



Plain-Ware Ceramics and Residential Mobility: A Case Study From the Great Basin

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Plain, utilitarian ceramics from prehistoric farmers and foragers in north-western Utah are used to identify whether ceramics reflect mobility. Simple methods measure the degree of investment in ceramic manufacture. Investment is treated as a general concept that subsumes other assessments of ceramic variability such as use-life and function. Investment is compared with mobility using archaeological sites with independent measures of mobility. A hypothesis proposing greater investment in the quality of ceramic manufacture with increasing residential stability, occupational redundancy and/or the presence of a logistic system is variously supported. X-ray diffraction of ceramic temper is used to test two hypotheses about the expected distance to raw material sources and variability in the use of sources with increasing mobility. Variation is best described by geographical proximity, and the number of utilized sources increases with mobility. © 1997 Academic Press Limited

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Introduction

Archaeological ceramics have long been recognized as useful for the chronological ordering of past cultures and for exploring the relationship between form and function. Within the last few decades, however, there has been a significant increase in emphasis on functional analysis, pursuant to the notion that attributes of material culture are to varying degrees shaped by the problems of life. Dean Arnold (1985) synthesizes the processual perspective and develops cross-cultural generalizations relating ceramic form with variation in behavioural and environmental setting. Philip Arnold (1991: 4) sees this trend as “releasing ceramics from the tyranny of culture history and relating ceramic studies to the broader anthropological issues of the day”.

Throughout this effort, most archaeological ceramic study, but especially the ethnoarchaeological, is directed at relatively complex systems of ceramic manufacture: cases of sedentism and craft specialization producing decorated ceramic industries featuring stylistic content. Less is known about ceramic use among foragers and in simple farmer–forager systems where only a few types of plain, utilitarian wares are produced (but see Whalen, 1994: 70–91; Skibo & Schiffer, 1995). We investigate variation in the

morphology and raw material procurement distance of plain-ware ceramics in a case of farmers and foragers in the eastern Great Basin (Figure 1) to identify the extent to which ceramics can reflect residential mobility.

Many highly mobile societies do not manufacture ceramics at all, but a surprising number do. Of ethnographically known societies in the Great Basin/Plateau culture area, an area known for low population density and semi-sedentary societies, 40% of them manufacture ceramics (Arnold, 1985: 124). It is also well established that reliance on ceramics increases among semi-sedentary groups (Arnold, 1985: 109–125). In fact, some constraints on ceramic manufacture are less in non-sedentary situations than in many cases of full sedentism (see Arnold, 1985: 120). Thus, study of relatively simple instances of ceramic manufacture may be informative of crucial processes and transitions in prehistory.

Information about raw material procurement distance also holds promise. In 111 ethnographical cases around the world, potters obtain clays for ceramic manufacture within 1 km of home in 33% of the cases, and within 7 km in 84% of the cases (Arnold, 1985: 49–50). Procurement distances for ceramic temper are similar, with temper obtained within 1 km of home in 52% of 31 cases. It follows that materials from

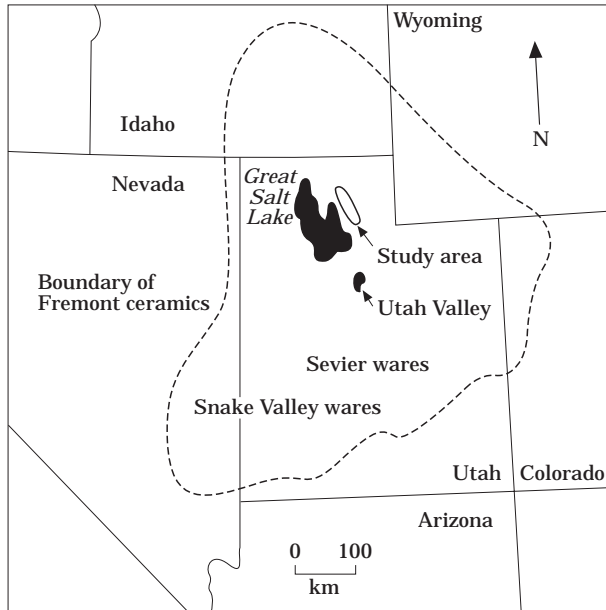


Figure 1. Map of study area and regional context.

relatively dispersed sources will be sampled in cases of higher mobility accompanied by expedient ceramic manufacture.

The above ethnographically documented patterns support the following propositions: greater investment in ceramics with decreasing mobility, and greater sampling of dispersed material sources with increasing mobility. These propositions are consistent with the general anthropological understanding that increases in the quantity and complexity of material culture places constraints upon mobility (e.g. [Sahlins, 1972: 11–12](#)). The same propositions were alluded to some time ago by [Gunnerson \(1969: 182, 185, 197\)](#) with reference to ceramic manufacture in the Basin/Plateau region.

We investigate these propositions in an archaeological context by hypothesizing relationships between mobility, degree of investment in ceramic manufacture, and variation in the use of material sources. Variability in ceramic morphology is to some extent conditioned by the vessel's function and use-life and we propose that these things are in turn influenced by the magnitude of residential mobility, occupational redundancy, and the presence or absence of a logistic system. Simple and inexpensive means are employed to measure aspects of investment in ceramics including temper size, wall thickness, and surface preparation, enabling a large sample size to be measured; 5345 sherds in this study.

As for material sources, we investigate the proposition that more mobile people will sample a wider variety of sources, while those who are more residentially stable will use a select few. If this is true, then the degree of raw material variability will increase at sites

indicating greater residential mobility, relative to sites indicating lower mobility. Since the proposed relationship is relative, the actual source locations, or degree of local variability in materials is irrelevant. Source variation is investigated using X-ray diffraction, again an inexpensive technique useful for assessing variation among materials without knowledge of the actual source locations—an expensive form of data to acquire and one that may not be necessary to answer many questions about ceramic variability and behaviour. A sample of 120 sherds were subject to X-ray diffraction.

If either of the above propositions are true, even in part, then frequency patterns for variables pertinent to ceramic investment should vary among sites reflecting differences in mobility. Furthermore, these patterns may cross-cut ceramic types and archaeological cultures because the behaviour responsible for them may also cross-cut these categories, which are typically rooted in a culture–historical perspective. The hypotheses resulting from our assumptions are tested by comparing variation in measures of ceramic investment and material sources at sites for which independent archaeological measures of occupational stability are available. A central goal of this study is parsimony in the exploration of an aspect of ceramic variation not previously investigated in plain ceramic industries to stimulate more detailed investigation in additional cases.

The Research Setting

In many foraging or simple farming systems, plain, utilitarian ceramics comprise the bulk of archaeological ceramic collections. This is the case for prehistoric farmers and foragers in the Great Salt Lake area of the north-eastern Great Basin where rim sherds (enabling an estimation of whole vessel form) and decorated sherds are relatively uncommon, but which exhibits high variability among numerous body sherds from plain, utilitarian vessels ([Figure 1](#)).

The Fremont period (AD 400–1300) and subsequent Late Prehistoric period (AD 1300–historic times) is a time of high adaptive diversity with subsistence systems ranging from foraging to full-time farming and a variety of dietary mixes in between. It is increasingly apparent that farmer and forager systems co-existed in the Fremont region ([Simms, 1986, 1994, n.d.](#); [Madsen, 1989; Coltrain, 1993, n.d.](#)). The Fremont period is contemporaneous with the better-known farming societies of the Southwest such as the Anasazi, and the expression of adaptive diversity in the Fremont area parallels that described for the Southwest ([Upham, 1984, 1994; Rushforth & Upham, 1992: 52–66](#)).

Ceramics of the Fremont and Late Prehistoric periods have traditionally been employed for culture–historical purposes resulting in their use as cultural

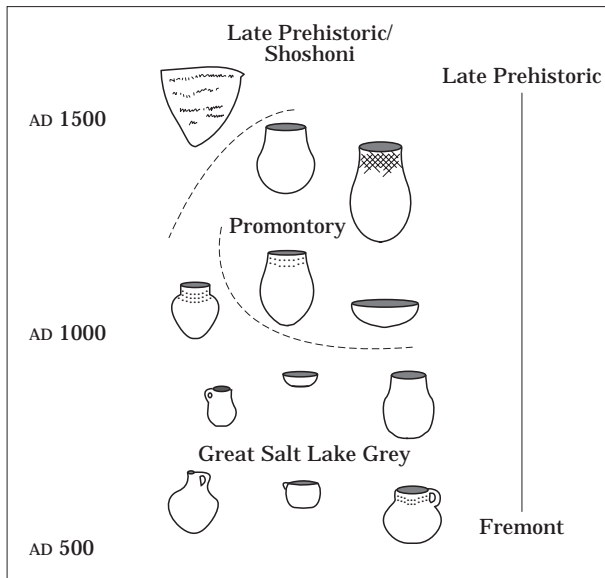


Figure 2. Types, chronology, and examples of form in the ceramics from the study area (after Butler, 1986: 55; and D. Madsen, 1986: 208–209).

badges and chronological markers. This exercise has produced about a dozen ceramic types that, in the case of the Fremont period, are spatially organized, and hence seen as synonymous with regional variants of the Fremont (e.g. R. Madsen, 1977; D. Madsen, 1986). Ceramics thought to date from the Late Prehistoric period are distinguished from the Fremont, typically on the basis of chronology alone, and assigned different labels.

Recent ceramic study in the north-eastern Great Basin shows there is considerable variability within the Fremont types and between the Fremont and Late Prehistoric types (Dean & Heath, 1988; Janetski, 1990; Dean, 1992; Simms *et al.*, 1993). Furthermore, the high degree of adaptive diversity across the Fremont and Late Prehistoric periods suggests the utility of analysing ceramic assemblages for variability. Surely any success at linking ceramic and behavioural variation can only complement our understanding of the culture history.

In the Great Salt Lake area, fieldwork between 1986 and 1993 recorded several hundred archaeological sites, provided excavation data from several of them (Simms & Heath, 1990; Simms *et al.*, 1991; Fawcett & Simms, 1993) and lead to analysis of skeletal remains from 85 individuals (see Hemphill & Larsen, *n.d.*).

The relevant ceramic types in the study area include the Fremont ware termed Great Salt Lake Gray, Late Prehistoric Gray (often termed Shoshoni ware), and the temporally overlapping ware termed Promontory Gray (Figure 2). Small numbers of painted sherds are found, or sherds with unusual temper based on visual examination. These are typically interpreted as intrusive Fremont wares from elsewhere in the region (e.g. Snake Valley or Sevier, see Figure 1).

General Methodology

The degree of ceramic variation observed during the Great Salt Lake fieldwork indicated value in an analysis of ceramics for variation in specific morphological characteristics. A total of 5345 sherds from 40 archaeological sites were studied. These include ceramics from areas recently surveyed and tested, and samples from museum collections. Sites were selected because they also contained independent lines of evidence indicating occupational stability and site function. Sites were organized on a continuum of high to low occupational stability represented by four categories of site type: agricultural bases, residential bases, residential camps, short-term camps/special-use sites.

Site type assignments to reflect a continuum of residential mobility are based on the size and type of architectural features, the presence, size, and type of subsurface storage facilities, and other, specialized features also indicative of occupational stability or redundancy. Assemblage composition and diversity, including the range of ecofacts, also play a role, taking into account redundancy in site use. In the case of agricultural bases, site location is also important because farming is spatially constrained to the toes of alluvial fans emanating from the mountains due to topography, hydrology, and soil salinity related to the Great Salt Lake. In cases of previously excavated sites, we largely agree with the site type interpretations of the original excavators as to the degree of residential stability the sites reflect. Since this aspect of the work is already developed elsewhere, the reader is referred to the basic data reported in Simms *et al.* (1991), Fawcett & Simms (1993) and the references therein for previously excavated cases incorporated in this analysis. Also, Simms (*n.d.*) provides a general discussion of adaptive diversity for the area during Fremont and Late Prehistoric times.

The categorical distinctions employed here rely on readily visible differences indicating variation in residential mobility among sites. For instance, a site with pithouses of substantial investment, numerous subsurface pits, and large and often dense middens, can be distinguished from sites with surface structures of poles and mud, stratigraphically documented intermittent occupation, and small-scale storage. In turn, sites indicating residential stability can be distinguished from sites with very light wickiups or brush windbreaks and recurrent, but brief, activity-based reuse.

We impose a categorical distinction on a continuous variable (mobility) for heuristic purposes. While there are no fixed criteria for rigorously categorizing these sites, the typology itself is not the point. Rather, the variability in sites that surveyors and excavators in the region have long described is compared with variation in a category of material culture which ethnographical observations in varied contexts around the world indicate should be responsive to residential mobility.

Table 1. Summary of ceramic data and sample size by site

Site #	Site type	Median wall thickness (mm)	N	Percentage rough sherds	N	Maximum size of temper particles (mm)	N
42WB40	Residential camp	5.000	36	19.444	36	0.20	52
42WB48	Residential base	5.750	14	11.796	17	2.20	22
42BO73	Residential camp	3.900	28	21.429	28	0.50	46
42BO110	Residential base	4.500	97	7.767	103	0.50	103
42WB184	Residential camp	4.500	16	26.316	19	0.90	29
42WB185a	Residential base	5.000	19	50.000	20	0.80	38
42WB185b	Residential base	5.000	4	60.000	5	0.55	8
42WB185c1	Residential base	4.450	236	48.133	241	0.70	439
42WB185c2	Residential base	4.700	81	5.495	91	0.50	105
42WB244	Short-term camp	5.400	48	23.636	55	1.50	93
42WB263	Residential camp	4.900	9	70.000	10	2.00	18
42WB269	Residential camp	5.000	153	31.169	154	0.40	167
42WB270	Residential camp	4.900	346	46.410	390	0.70	668
42WB317	Residential camp	5.400	246	25.897	390	1.00	457
42WB318	Residential camp	4.800	50	59.701	67	1.50	93
42WB319	Short-term camp	4.800	23	10.714	28	1.00	73
42WB322	Residential camp	5.000	102	11.429	105	0.40	132
42WB323	Residential camp	4.700	5	0.000	5	0.30	7
42WB324	Residential base	5.000	102	3.922	102	0.30	107
42WB325	Short-term camp	5.400	1	100.000	1	1.90	1
42BO579	Short-term camp	5.100	1	100.000	1	1.00	1
42BO599	Short-term camp	5.400	17	70.588	17	1.70	34
42WB32	Residential camp	5.200	512	11.494	522	0.50	568
42BO55	Short-term camp	5.200	198	25.126	199	0.80	200
42BO57	Residential camp	4.800	203	25.616	203	1.00	203
42BO98	Residential base	5.000	227	24.561	228	1.00	228
Grantsville	Agricultural base	4.800	127	0.000	127	0.30	127
42WB34	Residential base	5.250	196	19.192	198	0.50	198
42BO109	Residential base	5.000	180	46.111	180	0.50	180
42BO107	Residential base	4.700	193	13.918	194	0.50	195
42BO120	Residential camp	5.100	119	45.223	157	1.00	236
Tooele	Agricultural base	4.100	136	0.000	136	0.20	126
Warren	Residential base	5.000	102	5.825	103	0.50	103
Willard	Agricultural base	4.500	275	0.360	278	0.20	278
Totals			4102		4410		5335

The categories, the sites chosen for analysis, and the number of sherds analysed are reported on Table 1.

Ceramic Morphology and Mobility

Focusing on the idea of “pots as tools” (Braun, 1983), a variety of actualistic and experimental studies have shown how variation in ceramic form and composition affect vessel performance (e.g. Rye, 1976; Bronitsky & Hamer, 1986; Skibo & Schiffer, 1987; Feathers, 1989; Neupert, 1994). Morphology, paste composition, temper composition, and firing temperature all play an important, interlocking role in such characteristics as thermal efficiency, abrasion resistance, resistance to thermal and mechanical stress, vessel strength, and cooling ability, to name a few. At the same time, ethnographical and ethnoarchaeological research has examined the dynamic processes of ceramic production, use, and discard. Among other things, they have noted broad differences in the length of time various types of pottery are utilized before they are broken (i.e. differences in the vessel’s use-life), dependent on such factors as size, weight, and strength of the vessel, the

cost of manufacture, frequency and form of use, and the frequency of vessel movement (e.g. Foster, 1960; David & Hennig, 1972; DeBoer & Lathrap, 1979; D. Arnold, 1985; DeBoer, 1985; Longacre, 1985; P. Arnold, 1988).

This study seeks to merge these two issues by examining the relationship between investment in ceramic manufacture and constraints on a ceramic vessel’s use-life. We proceed from the commonly postulated assumption that pottery techniques which produce inefficient or frequently broken vessels, or that require substantial investments in labour and material, will be displaced by those which do not. Another assumption is that the choice of raw material and manufacturing technique will involve a compromise according to “their labour and material costs, and the desired vessel life expectancy, relative to the need or demand for the final product” (Braun, 1983: 109, 112, *italics added*). To this we add the idea of constraint: the character and degree of residential mobility will impose an external constraint on vessel use-life and potters will modify their level of ceramic investment accordingly. As duration of occupation increases, the ability to get continued use from a vessel should increase

correspondingly and greater investment in pottery technology should result. These generalizations are meant to be applied to a continuum of high to low residential mobility, but this basic relationship can be expected to be altered by at least two other approaches to mobility; the utilization of a system of logistical mobility, or the recurrent use of a site.

Many if not most pots are undoubtedly broken somewhere other than where they were made. Among sites that are logistically connected, pots constructed at more stable sites such as agricultural bases may well find their way to special activity sites and vice versa. Furthermore, residential and short-term camps which are repeatedly occupied but which are not associated with a logistic system may also exhibit greater ceramic investment. These sites are good candidates for "cached technology" (*sensu* Binford, 1977), and higher quality pots may be produced and stored in the expectation that they will be used repeatedly over a span of time.

Vessel function is another facet of intended use that produces variability in ceramic assemblages. Vessel function is also related to the more abstract notion of investment. We expect a greater variety of ceramic types to be manufactured at residentially stable occupations. Our measures of ceramic investment are one measure of this, since an assemblage containing carefully manufactured, relatively thin-walled open bowls, handled pitchers, and a variety of sizes and qualities of storage jars will show a greater degree of investment using the measures employed here.

We do not argue that mobility alone is responsible for variation in ceramic materials and manufacturing. However, the use-life of vessels utilized for similar purposes have been found to vary by as much as an order of magnitude among ethnographically known groups (Nelson, 1991: 176, 180; see also Rice, 1987: 296-7, table 9; Mills, 1989: 137, table 4). Nelson (1991: 176) notes that differences in paste, temper, firing, and production technique may well account for some of this variability. We seek to explore the role that mobility strategies may play in making a variety of decisions about ceramic manufacture that can be generalized in terms of investment, a measure with distinct theoretical content implying the reasons for the selection of some traits over others.

Sampling and measurement of sherds

As large a portion of the ceramic assemblage from each site as time and money allowed was selected for analysis Table 1. In the case of sites with large ceramic collections, including pre-existing museum collections, samples were drawn randomly and covered the complete range of traditional pottery types. Thus, samples range from 100% of collections from recently recorded sites (the vast majority of those in the study) to 24% of the Knoll site collection, 70% of the Orbit Inn collection, and a low 7% from the Levee site collection. In

the case of the Warren and Willard sites, which were examined prior to the 1960s and are now destroyed, the relationship of our subsample to these sites is not known. However, we examined all available sherds from these two sites.

The choice of variables for measurement was based on a desire to explore the utility of simple, inexpensive, and easily taught methods. Given that much of the variation we quantify here has long been observed in the field, parsimony dictates that simple measures of ceramic investment should be explored, enabling us to exploit the benefits of a larger sample than is possible using time-consuming and expensive means of ceramic analysis.

The first variable is temper particle size. The choice of temper materials and their size is important to the performance of ceramic vessels. Finer temper increases resistance to crack initiation as a result of thermal and mechanical stress (Kingery *et al.*, 1976: 768-813; Kirchner, 1979: 1-12). It also permits the production of vessels with thinner walls, which not only reduces weight but also increases thermal conductivity and thermal shock resistance (Rice, 1987: 227). Although a more heterogeneous paste containing larger pieces of temper increases resistance to crack propagation, there are limits. These are apparently set by the difference in rates of thermal expansion between paste and temper material, with such differences being exacerbated by increasing temper size (Rye, 1976: 116-118). Thus, investment increases when the goal is to control the size and consistency of temper, a process that can involve extra preparation of temper and paste. Since the critical variable appears to be the maximum particle size, the largest piece of temper was measured to the nearest tenth of a mm for each sherd. These data were subsequently log-transformed (to reduce skewness) and utilized to assess differences in degree of residential mobility.

The second variable is sherd thickness. As previously mentioned, thinner walls offer advantages in terms of weight, resistance to thermal stress, thermal conductivity, and heating efficiency. Since thinner walls require more effort for a given vessel size, we see thinner sherds as representing greater investment.

There are two confounding factors: increasing vessel wall thickness with increasing vessel size, and the tendency to employ thicker walls for cooking pots. As for the former, Shapiro has noted that larger, more stable sites from the Mississippian period in the mid-western United States have more large sized pots (1984: 703-5). If true generally, finding of thicker sherds at sites associated with higher mobility should be more unusual rather than less, and offer additional support for our general hypothesis. As for vessel function affecting wall thickness, greater use of cooking vessels would be expected with increasing sedentism, again demonstrating the relationship between vessel function and investment. However, even at sites indicating greater mobility, cooking

vessels may predominate where redundant use of the site places a premium on utility. In those cases, diversity in vessel form should be lower than in the more sedentary cases. We hypothesize that in the mobile cases, all forms of ceramics will tend to be more crude and hence tend to have thicker walls. Various factors influence wall thickness, but we argue that several of these conspire to produce a tendency toward thick walls when large samples are assessed.

The third variable is the degree of surface smoothing. Whether for purely aesthetic reasons or for more functional ones such as increased resistance to abrasion (Skibo & Schiffer, 1987: 93), or the propagation of subsurface imperfections, smoothing and polishing of the internal and/or external surface of a ceramic vessel represents increased labour investment. Each sherd was initially categorized as smooth, smooth-undulating, rough, or rough-undulating. These four categories were later conflated into “smooth” and “rough” for the purposes of analysis. Similar to our argument about wall thickness, we suggest that the morphologically diverse assemblages expected at sedentary sites, and the fact that we are attempting to measure degree of investment, a fundamental concept of which function is only one aspect, leads to an expectation of greater smoothing with the increased investment associated with residential stability. It should be noted that corrugated cooking vessels are extremely rare in the study area, hence the category “rough” does not indicate the presence of corrugated cooking vessels, only poorly finished plainwares.

Results

We assessed the three variables for all sherds and summarize the results for each site on Table 1. The same information is ranked from sites with the highest investment to those with the lowest and presented graphically in Figures 3–5. To test for significant differences in investment at each level of mobility, sherds were grouped by site type. A Mann–Whitney U test was then used to detect differences in the median temper size and wall thickness for adjacent levels of mobility, while a simple binomial test was used to assess differences in the frequencies of surface preparation. This information is presented in Table 2.

The trend evident in Table 2 across all variables is for a decrease in the level of investment as mobility increased, consistent with our hypothesis. Maximum temper particle size increases incrementally from a minimum of 0.000 (log-transformed data) to a maximum of 0.000, wall thickness (also log-transformed) from 1.504 to 1.649, and frequency of rough sherds from 0.185 to 26.578%. Of the three variables, temper size reflects investment most strongly and consistently (Figure 3). Differences in vessel wall thickness (Figure 4) are also consistent indicators, though not as marked, while surface preparation oscillates between strongly supportive and contradictory (Figure 5). The

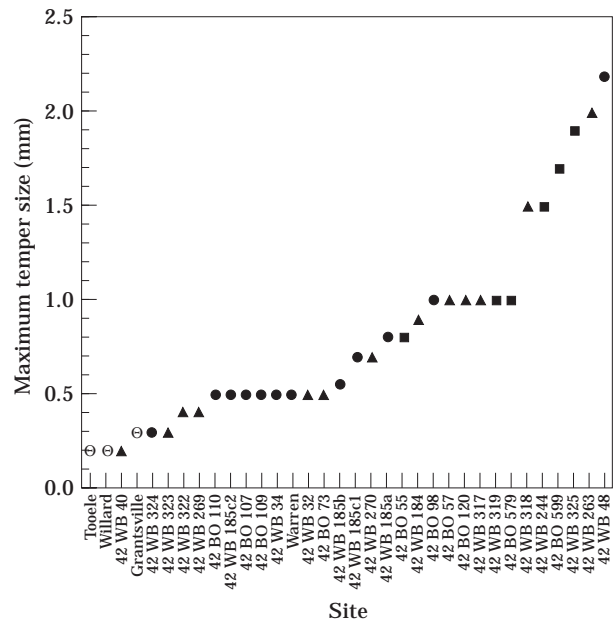


Figure 3. Median-maximum temper size by site. ⊙: Agricultural base; ●: residential base; ▲: residential camp; ■: short-term camp.

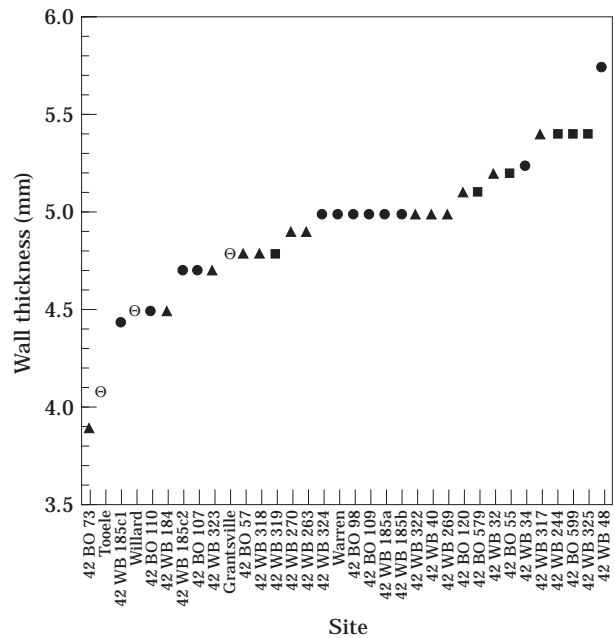


Figure 4. Median wall thickness by site. ⊙: Agricultural base; ●: residential base; ▲: residential camp; ■: short-term camp.

more temperate differences in wall thickness may well be an effect of other design considerations, but the cause of the discrepancy in the percentage of rough sherds remains less certain. The small number of short-term sites, their relatively limited ceramic representation, and the variability of their ceramic assemblages may all play a role.

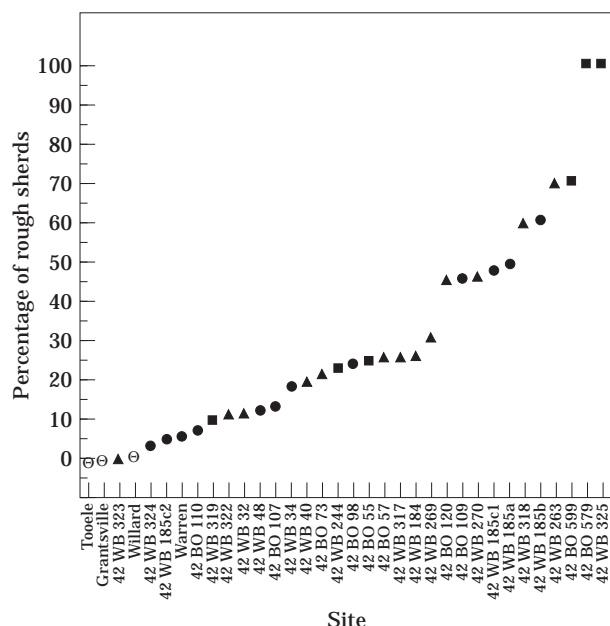


Figure 5. Percentage of rough sherds by site. Θ: Agricultural base; ●: residential base; ▲: residential camp; ■: short-term camp.

Table 1 and especially Figures 3–5 illustrate the variability in all measures of investment at individual sites. This variability is neither surprising nor at odds with our general prediction and conclusions. However, it does serve to illustrate the potential danger of drawing generalizations from specific cases, especially where sample sizes are small. This point is most pertinent in those instances where a relationship is posited between a particular ceramic type, some perceived level of investment (particularly in terms of surface preparation and temper material), and a chronological and/or cultural association. Our data clearly show that observed variability in ceramic investment cross-cuts both temporal and typological boundaries, undoubtedly because many aspects of human behaviour, including mobility, do so as well. With that in mind, we can only echo the well-rehearsed adage that adequate site specific interpretations must always draw upon multiple lines of evidence.

Material Source Variation and Mobility

The second part of our study explores whether variation in the material sources used to manufacture

Table 2. Test for differences between groups in three measures of ceramic investment

Mann-Whitney U test for ln (max temper)					
Site type	Median	N	Difference	P	Percentage of observed variation*
Agricultural base	- 1.609	541			
Residential base	- 0.693	1726	0.916	0.001	23.385
Residential camp	- 0.357	2676	0.336	0.001	8.578
Short-term camp	0.000	402	0.357	0.001	9.114
Total		5345			
Mann-Whitney U test for ln (wall thickness)					
Site type	Median	N	Difference	P	Percentage of observed variation*
Agricultural base	1.504	538			
Residential base	1.589	1451	0.085	0.001	4.743
Residential camp	1.609	1825	0.020	0.001	1.116
Short-term camp	1.649	288	0.040	0.001	2.232
Total		4102			
Z-test for surface preparation (% of rough versus smooth sherds)					
Site type	% Rough	N	Difference	P	
Agricultural base	0.185	541			
Residential base	24.157	1482	23.972	0.001	
Residential camp	28.284	2086	4.127	0.001	
Short-term camp	26.578	301	**	**	
Total		4410			

*This measurement is obtained by dividing the difference between groups into the empirically observed range of the given variable in order to provide some measure of practical as well as statistical significance.

**As can be seen, the frequency of rough sherds at short-term and special use sites does not follow the predicted trend. No statistical test was performed.

Table 3. Tally of sherds by type and site submitted for X-ray diffraction

	Great Salt Lake Gray	Promontory Gray	Late Prehistoric Gray	Sevier Gray	Snake Valley Red-on-Buff
Orbit Inn (42Bo120)	10	5	13	0	0
Willard (42Bo3-6 & 30)	10	0	0	1	1
Levee (42Bo107 Levee Phase 42B1110 Knoll Phase)	9	5	0	3	0
Bear River #1 (42Bo55)	5	0	4	0	0
Bear River #2 (42Bo56 & 57)	9	0	0	0	0
Warren (42Wb57)	10	0	0	0	0
42Wb270 (Simms <i>et al.</i> , 1991)	2	5	2	0	0
42Wb32	11	0	3	0	2
Knoll (42Bo106)	5	0	0	5	0

ceramics reflects residential mobility. The ethnographical findings cited previously show that among the world's potters, raw material procurement distances tend to be short, hence local sources are favoured.

We employ the technique of X-ray diffraction to investigate variation in the sources of temper used in ceramics from different kinds of sites. Ceramic temper has long served as the key variable in defining the ceramic wares of the Fremont and Late Prehistoric periods in the region. Hence, the choice to analyse temper sources enables the results of this study to be compared with the existing ceramic typology.

Two hypotheses describe the relationship between mobility and patterns of raw material occurrence:

- (1) If local temper sources are favoured in the manufacture of ceramics, then temper should vary on the basis of geographical proximity. This implies that constituents of ceramic manufacture may be similar regardless of culture or period;
- (2) If decreased mobility leads to the consistent exploitation of local raw material sources for ceramic manufacture, then variability in the sources of temper found at such sites will be relatively low. Conversely, at sites associated with higher mobility, potters will encounter a greater variety of sources, and variability in temper will be relatively high.

For the sake of clarity, we emphasize that our measures of temper variability are relative among geographically distinct assemblages. Thus, knowledge of source locations and of local variability among sources found within site assemblages is irrelevant to testing the hypotheses as framed here.

Methods

A total of 120 sherds were selected from the same collections measured for morphological attributes (Table 3). A portion of each sherd was crushed and temper was manually extracted. In a few sherds, temper was so fine as to be indistinguishable from paste, hence paste and temper were combined. The resulting diffraction patterns are similar to other sherds from the same sites, suggesting the mixing of temper with some paste had no effect.

Once a diffraction pattern is produced, its significant peaks are matched against computerized standards lists for identification. Initially, samples were prepared and analysed twice to check the replicability of the method. X-ray diffraction identifies minerals, but cannot indicate the relative abundance among minerals. Only the presence and absence of minerals is important to testing our hypotheses.

Findings

Hypothesis 1 argues that temper used in a particular locale will be similar regardless of ceramic type, culture, or period. Figure 6 illustrates the representative pattern found in the Great Salt Lake sample and shows results consistent with the hypothesis. The three types of ceramics are highly consistent in the location of significant peaks. A previous study using X-ray diffraction was done in Utah Valley, located 75–100 km to the south (Hendricks *et al.*, 1990). Figure 6 shows that in Utah Valley, sherds of different types also contain similar temper. However, regardless of ceramic type, the Utah Valley sherds contain different materials from

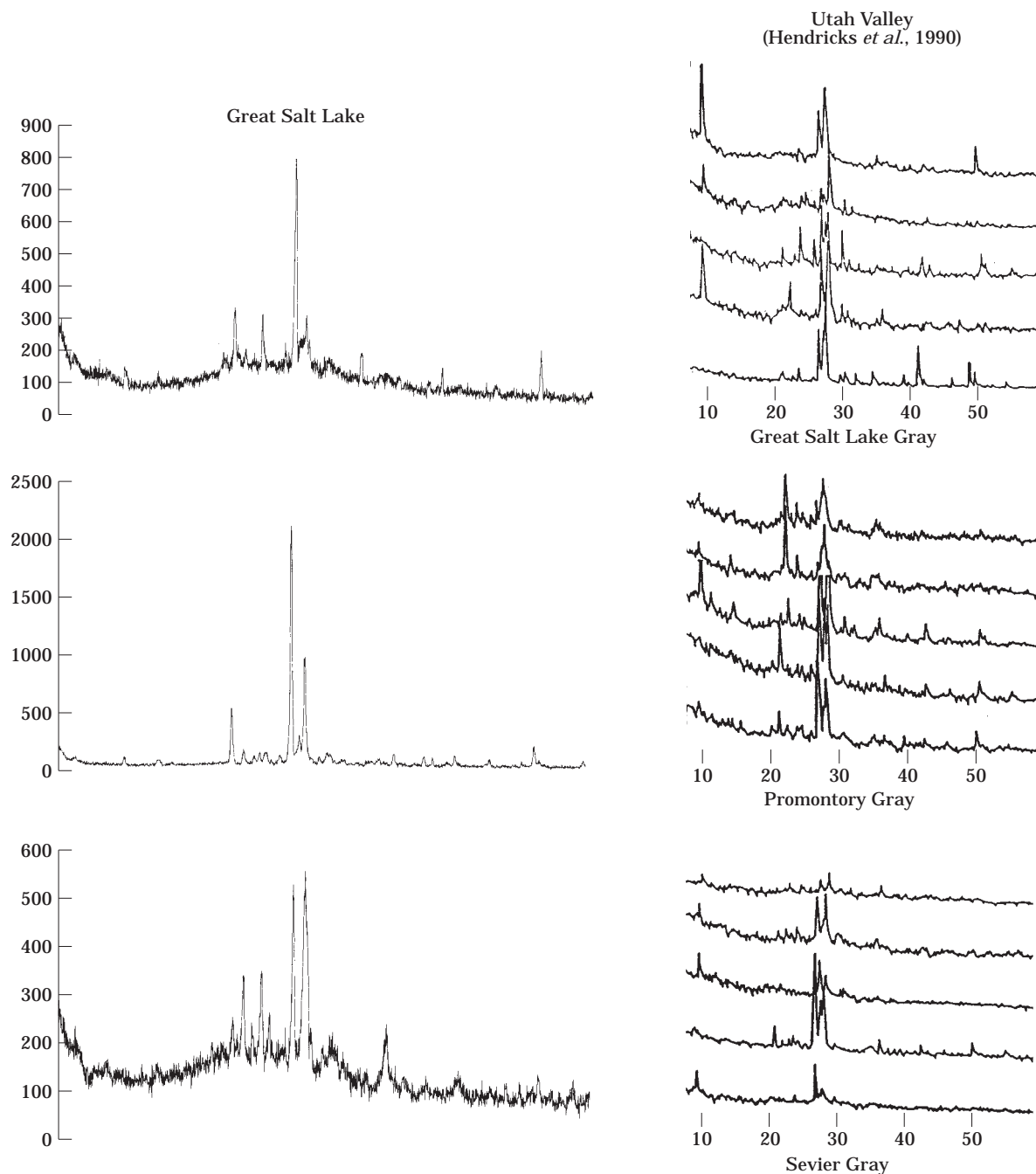


Figure 6. Comparison of X-ray diffraction results from Utah Valley (after Hendricks *et al.*, 1990: 45, 47, 48) with representative patterns from the ceramic types in the Great Salt Lake sample.

the Great Salt Lake sherds. In fact, this comparison shows there is greater variability *within* similar types between Utah Valley and the Great Salt Lake area than there is *between* types in either region. Findings consistent with hypothesis 1 are suggested by investigations in the Uinta Basin in north-eastern Utah, and summarized by Spangler (1995: 561), and a study by Spurr (1995) in central Utah.

Another line of evidence to explore hypothesis 1 comes from the Orbit Inn and Levee sites, both situated near the north edge of the Great Salt Lake. The Orbit Inn lays in close proximity to substantial calcite deposits, and during excavation it appeared as though dice-sized calcite blocks were being reduced at the site for use as ceramic temper (Simms & Heath, 1990: 806). The X-ray diffraction analysis indeed shows that the

Table 4. Percentage of sherds containing calcite in temper by site

Site name	Percentage of sherds containing calcite in temper
Warren	18.1
Willard	22.2
Levee	41.0
Knoll	20.0
Orbit Inn	78.6

highest frequency of calcite use is at the Orbit Inn, and that the next highest frequency is from the Levee site, the next closest site to the source of calcite (Table 4). Thus, proximity to source accounts for the patterns of temper observed in the sherds on both a regional level and in the relationship of individual sites to local sources. This implies a relationship with mobility.

Hypothesis 2 explores whether patterns of temper use might be informative of different degrees of residential mobility. As with the analysis of ceramic morphology, we compare different types of sites where there is independent evidence of occupational stability. Our findings are consistent with hypothesis 2 and

Figure 7 illustrates the results. Sherds from the Warren site, an agricultural base, are more homogenous than those from the Knoll site, a residential base, but with no evidence for maize agriculture. The Orbit Inn, a residential camp, exhibits greater variability in mineral composition. This takes on greater significance in light of the previous discussion about the high frequency of calcite temper used in ceramics at the Orbit Inn. While sherds with calcite temper are frequent, the other minerals present are extremely varied, suggesting that vessels made from a variety of sources are accumulating in the refuse at the site.

Table 5 further illustrates this point. It shows tabulations of the most common and second most common temper compositions, as well as the combined frequency of the two most popular compositions. At the agricultural bases, the two most popular temper compositions comprise 81.8% of the total at the Warren site and 77.7% at the Willard site. On the other hand, at the Orbit Inn, only 28.9% of the sherds contain the two most common compositions. At the Orbit Inn, many sherds remain unaccounted for by the two most common temper compositions. Thus, the number of

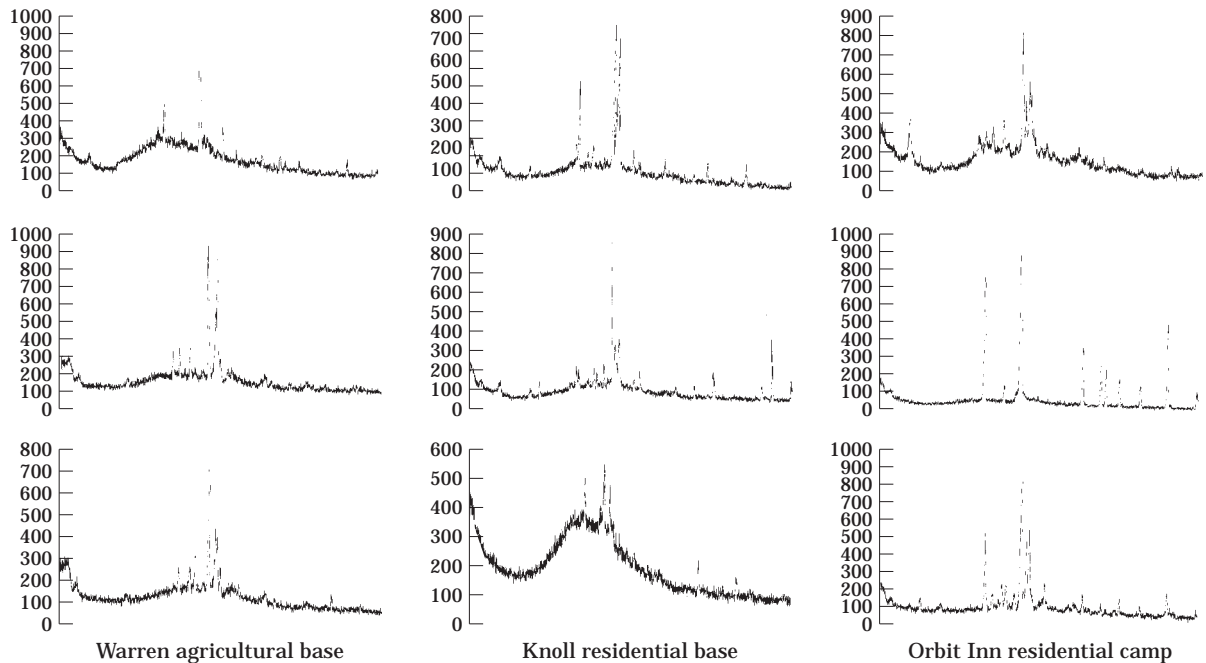


Figure 7. Comparison of typical X-ray diffraction patterns from three site types. Each column of patterns displays increasing variation in significant peak location as residential mobility increases.

Table 5. Percentage of sherds accounted for by two most common temper compositions by site type

	Warren	Willard	Levee	Knoll	Orbit Inn
Most common composition	63.6	44.4	17.6	20.0	21.8
Second most common composition	18.2	33.3	11.8	10.0	7.1
Combined	81.8	77.7	29.4	30.0	28.9

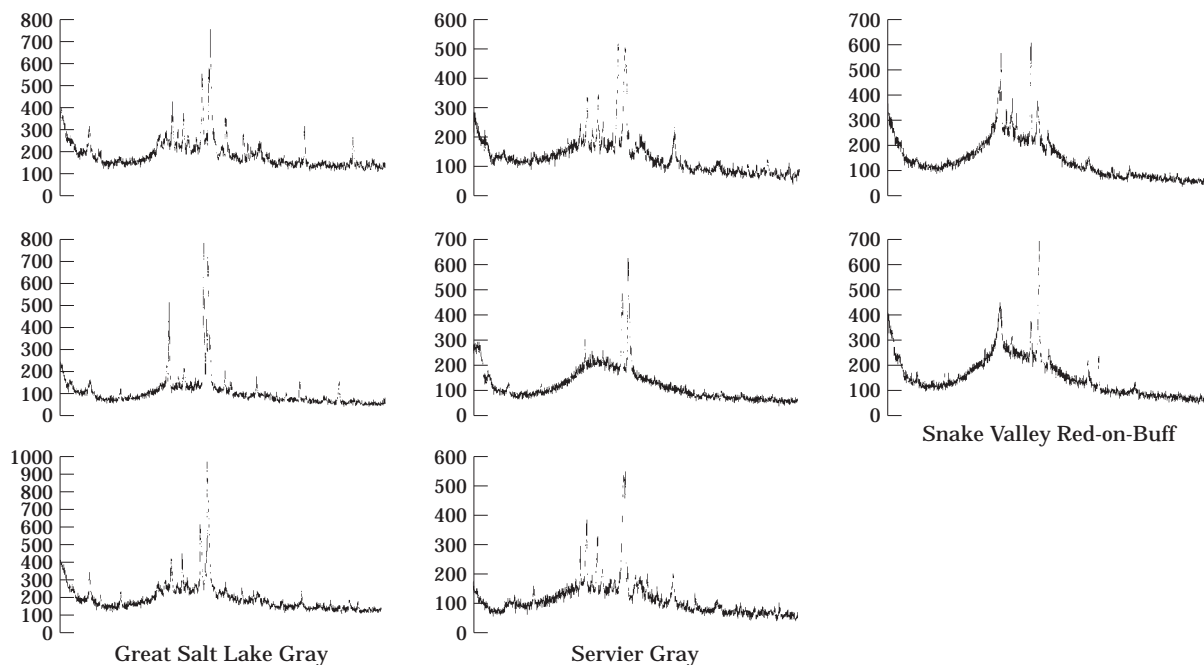


Figure 8. Comparison of typical X-ray diffraction patterns of Sevier Gray and Snake Valley Red-on-Buff with Great Salt Lake Gray ceramics. Consistency in significant peak location shows high mineralogical homogeneity across all three types.

temper sources represented at these sites increases with decreasing residential stability and duration of occupation.

Our findings about the sources of ceramic temper using X-ray diffraction are also relevant to the issue of trade and exchange. Analysis was performed on a small sample of sherds which, upon visual inspection, are classified as types considered to be exotic to the study area. Sevier Gray has long been seen as indicative of links with central Utah, (about 175 km from the study area), and in culture–historical reconstruction, it is used as a diagnostic of the Sevier variant of the Fremont culture (e.g. Marwitt, 1970). Thus, when Sevier Gray is found in other regions it is tempting to infer trade and exchange. Sevier Gray is identified by the use of basalt temper, leaving black specks throughout the paste (R. Madsen, 1977). We analysed nine sherds from museum collections of Great Salt Lake sites and labelled as Sevier Gray. None of them contained any basalt. More interesting is the finding that their compositions fall within the range of the other ceramics common to the Great Salt Lake study area (Figure 8 and comparison with Figures 6 & 7).

Similar results are apparent in data from Utah Valley (Hendricks *et al.*, 1990: 47–8). There, sherds labelled Sevier Gray due to black temper contained minerals consistent with other ceramic types found in Utah Valley.

To explore the issue further, we analysed an admittedly small sample of three sherds of another exotic type, Snake Valley Red-on-Buff. This painted ware is

rare in the study area and implies links with its type location in south-western Utah (over 250 km away). However, the results were as found in the analysis of Sevier Gray—the composition of the Snake Valley sherds are the same as the other sherds common to the study area (Figure 8).

Both of the small samples of exotic sherds analysed for temper composition were manufactured locally. Thus, any connection among regions is, at the most, diffusion of style and lends no evidence to the actual movement of ceramic vessels across large distances in the case of these simple farmer–forager systems. This is not to say there is no contact among people—no demographic fluidity. Rather, it is not apparent at a frequency detectable with our small sample sizes and is not reflected in the actual movement of ceramic technology (versus other technologies) as is assumed by the traditional approach to ceramic analysis.

Conclusions and Implications

This study compares the degree of investment in ceramic manufacture at archaeological sites reflecting different forms of mobility. Support is found for a hypothesis of greater investment in the quality of ceramic manufacture with increasing residential stability, occupational redundancy implying caching of ceramics with long use-life, and/or the presence of a logistic system moving high quality ceramics to short-term camps. The fit of the data with the hypotheses is strongly apparent in the preparation of temper,

generally apparent in measures of wall thickness, and shows mixed results with respect to surface finish.

X-ray diffraction of ceramic temper is employed to test two hypotheses about the expected distance to raw material sources used for ceramic manufacture and variability in the use of sources under different regimes of mobility. Local sources are used to such an extent that ceramic temper variation is better described by geographical proximity than by differences among either the traditional ceramic types, cultural affiliation, or time period for the study area. As mobility increases, the number of sources of raw material in ceramics discarded at sites increases. More mobile people encounter a wider range of sources. The findings with regard to both investment and raw material availability in the archaeological cases are consistent with expectations developed from patterns recorded ethnographically.

We are not arguing for a simplistic and unwavering relationship between mobility and the particular variables used to measure ceramic investment. Wall thickness and temper size in particular are responsive to a vessel's intended use or function. Rather, we are nominating a relationship between mobility and investment, an idea which conceivably covers a lot of conceptual ground. It may include not only effort to enhance performance characteristics, but effort to enhance aesthetic characteristics. Investment can also be thought of in more general terms such as the diversity of artistic styles present in an assemblage and the variety of functional classes of vessels. Is it easier to produce 13 sets of distinctly decorated china, or one set of plastic ware? Do you produce a griddle, skillet, egg-poacher, saucepan, and cookie sheet, or a single type of cast-iron pan?

There are two important reasons to keep these ideas in mind. The first is that constraints implied by investment at one level need not necessarily confound one's conclusions, especially when assessing trends broadly. For instance, one could reasonably ask whether or not the variation in wall thickness and temper particle size observed at short-term sites might not be more readily attributable to the function of vessels utilized at those sites. The answer is, of course, "yes". However, this would necessarily imply a limited variety of functional classes utilized at such sites, and thus indicate a reduction in investment as discussed above. This relationship is apparent in the findings that the influence of mobility on ceramic morphology will produce significant frequency shifts in measures of investment within collections of sherds.

The second point is that there are conceivably many different ways in which one might measure investment. Surface smoothing, wall thickness and temper particle size are by no means the only pertinent variables. Rather, they are employed here because they have historically received attention by those engaged in Great Basin ceramic research, are amenable to the characteristics of the ceramic assemblages found in

the region, and are simple and inexpensive, enabling the advantage of large sample size. Other measures of investment could certainly be used and this research invites further exploration of the relationship between ceramic variation and aspects of behaviour of fundamental interest to archaeologists in general.

With regard to sample sizes, it is appropriate to caution against using the findings here on a sherd by sherd basis, or on small collections of sherds to make conclusions about site-specific mobility, especially in the absence of other indicators of site function. We consider these findings to be applicable to sets of sites over regions and not a recipe for classification on site recording forms.

This study employs relatively simple and rapid analyses on body sherds. This does not discount the added information gained from highly detailed studies of small samples of sherds, but underscores the importance of describing variability, and indicates the sometimes unrealized benefits of parsimony.

A central premise of this work is that ceramic technology, like many aspects of culture, is shaped by the problems of life. It follows that as patterns of behaviour cross-cut periods and archaeological cultures, that morphological variability in ceramics should do likewise. Thus, there is more that simple, plain ceramics can be doing for us than dating sites and devising labels for ancient cultures. On the other hand, we do not contest the culture-historical framework as a heuristic for the study area. Rather, we see an opportunity to exploit ceramics better to reconstruct behaviour.

The implications of this analysis for the region's prehistory are discussed in light of other lines of evidence by Simms (1994, n.d.). Here, we suggest some implications of more general interest. The relationship between mobility and ceramics leads to an expectation of high ceramic variation in cases of contemporaneous farmer-forager systems and among ceramic-using foragers who exhibit high adaptive diversity. Such systems are probably common in the world after the spread of food-producing systems, but the ceramic-mobility relationship seems especially applicable to the initial stages of the food producing transition such as the Archaic-Formative transition in parts of the American Desert West.

There is increasing recognition that accounting for gender improves behavioural reconstruction. Ceramics can play a useful role in areas of the world where there is reason to expect ceramic manufacture is done by women. For instance, in the Great Salt Lake case, the presence of dozens of dated human skeletons (Simms, n.d.) enables the relationship between ceramics and mobility to be compared to evidence of sexual dimorphism in life-time mobility patterns indicated by mechanical analysis of human long bones (Ruff, n.d.). The biomechanical study indicates that males are engaging in more long-distance movement over difficult terrain than females (Ruff, n.d.). This pattern

is not typical of other studies of prehistoric North American populations, but is found in another Great Basin case, the Stillwater Marsh in western Nevada (Larsen *et al.*, 1996: 132). In both cases, the sexual dimorphism appears to be associated with the tethering of females to residential camps and bases in the lowlands around various wetland habitats, contrasting with logistic movement by males making greater use of the surrounding uplands (Larsen & Kelly, 1995; Simms, n.d.). The fit of the biomechanical results with this study suggests the potential for ceramics to track the movement of women. In the eastern Great Basin, the evidence suggests that the movement of women was relatively local during the Fremont and the early portions of the Late Prehistoric period. Whether the contrasting pattern of long-distance movement of men holds outside of the Great Salt Lake study area remains to be seen, but the relationship between plain ceramics and mobility indicates that artefacts may be useful for addressing this question. For instance, a comparison of projectile points (likely men's technology) with the ceramic evidence reported here may be a promising line of study.

Studies of ceramic plain-wares are often overlooked in favour of sherds or industries with greater stylistic content. However, this study suggests that variability in plain utilitarian ceramics provides an additional line of evidence to describe adaptive diversity: behavioural variation and plasticity across space and through time. This concept stands in contrast to explanations dependent on bounded and monolithic concepts such as abandonment, depopulation, and migration of peoples. Instead, attention is directed toward plasticity in boundaries and the interactions of people across them, both of which contribute to the character of socio-demographic fluidity. In this way, we can counter the tendency inherent in the habits of archaeological classification to construct prehistories assumed to exhibit far less plasticity and fluidity across social, ethnic, linguistic and physical attributes than is found in the historically known world.

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