

# Luminescence Dating of Pottery from Owens Valley and Death Valley

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## Abstract

We report 21 luminescence dates on brown ware pottery from Owens Valley and Death Valley, eastern California. Traditional interpretations suggest that pottery technologies were adopted around 650 years ago throughout the western Great Basin yet changed little over time. Our new dates suggest an earlier presence in the Owens Valley (1000 BP) and a slightly later appearance in Death Valley (600 BP). Moreover, the earlier Death Valley ceramics are different in form and temper composition from the later Owens Valley examples. We conclude that eastern California pottery technologies were dynamic, not static, with significant regional variation and diachronic innovation.

## Introduction

Ceramic classification is a vital part of archaeological research in most parts of the world where pottery is found. The creation of classes that can be used to measure variability in ceramics, usually based on decorative and/or technological characteristics, allows archaeologists to explore a broad range of topics including cooking/storage behavior (e.g., Henrickson and McDonald 1983; Smith 1985; Skibo et al. 1989; Schiffer 1990; Juhl 1995), exchange (e.g., Bishop et al. 1988; Adams et al. 1993; Rautman 1993), and craft specialization (e.g., Costin and Hagstrum 1995; Feinman 1999; Harry 2005; Vaughn et al. 2006). The most common use of such classifications, however, is in measuring ceramics with respect to variability through time.

As the cultural historians recognized long ago (e.g., Lyman et al. 1997; O'Brien and Lyman 1999), when measured with classes (i.e., "types"), decorative aspects of pottery can be observed to change over

time. By using the physical properties of spatial association and deposition to relate ceramics to other artifacts within a deposit, culture historians found that they could predict with great accuracy not only the age of other sites containing similar ceramics but also the composition of the rest of the archaeological assemblage.

While archaeologists have known about pottery in the western Great Basin for over 80 years (at least since Steward [1928]), there has been surprisingly little research on subdividing sherds into different categories to address any of the research questions noted above. Though pottery is nearly ubiquitous at habitation sites post-dating 600 BP in the western Great Basin, this artifact type is only occasionally afforded any extended analysis other than a simple count (e.g., Bettinger 1986; Griset 1988; Eerkens et al. 2002a; Eerkens 2003a, 2003b, 2004). Sherds are typically lumped together into a single analytical category, usually "brownware." Figure 1 shows the location of our study areas and important related geographic and political features.

## Classifying Western Great Basin Pottery

Several reasons account for this state of affairs. First, pottery in the western Great Basin is utilitarian in nature, rarely decorated, and never painted. Many pottery typologies worldwide, especially chronologies, are based on changes in painted designs or other decoration on pots. Western Great Basin archaeologists

are not off the hook so easy, however, because there are chronologies based on other non-stylistic factors. One example concerns changes in temper inclusions in the Southeast, where a change from sand to shell-tempered ceramics during the Mississippian period is well documented (e.g., Phillips et al. 1951; Feathers 2006).

Second, compared to other pottery-producing societies, population densities were low in the western Great Basin. Though pots seem to have been an important part of the material technology, raw numbers of sherds at most sites are relatively small, usually less than 100–200 fragments.

These low numbers make it harder to recognize and show statistical differences between assemblages. Moreover, western Great Basin brown wares are typically quite variable (e.g., Bettinger 1986), making it difficult to know which variables might be important when categorizing sherds.

Third, because pots are primarily a late prehistoric phenomenon, dating primarily to the last 600 years of prehistory (though see Eerkens et al. 1999), establishing a chronology has been complicated using radiocarbon means. This is due primarily to the extreme fluctuations in the calibration curve over the last 400 years (Stuiver and Reimer 1993). As a result, subdividing

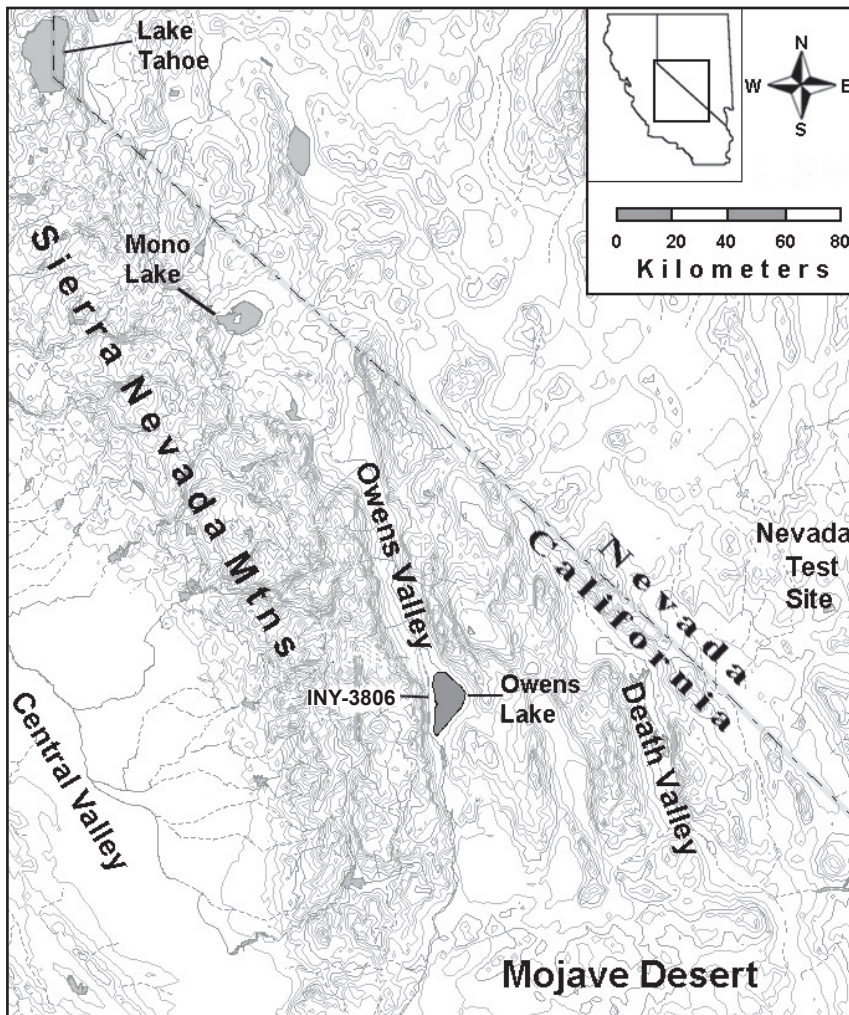


Figure 1. The Owens Valley and Death Valley study areas of southeastern California.

the late prehistoric period into distinct chronological units using radiocarbon dates is difficult.

Sherds are typically divided into three categories (rim, body, and basal pieces) and then tabulated; rarely is there additional detail. On very rare occasion sherds are measured for thickness and diameter. Moreover, sherds rarely offer much for site or behavioral interpretation. They are frequently used to date sites or site components to the late prehistoric period.

**Developing and Testing a Ceramic Chronology**

In 2003 the senior author proposed a tentative chronology of pottery based on 13 radiocarbon-dated

assemblages from the southern Owens Valley (Eerkens 2003a). That study suggested pot sherds could be divided into three distinct sets (early, middle, and late), though it was difficult statistically to isolate the early and middle due to fluctuations in the radiocarbon calibration curve. These divisions were based primarily on thickness measurements, exterior surface treatments, and the densities of organic material and mica in the pastes of sherds. As shown in Figure 2, thickness, the percent of sherds with smooth exterior surfaces, and the density of both organic and mica temper decreased over time.

Here we revisit that chronology and test it using new chronological information based on luminescence

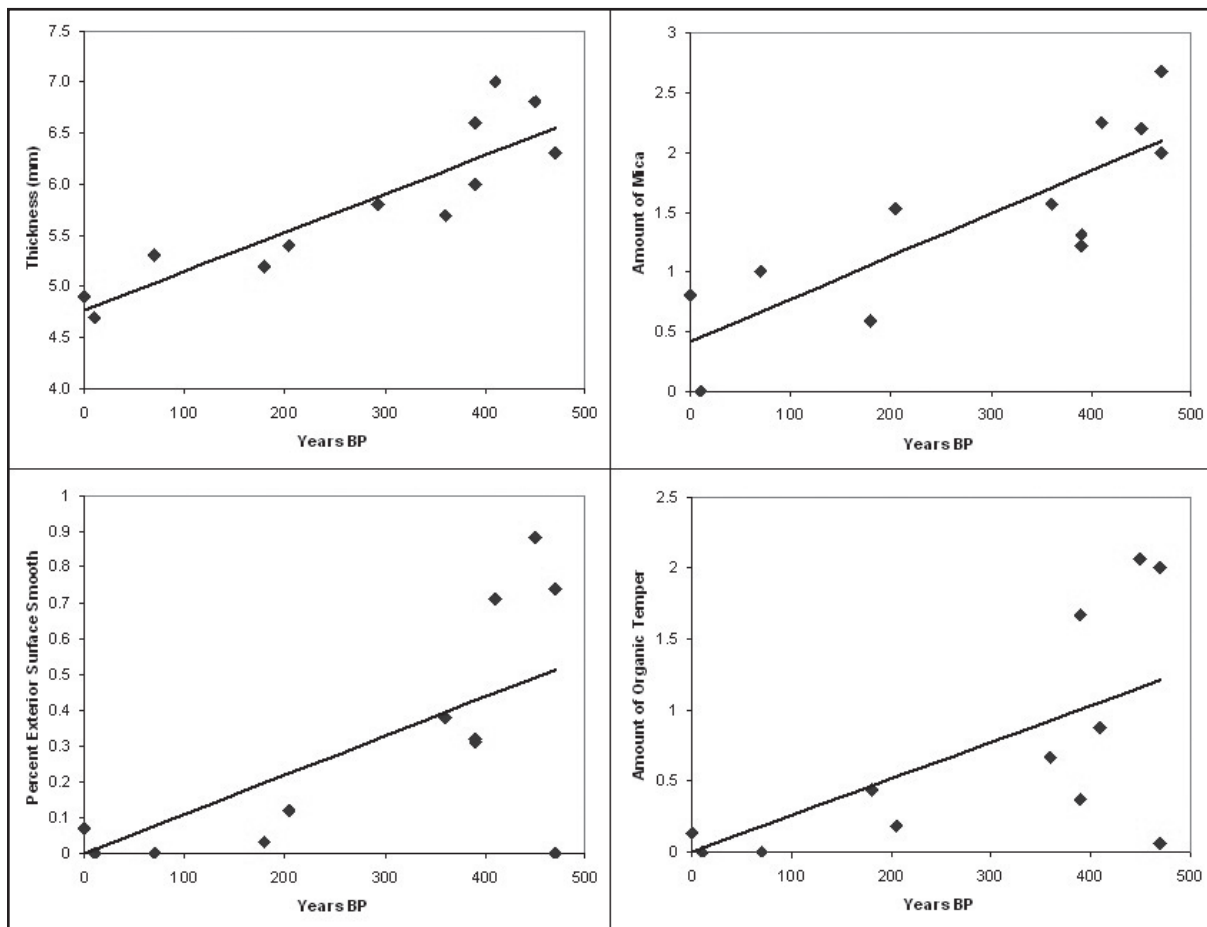


Figure 2. Changes in Owens Valley pottery based on radiocarbon dated assemblages.

dates from the Owens Valley and Death Valley. Luminescence dating allows for the dating of individual sherds, rather than requiring associations with radiocarbon dated materials, and can be used to estimate the age of surface sherds that are otherwise difficult to date. Although error terms can be much larger than for radiocarbon dates, they tend to increase linearly with absolute age. Thus, for younger sherds, error terms for luminescence dates can be smaller than for radiocarbon ones. Moreover, a major advantage of this technique for artifacts younger than 500 years is that the dates are not affected by the large fluctuations in atmospheric radiocarbon that create large deviations in the calibration curve.

### **Luminescence Dating Methods**

We selected 21 brown ware sherds for luminescence dating, 11 from six sites in the southern Owens Valley (most on the western shores of Owens Lake) and 10 from 10 different sites in Death Valley. All sherds are from the rims of pots. Each sherd was measured for a range of attributes by the senior author (see Eerkens 2003a) and then prepared and analyzed by the junior author at the CSULB Luminescence Lab.

Sherds were also analyzed by Instrumental Neutron Activation Analysis (INAA) for elemental composition to help define the nature of the clay and temper sources. We also include in the analysis two sherds from the eastern shores of Owens Lake, examined and measured previously by Eerkens (2005) for the same range of attributes that were dated by luminescence means at the University of Washington (UW1007 and UW1008).

Luminescence dating is based on the premise that charged particles generated from environmental radiation (through radioactive decay and the release of alpha, beta, and gamma particles) accumulate over time in flaws in the structure of crystalline materials. When sufficient energy is applied, these stored particles are released in the form of light (Feathers 2003:1493).

The amount of light released is a function of time and energy exposure. If the rate of luminescence accumulation is measured, a date can be calculated. Quartz and feldspar are common crystalline materials present in ceramics and sediments with properties that result in stable and well-known accumulation of luminescence over time. Analysis on the brown ware sherds was conducted on extracted quartz grains in the silt-to-sand size (90–125  $\mu$ ).

When measuring optically stimulated luminescence, one stimulates samples with light, usually a particular wavelength that is known to release luminescence from the material. The amount of light released is measured with a photomultiplier tube. The release of energy creates a “zeroing” event, which empties crystals of charged particles that accumulated since the previous “zeroing event” such as would occur during the firing of a vessel or exposure of crystals to the sun. Once the accumulated paleo-signal is measured, subsequent measures are made by exposing the material to calibrated amounts of radiation to determine the rate at which luminescence signals are generated in the sample.

One additional piece of information is necessary to calculate a date. One must estimate the amount of radiation in the environment that provided the particles (via alpha, beta, and gamma radiation) with the source of the luminescence signal. The annual dose rate of radiation is determined by measuring radioactivity (in uranium, thorium, and potassium) in the sample and in the surrounding sediments. We also estimate the contribution of cosmic gamma rays based on the latitude and longitude of the object. In this case sediment samples around each specimen were provided to calculate the effect of the natural radiation from the environment. The external dose rate allows us to better calculate the date of the ceramic and the sediments. Using measures of the amount of the archaeologically accumulated luminescence signal, the sensitivity of a sample to radiation, and the annual dose rate of radia-

tion, a direct date from the previous zeroing event can be calculated for a sample.

## Methods

Analyses of the submitted ceramic sample were completed in the luminescence lab at the Institute for Integrated Research in Materials, Environment, and Society (IIRMES) at California State University, Long Beach. Samples were prepared according to standard procedures modified from Aitken (1985) and adopted from the University of Washington Luminescence Dating Laboratory. The ceramic samples were processed and analyzed using a coarse-grained quartz extraction protocol (90–125  $\mu$  in size) (see Table 1).

We made luminescence measurements using an automated Risø TL/OS 12B/C reader that incorporates calibrated beta ( $^{90}\text{Sr}$ ) radioactive sources for evaluating the rate of luminescence signal accumulation. For the samples, we employed blue-light OSL (BOSL) stimulation with single aliquot regenerative dose (SAR) protocol (Murray and Wintle 2000; Feathers 2003). Blue light LED on the Risø TL/OS 12B/C stimulate samples in the 400–550 nm range (centered at 470  $\pm$  30 nm). A double-IR wash was employed to help eliminate contribution by any feldspar contaminants (Banerjee et al. 2001). For this step the samples were

stimulated using infrared diodes in the 800–900 nm transmission range. A U-340 filter is used to eliminate spillover from stimulation blue light. Table 2 outlines the BOSL protocol stimulation sequence, and Table 3 outlines the IROSL protocol stimulation sequence.

The rate at which radiation creates luminescence signals was measured through a series of incremental beta doses. The response curve based on these artificial doses is used to determine the amount of radiation that must have been present to generate the previously accumulated dose. Using the facilities at IIRMES, CSULB, dosimetric measurements were made to determine the amount of radioactivity that is present in the sample. We also evaluate the sediments surrounding the sample.

We utilized a GBC OptiMass 8000 ICP Time of Flight Mass Spectrometer attached to a New Wave Research UP-213 Laser Ablation system (LA-TOF-ICP-MS). The sample was ball-milled to  $\sim$ 5  $\mu\text{m}$  and thoroughly mixed with 40 ppm indium internal standard and briquetting additive before being pressed into a pellet using a 15-ton geological sample press. The resulting pellet was analyzed for U, Th, and K concentrations using laser ablation ICP-MS. Replicates of 5-second acquisitions were averaged, and the standard error of each analysis was reported with the sample averages.

Table 1. Coarse Grain Quartz Extraction Protocol.

Step	Procedure
1.	Calculate percent water absorption per sherd.
2.	Remove outer 2 mm of sherd using diamond drill at slow speed.
3.	Crush sherd sample using vice, and disaggregate sample in shaker mill.
4.	Screen samples to separate grains by size.
5.	Float quartz grains of disaggregated sample using sodium polytungstate.
6.	Treat quartz grains with HCL to dissolve carbonates.
7.	Treat quartz grains with H <sub>2</sub> O <sub>2</sub> to oxidize organic content
8.	Etch coarse grains with HF acid to remove outer surface.
9.	Adhere grains to stainless steel disk with silicon spray.

Table 2. BOSL/SAR Sequence.

Step	Procedure
1.	Preheat sample to 240 C for 10 seconds.
2.	Give dose, D <sub>1</sub> , for 5 seconds.
3.	Preheat sample to 240 C for 10 seconds.
4.	Stimulate with infrared light at 125 C for 50 seconds.
5.	Stimulate with infrared light at 200 C for 50 seconds.
6.	Stimulate with blue light at 125 C for 100 seconds.
7.	Measure OSL (natural signal).
8.	Give test dose, D <sub>t</sub> , for 15 seconds.
9.	Heat reduced to 160 C for 5 seconds.
10.	Stimulate with infrared light at 125 C for 50 seconds.
11.	Stimulate with infrared light at 200 C for 50 seconds.
12.	Stimulate with blue light at 125 C for 100 seconds.
13.	Measure OSL (regenerated signal).
14.	Repeat steps 2–13.

Table 3. Laser and Sample Gas Settings, ICP-MS Sampling Parameters.

<p><b>Sample Pre-Ablation:</b> Single pass, 100 <math>\mu\text{m}</math>/second scan speed, 5 <math>\mu\text{m}</math> sampling depth, 60% laser power, 20 Hz laser repetition rate, 200 <math>\mu\text{m}</math> spot size</p> <p><b>Sample Ablation:</b> Single pass, 30 <math>\mu\text{m}</math>/second scan speed, 5 <math>\mu\text{m}</math> sampling depth, 100% laser power, 20 Hz laser repetition rate, 100 <math>\mu\text{m}</math> spot size</p> <p><b>Sample Flow:</b> 1.2 liters per minute Argon through sample chamber into ICP-MS</p> <p><b>ICP-MS Method Properties:</b> 5 second sample introduction delay, 5 second acquisition, 4 replicates</p> <p><b>ICP-MS External Calibration Standards:</b> NIST SRM 612 and NIST SRM 612 glass reference materials, and NIST SRM 679 brick clay at 20% and 40% dilution in briquetting additive</p>
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All intensity counts were normalized to the internal standard, and calibration curves for each element were generated using external calibration standards (Table 3). These data were used to calculate the years since the last zeroing event (i.e., when it was fired or the last time it was heated to cook a meal).

## Results

Figure 3 shows the range of dates on the Owens Valley and Death Valley sherds. Mean dates are marked by horizontal hatch marks, with vertical bars showing one standard deviation around the means. As well, we plot the range of 16 thermoluminescence (TL) dates from previous research on the Nevada Test Site (NTS) (Rhode 1994; Feathers and Rhode 1998). As shown, the dates generated here generally overlap those from the NTS, though the error terms are smaller in this study. These smaller error terms are likely due to the use of the higher precision OSL SAR protocol that also enables dates to be generated for individual aliquots.

In general, the bulk of the Owens Valley dates are older than those from Death Valley. As well, dates tend to cluster into distinct time periods. Eight of the 13 Owens Valley dates fall between AD 1480 and 1580, while six of the 10 Death Valley dates fall between AD 1790 and 1900. By contrast, the NTS dates are somewhat more spread over time. For Owens Valley this may be a product of our sampling more heavily from certain sites, where nine of the 13 samples come from just three sites (the remaining four samples represent four different sites). However, this reasoning does not hold for Death Valley, where each sherd was from a different site.

The early date of AD 1005  $\pm$  20 on one sherd from the Owens Valley is somewhat earlier than dates generally cited for the inception of brown ware technologies in the region (e.g., Pippin 1986; Delacorte 1999). However, other early pottery has been noted in the Owens Valley, including some from CA-INY-3806 associated with features having radiocarbon assays around AD 700 (Eerkens et al. 1999).

This deposit is also on the western shores of Owens Lake within a few kilometers of the sherds dated by luminescence in the present study. As well, Rhode (1994) recorded early dates on brown ware elsewhere in the Great Basin, including one sherd dated to AD  $822 \pm 105$  from Conaway Shelter (26LN126) in south-eastern Nevada.

**Owens Valley Attributes**

Figure 4 shows time-transgressive patterns in attributes in Owens Valley. In comparing this graph to that in Figure 2, recall that we are examining individual sherds in Figure 4 while Figure 2 plots averages for assemblages of sherds (average sample size of over 20 sherds). Thus, while data points in Figure 2 for the density of organic material and mica and surface smoothing can vary continuously along the Y axis, in Figure 4 they are categorical in nature and can only occur in discrete locations on the Y axis. Similarly, we should expect greater noise in Figure 4 because we are plotting individual data points rather than averages which should be dampened in their variability. This factor explains some of the differences between Figure 2 and 4.

In spite of the different scales at which Figures 2 and 4 depict data, overall we see evidence for the same set of temporal changes. Thus, the older pots tend to be thicker, contain higher amounts of mica, and are less often smoothed on their exterior surfaces. The only attribute that does not show the expected pattern is the density of organic material, which remains nearly constant over time. Overall, this confirms the cross-temporal patterns suggested by Eerkens (2003a) based on sherds associated with radiocarbon-dated features. Unfortunately, we do not have enough data points to really examine whether Eerkens’ three-part system (early, middle, late) holds. This is primarily because nearly all the sherds analyzed by luminescence date to before AD 1560 (390 BP), corresponding to the “early” period of Eerkens’ (2003a) scheme. Additional luminescence dating will be required to obtain samples dating to the middle and late periods.

Eerkens (2003a) speculated that some of the changes in the density of mica and organic material might relate to the clay sources exploited to make pots. As mentioned earlier, all the sherds analyzed here were

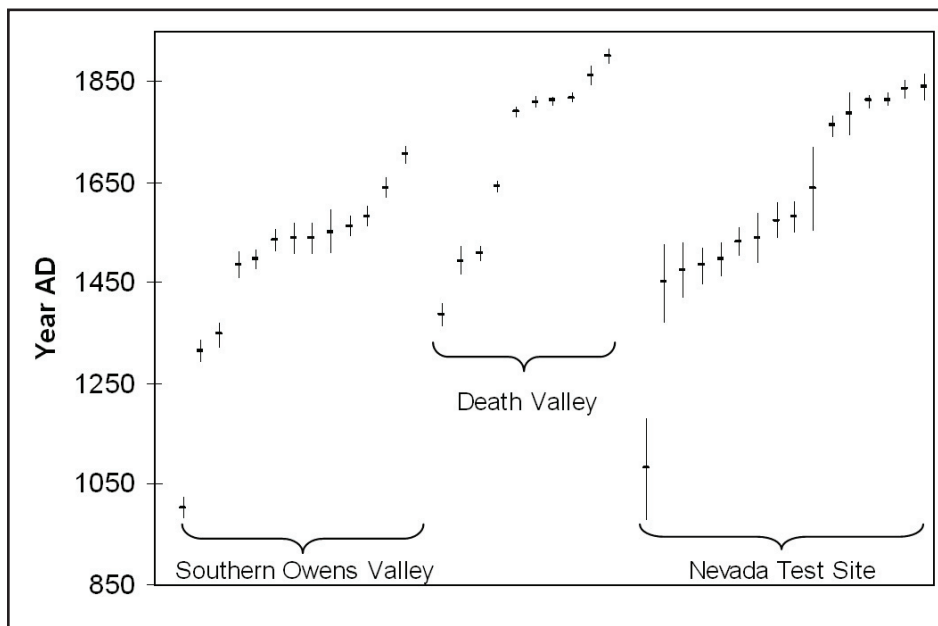


Figure 3. Temporal distribution of luminescence dates from Owens Valley and Death Valley and comparison to existing dates from the Nevada Test Site.

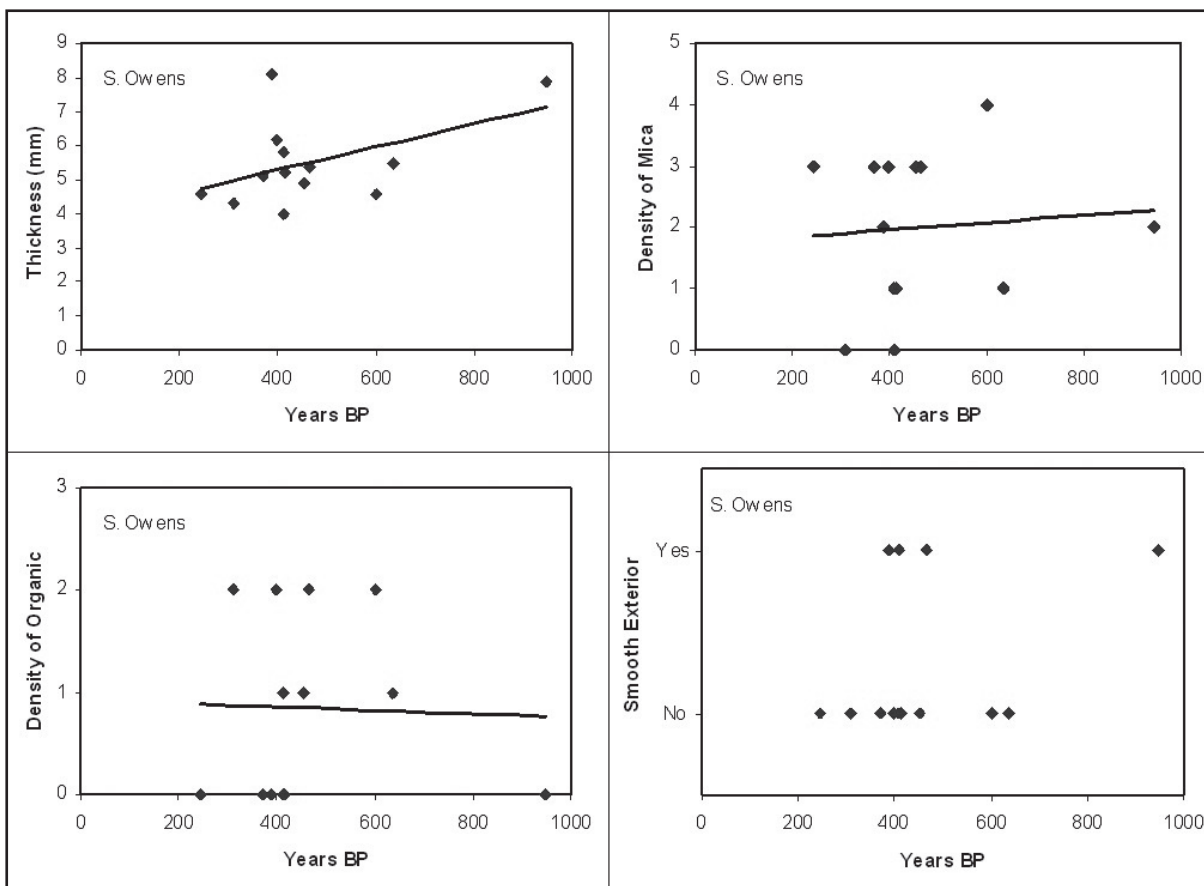


Figure 4. Time-transgressive changes in Owens Valley pottery based on sherds dated individually by luminescence.

also analyzed by INAA for chemical composition, which reflects, in part, clay source. One interesting trend in the Owens Valley data is that the oldest two sherds come from the chemical subgroup Eerkens et al. (2002a) identify as SOV1B. This chemical group is distinctive in some of the rare earth elements, such as Lu, and is not represented among any of the other later-dating sherds in this study. Moreover, a single sherd discussed in greater detail elsewhere (Eerkens et al. 1999), that was associated with a radiocarbon-dated feature dating to 1260 BP, was also assigned to this chemical subgroup. This suggests that the earliest ceramic vessels in the Owens Valley were made from a distinctive source of clay that was rich in mica and perhaps organic material. This early clay source was abandoned in favor of other sources with

alternative chemical signatures and lower amounts of mica.

#### Death Valley Attributes

Taking a look at Death Valley pottery, we see some of the same temporal patterns. Figure 5 shows three of the same attributes as Figure 4. We did not plot exterior surfaces because no pots were smoothed on their exteriors. Instead, we show two other attributes that seem to have some time-transgressive patterning, lip configuration and rim (neck) configuration. As Figure 4 demonstrates, like in Owens Valley, there is also a trend of decreasing thickness over time in Death Valley, from nearly 7 mm around 600 BP to around 4.5 mm near 100 BP. However, unlike Owens Valley,



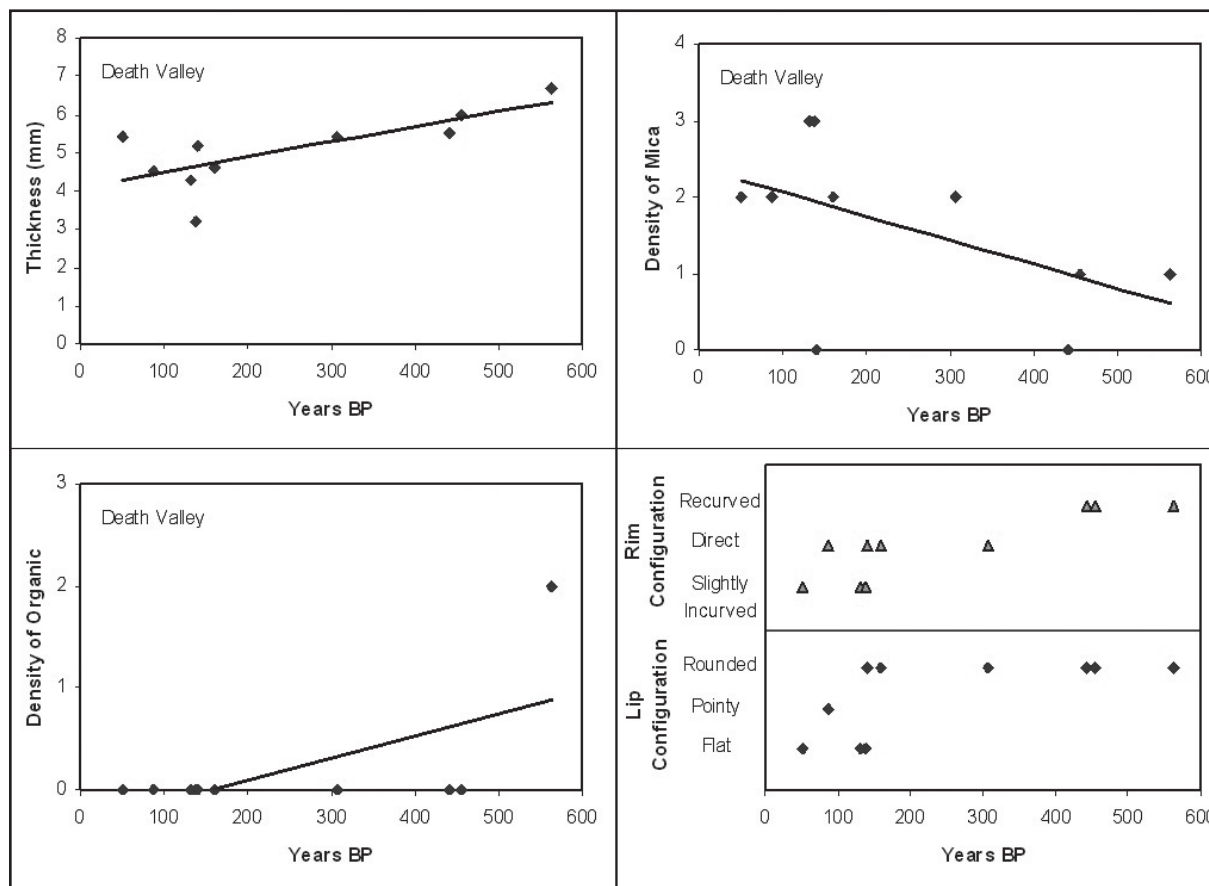


Figure 5. Time-transgressive changes in Death Valley pottery based on sherds dated individually by luminescence.

there seems to be an increase over time in the density of mica.

As in the Owens Valley, this may indicate a change in the sources of clay used to make pots. The INAA data from Death Valley (see Eerkens et al. 2002b) do not show a clear separation or change in the chemical composition of sherds over time. Some groups such as DV1A only appear late in time. However, others such as DV1C appear throughout the temporal sequence.

Turning to other attributes denoted in Figure 4, only one sherd had organic temper. However, it did have the oldest date, suggesting a decrease over time in this attribute, like in Owens Valley.

Finally, as shown in the lower right of Figure 5, there appear to be changes in the lip and rim configuration over time. Earlier sherds tend to have recurved rims with rounded lips. These pots also appear to be shaped more carefully with regards to symmetry and regularity (data not shown).

Later sherds tend to be direct or incurved at the rim and often have flat lips, with one pointy lip also later in time. In comparison to the earlier sherds, they are often irregular in shape (i.e., “lumpy”), suggesting less investment of time and energy and attention to symmetry. These patterns in rim and lip configuration and regularity and symmetry in shape are not evident in the Owens Valley data, where direct rims are nearly ubiquitous (12 of 13) and flat and round lips appear equally throughout time.

## Conclusions

Independent dates on sherds from Owens Valley generally confirm the temporal changes proposed by Eerkens (2003a) for brown ware pottery technologies in Owens Valley. Interestingly, some of these same patterns are also reflected in brown ware sherds from Death Valley, suggesting that some trends in the development of pottery technologies were region wide, while others were more region specific. In particular, there seems to have been a trajectory towards the development of thinner pots in both regions. These developments are in the absence of changes in the size of ceramic vessels, as measured by diameter. Mouth diameters are highly variable from pot to pot but seem to be equally so over time in both regions. We plan to test the notion that reducing thickness is a region wide phenomenon with additional luminescence dates on sherds from other nearby regions.

What may have driven ceramic formal variability toward thinner walls is unclear, but we note that thinner pots are lighter in weight and more efficient in terms of the amount of clay needed to construct them, the quantity of fuel required to fire them, and the transfer of heat from an exterior source (i.e., hearth) to the contents (i.e., food). Such advantages typically come at the expense of strength (Bronitsky and Hamer 1986; Schiffer 1990; Juhl 1995). Thus, in order to keep pots resistant to thermal and impact shock, concomitant changes in other aspects of the technology would have been necessary.

We hypothesize that in order to accommodate the decreased thickness of pots, yet maintain strength, prehistoric potters began to exploit new sources of clay and/or change their clay and temper recipes. We believe these changes are reflected in attributes such as the density of mica, density of organic materials, and chemical composition. In the Owens Valley, these newer clay recipes seem to have been depleted in

mica, while in Death Valley they appear to have been enriched. In both areas, organic temper decreased.

Additionally, in the Owens Valley, potters shifted from pots that were more often smooth on their exterior surfaces to those that were more often rough or brushed. This change also may reflect increased fuel efficiency, since roughened surfaces have greater surface area and absorb heat more efficiently (Juhl 1995). In Death Valley, pots were rarely smoothed on the exterior surface. It is possible that changes in firing conditions were also exploited to increase strength for these thinner pots, though we have yet to collect data to test this hypothesis.

Overall, relative to Death Valley, Owens Valley potters were more conservative in terms of changing the composition and form of their pots. Thus, there are many attributes in Death Valley, such as rim and lip configuration and overall symmetry and regularity, that changed noticeably over time, while these attributes remained constant in the Owens Valley. In particular, variability in vessel form in Death Valley seems to have changed from relatively symmetrical and regular pots with rounded lips and recurved rims, pots that were generally more bowl-like in shape, to forms characterized by reduced symmetry and regularity, flat or squared lips, and direct rims. Such pots are more typical of the V-shaped forms that resemble burden baskets in outline, a form that is dominant throughout the sequence in Owens Valley. In this respect, sometime between 300 and 450 BP, Death Valley assemblages were replaced with a form more commonly found in the Owens Valley.

Despite the common tendency of lumping pottery into a single analytical category in the western Great Basin, there is clear evidence that people were actively manipulating and modifying this technology over time in both the Owens Valley and Death Valley. All the pottery which may be encountered within our two

study areas are not the same, and moreover, there are temporal patterns to these differences. The earliest ceramic vessels in both regions are demonstrably different from their later counterparts.

Although the evolution of pottery varied in terms of tempo and appears to have involved different attributes over space, many of the changes are consistent with attributes related to the improvement of thermal transfer properties, that is, increased efficiency in heating. Thinner walls, the use of different paste and temper recipes, and changes in exterior surface treatment are all part of this process. As potters experimented with different clays, firing regimes, and shapes, small innovations in thermal properties were discovered and transmitted between artisans. Given performance advantages, these innovations were inherited by subsequent generations and diffused across regions, thereby resulting in long-term changes in pottery technologies that are similar across broad regions of space.

Based on the data we have generated, brown ware technologies appear earliest in the Owens Valley (ca. AD 1000). The earliest brown wares in Death Valley appear some 380 years later but are different in appearance. Perhaps the proximity to the Virgin River, where pottery was used earlier, resulted in interactions with potters from that region and had an influence on how brown wares were initially constructed in Death Valley. Alternatively, perhaps inhabitants of Death Valley simply borrowed the basic concepts from Owens Valley but implemented them in different ways.

In any case, while these pots were initially different, some 200–350 years later vessels took on an appearance that more closely resembled pots produced in Owens Valley. In other words, the brown ware technologies of these two regions appear to have converged. Whether this was due to independent innovations in Death Valley or further borrowing of ideas is unknown and will require additional analyses.

While it is tempting to take the luminescence dates produced here and elsewhere and propose a directional model for the diffusion of brown ware (e.g., west to east or vice versa), the data discussed here suggest such an exercise may not produce the desired outcome. While all the sherds dated are on brown ware, closer inspection of the data suggests that the earliest forms of brown ware, at least in the Owens Valley and Death Valley, were different. Additional luminescence and technological analyses on brown ware from other regions may reveal a similar pattern. Thus, if knowledge about brown ware diffused in such a time-transgressive manner, the way such information was materialized was different in different regions.

However, we think such an approach to the study of pottery adoption is somewhat misguided. People in the western Great Basin undoubtedly had knowledge of pottery long before they ever adopted it. There is ample evidence for interaction between preceramic Great Basin hunter-gatherers and pottery-making Southwestern and Fremont groups.

Surely, people who did not produce pottery were aware of the properties of clay and/or had interacted with populations where pots were used and/or made. We argue that decisions about whether or not to make pottery in the western Great Basin had less to do with knowledge about the technology and more to do with the need for manufactured containers, demands on the time and labor of women, the types of resources being processed, the availability of fuel, and settlement patterns, among other factors.

Our future research plans include the analysis and dating of a larger sample of brown ware sherds from both Owens Valley and Death Valley. We will include samples from other areas. These analyses might allow us to examine more fine-scaled temporal and spatial changes in pottery technologies. Furthermore, we

hope to be able to track specific “innovations” in pottery, such as the use of particular clay types or certain rim/lip configurations, in order to see how these diffused over time and space.

At a minimum, we hope to have convinced the reader that not all Great Basin ceramics are the same and that an immense amount of information about the patterns of innovation and inheritance can be teased out of ceramic assemblages. Tracking these differences over time and space should allow us to recover at least some of this data to highlight issues of technological innovation, transmission, regional interaction, and artifact function, among others. However, doing so requires more extensive and systematic implementation of analytical techniques such as luminescence dating and Instrumental Neutron Activation Analysis.

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