely subjective in nature and were based on visual examination, hence only temper large enough to be seen through low-powered magnification was included. Sherds which appeared to contain less than 33% temper by total sherd volume were classified as low density, 33% to 66% temper was termed medium density, and greater than 66% temper by volume was classified high density. Apparent average temper particle size below 0.25 mm in diameter was considered fine, between 0.25 and 0.5 mm was classified medium, and larger than 0.5 mm was termed coarse.

INAA RESULTS

As in most compositional studies, the INAA results were used to divide sherds into groups or clusters. Parts per million concentrations of thirty-two elements were used to define boundaries around certain sets of samples, where variability within sets was greater than variability between sets (chapter 1), and samples within the groups tend to covary among different elements. Nickel was the only element of the thirty-three typically produced at MURR that had to be dropped from the analysis due to levels below detection limits for most samples. The statistical methods employed to create the groups have been described elsewhere by Glascock (1992) and Neff (chapter 2).

Results from the chemical analysis show Death Valley pottery to be variable and complex. No single cohesive group or chemical signature defines the sample of sherds submitted for INAA, and variability within the data set for individual elements (such as calcium, rubidium) was often equal to or more variable than analogous data from pottery from Owens Valley, Sequoia National Park, Deep Springs Valley (Eerkens, Neff, and Glascock 1998), and extreme Southern California (see chapter 10). This variability, however, was not uniformly distributed across the data set, and samples tended to cluster into distinct compositional groups, where chemical differences between groups were greater than differences within groups. Approximately half (eighteen) of the Death Valley specimens display characteristics unlike other pottery from California analyzed to date, and were combined here into a single loosely defined group. For reasons discussed below, this group was defined as Death Valley 1 (DV1). In particular, these sherds exhibit elevated concentrations of strontium and, to a lesser degree, barium, chromium, and arsenic, in concert with lower levels of zinc, uranium, and thorium. Figure 11.2 shows bivariate plots for raw parts per million (ppm) concentration values of cerium and strontium and shows separation between brown-ware sherds collected in Death Valley and 140 others from various regions in Eastern California (Eerkens, Neff, and Glascock 1998). A similar effect can be achieved using principal component analysis, where Death Valley sherds stand off from other eastern Californian sherds. Note that sherds in figure 11.2 (that is, data points) are labeled only by where they were collected and not their chemical reference group. The DV1 sherds discussed above were given solid circles in Figure 11.2.

Two sherds (fig 11.2) from Northern Owens Valley and one from Deep Springs Valley have similar chemical signatures for these elements and may belong to the Death Valley

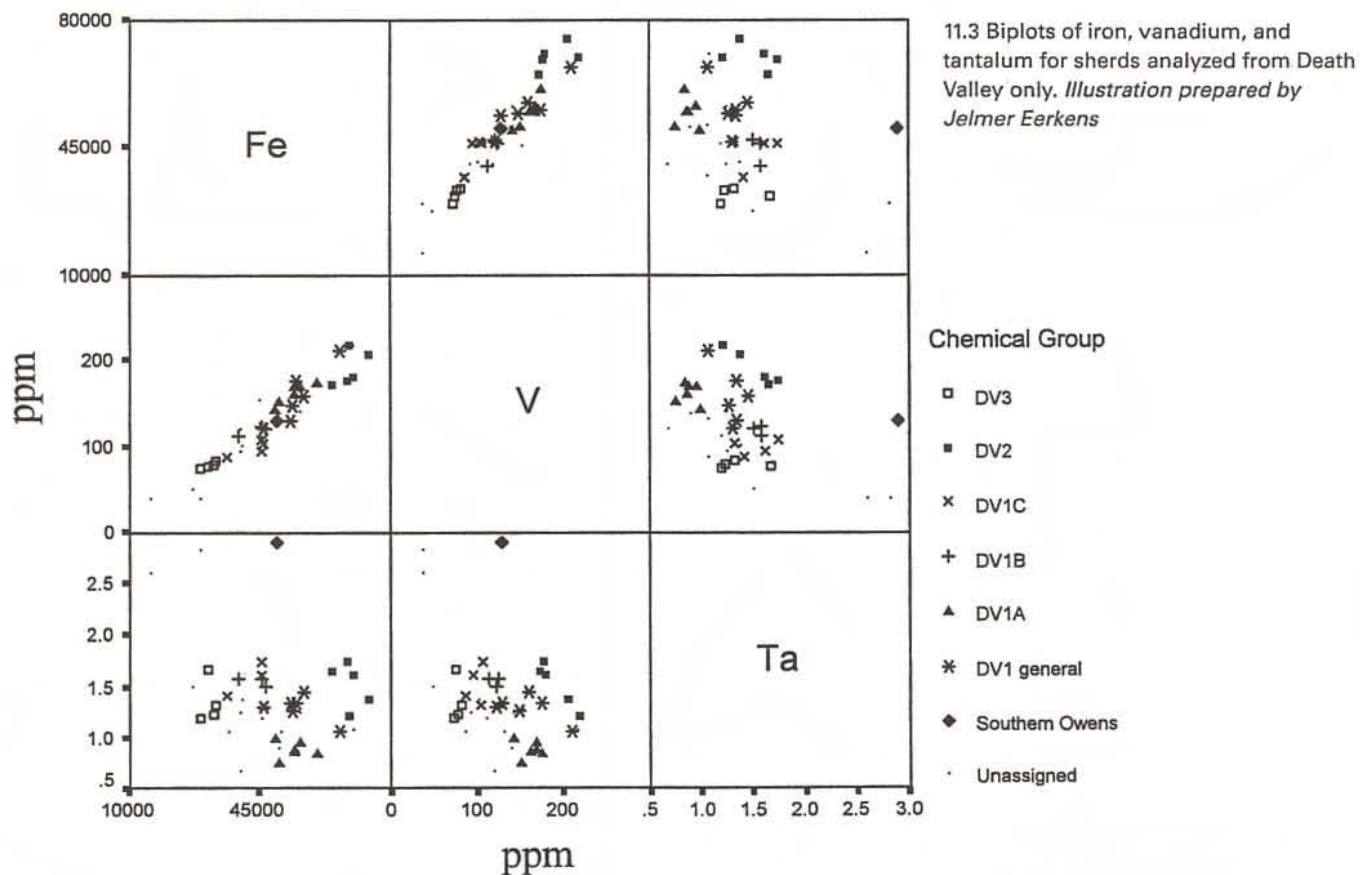
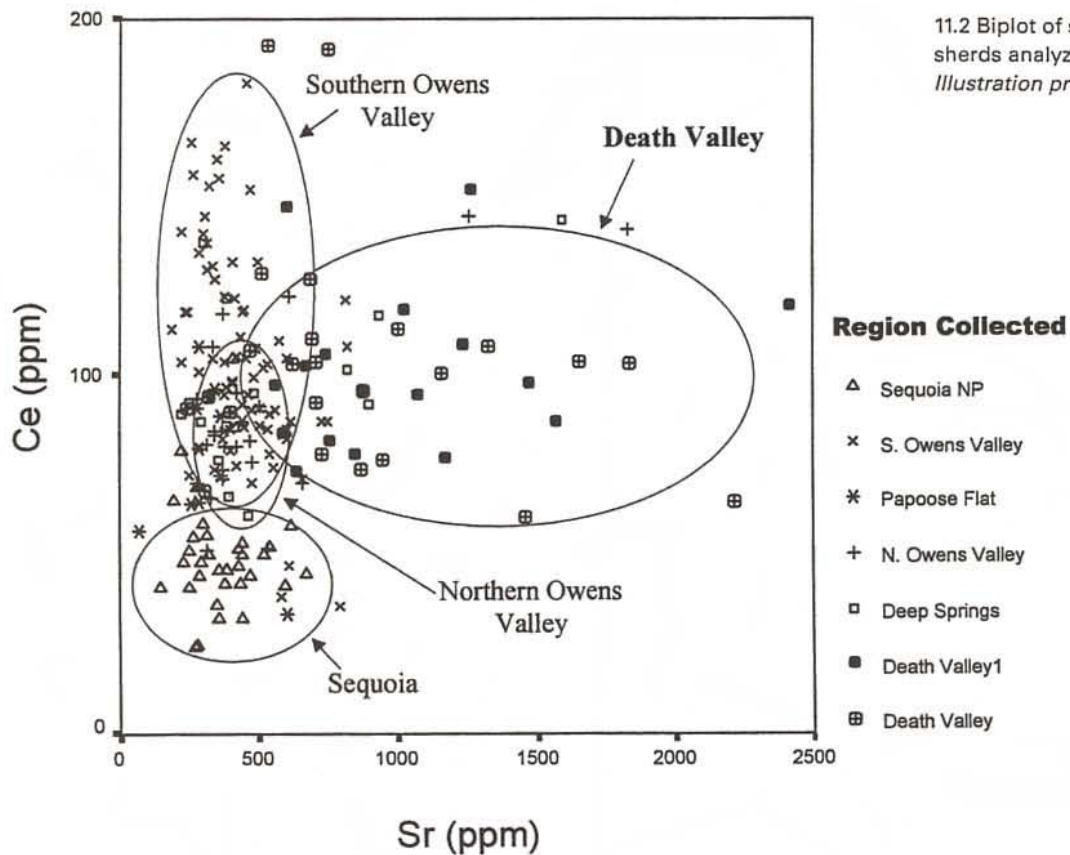
chemical group (but have slightly higher cerium values). Several Death Valley sherds display signatures at odds with the majority of other samples from the region and do not seem to be part of the DV1 group. These samples were given open circles with crosses in the middle in figure 11.2.

Within the DV1 group, three subgroups were further provisionally defined, DV1A, DV1B, and DV1C, composed of five, three, and four sherds respectively. Although sample sizes are small, these specimens again appear to form discrete clusters within the larger DV1 group. In addition to the larger DV1 group, two other sets of five and four artifacts appear to separate as distinct chemical groups. Similar in some respects to DV1 (with elevated strontium, chromium and lower zinc, uranium, thorium), they are distinct on several other elements, including iron, hafnium, potassium, cobalt, and vanadium. These groups were termed Death Valley 2 (DV2) and Death Valley 3 (DV3). DV2, in particular, shows ties to DV1, while DV3 departs further from this pattern. Figure 11.3 presents bivariate plots of unlogged values (raw data in ppm) for iron, tantalum, and vanadium. Principal component analysis further supports these findings, suggesting that better separation is achieved in higher dimensional spaces. Additional chemical analyses should be undertaken to determine the uniqueness and viability of these subgroups.

The higher levels of strontium seen in the majority of Death Valley sherds may be related to the presence of various calcium carbonates in the local geology. Strontium readily substitutes for calcium in the molecular structure of some calcium carbonates, especially aragonite. Moreover, Death Valley is a source of strontianite, a member of the aragonite mineral family that is commonly found with calcite and contains high levels of strontium. The mobility of strontium in clay and its tendency to bond with carbonates combined with the presence of significant quantities of strontianite in Death Valley may explain the high levels of strontium seen in the Death Valley sherds and clays. The senior author is currently investigating this possibility at the University of Calgary using an electron microprobe and petrographic analysis of thin sections of Death Valley pottery.

Only one sherd was defined as a "trade ware," having strong similarities to pottery collected from the western fringes of Owens Lake in Southern Owens Valley, approximately 160 walking km to the west. While no sherds displayed characteristics suggesting membership in the Sequoia, Northern Owens Valley, or Southern California (see chapter 10) chemical groups, several unassigned Death Valley pieces showed affinities to other sherds collected in Deep Springs

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Valley, Papoose Flat, and Northern Owens Valley. Yet, variability among these pieces was too great to warrant definition of a unique group. It is possible that these items derive from a distinct, but highly variable, clay source located somewhere between these areas (to the northwest of Death Valley), but this issue will have to await further research. Finally, the single ethnographic sherd examined proved to be the greatest outlier within the larger California pottery data set, having unusually high or low concentrations of almost every element analyzed.

Thus, of the forty archaeological sherds subjected to INAA, twenty-seven (67.5%) were assigned to clusters unique to Death Valley, and one to a cluster from Southern Owens Valley. The final twelve (30%), as well as the ethnographic sample, represent outliers that, based on current evidence, could not be assigned to discrete groups, even when compared to previously defined chemically based pottery groups from Owens Valley, Sequoia National Park, Deep Springs Valley, and extreme Southern California. Given the present information indicating they are not from the west or north, past inferences suggesting most Death Valley sherds are from areas to the east (C. Hunt 1960), and the presence of other painted ceramics in Death Valley known to be from the Southwest, it seems likely that at least some of these unassigned specimens are from regions of the Southwest to the east or southeast. Indeed, subsequent INAA analyses suggests that at least three of the unknown specimens are derived from clays collected to the northeast, in the Nevada Test Site (Eerkens 2001).

The two samples representing duplicates of the same pots, that is, specimens used to check the consistency of the INAA method, proved to be very similar to their appropriate counterparts. This suggests that chemical variability within a single pot is far less than variability between pots.

The five clay samples submitted for INAA proved, quantitatively, to be distinct from most of the Death Valley pottery samples. At the same time, the clays displayed certain properties making them distinct from other clay samples collected from California and Western Nevada, suggesting that clays in the area do contain a distinct chemical signature. In particular, and like the DV1 pottery group, the Death Valley clays contained unusually high concentrations of strontium, combined with lower levels of zinc and uranium, when compared to these other clay samples. When compared to the pottery specimens, however, these trends were sometimes greatly exaggerated. For example, while the DV1 pottery group ($n=18$) contained average strontium values of 1045 ppm and DV2 av-

eraged 1017 ppm (compared to, for example, thirty-six Southern Owens Valley sherds at 389 ppm), Death Valley clays ($n=5$) displayed average strontium values of 2836 ppm (compared to 483 ppm for twenty-one other clays collected to the north and west of Death Valley). Indeed, two clay samples collected in the Mesquite Flat region were provisionally assigned to the DV1 chemical reference group based on these similarities. In short, the sampled Death Valley clays do not exactly match the Death Valley pottery samples on a quantitative bases, but qualitatively are very similar, particularly to the DV1 pottery group. Clearly, the effects of temper added to the pottery sherds may be playing a role here, and future analysis will address this issue.

DISCUSSION

Having defined and discussed the chemical data and groups, four main questions present themselves. First, given the INAA pottery and clay data, what is the likely geographic origin of the clays used to make the pots ultimately discarded in Death Valley, in other words, were Death Valley pots made locally or carried in? Second, do the chemical groups correspond to any physical attributes on the sherds so that we can apply this new typology to other Death Valley pottery without having to subject each piece to INAA? Third, how do previous typologies of Death Valley pottery compare to INAA data? Finally, what do the clusters tell us about the prehistoric behavior of Death Valley inhabitants?

Origin of Death Valley pottery

Death Valley pottery (minus one Southern Owens Valley trade ware and twelve unassigned specimens) has little similarity to either clay or pottery collected in Owens Valley, hence the term Owens Valley Brown Ware is misleading and inappropriate for the majority of ceramics from Death Valley. Furthermore, these sherds show little affinity for clays collected to the north. In light of the qualitative similarities to the sampled Death Valley clays, particularly by the high values of strontium, the DV1 pottery group is interpreted as being local in origin. It is possible that these sherds derive from a chemically similar clay source to the south or east, as clay from these areas was not sampled, but the widespread availability of clay within Death Valley and the large number of sherds displaying these tendencies suggests a more local origin, probably within the valley proper. The case for DV2 and DV3, while certainly not from the west or north, is less clear. These sherds show certain affinities to Death Valley clay, but depart in some respects as well, particularly the DV3 group.

These items may have been made from clay found in a more distant or geologically different part of the valley, or from a nearby valley located to the east or south. In any event, the source of this clay was chemically similar but slightly different from clays from the center of Death Valley where the sherds were found.

The reasons why the Death Valley clays do not exactly match the pottery probably include the senior author's failure to sample the exact same clay beds and sources used by prehistoric inhabitants, but may also stem from the alteration of clay prior to firing through souring, leaching, addition of temper, and/or mixing of clays by Shoshone potters. Such alteration is likely to change quantitative chemical values, but ratios between different elements and qualitative differences should, for the most part, hold.

That much of Death Valley pottery is local in origin is in opposition to the conclusions reached by Charles Hunt (1960). He rejected valley bottom clays as suitable raw material for making pottery, stating that they contained too many salts and/or calcium carbonate minerals. In part, this led him to believe that all pottery was brought in from outside the valley, primarily from the east. However, he may not have adequately considered the potential for leaching clays of these minerals and/or alternative sources of clay, such as mid-elevation locations relatively free of salts. Moreover, experimental firing of small tiles made from valley bottom clays by the senior author suggests that some are of pottery quality (that is, they do not explode during firing or flake or fall apart following firing) and may have served prehistoric potters well. Finally, examination of fresh breaks on sherds under a black light suggests that some do contain calcium carbonate minerals such as calcite, which fluoresce when exposed to ultraviolet light, without any detrimental effects to the stability of the pot.

In sum, DV1 is interpreted as being made within Death Valley from local clay. Until further clay samples from regions to the south and east are collected and analyzed, DV2 and DV3 are tentatively interpreted as local to or from just east of Death Valley as well. Further sampling of clay from within Death Valley may also help to tie these groups to more specific localities within the valley.

Comparing chemical data and physical attributes

Table 11.1 presents values for several physical attributes of the sherds measured within each group, including thickness just below the rim, estimated mouth diameter, wall profile, neck or rim profile, lip shape, presence or absence of decoration,

surface finish, the density and average size of temper constituents, and surface color. Even with such small sample sizes, the range of characteristics for most attributes tends to overlap between groups. This suggests that it is not possible, with certainty, to assign a sherd to a particular chemical group based on physical characteristics alone.

At the same time, there are trends towards certain sizes, shapes, or attribute types within different groups. The small sample sizes prohibit rigorous statistical comparison and suggest caution in drawing absolute conclusions, but several differences can be observed. For example, DV3 sherds appear to depart from many of the norms seen in other groups in that they are about 20% thicker and display surface colors more in the grays than browns or reds. Temper within these sherds also tends to be on the large, coarse side, with fewer ferruginous (likely magnetite) and more clear quartz grains. These data are congruous with the INAA results, which suggest that DV3 is different from DV1 and DV2. Similarly, DV2 sherds have more micaceous and dark ferruginous temper constituents (and as a result higher iron levels) than either DV1 or DV3, are often smooth on the surface, and are more often recurved and decorated than DV1 pots. Within the sample analyzed for INAA, these sherds were also exclusively found on Mesquite Flat. Sherds in the DV1A group tend to be fired in an oxidizing atmosphere and often contain transparent green to yellow temper particles (likely epidote or olivine). Future thin-section work (currently in progress) will help in the identification of mineral temper constituents.

In some respects, the DV2, DV3, and unassigned sherds seem to share certain characteristics when contrasted to DV1. For example, these sherds are more often recurved (41% versus 6%), decorated (32% versus 11%), and smooth on their surface (40% versus 19%), than their DV1 counterparts. These differences suggest that DV2, DV3, and many of the unassigned specimens may represent distinct ceramic traditions, emphasizing different styles of manufacture and finish, vessel shapes, and/or qualities and sources of clay.

On the whole, DV1, DV2, and DV3 sherds, when considered separately, are more standardized than unassigned sherds. For example, lip lateralization (that is, whether the lip slopes towards the interior, exterior, or is symmetrical) is either symmetrical or exterior lateralized among DV1 rim sherds (thirteen symmetrical, five exterior), and entirely symmetrical among DV2 and DV3, but is more diverse among unassigned specimens, where all three forms occur (eight symmetrical, three interior, two exterior). Similarly, DV1 (for eight of nine sherds measurable for this attribute), DV2 (three of three),

Table 11.1: Physical Attributes of Sherds by Chemical Group

Attribute	DV 1 (n=18)	DV 1A (n=5)	DV 1B (n=3)	DV 1C (n=4)	DV 2 (n=5)	DV 3 (n=4)	Unassigned and Trade (n=13)
Locations found	8 Mesquite 8 Salt Pan 1 Grapevine 1 Unknown	2 Mesquite 2 Salt Pan 1 Unknown	1 Mesquite 1 Salt Pan 1 1 Grapevine	4 Salt Pan	5 Mesquite	2 Mesquite 2 Salt Pan	5 Mesquite 6 Salt Pan 1 Grapevine 1 Unknown
Avg. thickness	5.3	5.1	5.5	5.0	5.0	6.5	5.1
Avg. diameter	25.1	23.2	29.2	23.4	25	25	21.4
Wall profile	9 Bowled 5 Straight	3 Bowled 1 Straight	2 Bowled 1 Straight	1 Bowled 1 Straight	4 Bowled	4 Bowled	3 Bowled 5 Straight
Rim form	17 Direct 1 Recurve	4 Direct 1 Recurve	3 Direct	4 Direct	2 Direct 3 Recurve	2 Direct 2 Recurve	9 Direct 4 Recurve
Lip shape	14 Rounded 4 Squared	5 Rounded	3 Rounded	2 Rounded 2 Squared	4 Rounded 1 Squared	3 Rounded 1 Squared	6 Rounded 3 Squared 4 Pointy
Lip lateralization	13 Sym.* 5 Exterior	2 Sym. 3 Exterior	1 Sym. 2 Exterior	4 Sym.	5 Sym.	4 Sym.	8 Sym. 2 Exterior 3 Interior
Finish	6 Tooled 7 Brushed 3 Smooth	2 Tooled 2 Brushed	1 Tooled 2 Brushed	1 Tooled 2 Brushed	2 Tooled 2 Smooth	3 Tooled 1 Brushed	1 Tooled 4 Brushed 6 Smooth
Coil welding	8 Interior 1 Even	1 Interior		2 Interior 1 Even	3 Interior	2 Interior 1 Even	2 Interior 2 Even 3 Exterior
% Decorated firing atmosphere	11% (n=2) 9 Oxidized 9 Reduced	0% (n=0) 4 Oxidized 1 Reduced	0% (n=0) 1 Oxidized 2 Reduced	0% (n=0) 1 Oxidized 3 Reduced	40% (n=2) 3 Oxidized 2 Reduced	25% (n=1) 1 Oxidized 3 Reduced	31% (n=4) 4 Oxidized 9 Reduced
Temper size	6 Fine 9 Medium 3 Coarse	2 Fine 3 Medium	2 Fine 1 Medium	3 Medium 1 Coarse	4 Medium	2 Medium 2 Coarse	3 Fine 7 Medium 3 Coarse
Temper density	8 Low 7 Medium 3 High	1 Low 4 Medium	3 Low	2 Low 1 Medium 1 High	1 Low 2 Medium 2 High	4 Medium	4 Low 7 Medium 2 High
Range in surface color	Red, Grey to Dark & Red Brown	Red; Grey- Brown	Grey to Red Brown	Red; Grey- Brown	Grey & Red Brown; Black	Yellow to Brown Grey	Red to Dark Brown; Grey; Red

* symmetrical

and DV₃ (two of three) pots were constructed mainly by overlapping coils on the interior of the pot, while unassigned sherds display coils overlapping on the exterior (three of seven), interior (two of seven), as well as nonoverlapping or even coils (two of seven), where coils were stacked on top of one another. These findings support the INAA results, suggesting DV₁, DV₂, and DV₃ represents distinct and coherent groups made by a restricted range of individuals with a common method of manufacture, while unassigned sherds represent multiple people and more diverse manufacturing techniques.

In short, while groups tended to have restricted variation, the range of characteristics between groups overlapped sufficiently to make assignment of unanalyzed sherds to groups, based solely on physical characteristics, impossible. With additional studies, however, it may be possible to give probabili-

ties of membership based on observable traits, particularly if multiple attributes are used in combination. For example, decorated sherds with recurved rims are unlikely to belong to DV₁ (n=0 of 18) but are more likely to belong to DV₂ (n=2 of 5) or DV₃ (n=1 of 4), based on the current sample of sherds analyzed. For the time being then, INAA or some other method of compositional analysis will have to be used to replicate the typology defined here.

Comparison of chemical data and previous typologies

Unfortunately, this study was unable to compare the typology developed by Alice Hunt (1960) in categorizing Death Valley pottery to the typology developed from INAA data. This was largely because we were unable to replicate her typology, despite the fact that nine of the same sherds Hunt used to de-

velop her typology were included in the INAA study. The main typological division in the Hunt system concerns the mode of thinning and finish, that is, whether the pot was thinned using paddle and anvil technology or was wiped using fingers or some other object (such as a stone or pot sherd). Hunt had found that approximately 25% of the one thousand sherds she collected from around the Death Valley Salt Pan were thinned using paddle and anvil. Of the sherds included in this study, however, only two, both DV₃, displayed any obvious dimpling characteristic of the paddle and anvil technique (A. Hunt 1960). Moreover, one of these sherds contained wiping marks on the opposite (that is, the supposed paddled) surface, making for confusion as to the source of the dimples (whether by paddle and anvil or simply depressing fingers into the wet clay to help shape the pot). Similarly, in a sample of over four thousand sherds collected from Mesquite Flat, only 25 km north of the Salt Pan, W.J. Wallace (1986) did not find a single sherd finished by paddle and anvil. It seems remarkable, particularly given their geographic proximity and the overlap in raw materials between the two areas, that one collection would contain so much paddle and anvil finished pottery while the other lacked it completely.

Further replication of Hunt's typology could not be performed because much of it was based on the analysis of petrographic thin sections, a method not used here. However, there is likely to be some correlation between the two typologies developed, and some of the previously mentioned differences between chemical groups: For example, the presence of transparent green and yellow temper may correspond to types defined by Hunt. Based on the descriptions offered by A. Hunt, there seems to be some correspondence between what she defined as "Shoshone Ware" and the DV₁ group. Moreover, our DV_{1A} fits the description offered for Hunt's II B₁ (her "Death Valley Brown"), and our DV_{1B} roughly matches Hunt's II A₃, both specific varieties of Hunt's "Shoshone Ware." In fact, one of the DV_{1A} sherds included in this study may have been thin sectioned by Hunt and used to define her Death Valley Brown type. Similarly, our DV₃ may be related to Hunt's Southern Paiute Utility Ware, specifically her type II A₁. Our DV₂ does not seem to match any of the types defined by Hunt, but in this study its range was confined to Mesquite Flat, an area she did not study.

At the same time, some of the definitions provided by Alice Hunt seem too restrictive for the chemical groups defined here. For example, a third variety of Shoshone Ware contains specimens with only smooth exteriors. Yet, smooth

surfaces were relatively rare in the DV₁ group, and never occurred exclusively in any of our chemical groups. Similarly, DV₃ seems to include greater variation than Alice Hunt defined specifically for Southern Paiute Utility Ware (II A₁). It seems then, there is some degree of overlap between Hunt's typologies and our own. Unfortunately, the present study did not generate the necessary data to reliably duplicate Hunt's typology, namely a mineralogical study of temper constituents through petrographic thin sections. Thus, without her original sherd classification or petrographic study, the exact degree of overlap is not known. The degree of correlation between our chemical groups and the types defined by Hunt will have to await verification by a more thorough analysis of thin sections of samples included in the INAA study.

Inferences about prehistoric behavior

Other than the attempts of the Hunts (A. Hunt 1960; C. Hunt 1960) to separate Death Valley pottery into distinct types, Death Valley archaeologists have generally lumped pottery into a single category. Yet, INAA has shown that ceramics from this area are quite diverse. Even within the small sample of forty sherds, there are no fewer than five distinct groups with three or more members. In addition, twelve sherds remain unassigned which, with a larger sample and additional studies, would undoubtedly find membership in further groups. We believe that dividing Death Valley pottery into meaningful groups goes a long way toward furthering our understanding of prehistoric behavior.

First, as discussed above, the chemical groups display different modal and average shapes, sizes, and styles of production. Many of these differences, such as preferences for a certain type of coil welding or lip lateralization, appear to be unrelated to pottery function. This suggests manufacture by disparate peoples with different pottery-making traditions. Differences in other traits, such as preferences for a certain thickness or rim form, may be more directly related to the function of pots, and may indicate different roles for ceramics within these traditions. Whether the differences are a function of chronological change in how and where pottery was made, represent simultaneous use of Death Valley by different peoples, exchange of vessels across space, or preferences for certain clays for certain pot functions is unknown, but should be the subject of future research. However, outlining some of the differences through INAA and acknowledging that different traditions emphasize different features and do not necessarily incorporate the full range of variation seen in all brown-ware pottery is an important first step in deepening

our understanding of brown-ware pottery, and how and why it varies within the region.

Second, just as sourcing obsidian and tracking movement of shell artifacts has deepened our understanding of long distance exchange and mobility patterns in the area (see, for example, Basgall 1989; Hughes and Bennyhoff 1986), sourcing pottery and developing a typology of different source groups can also contribute to this arena. At least 45 to 65% of the sherds were determined to be of local origin. The current research also shows that long-distance trade of pottery with areas to the north, south, and west was not an important aspect of making a living in Death Valley. Only one of the forty archaeological sherds analyzed was confidently placed within an existing group that has origins 100 or more kilometers away, an item derived from Southern Owens Valley (160 km west). This piece is decorated and has a recurved rim, traits that are rare to the Owens Valley area (Griset 1988; Riddell 1951), but more typical of Death Valley pots (Eerkens 2000). No Death Valley sherds matched the chemical signatures of groups and clays native to Sequoia National Park, Northern Owens Valley, or extreme Southern California. If trade or exchange was important to prehistoric Death Valley inhabitants, it was over shorter distances, or was carried out with people living to the east (for which no database of ceramics analyzed by INAA currently exists). It seems likely that a significant fraction of the 30% unassigned sherds are from areas in this direction, indicating the ties Death Valley people had with the western Southwest. Again, developing a typology and dividing ceramics into different categories, in this case local versus extralocal, is crucial to recovering such information.

Finally, the development of a typology, if tied to chronological dates, can help document change in ceramic technology through time. The single ethnographic specimen analyzed was without exact information regarding when it was made or by whom, but was labeled as being from the twentieth century and made by a Timbisha (Death Valley) Shoshone, probably near Furnace Creek. It proved to be unlike any other sherd analyzed from Death Valley, or anywhere else in California for that matter, and did not match any of the sampled clays either. Moreover, the vessel is shaped like a deep circular pan, atypical of prehistoric Death Valley or Great Basin ceramic forms (Griset 1988; Pippin 1986; Riddell 1951; Steward 1928; Touhy 1986, 1990; W.J. Wallace 1986). Although only a single sample, together these items suggest a change in the style of manufacture and the source of clays from prehistoric to historic times. Others have noted that pottery was one of the first crafts abandoned by Native Cali-

fornian peoples following contact with Europeans in the early nineteenth century, replaced quickly by metal cooking containers (Griset 1988). It may be this replacement, combined with a loss of knowledge about how to make pottery, which led to such a departure in traditional ceramic manufacture. Timbisha Shoshone in the twentieth century may have tried to rekindle the pottery craft, but resorted to using imported, perhaps commercially sold, clays to make pots similar in appearance to pans, a common shape of metal cooking vessels. Indeed, ethnohistoric photographs of Western Great Basin people often show metal pans in domestic shelters (Milliken, Gilreth, and Delacorte 1995). It is possible that such a pan served as a mold for the ethnographic vessel.

CONCLUSIONS

Previous research in Death Valley has tended to lump all brown ware into a single category, and, as a result, has compromised the utility of ceramic analysis. This study has shown that brown wares from Death Valley are not all alike. Sherds tend to fall into chemically distinct, but technologically, physically, and visually overlapping categories. Although there are trends towards certain shapes, sizes, styles, and construction techniques, it is not possible with absolute certainty to assign sherds to chemical categories based on these visible characteristics alone.

INAA of sherds and clays and the development of a preliminary typology for Death Valley brown wares have helped to resolve the debate on where this pottery was manufactured, in addition to providing new information on mobility and exchange patterns of late prehistoric inhabitants. Slightly less than half of the samples analyzed were attributed to three distinct local clays from central Death Valley. An additional nine samples were probably produced from clays found elsewhere in the valley, such as in more remote locations or just outside the valley (to the east or south). A single specimen was attributed to clays from Southern Owens Valley, while twelve were unlike other sherds thus far analyzed from the desert west. These twelve may be imported from areas to the east, such as the Virgin River area or the Colorado River area to the southeast. A high degree of chemical diversity among the sampled sherds may be consonant with high residential mobility for late prehistoric people in the region. However, additional clay sourcing analysis is needed to verify this conclusion.

Future INAA studies should seek to expand the database of sherds and clay samples. For example, we are currently in the process of analyzing specimens from the Mojave Desert

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to the south and the Nevada Test Site to the northeast. Doing so will increase the power of statistical comparisons between chemical groups, will better document the range of variation within groups, will give a broader overview of ceramic variability within Death Valley, will better document the extent and frequency of long distance exchange and/or mobility, and will bring greater precision in assigning chemical groups to specific geographic locations.

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