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The Role of Standardization in Specialization of Ceramic Production at San Marcos Pueblo, New Mexico

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BY

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ABSTRACT

In my dissertation research, I examine decorated pottery production at San Marcos Pueblo, in the Galisteo Basin of north central New Mexico. San Marcos Pueblo was occupied from A.D. 1250 until the Pueblo Revolt against the Spanish in 1680. In previous research, San Marcos Pueblo was suggested to be a production center for Northern Rio Grande Glaze Wares (Glaze Ware) (Warren 1976, 1979). I evaluate this claim by examining over 700 pottery sherds and whole vessels from the site and surrounding region. In addition, I examine how pottery production at San Marcos was organized and how this structure changed through time. I examined attributes of the pottery using electron microprobe, petrographic, and attribute analyses to determine local production and degree of standardization of production throughout the occupational sequence at the site.

Production specialization, defined as production over the needs of the household (Costin 2001), has been tied to product standardization. Standardization, reduction in variability of an assemblage, has thus been used as an indicator of specialization of

ceramic production in archaeological contexts (Benco 1988; Costin 1991; Hagstrum 1985). However, its validity as an indicator of specialized production has been tested only in modern ethnographic contexts and with varying results (e.g., Benco 1988; London 1991; Longacre 1999; Roux 2003; Stark 1995). Within the Northern Rio Grande region of the Southwest, glaze-paint ceramics were produced from A.D. 1315 to 1700. Evidence suggestive of specialization in ceramic production in the Galisteo Basin is found in the glaze-paint ceramics made with latite or monzonite temper (a material found in and along the margins of the Galisteo Basin) occurring in ceramic assemblages from sites outside of the basin (Shepard 1942, 1965; Warren 1969, 1976, 1979). The widespread distribution is indicative of some level of specialized production in the Galisteo Basin, and specifically at San Marcos Pueblo. One important component of the organization of production is intensity, defined as the number of goods produced in a given unit of time (Costin 1991, 2001). High intensity of production is also frequently equated with standardization, assuming that the more time producers spend making pots (the higher the intensity of production), the more standardized their products become (Rice 1992). Previous researchers (Shepard 1942, 1965; Warren 1976, 1979) have argued that Glaze Ware production intensified from approximately A.D. 1400 to 1500, then decreased until the time this pottery was no longer produced. My dissertation research evaluates, first, the extent of production for local use and export at San Marcos, and second, the changes in the level of standardization throughout the production of Glaze Wares at the site.

My dissertation results suggest that San Marcos Pueblo potters made more pottery than was used at the site and exported pots to sites throughout the Rio Grande Valley. In

addition, the assemblage of pots at San Marcos is over 80% locally made, with the proportion rising to almost 100% during some of the most intense periods of production. These results support earlier suggestions of specialized production of pottery at the site. The findings for standardization are intriguing, as there are almost no changes in the level of standardization through time. These results indicate that the production system was incredibly stable, even with other major changes in the lives of the potters, including Spanish contact and the establishment of a Spanish mission at the site. In addition, my research at San Marcos suggests that there is not a direct relationship between intensity of production and standardization of the assemblage produced, at least at the low level of specialized production practiced at San Marcos.

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Chapter 1

Introduction

Ceramic production and exchange during the Classic and early Historic periods (A.D. 1325–1680) in the Northern Rio Grande was complex and variable, in that a number of villages produced more than others for export to and exchange with others. In addition, different villages dominated production of certain types within the Northern Rio Grande Glaze Ware sequence (Nelson and Habicht-Mauche 2006; Shepard 1942; Warren 1969, 1979). One of the most notable of these ceramic producing sites is San Marcos Pueblo (LA 98).

Significant research focus has been placed on reconstructing distribution and exchange, with less focus on the organization of production *within* individual villages. What is lacking is a clear understanding of how the entire ceramic production process, from material selection to firing, was organized at any of these large villages during the Classic period. In addition, the amount of variation within individual production steps is unknown. How much variation is present and how does this variation relate to changes in quantities of goods produced over time?

The question of the amount of variation in different production steps is a significant one, especially as it relates to specialization of production. Specialization is defined as production over the needs of the household (Costin 1991). Standardization, which is defined as the reduction of variability in an assemblage, has been used in the Southwest as an indicator of specialization of ceramic production in archaeological contexts (e.g., Crown 1995; Hagstrum 1985; King 2003; Lindauer 1988; Mills 1995; Toll 1990). However, the validity of standardization as an indicator of specialized production

has been evaluated only in ethnographic contexts and with varying success (Benco 1988; Birmingham 1975; London 1991; Longacre 1999; Roux 2003; Stark 1995). Complicating the issue further, many of these studies address specialization in complex or market based societies (Benco 1988; Costin and Hagstrum 1995; Kramer 1997; London 1991; Roux 2003; Voyatzoglou 1974) but not in middle-range societies (Mills and Crown 1995). Despite these issues, the assumed correlation between standardization and specialization, developed in ethnographic research, is commonly used to interpret the archaeological record. This assumption is examined here using the ceramics from San Marcos Pueblo.

Research Problem

This study examines the organization of decorated ceramic production at San Marcos Pueblo in the Galisteo Basin of north-central New Mexico from A.D. 1300 to 1680. In particular, it focuses on the relationship between standardization of ceramic products and one aspect of specialization, the intensity of production, which is the number of goods produced in a given unit of time (Costin 1991, 2001). San Marcos Pueblo is frequently mentioned as a center for production of Northern Rio Grande Glaze Ware, with a low level of household industry specialization (e.g., Habicht-Mauche 1993, 1995; Huntley 2008; Mills and Crown 1995; Nelson and Habicht-Mauche 2006). With this in mind, this research addresses several important questions:

- What aspects of the organization of production are reflected in the ceramics manufactured at San Marcos, and how did that production change through time? How does the organization of production reflect the production groups of potters at the settlement?

- How is assemblage standardization related to changes in the intensity of production during the occupation of the site? On a broader scale, this research seeks to examine the role of standardization in the specialized organization of ceramic production in middle-range societies.

In the Northern Rio Grande region of the Southwest, specialized production of ceramics occurred with the production of Northern Rio Grande Glaze Ware from AD 1325 to 1700 (shortened to Glaze Ware in the rest of the dissertation). Definitive evidence for ceramic specialization in the Galisteo Basin is found in the occurrence of Glaze Ware made with latite or monzonite temper (a material found in and along the margins of the Galisteo Basin) in ceramic assemblages from sites outside of the basin—ranging from Pecos Pueblo to the Salinas pueblos (Shepard 1936, 1942; Warren 1969, 1979). This widespread distribution is clearly indicative of some level of specialized production in the Galisteo Basin and at San Marcos Pueblo—the extent of which is heavily debated and will be addressed in detail in Chapter 3.

Intensity is one important component of the organization of production. Previous researchers (Shepard 1942, 1965; Warren 1976, 1979) have argued that Glaze Ware production intensified from Glaze A to Glaze C (approximately AD 1400 to 1500) and then decreased from Glaze D through Glaze F. They base this argument on evidence that indicates increasing and decreasing export of these Glaze Ware types. An increase in the frequency of wares with latite and monzonite temper in pueblos outside the Galisteo Basin suggests increased intensity of production at the Galisteo Basin pueblos, and specifically at San Marcos. At the same time that exports were increasing, the San

Marcos assemblage was dominated by locally made ceramics (Nelson and Habicht-Mauche 2006). Thus, the site is an ideal place to examine how standardization varies with increasing and decreasing intensity of specialized production.

In this research, standardization is examined through attributes of form, technology, and, to a lesser extent, decoration of Glaze Ware ceramics from San Marcos Pueblo. A comparative collection of sherds exported from San Marcos is also examined to determine whether exported ceramics are more or less standardized than those remaining at the pueblo. This research will contribute to an understanding of how specialized production intensity is visible archaeologically in middle-range societies producing crafts at a household or community level.

Research Domain

Archaeologists consider the organization of production an important component of economic, technological, political, and social organization (e.g., Brumfiel and Earle 1987; Chavez 1992; Clark and Parry 1990; Costin and Hagstrum 1995; Mills and Crown 1995). The organization of production is frequently examined in the context of complex societies and the maintenance of hierarchy in those societies (e.g., Brumfield and Earle 1987; Costin and Hagstrum 1995). Because of this emphasis, most models dealing with the organization of production focus on complex societies. Development of theoretical models to address the organization of production in middle range societies has lagged behind (Mills and Crown 1995).

Specialization is simply one way to organize production. Thus, craft production may or may not be specialized. Using the simple definition of specialization as production over the needs of the household, a specialist is someone who produces more objects than she or

he uses in the immediate household (Costin 2001:276), and thus has extra objects to gift, barter, or exchange.

Numerous typologies and classifications describe organization of production (Costin 1991; Peacock 1982; Rice 1987; Santley and Pool 1989; Sinopoli 1988; van der Leeuw 1977). For the current research, I use the four parameter approach for craft production developed by Costin (1991). These four parameters—context, concentration, scale, and intensity—describe the degree of specialization in the organization of craft production. Each parameter can be addressed at San Marcos Pueblo, although the major focus of this project is the intensity of production.

Intensity of production addresses the time investment of producers—assuming that increased time investment leads to an increase in the number of goods produced. The identification of the various parameters of specialized production may be more straightforward in complex, state-level societies when craft producers and workshops are obvious in the archaeological record. However, craft specialization is less visible in the archaeological record of middle-range societies, such as the Northern Rio Grande region of the American Southwest. Many specialists in this region were likely part-time, independent producers who worked in their homes, leaving few archaeological traces. This aspect of the archaeological record of middle-range societies requires that proxy indicators of organization of production be used to determine specialization. One proxy indicator that has been used to view the intensity of production is the relative degree of standardization of products (Mills 1996).

Standardization addresses the "relative degree of homogeneity or reduction of variability in the characteristics of pottery" (Rice 1992:268). Standardization is

frequently equated with high intensity of production, meaning that the more time producers spend making pots (the higher the intensity of production), the more standardized their products become (Rice 1992). Standardization and intensity of production are thought to be related in market-based state-level societies as a result of four variables: (1) crafts made by intensive specialists are mass produced for the sake of economic efficiency; (2) standardization results from quality control; (3) standardization is a risk aversion tactic based on the conservative nature of pottery production; (4) standardization is a result of increasing skill developed through repetition and routinization (Rice 1992:268). Similarly, Costin (1991:33) argues that products become more standardized with specialized production because there are fewer producers relative to consumers (basically, fewer hands working on the products), and because producers become more efficient as they intensify production. In non–market-based systems, consumer demands for a certain standardized product or social expectations of adherence to standardized canons may also explain why specialized products become more standardized. As will be discussed further in Chapter 4, the relationship between standardization of assemblages and intensity of production may be clearer in complex archaeological societies if workshops or producers are clear, and in most middle-range societies in modern settings as well, but the relationship is much less clear in the archaeological record of ancient middle-range societies. These issues are examined to determine which attributes of ceramics, if any, change in standardization on vessels made by potters at San Marcos Pueblo.

The Northern Rio Grande is an ideal place to examine standardization in an archaeological middle-range society because we have independent evidence of change in

the intensity of specialized production in the wide distribution of Glaze Ware ceramics made at San Marcos Pueblo (Warren 1979). The question is not whether specialization occurred, but how or if standardization resulted from this specialization. By examining standardization in this known setting, this research will show other researchers which attributes, if any, hold the most promise for examining standardization in middle-range societies. Although to a lesser extent, the other three parameters of the organization of production, concentration, scale, and context, are also addressed.

For the parameter of concentration, which addresses how specialist producers are distributed across the landscape, we have evidence in the Northern Rio Grande that a number of sites, such as Pecos Pueblo during Glaze E and Tonque Pueblo during Glaze D, produced and exported more ceramics than other contemporaneous villages (Dyer 2010; Shepard 1942; Warren 1969). Previous research suggests that San Marcos Pueblo potters made enough pottery to export vessels to other sites and that the local assemblage was dominated by locally made wares (Nelson and Habicht-Mauche 2006; Warren 1976, 1979). One limitation of the previous studies of concentration of production at San Marcos has been a focus on exported samples recovered from other sites, with limited sample sizes used to evaluate the extent of local wares retained in the home village. In this dissertation, I clarify the interpretation of this parameter by evaluating the percentage of locally produced wares in a large sample of ceramics from the site. If the local assemblage is dominated by locally produced wares and there is extensive evidence of export of vessels from the site, these data will suggest higher levels of production concentration.

The parameter of scale addresses who the producers are and how the production unit is organized. At one end of the scale continuum are small, household-based production

units, and on the other end are wage-labor forces (Costin 1991:13–16). It is likely that most or many Northern Rio Grande households were making pottery, but this assumption is assessed in the current research by evaluating the products made at San Marcos. If there are differences in scale, with a smaller group of producers or households making pots for export, then exported products may look different than those made by the overall community for use at the site. I examine differences in a sample of exported sherds recovered from sites throughout the Northern Rio Grande that were made at San Marcos and compare them to vessels made and used at the site to determine if there were differences in the scale of production at the site. This portion of the analysis addresses if fewer hands were engaged in making exported vessels than in manufacturing pottery for local use, which will help archaeologists working in the Northern Rio Grande gain a better understanding of both the context of exchange and aspects of production.

The production context, defined as the degree of elite sponsorship in production (Mills 1996:121), is likely independent, as there is no clear archaeological evidence of the presence of elites in the Classic period Northern Rio Grande, much less evidence of control over producers. Thus, the focus of this dissertation is on exploring the organization of production at San Marcos in reference to concentration, scale, and intensity, with a focus on the relationship between changes in the intensity of production and standardization of the products produced.

Organization of the Dissertation

Following this introduction to the problem of the study, Chapter 2 presents the culture historical background of the Northern Rio Grande, the Galisteo Basin, and the site of San Marcos Pueblo. Chapter 3 gives an overview of ceramic production studies in the

Southwest, presents the Northern Rio Grande Glaze Ware typology, and discusses previous studies of Glaze Ware production, distribution, and specialization.

Chapter 4 describes the theoretical background of the study, with a detailed description of the organization of production as well as an ethnoarchaeological and archaeological comparison of how standardization has been used by researchers to examine the organization of production. Problems in evaluating standardization in archaeological assemblages are discussed, including the differences in time scale, number of producers, number of production episodes, and unclear vessel size classes.

Chapter 5 describes the basic research methodology and presents the models of standardization in Glaze Ware production at San Marcos that are tested with the data presented in the following chapters. In this Chapter, I also evaluate local production at San Marcos through aplastic/temper analysis and demonstrate that over 80% of ceramics recovered at the site were manufactured there.

Chapters 6 through 10 present the specific analytic methods used to examine aspects of the organization of production throughout the production process used by potters at San Marcos Pueblo and the results obtained from the examination. The organization of these chapters follow the production steps, from temper material selection and processing, to forming and morphology, to glaze paint preparation and color, to decoration and design, and finally, to firing methods used to transform the clay into the final finished vessel.

In Chapter 11, I present an overview of the production processes at San Marcos and evaluate the models of the relationship between standardization and intensity of

production as seen at the Pueblo. The dissertation concludes with ideas on directions for future research on Glaze Ware production.

Chapter 2

San Marcos Pueblo in Culture Historical Context:

The Northern Rio Grande during the Classic Period

In addition to the complex pattern of Glaze Ware production and distribution, a number of other trends characterize the Classic period (A.D. 1325–1600) in the Northern Rio Grande. Throughout the wider Pueblo Southwest, the Pueblo IV period (approximately A.D. 1275/1300 to 1600) was a time of community reorganization and migration (Adams and Duff 2004; Spielmann, ed. 1998). This period witnessed changes in village size, layout, and location that differ from the previous Pueblo III period (Adams and Duff 2004). Village size increased beyond the size of earlier centers such as Sand Canyon Pueblo in the Mesa Verde region. Village layout often contained enclosed plazas or other formal ritual space, and villages are almost always located in settlement clusters close to a few other villages, with gaps between clusters (Adams and Duff 2004:4–5). Within the Northern Rio Grande, these changes occur during the Coalition (A.D. 1200–1325) to Classic period transition.

Geographical Background

The Northern Rio Grande culture area covers much of north-central New Mexico, from Isleta Pueblo in the south to Taos Pueblo in the north, and from the Jemez Mountains in the west to the upper drainage of the Pecos River in the east (Wendorf and Reed 1955) (Figure 2.1). The Northern Rio Grande region comprises six archaeological districts: Taos, Española–Chama, Santa Fe–Pecos, Galisteo, Zia–Kewa (formerly Santo Domingo), Jemez, and Albuquerque (Habicht-Mauche 1993). San Marcos Pueblo is in the Galisteo District, which is just south of Santa Fe and includes the watershed of

Galisteo Creek (Snead et al. 2004:27). San Marcos Pueblo is the northwestern-most village in the Galisteo District, between the Sangre de Cristo Mountains to the north and the Ortiz Mountains to the south (Hill 1998:210). The Classic period trends of population increase and aggregation are particularly evident in the Galisteo Basin. Within the Galisteo District, 10 large sites were occupied between A.D. 1275 and 1550 (Snead et al. 2004). In addition to San Marcos Pueblo, the district contains the large Classic period towns of Pueblo Largo (LA 183), Pueblo Blanco (LA 40), Pueblo Colorado (LA 62), Pueblo Shé (LA 239), San Cristobal Pueblo (LA 80), Las Madres (LA 25), San Lázaro Pueblo (LA 91/92), Galisteo Pueblo (LA 26), and Piedra Lumbre (LA 309) (Snead et al. 2004) (Figure 2.2). None of these sites have been fully excavated, but room estimates range from 500 to 4,000 (Creamer and Renken 1994; Dutton 1964; Nelson 1914, 1916; Snead et al. 2004).

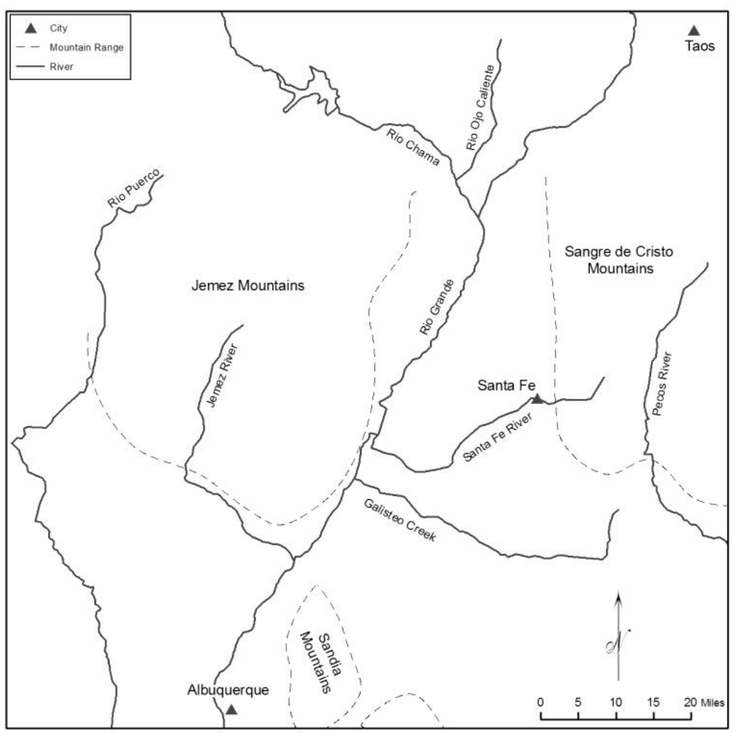


Figure 2.1: **The Northern Rio Grande (map by Audrey Salem).**

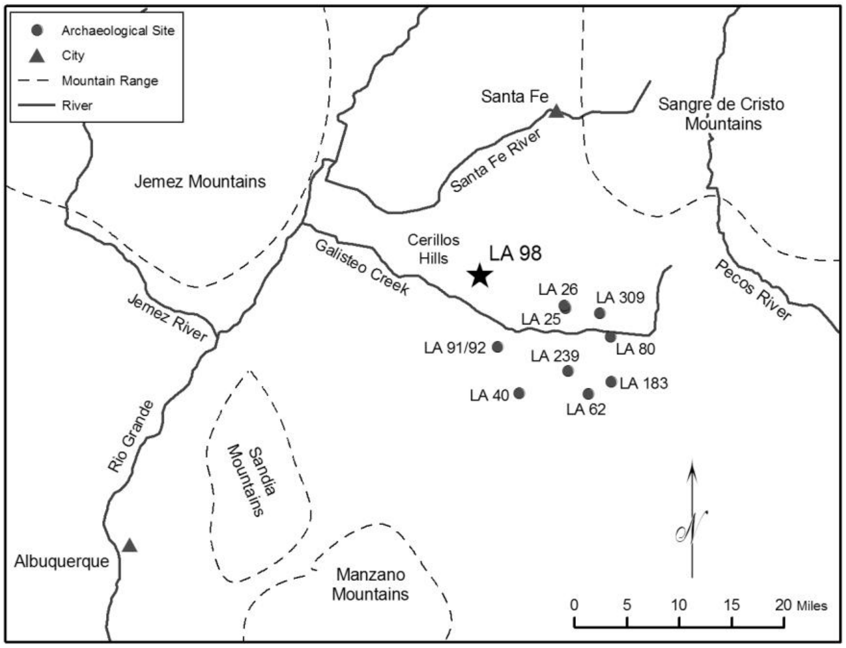


Figure 2.2: **Classic period towns in the Galisteo District** (map by Audrey Salem).

Changes during the Coalition to Classic Period Transition

Early in the Pueblo IV period, major shifts in ceramic traditions occurred in regions across the Southwest, with change from the standard bichrome, black-on-white ceramic traditions to glaze-painted and polychrome traditions (Adams and Duff 2004; Crown 1996; Habicht-Mauche 1993; Spielmann 1998). In addition, ceramic traditions became more regionally distinctive (Adams and Duff 2004:5). In the Northern Rio Grande during the early Classic period, a number of different ceramic wares were being produced— Glaze Ware types in the south, Biscuit Ware types in the north, Jemez Black-on-white in the Jemez mountain region, and the continuation of black-on-white types in the Taos area (Figure 2.3).

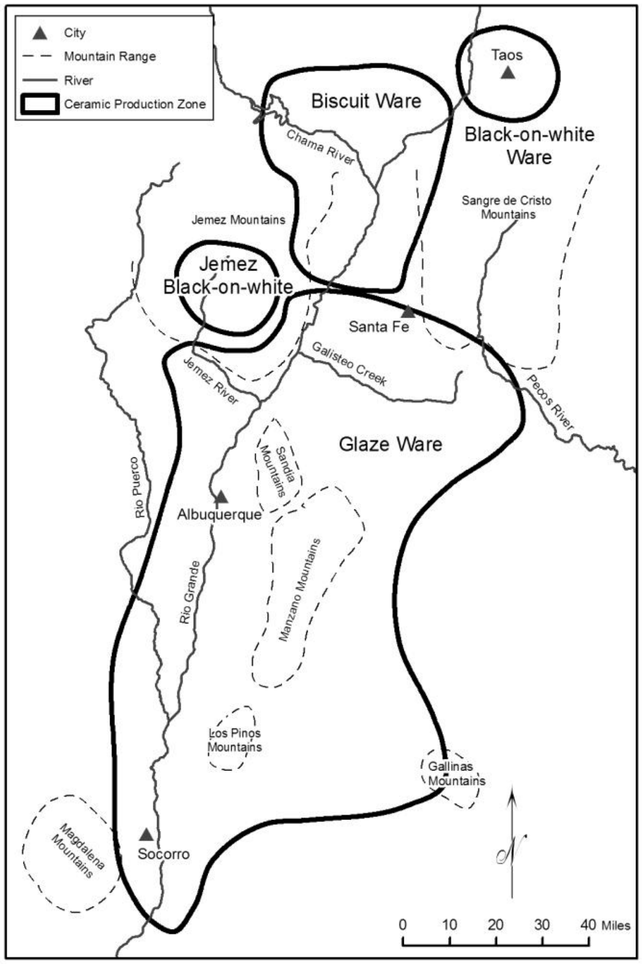


Figure 2.3: **Map of the ceramic production zones in the early Classic period in the Northern Rio Grande (modified from Futrell 1998:286 by Audrey Salem).**

Changes also occurred in centers of population at this time; some areas decreased in size, while immigrants from these areas increased population in others (Adams and Duff 2004:5). In the Northern Rio Grande specifically, there were significant population increases and a trend of movement into increasingly larger villages from the Coalition to the Classic period. This population increase has been attributed to the movement of peoples from the west (Crown et al. 1996), natural growth of local peoples, the "ripple effect" of migrants moving south (Habicht-Mauche 1993), or a combination of local

demographic expansion and the introduction of migrants (Snead et al. 2004:26). A number of "push" and "pull" factors have been cited as possible reasons for the draw of migrants from the Four Corners area to the eastern and southern regions of the Southwest, including more stable communities, new ritual systems, and environmental factors, as discussed below (Adams 1991; Ahlstrom et al. 1995; Crown 1994).

Small, dispersed settlements were abandoned as populations aggregated into villages ranging in size from hundreds of rooms to over a thousand (Crown et al. 1996). The average village size in the northern Rio Grande ranges from over 300 to more than 1,000 rooms during the Classic period, with increases in average village size throughout the Greater Southwest during the Pueblo IV period (Adams and Duff 2004:9). Aggregation begins in the late Coalition at some northern Rio Grande sites, such as Rowe Ruin (LA 108), Arroyo Hondo Pueblo (LA 12), and Pot Creek Pueblo (LA 260), and continues into the early Classic period (Creamer 1993a; Cordell 1998; Crown 1991; Habicht-Mauche 1993; Kohler 2004; Schwartz 1993). Large, multistoried villages, many with multiple plazas, occur all across the Northern Rio Grande region during the Classic period, including Tijeras Pueblo (LA 581), San Marcos Pueblo, Pecos Pueblo (LA 625), Tonque Pueblo (LA 240), Puaray Pueblo (LA 326), Unshagi (LA 123), and Sapawe (LA 306) (Barnett 1969; Cordell 1980; Elliott 1982; Kidder 1958; Kohler 2004; Snow 1963).

The development of so many large, aggregated sites and settlement clusters, not just within the Northern Rio Grande but throughout the Pueblo world, during the Classic period has led researchers to suggest a number of models of social or regional organization that focus on autonomy, alliances or polities, and centralization (Huntley 2008:13). In the Northern Rio Grande, these models include complex tribes (Habicht-

Mauche 1993), clustered confederacies (Spielmann 1994), and alliances (Creamer 1996, 2000a; Creamer and Haas 1998; Plog 1983; Wilcox 1981, 1991). Wilcox (1981) proposed a model in which pueblos were linked together into larger polities separated by linguistic boundaries, where hierarchical decision making occurred. Habicht-Mauche (1993) presents a model in which pueblos were tied together by informal economic and social ties to better mitigate subsistence uncertainty. Spielmann (1994) develops a model similar to Habicht-Mauche's, in which confederacies developed among clustered sites to address conflict over resources. In Creamer's (1996, 2000a; Creamer and Haas 1998) model, villages are linked to a wide range of other communities through ties of trade and exchange. As noted by Severin Fowles (2004:17), the difficulty in evaluating these models of social structure organization is in their reliance on much of the same settlement data.

A major conceptual issue with interpretations of Northern Rio Grande social or political organization is that many of the large sites in the region have complex histories of use (Crown 1998; Ramenofsky et al. 2009; Snead et al. 2004:29). The lengthy dates of occupation for many sites mask the use, abandonment, and reuse of entire sites or areas of sites. For example, Crown's (1991:305) work at Pot Creek Pueblo documents average use-life of individual rooms at just 19 years. Similar trends are noted at other sites, including Tijeras Pueblo (Cordell 1980) and Arroyo Hondo (Creamer 1993a). Furthermore, the two architectural components at Arroyo Hondo Pueblo were not occupied at the same time (Creamer 1993a). Such patterning has been suggested for San Marcos as well. As is discussed in more detail below, it is likely that only portions of San Marcos were occupied at any one time (Creamer and Haas 1988; Ramenofsky 2001),

and it may even have been completely abandoned for periods within its traditionally defined occupation span (Ramenofsky et al. 2009; Welker 1997). In addition, although the general pattern in the Classic period is aggregation into larger sites, small sites are not completely abandoned and are often occupied for use as field houses (Kulisheck 2005; Preucel 1990; Ramenofsky et al. in press).

Environmental Background

During the Coalition to Classic period transition, environmental conditions in the Northern Rio Grande region may have been one of the factors that drew migrants from the San Juan and Mesa Verde regions (Ahlstrom et al. 1995). The "Great Drought" of A.D. 1276–1299 in the American Southwest (Crown et al. 1996) was especially severe in the San Juan and Mesa Verde regions but less so in the Northern Rio Grande region (Ahlstrom et al. 1995). During the late 1200s, precipitation was higher in the Rio Grande region than in the rest of the northern Southwest. Climate data for the Pajarito Plateau indicate that the period from A.D. 1200 to 1400 was wetter and therefore more conducive to dry farming (Allen 2004:64) and multiple farming techniques, including dry farming, could be used in the Northern Rio Grande (Anschuetz 1998). During the Great Drought, many large sites in the region, from the Galisteo Basin to Santa Fe, were established near perennial water sources; following the drought, precipitation was high in the region, making the Northern Rio Grande a desirable location for migrants (Crown et al. 1996:199–200). Dean and Funkhouser (1995:94) document a stable unimodal, summer-dominant precipitation pattern for the Northern Rio Grande for the period from the A.D. 1250s to the 1450s, when the more northern areas of the Southwest were less stable. In

addition, many areas within the region have longer growing seasons than areas to the north.

Although environmental factors may have drawn migrants to the region, the late 1300s witnessed high variability in precipitation and a number of short droughts that may correlate with short periods of abandonment of sites in the region. Arroyo Hondo Pueblo and Tijeras Pueblo both show evidence of abandonment during the mid 1300s, likely due to drought conditions (Cordell 1980; Creamer 1993a:138). During the Historic period, precipitation increased enough in the Galisteo Basin that it was described as "fertile and well-watered" (Hill 1998:210).

Geological Resources in the Galisteo Basin

In addition to perennial water sources in the form of springs, people may have been drawn to the Galisteo Basin because of the rich mineral resources, especially lead ore and turquoise in the Cerrillos Hills (Bice et al. 2003; Cordell 1989; Habicht-Mauche et al. 2000; Warren and Mathien 1985). Turquoise from the Cerrillos Hills was widely traded within the greater Southwest and into northern Mexico (Snow 1981). Glaze Ware production required lead ore for production of glaze paint, so this resource was especially important for the manufacture of Glaze Ware ceramics at San Marcos Pueblo that began later in the site's occupation. Recent lead isotope research by Judith Habicht-Mauche and her colleagues (Habicht-Mauche et al. 2000; Habicht-Mauche et al. 2002) clearly defines the Cerrillos Hills lead as a major source in the manufacture of this glaze paint. The combination of favorable environmental conditions, perennial water sources, and rich mineral resources made it possible for many large villages to develop in the Northern

Rio Grande during the Classic period. San Marcos Pueblo was one such village that thrived in the Galisteo Basin.

Previous Archaeological Investigations in the Galisteo Basin and at San Marcos Pueblo

Archaeological research in the Galisteo Basin and at San Marcos Pueblo has focused primarily on questions of time, demography, and exchange. Many of these projects have depended heavily on ceramics for elucidating information about the native residents of the Galisteo Basin villages. The ceramics used to address these questions were collected through a number of field archaeological investigations. Here I present information on the extensive archaeological field research project in the Galisteo and at San Marcos, with a detailed presentation of ceramic analyses on pottery collected during these field projects in the following chapter.

Archaeological field research has been going on in the Galisteo Basin and at San Marcos Pueblo for the last century. Nels Nelson conducted the first archaeological excavations in the Galisteo Basin in 1912 and 1913 at Galisteo Pueblo, Pueblo Blanco, Pueblo Colorado, Pueblo Largo, Pueblo Shé, San Cristobal Pueblo, and San Lázaro Pueblo, and in 1915 at San Marcos Pueblo (Nelson 1914, 1916). Galisteo Pueblo and Las Madres were partially excavated by Bertha Dutton (Dutton 1964; Schaafsma 1995). Richard Lang surveyed the Arroyo San Cristobal drainage as well as agricultural features at San Marcos (Lang 1977). With the goal of examining chronology and demography across the Northern Rio Grande, Winifred Creamer and Jonathan Haas conducted a number of field schools at Pueblo Blanco and excavated test pits at a number of sites across the region, including San Marcos as a part of the Northern Rio Grande Research

Project (Creamer 1993b; Creamer et al. 2002; Creamer and Renken 1994). In the past decade, archaeological research has been expanding. James Snead has conducted survey in the Galisteo Basin and excavations at Burnt Corn Pueblo (Snead 2008a, 2008b) through the Tano Origins Project to explore population movement and conflict in the region during the A.D. 1300s. Marit Munson is studying rock art in the areas adjacent to San Cristobal Pueblo (Munson 2008). Ann Ramenofsky, Chris Pierce, David Hurst Thomas, and Emily Hinz have conducted research at San Marcos within the last decade as well. All of these projects, including archaeological research at San Marcos Pueblo, are discussed in more depth below.

Numerous archaeological investigations, primarily test excavations, surface surveys, and ceramic analyses, have been carried out at San Marcos from the early 1900s to the present (Creamer 1993b, 2000a; Creamer and Haas 1998; Creamer and Renken 1994; Eddy et al. 1996; Ferguson et al. 2003; Haas and Creamer 1992; Habicht-Mauche 1988; Habicht-Mauche et al. 2000; Habicht-Mauche et al. 2002; Hinz et al. 2008; Hinz et al. 2006; Ivey and Thomas 2005; Lightfoot 1993; Nelson 1915; Nelson and Habicht-Mauche 2006; Pierce and Ramenofsky 2000; Ramenofsky 2001, 2003; Ramenofsky et al. 2009; Ramenofsky et al. 2008; Reed 1954; Reed 1990; Thomas 2000; Welker 1994, 1995, 1997). The extensive number of projects using ceramics from San Marcos Pueblo is discussed in the next chapter.

The earliest archaeological work at San Marcos was conducted by Nels Nelson (Nelson 1914, 1915, 1916) under the auspices of the American Museum of Natural History in New York. Nelson's goals were culture historical; he excavated, collected, and mapped nine sites in the Galisteo Basin to acquire artifacts for the Museum. The majority

of the large pueblos Nelson excavated in the Galisteo Basin were excavated in 1912. The San Marcos excavations were conducted a few years later, in 1915. At San Marcos, Nelson excavated four to six rooms in each of the room blocks, a total of 172 rooms, and created a planimetric map of the site showing locations of excavated areas (Figure 2.4). The artifacts collected during Nelson's excavations are housed at the American Museum of Natural History. The whole vessels collected by Nelson are part of the whole-vessel sample used in the current project, and all the ceramics from Nelson's collections from San Marcos were used in Eden Welker's dissertation research into the occupational history of the site (Welker 1997).

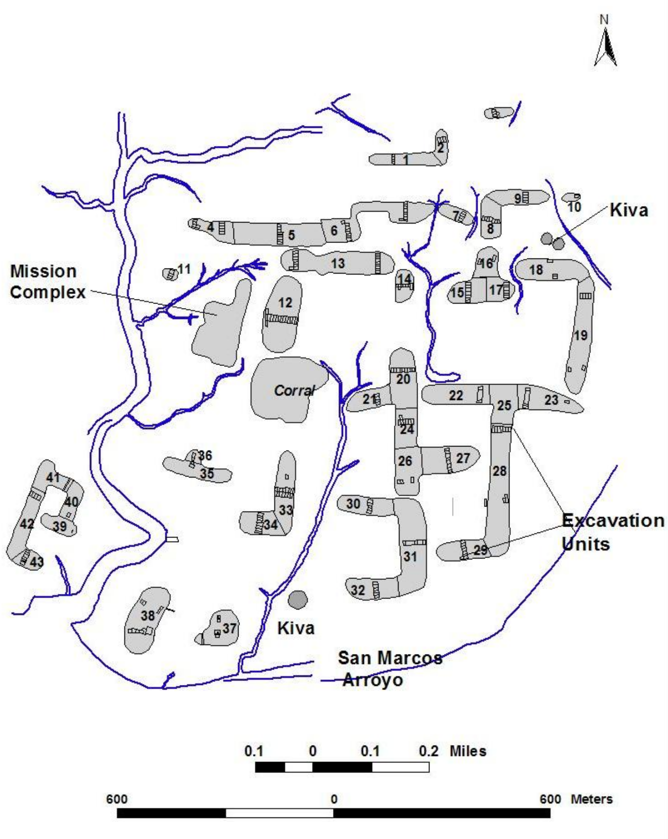


Figure 2.4: **Nelson's 1914 planimetric map of San Marcos Pueblo (figure provided by Ann Ramenofsky)**

The next research at the site did not occur until the 1930s, with H. P. Mera's wide-scale surface collection of ceramic sherds from a majority of the known archaeological sites in the Northern Rio Grande region, including San Marcos pueblo (Mera 1933, 1940). Mera's goals were to reconstruct demographic changes in the Pueblos during the late prehistoric and early historic periods. Mera's research included assigning Laboratory of Anthropology (LA) numbers, making pace and compass maps, and collecting rim sherds from hundreds of sites, from Socorro to Taos. The ceramics collected for this project were used by Mera to establish the Northern Rio Grande Glaze Ware rim sequence, which is discussed in the next chapter.

Archaeological research at San Marcos following the excavation and surface collection projects of Nelson and Mera was reduced in scale. Eric Reed conducted test excavations at the southern end of the site, in roomblocks 37 and 38 (see Figure 2.4), during the summer of 1940 for the Museum of New Mexico (Reed 1954). Reed excavated nine rooms and cleared five rooms that had been partially excavated in two room blocks just to the north of San Marcos Arroyo. A small number of artifacts were recovered from one roomblock, Nelson's Building 38. Most were black-on-white and Glaze A sherds, suggesting that the southern end of the site was the earliest occupation of the pueblo (Reed 1954:323). Excavations in the other roomblock, Nelson's Building 37 just to the east of Building 38, uncovered additional Glaze A vessels, as well as the later Glaze B and C types (Reed 1954:324). A "compact piece of wood ash from a pot mold" from one of the excavated rooms in Building 38 was recovered suggesting pottery was made in this room (Reed 1954:328). The ceramics in the fill of this room included black-on-white types and Glaze A Red and Yellow. Reed (1954) also wrote a brief report

recording architectural details in the excavated rooms and describing all artifacts recovered. Artifacts from these excavations are housed at the Museum of New Mexico.

In 1980 and 1981, five rooms eroded by the arroyo were excavated by the Archaeological Conservancy under the direction of Curtiss Brennan. The artifacts from this excavation are curated at the Museum of New Mexico's Laboratory of Anthropology. Judith Habicht-Mauche used ceramics collected during this project for her dissertation research on Plains-Pueblo interaction (Habicht-Mauche 1988).

In 1988, the Northern Rio Grande Research Project, under the direction of Jonathan Haas and Winifred Creamer, conducted test excavations at thirteen Classic period sites in the Northern Rio Grande, including San Marcos Pueblo and Pueblo Blanco within the Galisteo Basin (Creamer and Renken 1994). At San Marcos the excavations included five 1 x 2 meter test pits in different middens in the central section of the site, as well as room blocks on the western edge of the site. The goals of this research were to better understand chronology and demography across the wider Northern Rio Grande region. The data and results from this work were presented in numerous conference presentations and publications (e.g., Creamer 1993b, 2000a; Creamer and Haas 1998; Creamer and Renken 1994; Haas and Creamer 1992). Much of the research from the Northern Rio Grande Research Project addresses ceramics, especially ceramic typology, production, and exchange, and is discussed in later sections of this study. Most notably, some of the ceramics from this project were used to address issues of intercommunity dynamics through reconstruction of trade and exchange of both ceramics and lead used to make glaze paint, in the Galisteo Basin and beyond (Habicht-Mauche et al. 2000; Habicht-Mauche et al. 2002; Nelson and Habicht-Mauche 2006). The majority of the

collections from the Northern Rio Grande Research Project are housed at the Field Museum in Chicago; while Judith Habicht-Mauche has retained some of the ceramic rim sherds at the University of California–Santa Cruz.

In the early to mid 1990s, numerous surveys were carried out at San Marcos and in the surrounding area by researchers at the University of Colorado (Eddy et al. 1996; Lightfoot 1993; Lightfoot and Eddy 1995; Welker 1994, 1995, 1997). Frank Eddy and Dale Lightfoot used aerial photogrammetry to examine evidence of agricultural intensification in the areas surrounding San Marcos (Eddy et al. 1996; Lightfoot 1993; Lightfoot and Eddy 1995). Eden Welker's dissertation examined occupational history and demography, as well as the economic factors affecting aggregation at both San Marcos and Pecos. In addition to analyzing Nelson and Brennan's ceramic collections, Welker (1997) did in-field recording of ceramic types.

From 1997 to 2002, Ann Ramenofsky of the University of New Mexico (UNM) directed a number of mapping, systematic surface collection, and limited excavation projects at San Marcos (Penman 2001; Pierce and Ramenofsky 2000; Ramenofsky 2001, 2003). In 1997 and 1998, architectural and topographic features of the site were mapped (Penman et al. 1998; Pierce and Ramenofsky 2000). In 1999 and 2000, the UNM archaeological field school was held at San Marcos. The field school work involved systematic surface collections, continuation of the mapping of the architectural features, stratigraphic profiling of the arroyo bank, and an attempt to locate possible areas of metallurgy (Pierce and Ramenofsky 2000:3). The 2000 field school continued with surface collection and excavations of a number of 1 x 1 meter test units to a depth of 10 centimeters to increase the size of ceramic samples for later analysis. In this field sessions

students also continued the profiling of the arroyo bank and re-excavated a number of the rooms originally excavated by Nels Nelson in 1915 (Ramenofsky 2001). The ceramic sample used to create the seriation of midden use at the site consisted of 3,391 sherds (Ramenofsky 2001:42). In 2002 an additional field season, under the direction of Ann Ramenofsky and C. David Vaughan, investigated evidence of metallurgical production at San Marcos (Ramenofsky 2003). Systematic surface collection, remote sensing-survey, and excavation of some magnetic anomalies identified through remote sensing were conducted on one area of the site with evidence of possible metallurgical activity (Ramenofsky et al. 2008; Vaughan 2006). The Northern Rio Grande Glaze Ware ceramic rim sherds recovered during the 1999 through 2002 UNM field seasons make up the majority of the ceramics used for this analysis. These artifacts are currently housed in the Department of Anthropology at UNM and will be curated at the university's Maxwell Museum of Anthropology following the completion of all analyses.

Also in 1999 and 2000, David Hurst Thomas conducted topographic mapping, remote sensing, and excavation of the mission complex at San Marcos to examine mission use and abandonment (Ivey and Thomas 2005; Thomas 2000). The artifacts from this research are curated at the Maxwell Museum. Most recently, the Summer of Applied Geophysical Experience (SAGE) program, under the direction of Scott Baldwin, conducted geophysical remote sensing of sections of the pueblo (Hinz et al. 2008; Hinz et al. 2006).

All of the previous archaeological research conducted at San Marcos Pueblo reveals aspects of the occupational history, chronology, and significance this site.

Ceramics, and especially typological analyses of ceramics, have been used in many of the archaeological research projects at the site.

San Marcos Pueblo

All available evidence suggests that San Marcos was first occupied in the thirteenth century and was abandoned during the Pueblo Revolt of 1680 (Pierce and Ramenofsky 2000; Ramenofsky 2001; Ramenofsky et al. 2009). The time periods of interest for the current study are the Classic and early Historic periods (approximately A.D. 1325–1680). Direct Spanish contact occurred at San Marcos in 1581 during the Chamuscado and Rodriguez expedition. The site is composed of approximately 43 room blocks (Nelson 1914, 1915; Figure 2.4) of over 1,500 rooms with 20 exposed middens, many of which are associated with specific room blocks (Pierce and Ramenofsky 2000:32; Figure 2.5).

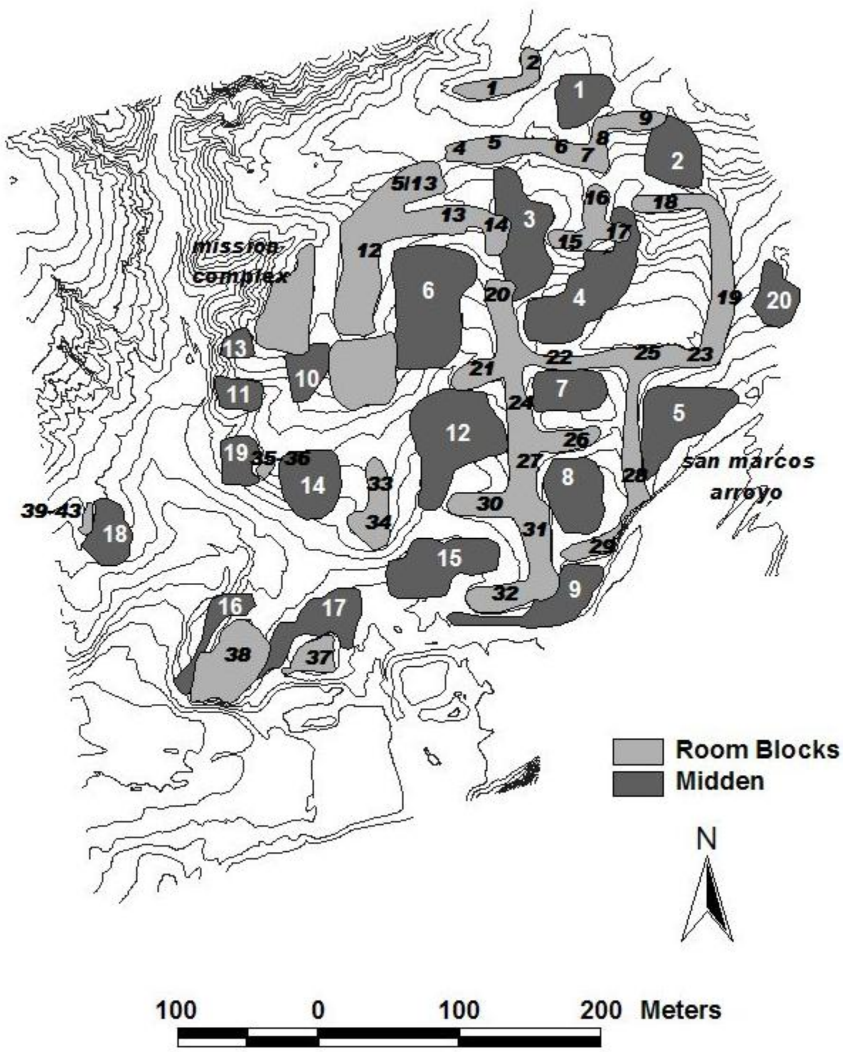


Figure 2.5: **San Marcos Pueblo, showing roomblocks in light gray and middens in dark gray (From Ramenofsky 2001:11).**

The ethnohistorical literature suggests the possibility that there may have been multiple language groups living at San Marcos at the time of Spanish contact. Documents and diaries of early Spanish explorers report that the residents of San Marcos were Tano, Tewa, Keres, or combinations of these linguistic groups (e.g., Barrett 1997, 2002; Harrington 1916:551; Schroeder and Matson 1965:145). Based on these Spanish

accounts, archaeologists have hypothesized that the pueblo may have been made up of numerous “barrios” or districts where members of different ethnic or linguistic groups clustered (e.g., Nelson 1915; Pierce and Ramenofsky 2000). In a recent reanalysis of the historical evidence, David Snow (2008:190–191) has made a convincing argument that the San Marcoseños were Keres speakers. Snow’s conclusions is based on Spanish records, the fact that the San Marcos priest also preached to the Keres speakers at La Cienega, San Marcos ties to Keres-speaking Laguna Pueblo, and baptismal records at Pecos for a child born to a father from the Keres pueblo of San Marcos.

The first Spanish explorers to visit San Marcos, Chamuscado and Rodriguez, named it “Malpartida” in 1581 (Hammond and Rey 1966). The Espejo expedition of 1583 also visited San Marcos, which Espejo called the pueblo Santa Catalina. The name San Marcos was first used in 1590 by Gaspar Castaño de Sosa (Hammond and Rey 1966). The missions at San Marcos and Santa Cruz de Galisteo were established in 1610 to 1611 (Hammond and Rey 1966), and the Franciscan mission was established there in 1638 (Hodge et al. 1945). San Cristobal, San Lázaro, and La Cienega then became *visitas* of San Marcos and Galisteo (Ayers 1916; Hodge et al. 1945; Hackett 1937; Hammond and Rey 1966; Scholes 1936; Reed 1954). San Marcos is identified by that name by all Spanish expeditions during the 1600s (Barrett 1997, 2002). In sum, the ethnohistorical literature suggests that San Marcos Pueblo was a notable village during the early Historic period.

Temporal Control at San Marcos Pueblo

The history of occupation at San Marcos Pueblo is complex. Recent research documents four periods of abandonment over the site’s occupation before final

abandonment (Ramenofsky et al. 2009). The few chronometric dates available are augmented by the ceramic seriation developed by Ramenofsky (2001). The resulting temporal groupings are reflected spatially across the site.

Very few chronometric dates have been produced over the large number of projects at San Marcos. Creamer and Renken (1994) discuss the difficulty they had in obtaining tree ring dates—the samples sent to the Laboratory of Tree-Ring Research resulted in only 1.7 dates for every 100 samples. The five non-cutting dates published by Creamer and Renken (1994:Figure 9)—1613vv, 1615vv, 1625vv, 1630vv, and 1633vv—are from wood in levels associated with all of the six Glaze Ware types. The more recent dates (1625vv, 1630vv, 1633vv) are associated with ceramics from Glaze A to Glaze F; the older dates (1613vv and 1615vv) are associated with Glaze A through Glaze E. There are two radiocarbon dates (from fiber and a corncob fragment) from the recent UNM work at the site. These dates were recovered from a midden profile and a room block that were cut by the San Marcos Arroyo. One of these dates 1425 ± 30 [500 ± 30 BP, AD 1425 ± 30, Beta – 141591] is from a corncob fragment recovered from a midden on the southern edge of the site. The other date 1410 ± 50 [550 ± 50 BP, AD 1410 ± 50, Beta – 141590] comes from organic fiber recovered from a burial. Both samples were materials in association with Glaze A Yellow, Glaze B, and Glaze C ceramics (Ramenofsky 2001).

Because there are so few chronometric dates from San Marcos Pueblo, ceramic cross dates are critical and are the primary means of determining occupation and temporal trends at the site. I used an early version of the ceramic seriation (Ramenofsky 2001:44) as the major means of sampling and relative dating of areas of the site for the current project. The most recent version of the San Marcos seriation (Ramenofsky et al.

2009) differs from the early version only in terms of the earliest use of the site, with the production of black-on-white and Glaze A Red ceramics (types that are not included in the current research due to small sample sizes).

The seriation (Ramenofsky 2001:44; Figure 2.6) of the decorated ceramics recovered from surface collection of all middens at San Marcos shows that the middens were used roughly sequentially over the occupational history of the site (Figure 2.7), with periods of abandonment between the occupations (Ramenofsky et al. 2009). Certain middens are dominated by higher counts of particular ceramic types. I have assumed that the room blocks adjacent to middens were occupied at the same time the middens were in use. The earliest use of the site occurred at the southern end, where Middens 16, 17, and 18 are located. These three middens are associated with the black-on-white ceramic wares that date to the late Coalition and early Classic periods, as well a small number of Glaze A Red ceramics. The earliest of the Rio Grande Glaze Ware found in abundance at the site is Glaze A Yellow. This type does not seriate well, as it was produced throughout much of the Glaze Ware sequence (Ramenofsky 2009), an issue that is discussed in greater detail in Chapter 3. Glaze C and D ceramics are most strongly associated with middens located at the northeast corner of the site (Middens 1, 2, 3, 4, and 20). Glaze E and F ceramics are most strongly associated with Middens 6, 10, and 13 on the northwest corner of the site, which is also the area around the Spanish Mission.

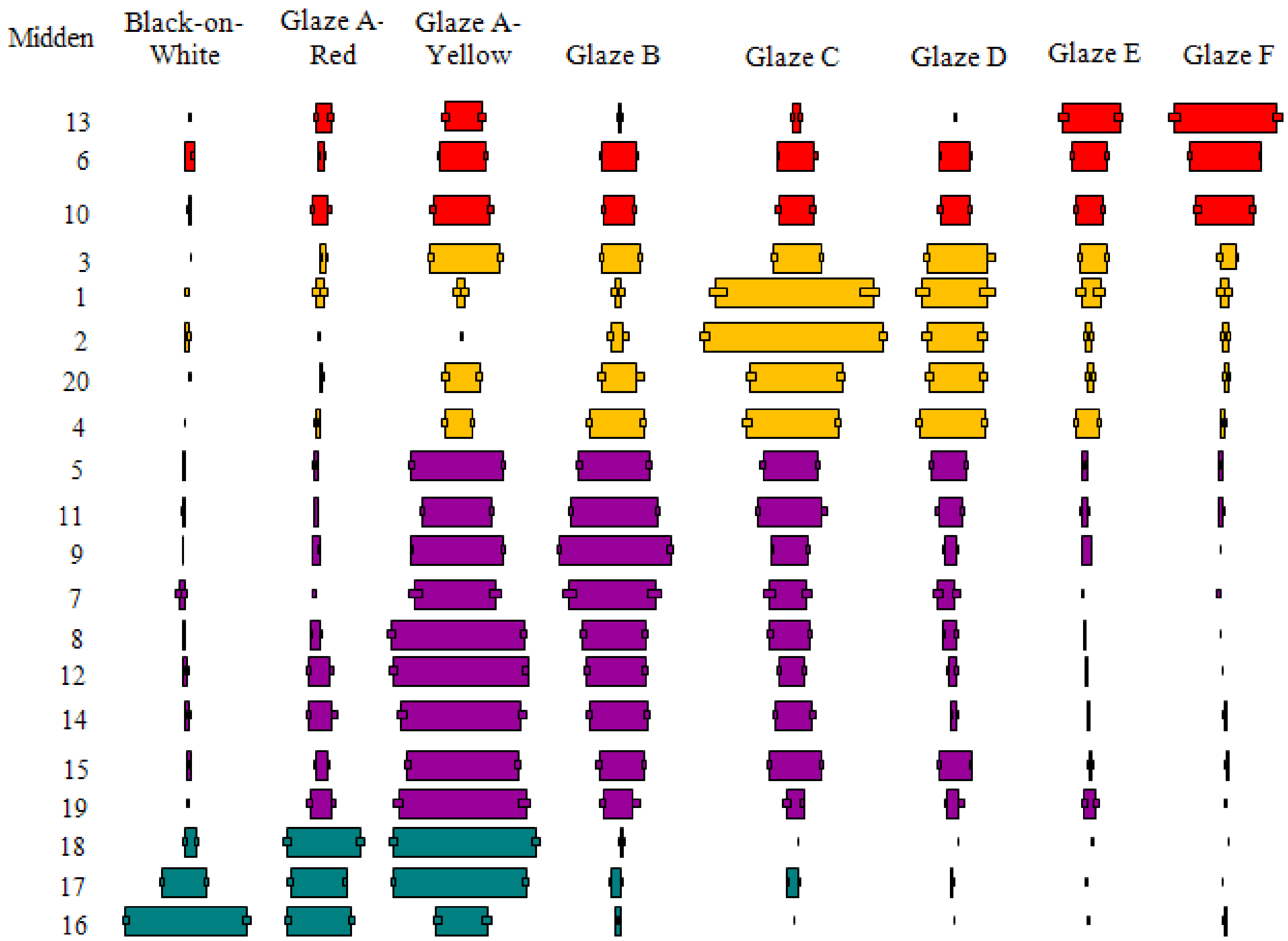


Figure 2.6: **Seriation of ceramic rims from San Marcos Pueblo with colors indicating division of the middens in use based on dominant counts of sherds of the different ceramic types (figure modified from Ramenofsky 2001). Turquoise represents middens associated with the largest counts of Black-on-white and Glaze A Red sherds, purple represents middens associated with the largest counts of Glaze A Yellow and Glaze B sherds, yellow represents dominance of Glaze C and D sherds, and red represents dominance of Glaze E and F sherds.**

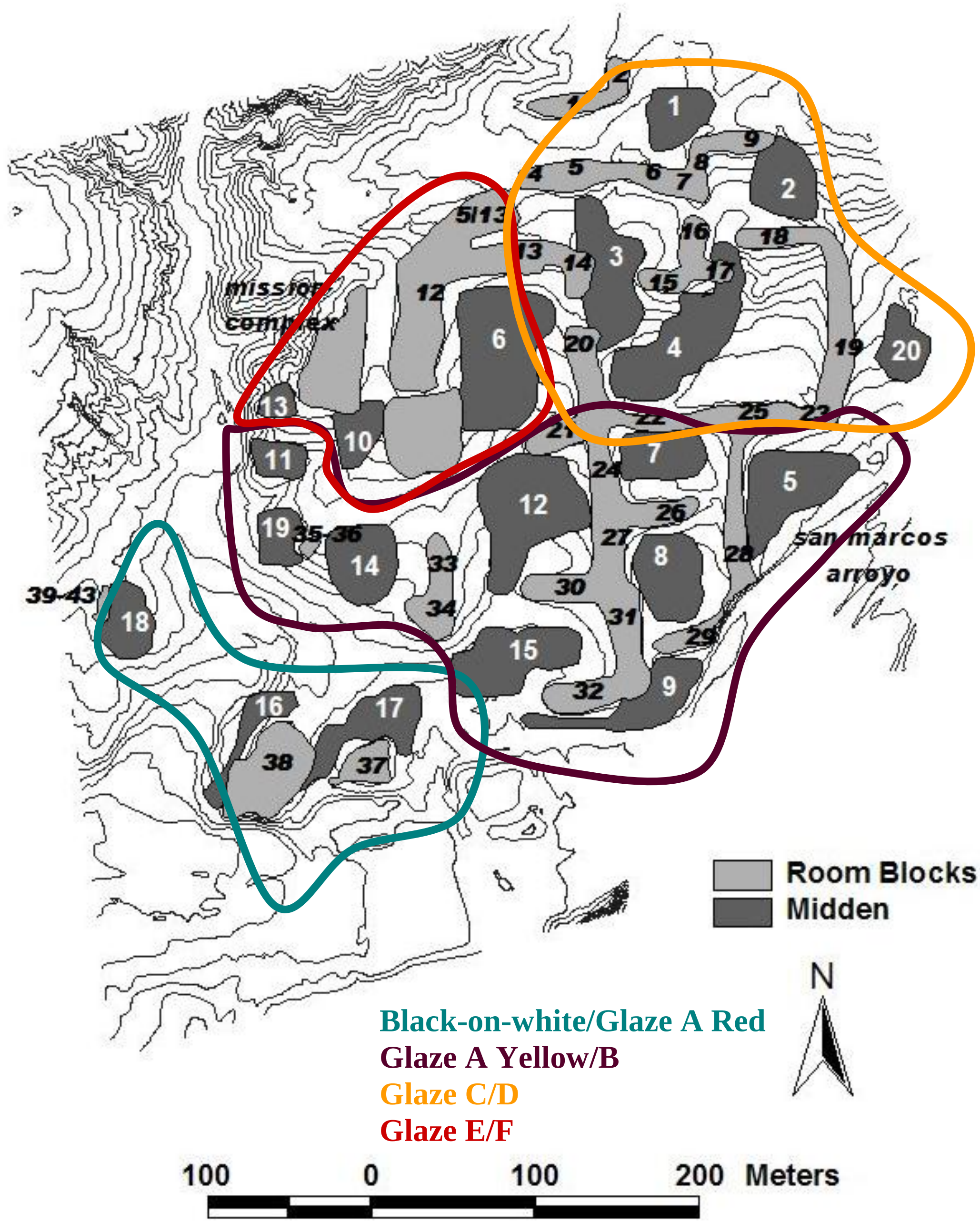


Figure 2.7: **Map of San Marcos Pueblo showing middens and room blocks with my divisions of the site based on dominant counts of sherds of ceramic types from the seriation (Figure 2.6) (figure modified from Ramenofsky 2001). The turquoise-outlined area represents middens and associated room blocks with the largest counts of black-on-white and Glaze A red sherds, purple identifies Glaze A Yellow and Glaze B sherds, yellow is Glaze C and D sherds, and red represents Glaze E and F sherds.**

The associations between room blocks and middens are indicated by previous research at the site, supporting the divisions of the site based on the Ramenofsky (2001) seriation. Eric Reed's (1954) excavations in room blocks 37 and 38 uncovered primarily black-on-white and Glaze A ceramics, the same types dominant in the adjacent middens 16 and 17. Excavation in the mission complex (Thomas 2000) recovered all of the Glaze Ware ceramic types, but the larger sherds tended to be Glaze F (Blinman 2000). The five tree-ring dates and the seriation show a similar pattern: although certain ceramic types dominate in particular rows of the seriation, all of the ceramic types are present in every row. This finding parallels the pattern in the tree-ring dates recovered during Creamer and Haas's work at the site, where the majority of the dates are in direct association with most, if not all, of the six Glaze Ware ceramic types (Creamer and Renken 1994). Creamer and Haas's work was restricted to the central area of the site, around midden 6, where the highest counts of rim sherds were recovered (Ramenofsky 2001). Again, although this midden did yield a slight predominance of Glaze E and F sherds, all other Glaze Ware types were represented. This issue of overlap of the types is not unique to San Marcos and is discussed further in the next chapter.

What is clear from the seriation is that all areas of the site were not continuously occupied. Certain areas were used primarily during certain Glaze Ware type production periods. Figure 2.7 shows the divisions of the site used for this analysis based on Glaze Ware dominance in the seriation. For the current research, it is significant that the three main Glaze Ware type areas (Glaze A Yellow/B, Glaze C/D, and Glaze E/F) are not drastically different in spatial extent, although the Glaze A Yellow/B area is a bit larger.

Summary

Much is known about the Classic period in the Northern Rio Grande Region. Many large villages were established, flourished, and were abandoned during this period. San Marcos Pueblo, in the Galisteo Basin, is one of these settlements. This site is large, with 43 room blocks and a complex history of use. Periods of abandonment punctuated the occupation at San Marcos and perhaps other large Galisteo Basin villages (Ramenofsky et al. 2009). The extensive archaeological research at the site has yielded large samples of ceramics, some of which were utilized in this study. All of the six Northern Rio Grande Glaze Ware types, from Glaze A to Glaze F, were recovered from the site during the recent UNM surface collections and the work by Creamer and Haas in the mid 1990s. Although there are periods in which the site was abandoned, when residents returned they continued with ceramic production. As is demonstrated in Chapter 5, all six types were made locally at San Marcos. In addition, the occupied portion of the site is not drastically different from the Glaze A Yellow/B to Glaze C/D or Glaze E/F production periods. And certainly, the spatial extent of use at the site from Glaze A Yellow/B to Glaze C/D does not increase—based purely on dominant frequencies of glaze types recovered from the surface the area of use during each occupation period actually seems to decrease somewhat. Previous archaeological research on the Classic period has argued that San Marcos Pueblo was a ceramic production center, especially for Glaze C and D ceramics (e.g., Habicht-Mauche 1993, Shepard 1942; Warren 1979). The next chapter discusses the archaeological background of ceramic production in the American Southwest and the data that support specialization of ceramic production at San Marcos Pueblo.

Chapter 3

Southwestern Ceramic Production and Specialization

Southwestern archaeologists depend heavily on ceramics to address certain kinds of questions, including issues of chronology (e.g., Kidder and Kidder 1917; Kroeber 1916; Mera 1940), migration (e.g., Herhahn 2006), ritual (e.g., Crown 1994; Spielmann 1998), economic and political aspects of social structure (e.g., Habicht-Mauche 1993, 1995), and craft production and specialization. In this chapter, I explore how ceramics can be used to infer information about specialization in production. In addition, I discuss the specific ceramic types analyzed in this study, the Northern Rio Grande Glaze Ware, and present some of the concerns with the typology. I then discuss previous studies of Glaze Ware production and specialization in the Northern Rio Grande and within the Galisteo Basin, specifically addressing the evidence for specialized production at the site of San Marcos.

Ceramic Production in the Southwest

There is extensive literature on archaeological pottery production in the Southwest, as many areas of the Southwest have a long history of ceramic production, distribution, and specialization research. Anna Shepard's (1942, 1965) seminal research on ceramics at Pecos Pueblo dispelled the previously held idea that Pueblo pottery was made by every household and that all villages were self-sufficient in their pottery production (Kidder and Shepard 1936:xxiii). The extensive research into craft production by potters in the past had greatly expanded our knowledge of the archaeological cultures of the Southwest. My focus is on the organization of ceramic production, and thus in

reviewing this past work I first explore how archaeologists have examined ceramic craft production and specialization.

Archaeological inferences about craft production and specialization can be either direct or indirect. Direct evidence most commonly consists of production tools, facilities, and materials used in craft manufacture. Direct production evidence is relatively rare in the Southwest, due primarily to the lack of extensive excavations outside of primary habitation areas of sites (Mills and Crown 1995:7). Because firing areas and kilns often occur outside of habitation areas, only a few have been documented (e.g., Bernardini 2000; Fuller 1984; Haury 1976:194–197; Heacock 1995; Maxwell et al. 1994; Post and Lakatos 1995; Sullivan 1988; Wilson and Blinman 1995). Most direct evidence comes through identification of pottery production tools, such as polishing stones, scrapers, and *pukis* (e.g., Blinman and Wilson 1988, Geib and Callahan 1988). Using a remote sensing spectral signature, Welker identifies one possible firing area near San Marcos (Welker 1997:153). Some unfired vessels and raw materials have also been recovered in areas across the Southwest, such as stashes of temper or clay and unfired vessels (e.g., Kojo 1996). Polishing stones and ground stone that may have been used in pottery production are common, but other direct evidence, such as potters tool kits in burials (Shafer 1985), are rare archaeologically in the Southwest.

As a consequence, indirect evidence of production is the dominant means used to study the organization of production in Southwestern archaeology. Two primary means of using indirect evidence to study production are through compositional analysis to determine location of production and through analysis of the final ceramic products themselves. Compositional studies can be used to investigate source areas for pottery or

materials in pots, as well as areas of production concentration, and to view the intensity of production at particular sites or in particular regions (Mills and Crown 1995:8). The most frequently used compositional techniques include petrography (e.g., Curewitz 2008; Garrett 1982, 1986; Goff 2009; Hegmon 1995a; Miksa and Heidke 1995, 2001; Oppelt 1994, 1996), electron microprobe (e.g., Abbott and Schaller 1991; Abbott and Walsh-Anduze 1995; Fenn et al. 2006), X-ray fluorescence (e.g., Crown 1984; Crown et al. 1988; Olinger 1987a, 1987b, 1988; Olinger and Woosley 1989), inductively coupled plasma spectroscopy (e.g., Duff 1993; Habicht-Mauche et al. 2000; Habicht-Mauche et al. 2002; Nelson and Habicht-Mauche 2006; Zedeño 1994), and instrumental neutron activation analysis (e.g., Bishop et al. 1988; Crown and Bishop 1991; Neff and Glowacki 2002; Neitzel and Bishop 1990; Ravesloot 1989; Whittlesey et al. 1992).

A number of these compositional techniques have been applied to the study of Northern Rio Grande Glaze Wares. Shepard first used spectrographic and microchemical analysis (Shepard 1936, 1942, 1965) to determine composition of the ceramics and glaze paint. Petrographic analysis is used extensively (Capone 1995, 2006; Curewitz 2008; Dyer 2010; Eckert 2008; Goff 2009; Habicht-Mauche 1993, 1995; Nelson and Habicht-Mauche 2006; Schleher and Boyd 2005; Shepard 1942, 1965; Warren 1969, 1976, 1979). More recently, techniques such as electron microprobe for analysis of the glaze paint (Bower et al. 1986; Herhahn 1995, 2006; Herhahn and Huntley 1996; Huntley et al. 2007) and a new method of inductively coupled plasma mass spectroscopy for determining lead isotopes (Habicht-Mauche et al. 2000; Habicht-Mauche et al. 2002; Huntley et al. 2007; Nelson and Habicht-Mauche 2006) have been used specifically to examine the glaze paint component of the Glaze Ware.

A major goal of many compositional studies is to show that certain areas or sites produced more ceramics than others. In areas of geologic diversity, linking the clay or temper used to manufacture ceramics to locations on the landscape can allow archaeologists to develop inferences about the communities that were manufacturing pottery. Ethnographic studies show that potters do not travel far to collect clay or temper materials (Arnold 1985), and identifying the source of materials used in manufacture can thus allow archaeologists to identify production by particular villages or in particular areas. Compositional evidence for increased intensity of production, or changes in the amounts of ceramics produced over time, has been documented for areas within the Hohokam region (Abbott 2009; Crown 1990:239; Doyel 1991:233; Neitzel 1991:185–196), the Chacoan region (King 2003; Toll 1984, 1985; Toll and McKenna 1987), and the Northern Rio Grande (Shepard 1942, 1965; Habicht-Mauche 1993, 1995; Nelson and Habicht-Mauche 2006; Warren 1969, 1979).

Other lines of indirect evidence for understanding production stem from analysis of the vessels themselves (Mills and Crown 1995). Attributes of vessel assemblages, such as nestability (Kidder and Shepard 1936; Whittlesey 1974) and standardization (Crown 1995; Hagstrum 1985; Hegmon et al. 1995; King 2003; Longacre et al. 1988; Lindauer 1988; Mills 1995; Motsinger 1992, 1997; Toll 1981) have been used to interpret the organization of production in the Northern Rio Grande. These studies of standardization are discussed in detail in Chapter 4. Because ceramic production cannot be understood without a system of classification for the pottery, we now turn to a discussion of ceramic typology for Northern Rio Grande Glaze Paint Ware.

Ceramics in the Pueblo IV/Classic Period: From Black-on-white to Glaze Ware

Major changes occurred in the ceramics produced across the Southwest from the A.D. 1200s to 1300s, including shifts in paint technology, colors used in decoration, vessel sizes, and decoration. Although glaze paints were used earlier in the Southwest in lesser frequency (Blinman and Wilson 1993; DiPeso et al. 1974), this form of decoration is used extensively over much of the Southwest during the Pueblo IV period (Eckert 2006). Many new types of bichrome or polychrome pottery appeared in many regions (Crown 1996), including in the Northern Rio Grande. Potters began to make larger vessels (Crown 1994, 1995; Spielmann 1998). New decorative styles, such as the Pinedale style (Carlson 1970; Crown 1994, 1996), appeared on vessels across the Southwest in the Pueblo IV period. Often these new decorative styles incorporated identifiable icons, a major change from the earlier, predominantly geometric designs. These ceramic shifts may reflect population changes through immigration, new ritual systems, and/or changes in ideology (Adams 1991; Crown 1994, 1996, 1998; Cordell 1995; Eckert 2008; Spielmann 1998).

Such marked changes also occurred in ceramic assemblages across the Northern Rio Grande in the early 1300s. At the beginning of the Classic period, ceramic types shifted from carbon painted black-on-white ware to glaze-painted ware in the southern portion of the Northern Rio Grande Valley, with black-on-white types continuing to be manufactured in the more northern areas of the region. Plainware types are not as well documented, but the general trend in the Galisteo Basin was from corrugated during the Coalition period to smeared or obliterated corrugated in the Classic period (Wendorf 1954). During the thirteenth century, Santa Fe Black-on-white was the most common

decorated type, with broad regional stylistic uniformity and a high degree of local compositional and technological variation (i.e., local production with adherence to regional stylistic canons) (Habicht-Mauche 1993, 1995; Stubbs and Stallings 1953). At the beginning of the fourteenth century, there was a rapid proliferation of local black-on-white decorative and technological styles throughout the Northern Rio Grande, with Galisteo Black-on-white as the local style in the Galisteo Basin (Habicht-Mauche 1993, 1995). Red-slipped Glaze Ware pottery was first produced in the Rio Grande Valley near Albuquerque at this time, with likely ties to glaze-painted ceramics produced in the Western Pueblo region, especially the Zuni area (Eckert 2006; Herhahn 2006). Soon afterwards, the Galisteo Basin became a production center for yellow-slipped Glaze Ware (Cordell 1989). Between A.D. 1340 and 1350, Glaze Ware became common throughout the region (Habicht-Mauche 1995). Within the Northern Rio Grande, Glaze Ware was produced from Santa Fe to Socorro at the same time that Jemez Black-on-white was produced in the Jemez area. Biscuit Ware was manufactured along the Rio Chama in the north, and black-on-white wares were made in the Taos/Picuris area (Dick 1965; Futrell 1998; Fowles 2004).

The typological sequence most commonly used for Northern Rio Grande Glaze Ware was developed by Kidder (Kidder and Kidder 1917; Kidder and Shepard 1936) and assigned dates by Mera (1933, 1940). There has been little further refinement since that time. Nels Nelson (1914) first noted that there were “time-sensitive patterns in the rim forms” (Creamer and Renken 1994:3; Nelson 1914) among the glaze painted ceramics from his stratigraphic excavations in the Galisteo Basin. Kidder’s work at Pecos built on Nelson’s idea of this temporal sequence of rim forms and developed a sequence using

Glaze Ware from Pecos Pueblo. Mera further refined the Kidder sequence and assigned dendrochronology dates to it using surface collections from sites with available tree-ring dates (Mera 1940). In general, Kidder and Mera's Rio Grande Glaze Ware series (Figure 3.1) shows a progression chronologically from glaze group A to group F, based primarily on bowl rim profile and quality of the glaze paint (Mera 1933, 1940). Glaze A rims are thin and straight and later rims are thicker and more complex. Subtypes, based on slip color, decoration, and temper, have been defined for many of the rim form types (Eckert 2003:49; Mera 1933). Table 3.1 lists the types, subtypes, and date ranges for each of the rim forms (Glaze Type Codes used in this study are included in Appendix A, Table 1). The dates used follow Eckert 2006.

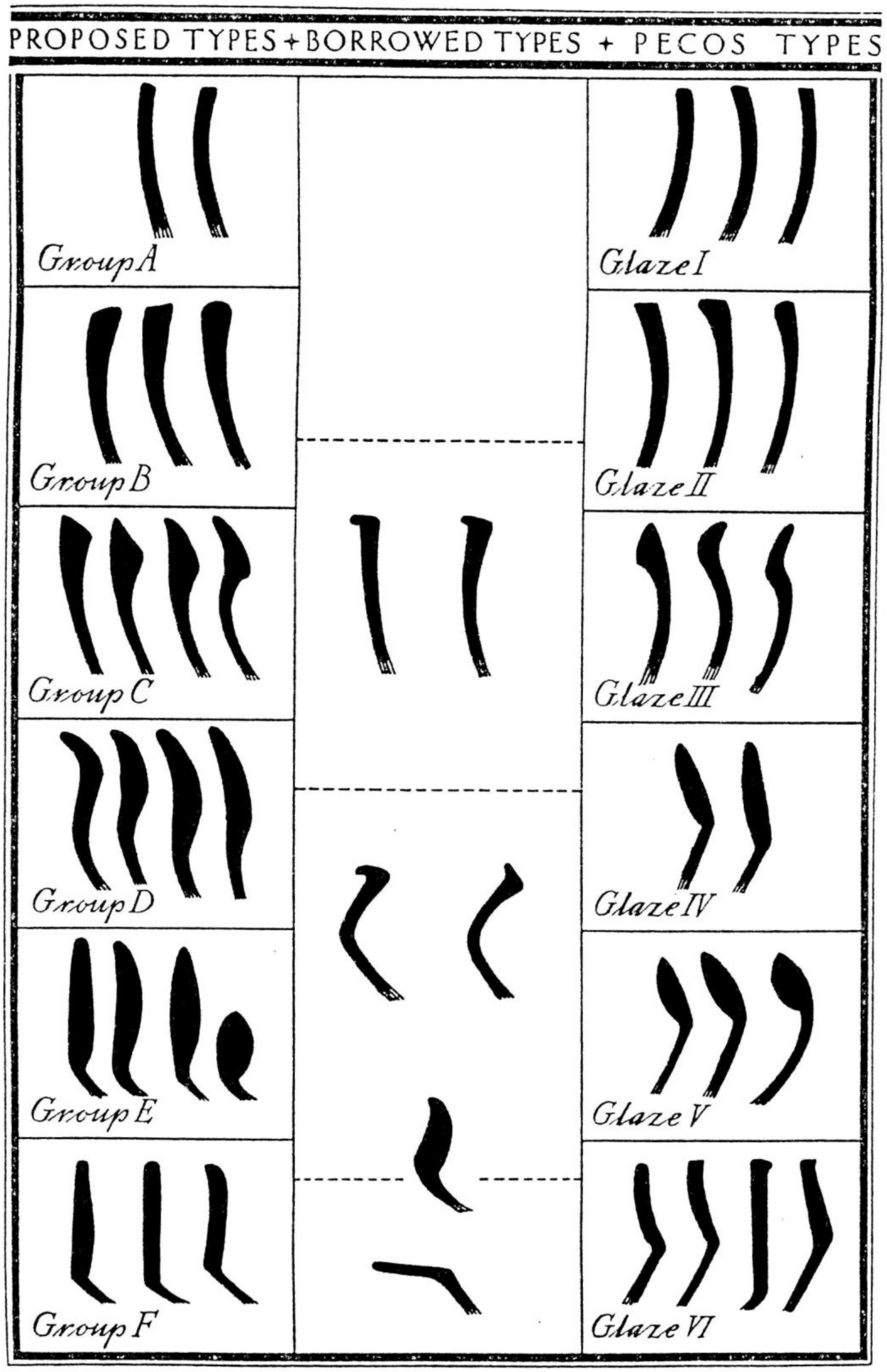


Figure 3.1: **Bowl rim profiles for Mera and Kidder's Rio Grande Glaze Ware Series (from Mera 1933).**

Table 3.1: ***Pottery Types in the Rio Grande Glaze Ware Series (modified from Eckert 2006: table 3.5)***

Glaze Rim Form	Glaze Ware Types	Date Range
A Red	Agua Fria Glaze-on-Red Los Padillos Polychrome Sanchez Glaze-on-Red	1313–1500+
A Yellow	Cieneguilla Glaze-on-Yellow & Polychrome Sanchez Glaze-on-Yellow & Polychrome	1321–1450+
A Polychrome	San Clemente Polychrome	1321–1450+
B	Largo Glaze-on-Red, Glaze-on-yellow, & Polychrome Medio Polychrome	1410–1500+
C	Espinosa Glaze-on-Red & Polychrome Kuaua Polychrome	1410–1600+
D	San Lázaro Polychrome	1460–1550+
E	Puaray Glaze-on-Red, Glaze-on-Yellow, & Polychrome Trenaquel Polychrome Escondido Polychrome Tiguex Polychrome Encierro Polychrome Pecos Polychrome	1480–1630+
F	Kotyiti Glaze-on-Red, Glaze-on-Yellow, & Polychrome San Marcos Glaze-on-Red and Polychrome Cicuye Glaze-on-Red and Polychrome Yunque Glaze-on-Red Polvadrea Glaze-on-Red & Glaze-on-Yellow	1520–1700

A number of temporal and spatial problems with the Northern Rio Grande Glaze Ware series have been noted (e.g., Ramenofsky 2009; Snow 1997). The three major problems are: (1) temporal overlap of many of the types, (2) temporal differences in first occurrences in different regions of the Northern and Central Rio Grande, and (3) absence of local production of some types in certain regions. The temporal overlap is a

significant concern with use of the Rio Grande Glaze Ware series, especially as it relates to production of Glaze A ceramics. Glaze A rim forms overlap with many of the later types and continued to be manufactured much later in the series than the 1450 date assigned by Mera (1940). Since the 1960s, researchers have documented Glaze A vessels in association with Glaze B and Glaze C types (e.g., Brody 1964; Creamer and Renken 1994; Franklin 2007; Ramenofsky 2009). At Pottery Mound, Brody (1964) found that a local Glaze A type, Pottery Mound Polychrome, occurred with Glaze C. In his description of the stratigraphy and stylistic characteristics of the Glaze Ware ceramics from Pottery Mound, Franklin (2007:73) also noted that the Glaze A type rim continued to be used into the period of Glaze C production. Hidden Mountain Polychrome, a Glaze Ware type made exclusively at Pottery Mound, can have a Glaze A or a Glaze C rim shape (Eckert 2003, 2006, 2008). One Glaze A type, Sanchez Glaze-on-red, actually has a Glaze C style rim, further complicating the Glaze A problem.

Problems with Glaze A as a temporal type have also been documented through archaeological research in the Galisteo Basin. During the Northern Rio Grande Research Project, Winifred Creamer noted that in the majority of levels excavated at sites across the region, Glazes A, B, and C were recovered in direct association with one another (Creamer and Renken 1994:12). At San Marcos, Glaze A ceramics were present in significant amounts (approximately 10–40%) in levels with Glaze E types. This same pattern is clear from the seriation of the ceramics from the extensive, site-wide surface collection at San Marcos (Ramenofsky 2001:44); Glaze A Yellow sherds were recovered from almost every midden on the site, even in association with Glaze F ceramics. Using the data from the seriation, Ramenofsky (2009) shows that Glaze A Yellow was

manufactured at San Marcos throughout the occupation of the site. David Snow (1986) also notes the high frequency of Glaze A ceramics in association with Glaze F at Gran Quivira. Glaze A may have been made in many locations throughout the Glaze Ware series, even extending into the sixteenth century (Snow 1997:348), including at San Marcos Pueblo (Ramenofsky 2009).

In addition to the Glaze A overlap problem, many of the other Glaze Ware types in the series appear to overlap. As shown in Table 3.1, almost all of the types have significant temporal overlap in the widely accepted dates of production. The dates presented are the most recent accepted dates for each type (Eckert 2006), and are derived from radiocarbon and tree-ring cross dates from a wide range of sources. These date ranges do not address the longer range that may be shown in future research for Glaze A. The overlap with other types that is so drastic for Glaze A is suggested to lesser extents for other types in the series. Glaze B dates suggest significant overlap with both Glaze A and Glaze C (Eckert 2006; Snow 1997). Creamer and Renken (1994) found a significant amount of Glaze C ceramics in contexts with non-cutting tree-ring dates of AD 1613, 1615, and 1633. Even without these late dates for production of Glaze C, there was already overlap with all other Glaze Ware types in the series. With these late dates, Glaze C production subsumes all of the documented periods of production of Glaze D and E.

The second major problem with the Glaze Ware sequence is that the date of first occurrence of types in different areas, or at different sites, varies. Glaze A Red, specifically Agua Fria Glaze-on-red, is associated with a tree-ring date of AD 1287rB and a group of tree-ring cutting dates around AD 1313 (Cordell 1975). Glaze A Yellow is first associated with a tree-ring date of AD 1321r (Lang 1993), AD 1322 at LA 4 (Mera

1940), AD 1330 at Galisteo (Mera 1940), AD 1348 at Pueblo Blanco (Creamer and Renken 1994) and Pindi Pueblo (Stubbs and Stallings 1953), and AD 1370 at Las Madres (Schaafsma 1969, 1995). This variation in dates of first occurrence for Glaze A lead Creamer and Renken (1994:14) to argue that it took "several decades of the 14th century" for the glaze decorating technique to spread across the Northern Rio Grande. Due to the relatively few chronometric dates that are available for the Northern Rio Grande (Creamer and Renken 1994), it is possible that this variation in early production dates may just be a sampling issue. Archaeologists simply may not have enough chronometric dates to document the early occurrences of Glaze A across the region.

The final problem is that some types, especially Glaze B, C and D, may not have been manufactured in all areas, or at least not in significant amounts (Eckert 2006; Snow 1997). Mera (1940) argued that if a particular Glaze Ware type was not found at a site, the site was not occupied during that Glaze Ware production period. Current knowledge indicates that this is not always the case. Glaze B yellow vessels are characteristic of the Galisteo Basin and not found or produced in high frequencies anywhere else (Warren and Snow 1976). Glaze C may be a variant of Glaze A in certain areas, especially south of Albuquerque such as in the Abo Pass area (Snow 1997). Snow (1997:350) also argues that Glazes C and D were only produced in certain areas, specifically Glaze D at Tonque (Morales 1997; Warren 1969), and many local production sequences only ran from Glaze A (and occasionally Glaze B) to Glazes E and F. Glaze B types do not occur in the Rio Abajo sites, especially Pottery Mound and Hummingbird Pueblo (Eckert 2008). Thus, absence of some types at particular sites may not be indicative of abandonment of that site, just of what types were produced there.

In short, the Rio Grande Glaze Ware series is not a simple or direct sequence from Glaze A to Glaze F, as proposed by Mera (1933). Production of Glaze Ware at San Marcos may have fewer problems because, as is clear from the current research (see results of the Petrographic Analysis in Chapter 8) ceramics from each of the six types were locally made at the site, although production of Glaze E may have been limited.

The ceramic seriation described in Chapter 2 shows that there were temporal overlaps for the ceramic types used at San Marcos. What is most significant is that the seriation shows frequency peaks of Glaze Ware rim types and a clearly sequential history of use of the individual types. Thus, I use the Glaze Ware series as a tool with which to categorize the sample of sherds in this research. Although it is not a perfect tool it is the best proxy we have for the study of temporal change at San Marcos Pueblo.

Description of the Northern Rio Grande Glaze Ware Series

The Rio Grande Glaze Ware series is frequently subdivided into early (Glazes A and B), intermediate (Glazes C and D), and late (Glazes E and F) periods (e.g., Eckert 2006; Eighth Southwestern Ceramic Seminar 1966). These divisions are based on changes in attributes other than rim form, such as glaze paint, slip color, and temper type (Eckert 2006:49). Certain attributes, including glaze paint composition (Herhahn 2006) and temper type (Shepard 1942), may become more standardized through the series from Glaze A to F. Glaze paint color and appearance have clear temporal trends as described by the Eighth Southwestern Ceramic Seminar (1966). Early glaze paint tends to be the darkest in the series. It ranges from black to brownish black to greenish black and "holds to the line of original application" (Eighth Southwestern Ceramic Seminar 1966:I1). Intermediate glaze paint tends to be lighter in color and is more likely to be brownish

with a color range from greenish brown to yellowish brown to brown to dark brown to brownish black. This paint can range from dull to lustrous and runs occasionally, although not as frequently as late glaze paint. Late glaze paint tends to be the most variable. Most of the colors from the earlier paints are present, as well as the occasional apple green. Late glaze paint often runs and ranges from semilustrous to lustrous. Slip color for the early glazes tends to be brighter and includes shades of orangey red, red, yellow, white, and yellowish white, whereas the intermediate and late glazes tend to have more muted slip colors of softer reds, fawn, tan, tannish, orangish, reddish, red brown, and whitish.

Organization of Production and Specialization of Northern Rio Grande Glaze Ware

Many researchers have examined Northern Rio Grande Glaze Ware ceramic production in the Central and Northern Rio Grande (Habicht-Mauche 1993, 1995; Herhahn 1995, 2006; Herhahn and Huntley 1996; Huntley et al. 2007; Jones 1995; Motsinger 1992, 1997; Nelson and Habicht-Mauche 2006; Reed 1990; Shepard 1942, 1965; Staley 1990; Warren 1969, 1979; Welker 1997), and most of these studies have addressed the issue of specialization of production (Habicht-Mauche 1993, 1995; Motsinger 1997; Nelson and Habicht-Mauche 2006; Reed 1990; Shepard 1942, 1965; Staley 1990; Warren 1969, 1979; Welker 1995, 1997). Almost all of these studies use mineralogical tests—most commonly petrographic analysis of temper—to determine the spatial extent and quantity of materials produced at a given site (Habicht-Mauche 1993, 1995; Nelson and Habicht-Mauche 2006; Reed 1990; Shepard 1942, 1965; Warren 1969, 1979). A handful of analyses examine the products themselves in an attempt to determine

degree of specialization (Herhahn 1995, 2006; Herhahn and Huntley 1996; Jones 1995; Motsinger 1997; Staley 1990; Welker 1995).

Some of these researchers argue that there was a relatively high level of production, in the form of village or community specialization. Others argue that most villages made their own pottery. As will be shown in the previous research discussed below, the extent of the role of the Galisteo Basin Pueblos in Glaze Ware production has been debated, but there is no doubt that there was some level of Glaze Ware production and a change in the level of production through time at particular sites. Changing interpretations reflect changing views of levels of complexity within the Northern Rio Grande Region as a whole.

Anna Shepard was the first researcher to examine Northern Rio Grande Glaze Ware production and demonstrated specialization (Kidder and Shepard 1936; Shepard 1942, 1965). Shepard conducted petrographic analysis on a large sample of ceramics from Pecos and demonstrated that many of the ceramics were tempered with non-local materials (Kidder and Shepard 1936). Shepard (1942, 1965) expanded her ceramic sample by using sherds collected by H. P. Mera from over 40 sites that were originally used in Mera's assignment of temporal ranges to the Glaze Ware series (Habicht-Mauche 2002:53). In these later volumes, Shepard (1942, 1965) argued for specialized production in several regions, including the Galisteo Basin. She found that the Galisteo Basin dominated production during the Intermediate period. The Early and Late periods, in contrast, saw local centers of production over many areas. These results had significant implications for archaeologists' interpretations of Pueblo society. Pueblo people were seen to have participated in complex systems of craft specialization and

exchange, a contrast to the prevailing assumptions of Pueblo household self-sufficiency (Habicht-Mauche 2002:52).

Shepard included San Marcos Pueblo in her Galisteo Basin District, and grouped the temper used by San Marcos potters with her general andesite rock temper. In Shepard's unpublished work and her collection of thin sections, she clearly notes that the temper that dominates at San Marcos is an augite diorite. Figure 3.2 shows the distribution of andesite tempered ceramics throughout the Early, Intermediate and Late Glaze Ware periods. Note the changes in dominance of andesite, highlighted in pink, throughout the Glaze Ware series. Andesite-tempered ceramics were exported out of the Galisteo in significantly larger proportions during the Intermediate period. At the same time, the local ceramics—recovered within the Galisteo—are also locally made. During the late part of the Glaze Ware series, with the production of Glaze E and F ceramics, dominance in Galisteo production declined—many more temper types began to be used, and many areas produced most of their own ceramics. The view of sites in the Galisteo Basin as major ceramic producers continues with the work of Helene Warren.

Warren, a geologist, worked with archaeologists on numerous contract archaeology projects from the 1960s to the 1980s (Peckham 1995). Warren's research (1969, 1979) took Anna Shepard's study of centralized production in the Galisteo further and suggested that there was centralized production of Glaze Ware at particular sites in and near the Galisteo Basin during the Intermediate period. Warren argued that San Marcos Pueblo was a major production center during the fifteenth century, with the production of Glaze A and Glaze C ceramics. Tonque, a village just to the west of the Galisteo, peaked in production somewhat later than San Marcos and dominated

production with Glaze C and D vessels. Warren's view was that these two sites were production centers for Glaze Ware ceramics and that the intensity of production at these sites changed over time (Warren 1969, 1976, 1979). In Figure 3.3, Warren (1979) uses isopleths to show the distribution of ceramics tempered with augite latite (or "San Marcos latite") across the Northern Rio Grande. This temper is the same material I identity as augite monzonite, following Nelson and Habicht-Mauche (2006). San Marcos Pueblo (LA 98) is in the center of both maps. The numbers of ceramics with the San Marcos–specific temper increase in distribution area and quantity across the Northern Rio Grande from Glaze A to Glaze C (Figure 3.3).

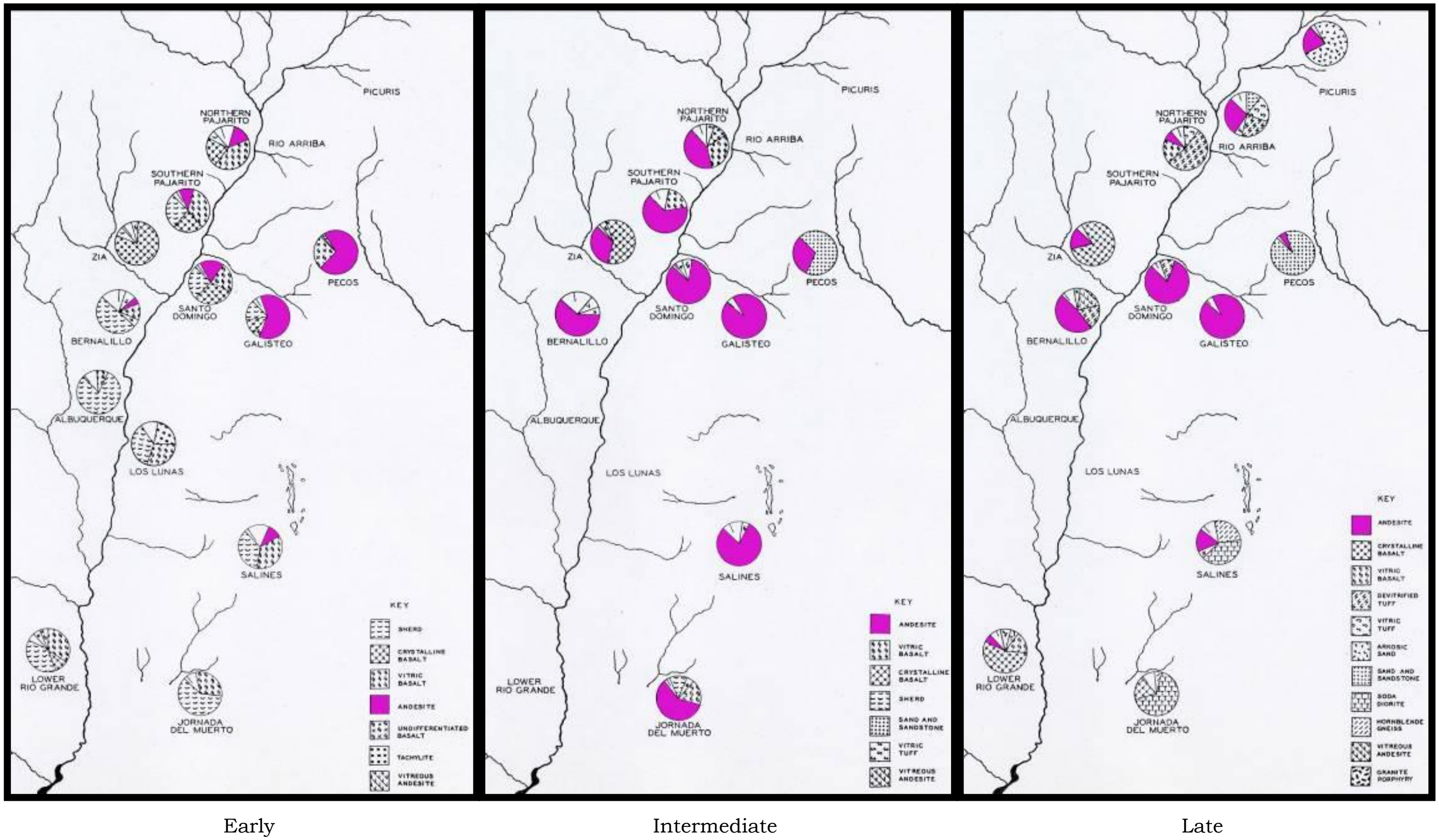
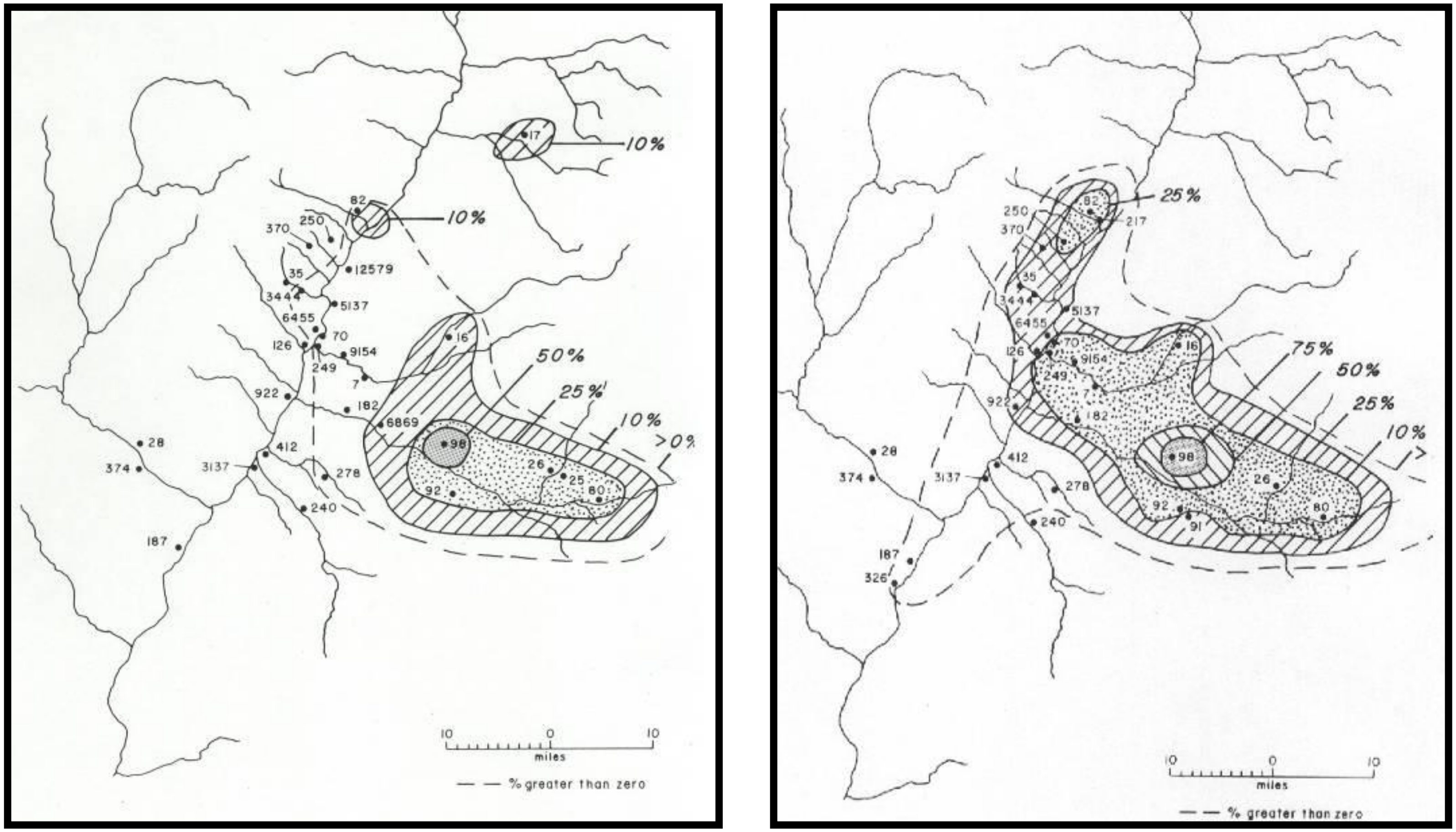


Figure 3.2: **Distribution of andesite tempered ceramics, modified from Shepard (1942)**



Glaze A Glaze C

***Figure 3.3:* Distribution of augite monzonite–tempered ceramics within and surrounding San Marcos Pueblo (LA 98) (figures modified from Warren 1979)**

Research conducted in the late 1980s and early 1990s continued to support Shepard's view of the Galisteo Basin region as a production center, but also expanded the number of areas that may have been important producers at different times. Interpretations of complexity in the Northern Rio Grande during this period included the emergence of craft specialization as a major factor in reflecting a regionally integrated socio-political and economic system (Snow 1981; Wilcox 1981). Within this framework, Habicht-Mauche examined ceramic production at Arroyo Hondo Pueblo (1993, 1995). She found that a regional system of production and exchange of Glaze Ware ceramics indicated craft specialization, specifically in the form of community specialization in the Albuquerque, Galisteo Basin, and Santa Domingo areas.

More recently, a slightly different picture of Glaze Ware production has emerged in a number of systematic studies. These studies represent the accumulation of data on Glaze Ware production and present a significantly more complex picture of production than the earlier studies of Shepard and Warren. Models of socio-political complexity also shifted from regionally integrated models to less integrated regional models based on the concept of alliances (Creamer 1996, 2000a; Creamer and Haas 1998; Wilcox 1991). Both socio-political complexity and craft production appear to have been more fluid than previously thought, and related to ties between specific communities rather than regional systems.

An X-ray diffraction analysis of Rio Grande Glaze Ware from six Protohistoric sites in the Galisteo Basin, conducted by Lori Reed (1990), suggested that San Marcos was just one of several villages in the Basin that specialized in Glaze Ware production. Reed's (1990) research suggests that there was no centralized production of ceramics at

any one site in the Galisteo Basin, but that many sites may have been involved in specialization (Creamer 2000a:103). Creamer and Renken (1994) also note that ceramics were produced at all of the six villages examined by Reed including San Marcos (1990). Creamer (2000a:103) argues that these data suggest that there "is no firm evidence indicating village-level specialization." Creamer finds that Tonque ceramics "did not form a significant proportion of the late Glaze Ware assemblages anywhere in the Galisteo Basin" and thus discounts Warren's model of centralized production of Glaze Ware at Tonque (2000a:103). On the other hand, Thomas Morales (1997) found that there was extensive production evidence at Tonque Pueblo (1997:699) and that Tonque exported relatively large quantities of Glaze D pottery during the late Intermediate period. Morales (1997:929) also notes, like Creamer and Renken (1994) and Reed (1990), that ceramic production was widespread—even the smallest sites had evidence of ceramic production.

Motsinger (1992, 1997) examined ceramics manufactured in the Galisteo Basin recovered from Pueblo Colorado and Gran Quivira in the Salinas District. Using standardization as a proxy for increases in intensity of production and specialization, he found that standardization increased from Glaze A through D for framing line thickness and distance of the framing line below the rim (1992:65–66). Motsinger argues that this evidence supports regional specialization of production in the Galisteo Basin for pottery exported to the Salinas District.

In a study of seven sites, Staley (1990:223) also found, using the Production Step Measure and metric attribute analysis, that a "standardized manufacturing procedure was followed at all the Galisteo Basin sites." These sites, which included San Marcos, San

Cristobal, Pueblo Colorado, Pueblo Largo, Pueblo Blanco, Pueblo Shé, and Kuapa, did not reflect significant differences in the degree of standardized production, as viewed using the Production Step Measure (Staley 1990:231).

A recent petrographic analysis conducted by Kit Nelson and Judith Habicht-Mauche (2006) of 165 bowl sherds indicates that, although San Marcos was an "important Glaze Ware production center," distribution of wares made at San Marcos was primarily focused within the Galisteo Basin and on specific sites outside of the Basin. Nelson and Habicht-Mauche (2006) found that the villages of Cieneguilla/Tzeguma and Pueblo Blanco received 40 to 50 percent of their ceramics from San Marcos during the Early or Intermediate periods, but that Kuapa obtained only about 5 percent of their ceramics from San Marcos. Another petrographic analysis of Early and Intermediate Glaze Ware from field house sites near Cieneguilla also supports the tie between this site and San Marcos (Schleher and Boyd 2005). Approximately 50 percent of the 69 Glaze Ware sherds examined for the study came from San Marcos.

These recent studies, conducted on a finer scale than those of Warren (1969, 1976, 1979) and Shepard (1942), suggest a more complex pattern of manufacture and exchange than originally expected. All of the recent studies continue to support San Marcos as *one* location of production for export to other sites, especially during the later Early period and early Intermediate period. Although they do not show a consensus on the *degree* of Glaze Ware production, all studies indicate Glaze Ware vessels were produced in the Galisteo Basin and specifically at San Marcos. Many villages manufactured pottery for their own use and exchange, but certain sites, including San Marcos, Tonque, and San Lázaro, seem to have produced and exchanged more than some

other sites. The nature of production and level of specialization is debatable, but Galisteo Basin sites, including San Marcos, were major producers of pottery, and their production increased during the Intermediate period of Glaze Ware production. My research now takes studies of San Marcos ceramic production to the next step to determine if changes in standardization are reflected in the documented changes in intensity of production (amount of pottery produced) during the Intermediate Glaze Ware production period.

Chapter 4

Standardization in Pottery:

An Ethnoarchaeological and Archaeological Comparison

Standardization is considered to be an indicator of specialization of ceramic production in archaeological contexts (Benco 1988; Costin 1991; Hagstrum 1985), but its validity as an indicator of specialized production is inconclusive in ethnographic contexts (Stark 1995). In other words, some ethnographic research suggests that sometimes there is a direct relationship between standardized products and specialized production, and in other ethnographic case studies there is not a direct relationship between the two. In addition, many of the ethnographic studies address specialization and standardization in complex, state-level or market-based societies (e.g., Kramer 1997; London 1991). The role of standardization in less complex, middle-range societies, although examined by some (e.g., Graves 1991; Longacre et al. 1988), has not been a focus of research. In this chapter, I examine the validity of using standardization as an indicator of specialization for both ethnographic and archaeological producers by comparing morphological standardization of ceramics from cross-cultural ethnographic groups and Southwestern and state-level archaeological societies.

This chapter has four main goals:

1) Evaluate the standardization hypothesis by determining if the "magic number" of 10 percent coefficient of variation (Crown 1995) is the dividing line between specialist and non-specialist producers ethnographically.

2) Address other sources of variation that may reduce standardization in an assemblage, as well as evaluate what issues may exist in comparing ethnographic and archaeological data for the level of standardization.

3) Use data on the intensity of production, in this case numbers of vessels produced per year, to determine if coefficients of variation correlate directly with production intensity.

4) Examine how archaeologists can use the results of this research to interpret the degree of specialization through standardization in the archaeological record and determine ways other researchers may use coefficients of variation to facilitate more detailed interpretations.

These goals are addressed by comparing the coefficients of variation of specialists and non-specialists documented ethnographically, as well as comparing ethnographic data to archaeological data. The results of this chapter are used as the theoretical backdrop for the examination on the relationship between the intensity of production, one aspect of specialized production, and standardization in ceramics at San Marcos Pueblo.

Background

Craft production, the transformation of raw materials into usable objects (Costin 1991:3), has been a subject of research in the Southwest for almost a century. The first archaeologists working in the Southwest assumed that craft production occurred within each household its members' own use. As mentioned in Chapter 4, it was only the pioneering work of Anna Shepard (1936, 1965) with petrographic analysis that documented that ceramics were traded widely and that some areas produced much more than what they needed, or, in other words, that some groups were specializing in

production of some items. This was an important discovery for researchers, and this concept of specialization, or production over the needs of the household, has shaped much of the recent research on crafts in the Southwest (Mills and Crown 1995).

The Organization of Production and Specialization

As noted in Chapter 1, Cathy Costin (1991) defines four parameters that characterize the organization of production: context, concentration, scale, and intensity. The context of production describes the "degree of elite sponsorship in production" (Mills 1996:121). *Independent* specialists produce for a general market of potential customers, whereas *attached* specialists are sponsored and managed by elite or governmental institutions. Concentration characterizes the geographic organization of production. The focus is on how specialist producers are distributed across the landscape (a continuum from even distribution to aggregation) and the spatial relationship between producers and consumers. Scale describes who the producers are, or "the composition of the production unit." At one end of the continuum are small production units, based on individuals or families. At the other end of the continuum are wage-labor forces. Intensity of production "reflects the amount of time producers spend on their craft" and addresses whether the specialists are part-time or full-time producers (Costin 1991:13–16).

Specialization is a way of organizing production (Costin 1991:3). Not all craft production systems are specialized, and even when specialization does occur, there are many types and degrees of specialization. Here I will follow Costin's (2001:276) definition of specialization: "fewer people make a class of objects than use it."

Archaeological Identification of Specialized Production and Production Intensity

Specialization may be evident in highly complex, state-level societies. In many state-level archaeological cultures, craft producers and workshops are often fairly obvious in the archaeological record (e.g., Bawden 1996), and there is frequently direct evidence of craft production in these societies. However, as discussed in the previous chapter, craft specialization is less visible in the archaeological record of middle-range societies, such as the diverse cultures of the prehistoric American Southwest, where we are often limited to indirect indicators of production.

This issue arises because many specialists in the American Southwest were likely part-time, independent, and working out of their homes, leaving few archaeological traces. Mills (1996) addresses this problem and offers suggestions that can be used to identify craft production in the Southwest archaeological record. Mills (1996) applies Costin's (1991) four parameters for organization of production to Southwestern data and suggests ways that future researchers in the Southwest can utilize these parameters to better interpret our data.

Mills (1996) stresses that craft production *should not be approached typologically*—all four parameters should be viewed as a continuum. Whereas researchers working with complex, state-level societies may need to be concerned only with the most "specialized" end of this continuum, those working in the Southwest need to fully embrace this continuum in order to identify variation within the broader region and to gain knowledge of the range of craft production systems that may have operated in the prehistoric Southwest. If we, as archaeologists, see only a part-time/full-time or

independent/attached dichotomy, then all Southwestern ceramic producers were part-time and independent and there is nothing more that can be understood about them.

Within each parameter, Mills (1996) proposes methods for identification in the middle-range cultures of the Southwest. Because vertical differentiation (i.e., presence of elites) in the Southwest is debated, *variation* in the context of production should be examined. Spatial context of production, Costin's concentration (1991), can be examined through the identification of production tools or by looking at differing regional ratios of producing to non-producing households/sites through mineralogical analysis of temper or chemical compositional analysis (Mills 1996:122). Identification of the scale of production may be visible through distribution of production debris and tools or by identification of production within residential or ritual structures (kin-based vs. supra–kin-based production) (Mills 1996:123).

Intensity of production, the main focus of the current research, can be examined through analysis of the "continuous scale of the ratio of producers to consumers" (Mills 1996:123), which will decrease as production intensifies. This ratio becomes visible by examination of producing vs. non-producing households through identification of tools or other production debris. Because it is not always possible to identify producing households, a more common method used in the identification of intensity of production is the relative degree of standardization in final products (Mills 1996; Mills and Crown 1995; Rice 1992).

Determining Intensity through Standardization

Standardization is frequently equated with high intensity of production (e.g., Rice 1992), even though researchers also cite other influencing factors (e.g., Mills 1996). For

example, Mills (1996:123) asserts that other factors, including vessel function, intended market, building techniques, and boundaries between artifact classes, effect standardization. According to Rice (1992:268), standardization addresses the “relative degree of homogeneity or reduction of variability in the characteristics of pottery.” In other words, standardization is a question of degree, not merely one of presence or absence (Rice 1992). Standardization and specialization are thought to be related for several reasons. Crafts made by intensive specialists are mass produced for the sake of economic efficiency and consumer demand; standardization is the result of quality control, risk-averse tactics (conservatism), and skill developed through repetition and routinization (Rice 1992:268). Costin (1991:33) argues that products become more standardized with specialized production because there are fewer producers relative to consumers and the producers become more efficient as they intensify production, resulting in a loss of variation in the products made. This hypothesis about the relationship between standardization and intensity of production needs to be tested. Many researchers have done just that with ethnoarchaeological studies, but with varying success.

Ethnographic and Ethnoarchaeological Data and Standardization

Researchers working with modern groups have documented a relationship between level of production intensity and standardization (e.g., Balfet 1965; Bowser 2000; Kvamme et al. 1996; London 1991; Longacre 1999; Longacre et al. 1988). In her studies in North Africa, Balfet (1965) notes that specialists’ products were more standardized than pots produced by non-specialist household producers. London’s (1991) research, in Paradijon in the Philippines, suggests that standardization of designs is based

on age and experience of the potter. Longacre and associates (1988) documented greater levels of standardization for specialist producers than non-specialists. Longacre (1999) found the more experienced potters produced more standardized wares. Bowser (2000) found that designs were standardized to show political or group affiliation. Neupert (2000), again working in Paradijon, suggests that paste composition formed distinct groups that may have been standardized.

On the other hand, researchers have also found evidence to the contrary and have questioned the linkage between standardization and specialization. For example, Stark (1995) notes variation in standardization by level of production (i.e., specialist or non-specialist production). Some of the specialist producers she cites do not have more standardized wares than non-specialists. Arnold and Nieves (1992) suggest that standardization of ceramics is dependent on factors other than degree of specialization, such as the potters' perceptions of the variability of particular vessel shapes, the forming technique used, and the intended market. Roux's (2003) research indicates that high-intensity production results in standardized wares in some cases, but that factors including potter skill and size classes of vessels impact the degree of standardization with similar rates of production. These ethnoarchaeological studies indicate that the relationship between standardization and intensity of specialization is variable and requires systematic evaluation.

Using the Coefficient of Variation to Quantify Standardization

One method employed to assess the question of standardization is the coefficient of variation for particular attributes in a class of ceramics. This method is preferable to standard deviation, as it "describes relative variation by expressing the standard deviation

as a percentage of the mean, thereby removing scale effects" and is comparative across assemblages of different sizes (Longacre et al. 1988:103). The larger the coefficient of variation, the more variation there is within the sample. A lower coefficient of variation indicates greater standardization of the assemblage in question. Crown (1995:148–149) notes that most specialist producers documented ethnographically produce wares with coefficients of variation lower than 10 percent while non-specialists make wares with coefficients of variation above 10 percent. She also notes, however, that specialists do occasionally produce wares with coefficients of variation above 10 percent. Benco (1988) also found that historic Islamic and Roman specialists produced wares with coefficients of variation lower than 10 percent. In this chapter, I evaluate 10 percent coefficient of variation to determine the degree to which specialist potters ethnographically stay below this number. I then compare this result to recorded archaeological assemblages.

Eerkens and Bettinger (2001:494) argue that the "coefficient of variation is a stable and reliable measure of variation." They develop a range of coefficient of variation values that can be used to interpret the relative degree of standardization of assemblages. With this in mind, they determine upper and lower coefficient of variation boundaries that can be used in interpretation:

> The upper baseline (highest degree of standardization) describes the minimum amount of metrical variation humans can generate without such external aids as rulers. The lower baseline describes the amount of variation that will occur when there is no attempt at standardization at all, i.e., when production is random relative to a standard [Eerkens and Bettinger 2001:494].

Their upper baseline is a coefficient of variation of 1.7 percent, although they suggest that coefficients of variation "in the range of 2.5 to 4.5 percent are more typical of the minimum error attainable by individuals in manual production without use of external

rulers" (Eerkens and Bettinger 2001:496). Their lower baseline is 57.7 percent coefficient of variation, which indicates an unstandardized assemblage (2001:497). This research thus suggests a very wide range for standardized assemblages. The authors suggest that the coefficient of variation "is appropriate for archaeological studies comparing sample variation" (Eerkens and Bettinger 2001:499). It is with this in mind that the current research developed.

Problems with Comparing Coefficients of Variation

Comparisons of coefficients of variation have been done by many researchers (Benco 1988; Crown 1995; Eerkens and Bettinger 2001; Longacre et al. 1988); others have argued that coefficients of variation should not be compared (Arnold and Nieves 1992; Longacre et al. 1988). Longacre et al. (1988:106) argue that the danger in comparing coefficients of variation from ethnographic and archaeological data sets and interpreting degree of specialization from this comparison lies in the differences between etic and emic categories. When examining ethnographic assemblages, the researcher can be told what the emic ceramic classes are, whereas in the archaeological record, we have to define etic ceramic classes. Arnold and Nieves (1992:94) also suggest that standardization should "refer to the same tradition and thus to the products of the same population through time." A comparison of populations in different areas is not fruitful and is like "comparing apples and oranges" (Longacre et al. 1988:111). Rice (1989:112, 116) also suggests that temporally or geographically removed industries should not be compared.

Although I believe the issues raised regarding comparison of coefficients of variation between groups are valid, I undertook such a comparison with the idea that

these results would yield generalizations that may be useful in sorting out the range of coefficients of variation documented in ethnographic and archaeological cases. Within the broader research on San Marcos standardization, the coefficient of variation is used so that the data produced can be compared to other data sets.

The Cross-cultural Comparison

Methods for the cross-cultural comparison. Thirteen modern groups and eight archaeological culture groups were selected for this analysis of published literature. While other studies of standardization have been conducted with modern groups and on archaeological remains, many of these studies cannot be compared to one another because different sherd or vessel attributes were examined. For example, archaeologists examining standardization on ceramic sherds are limited in their ability to examine some of the common attributes examined ethnoarchaeologically, such as vessel height, orifice diameter, and maximum diameter. The variables I selected to use in the analysis are vessel height and orifice diameter, because they are the variables most commonly examined in ethnographic studies and in archaeological analyses of whole vessels (Tables 4.1 and 4.2). Note the dominance of undecorated culinary vessels in the ethnoarchaeological sample in Table 4.1 compared to the archaeological sample in Table 4.2.

Table 4.1. ***Coefficient of Variation for ethnoarchaeological ceramics for specialist and non-specialist groups.***

Culture Group	Source	Vessel Form	Vessel Type*	C.V. for Height	N	C.V. for Orifice/ Aperture	N
Specialists:							
Spain	Roux 2003	pitchers	UC	2.9	100	2.5	100
Uttam Nagar, New Delhi, India	"	ghariya, pitcher	UC	3.77	180	4.85	180
Andhra Pradesh, India	"	kura catti, cooking jars	UC	5.23	174	6.24	174
"	"	ralla catti, cooking jars	UC	6.27	166	7.35	166
"	"	pedda bana, large storage jars	UC	6.56	84	9.07	84
San Nicolas	Longacre 1999	water jar, pooled for experienced potters	UC	3.5	98	3	98
"	"	water jar, pooled for all four potters	UC	3.6	143	4.6	143
"	"	water jar, pooled for two inexperienced potters	UC	3.7	45	6.1	45
Paradijon	Longacre et. al. 1988	pooled ceramic classes	UC	6.2	180	4.5	180
"	"	flower pots	UC	11.9	527	11.7	527
Ticul	Arnold & Nieves 1992	bola (decorative tripod bowl)	DS	6	107	4	107
"	"	cajete (small bowl for offerings)	UC	18	186	11	186
"	"	Risado (flower pot)	UC	14	155	12	155
Sacoj Grande	Stark 1995	medium cooking	UC			11	20
"	"	medium cooking	UC			6	6
Duranzo	"	small water jar	UC			9	6
"	"	medium-large water jars (D6)	UC			5	13
"	"	medium-large water jars (D7)	UC			2	5
Sacojito	"	medium-large water jars (SJ3, large ori.)	UC			10	21
"	"	medium-large water jars (SJ3, small ori.)	UC			13	8
"	"	medium-large water jars (SJ7, large ori.)	UC			5	13
"	"	medium-large water jars (SJ7, small ori.)	UC			13	8
"	"	medium-large water jars (SJ8, small ori.)	UC			9	4
"	"	medium-large water jars (SJ8, large ori.)	UC			5	19
Amphlett Is.	"	cooking pot, type 1	UC			18	14
"	"	cooking pot, type 2	UC			10	18
"	"	cooking pot, type 3	UC			6	12
"	"	cooking pot, type 4	UC			21	36
"	"	cooking pot, type 5	UC			30	15
Non-Specialists:							
Kalinga	Longacre et. al. 1988	pooled ceramic classes	UC	12.7	246	12.5	246
Goodenough Is., Manubuleya & Vedakala Hamlets	Stark 1995	cooking pot, form A	UC			15	10
"	"	cooking pot, form b	UC			14	12
Goodenough Is., Buduna Hamlet	"	cooking pot, form A	UC			12	15
Shipibo-Conibo	"	large brewing jar	UC			17	4
"	"	water jar, Fam. 17	UC			12	5
"	"	water jar, Fam. 19	UC			11	5
"	"	water jar, Fam. 20	UC			20	6

* UC = Undecorated Culinary, DS = Decorated Serving.

Table 4.2. ***Coefficient of Variation for archaeological ceramics from the prehistoric Southwest and a prehistoric "State."***

Culture Group	Source	Vessel Form	Vessel Type*	C.V. for Height	N	C.V. for Orifice/ Aperture	N
Prehistoric Southwest:							
Pueblo Alto	Toll 1981	PII corrugated sherds	UC			26.34	373
site 627 (Chaco)	"	PII corrugated sherds	UC			26.52	312
Pueblo Alto	"	PII-PIII corrugated sherds	UC			31.04	157
site 627 (Chaco)	"	PII-PIII corrugated sherds	UC			28.18	111
Chaco Canyon	Toll 1990	red ware cylinder jars	UC	3.4	4	5.1	4
"	"	B/W cylinder jars	DS	12	82	17.1	67
"	"	plain white cylinder jars	DS	12.9	51	21.2	49
"	"	Puerco B/W pitchers	DS	17.2	78	19.1	78
"	"	Gallup B/W pitchers	DS	18.2	77	14.7	79
"	"	Puerco Black-on-red bowl	DS	16.5	23	14.8	23
"	"	PII corrugated jar	UC	24	68	22.6	68
South Central Arizona (Gila Pueblo)	Crown 1995	small incurved bowls	DS	13	32		
South Central Arizona (Angler's Inn)	"	small straight-walled bowls	DS	14	27		
South Central Arizona (Gila Pueblo)	"	small jars	DS	19	32		
South Central Arizona (Kuykendall)	"	large jars	DS	12	21		
South Central Arizona (Gila Pueblo)	"	large jars	DS	8	10		
Pecos Area	Powell 2002	small Indented Blind Corrugated jars	UC	19.8	10	32.4	10
"	"	medium Indented Blind Corrugated jars	UC	15.7	12	29.1	14
"	"	large Indented Blind Corrugated jars	UC	22.8	5	13.3	4
"	"	Pecos striated utility ware jars	UC	16.5	11	21.8	17
"	"	medium Santa Fe B/W bowls	DS	11.4	15	12.8	17
"	"	medium Galisteo B/W bowls	DS	16.1	18	15.1	24
"	"	large Santa Fe B/W bowls	DS	12.3	9	10.1	18
"	"	large Galisteo B/W bowls	DS	9.7	15	10.8	26
Northern Rio Grande	Hagstrum 1985	large Santa Fe/Wiyo B/W bowls	DS	9.62	8	9.06	8
"	"	large Biscuit B bowls	DS	16.5	12	6.27	12
Zuni	Mills 1995: Table 8.5	buffware bowls	DS	25.5	143	22.9	149
"	"	early glaze ware bowls	DS	22.5	56	20	57
"	"	buffware shouldered bowls	DS	26.9	282	20.7	290
"	"	late glaze ware shouldered bowls	DS	27.1	11	22.8	115
"	"	early buffware globular jars	DS	22	71	14.3	76
"	"	early glaze ware globular jars	DS	17.8	25	16.5	31
"	"	late buffware shouldered jars	DS	24.1	132	17.7	151
"	"	late glaze ware shouldered jars	DS	11	51	6.9	66
Grasshopper Pueblo	Longacre et. al. 1988	"large" class for cooking pots	UC	22.5	41	15.1	41
"	"	"small" class for cooking pots	UC	22.3	57	28.8	57

Table 4.2 Continued

Culture Group	Source	Vessel Form	Vessel Type*	C.V. for Height	N	C.V. for Orifice/ Aperture	N
Prehistoric Southwest:							
Hohokam	Lindauer 1988	red-on-buff, form 13, flared rim bowl	DS	40	80	35	3
"	"	red-on-buff, form 15, plate	DS	37	105	59	7
"	"	red-on-buff, form 20, jar	DS	61	172	58	170
"	"	red-on-buff, form 10, bowl	DS	39	62	49	59
"	"	red-on-buff, form 9, incurved rim bowl	DS	31	35	39	33
Prehistoric "State":							
Leilan, Syria	Blackman et al. 1993	fine-ware bowl (waster stack)	DS	4.4	13	9.19	23
"	"	fine-ware bowl, Lot 1	DS			11.57	8
"	"	fine-ware bowl, Lot 23	DS			17.26	5
"	"	fine-ware bowl, Lot 24	DS			14.82	5
"	"	fine-ware bowl, Lot 27	DS			23.53	7
"	"	fine-ware bowl, Lot 28	DS			19.87	11
"	"	fine-ware bowl, Lot 29	DS			26.97	12

* UC = Undecorated Culinary, DS = Decorated Serving.

Different researchers use different terms for similar vessel attributes. In a number of cases, I combined terms relating to the measurement of a particular area of the vessel—some are just differences in terms (such as orifice, mouth, aperture), whereas others are different types of measurements of roughly the same area on a vessel (orifice diameter, neck diameter, etc.). Based on examination of the drawings of vessel forms in Mills (1995) and Blackman et al. (1993), rim diameter is also considered orifice diameter. Because I am comparing only the amount of variation with one group of vessels or sherds to the variation within another group, I maintain that it is not essential that the measurements be of exactly the same area of the vessel/sherd.

Most studies contain additional data that I have not included. For example, Lindauer (1988) presents data on 40 forms, but I selected just those five that are most similar to other forms throughout the American Southwest (various bowl forms, a jar, and a plate). I did not include the more uniquely Hohokam vessel forms.

In addition, many of the studies divide up or group ceramic classes differently. For example, Lindauer's (1988) numerous vessel types are not divided into size classes, but Powell's (2002) relatively few vessel types are divided into three size classes.

The general rule used here is that for ethnoarchaeological samples, pooled or grouped data are used before individual data, and for archaeological samples the smallest unit was used. It is assumed that pooled ethnoarchaeological data would be more comparable to individual site archaeological data. For example, grouped data for the vessels made by *all* potters in Longacre's (1999) ethnoarchaeological work in San Nicolas are included over the data for one potter, whereas site level data are included over regional level data for Salado archaeological ceramics (Crown 1995).

Ethnoarchaeological data sets. Roux (2003) reports data on production by Indian and Spanish potters. The data from the Indian producers included in this study are the combined data for three vessel types produced by all potters in Andhra Pradesh in Northern India and for one vessel type made by potters in Uttam Nagar (New Delhi). The Spanish data included are for vessels made by one potter over the course of two days.

The data included from Longacre's (1999) work in village of San Nicolas in the Philippines are three sets of data that combine the work of multiple potters. The first data set consists of pooled data for water jars made by the experienced potters in the community. The second data set is pooled data for water jars made by all four of the potters studied. The third is all data for the water jars made by the inexperienced potters.

In Longacre et al. (1988), the authors examine vessels made by modern specialists in Paradijon and by non-specialists, the Kalinga, both in the Philippines. Pooled ceramic classes data from Paradijon and the Kalinga are included here, as well as ungrouped

ceramics. The ungrouped ceramics data, where the ceramic classes are ignored, might be especially comparable to archaeological assemblages in that these grouped data may be more indicative of archaeological ceramic types for which we do not have emic notions of the divisions among groups.

Arnold and Nieves (1992:106) examine three categories of vessels produced by the modern potters of Ticul in Mexico: the bola, a decorative tripod base vessel; the risado, a plant pot with a tripod base; and the cajete, a bowl used to hold food offerings for Day of the Dead ceremonies (1992:103). Vessels of each type were made using up to three potting techniques: turntable, wheel, or two-piece mold (1992:103).

From Stark's (1995) study, 23 categories are included. Stark presents data on pottery producing industries in the D'Entrecasteauz Islands in Papua, in Amazonia, and in the Guatemalan Highlands. All forms and types are included, grouped by hamlets or cultural groups. For example, measurements of vessels made by the Shipibo-Conibo come from villages that are within approximately 225 km of each other (Stark 1995:248). Stark's data come from Arnold (1978) and Lauer (1974).

Archaeological data sets. Toll (1990:284) presents the coefficients of variation of Chaco cylinder jars and comparative forms from the Chaco region. Three data sets for cylinder jars were included in my analysis: grouped black-on-white ceramic vessels, redwares, and plain white vessels. I also include height and orifice diameter for four comparative forms: Puerco Black-on-white and Gallup Black-on-white pitchers, Puerco Black-on-white bowls, Pueblo II corrugated jars, and corrugated vessels from two additional Chaco sites (Pueblo Alto and Site 627) from two time periods (Pueblo II and Pueblo II–III) (Toll 1981:105).

Crown (1995) examines the standardization of Pinto, Gila, and Tonto polychrome. Five vessel forms are examined, subdivided into three size classes. I selected single vessel forms in all three size classes from individual sites to keep data as comparable to ethnographic data sets as possible. The sample includes small incurved Gila Polychrome bowls from Gila Pueblo, small straight-walled Gila Polychrome bowls from Angler's Inn, small Gila Polychrome jars from Gila Pueblo, large Tonto Polychrome jars from Kuykendall, and large Tonto Polychrome jars from VIV (Crown 1995:153–154).

Powell (2002) examines utility and decorated wares made in the Pecos area from approximately 1200 to 1400 A.D. For comparability with ethnographic data, I selected eight ceramic type classes for this analysis based on single ceramic types and/or single recovery sites. For example, the category of medium Indented Blind Corrugated jars was used instead of the grouped category of medium utility jars.

Hagstrum (1985:67) examines 20 whole vessels from the northern Rio Grande region of New Mexico: 8 Santa Fe/Wiyo Black-on-white bowls and 12 Biscuit B bowls. Data on orifice diameter and vessel height are included in the current analysis.

Mills (1995) examines the standardization of Zuni ceramics (Matsaki Buff Ware and Zuni Glaze Ware). All eight categories are included here: buffware and early glaze ware hemispherical bowls, buffware and late glaze ware shouldered jars, early buffware and early glaze ware globular jars, and late buffware and late Glaze Ware shouldered jars (Mills 1995:216). Based on observation of the vessel shapes (Mills 1995:206), rim diameter is roughly equivalent to aperture or orifice elsewhere and is included in that category in the current research.

In Longacre et al. (1988), the authors also present data on the archaeological assemblage from Grasshopper Pueblo. The archaeological data that were separated into “small” and “large” size classes were used for the present analysis (Longacre et al. 1988:106).

Lindauer (1988) examines red-on-buff ceramics from the Sedentary period Hohokam, approximately A.D. 900 to 1100. His research includes over 40 forms, and vessels in each form category “could vary greatly in size” (Lindauer 1988:33). I selected five forms that are common throughout the Southwest to include in the current analysis, including incurved, everted, and straight-rimed bowls, a jar form, and a plate form (Lindauer 1988:120).

Seven data points from Blackman et al. (1993:73, 75) are included for fine-ware ceramics: one from a waster stack and six from different contexts at the third millennium B.C. Mesopotamian center of Tell Leilan, Syria.

Results. As discussed above, Crown (1995) suggests that coefficients of variation below 10 percent indicate specialists, whereas coefficients of variation above 10 percent require additional information to determine if production is specialized or non-specialized. Figure 4.1 and Table 4.3 show that this suggestions is empirically supported in the majority of the ethnographic cases where specialization is documented; in other words, the coefficient of variation is below 10 percent for the majority of specialists (62–77% of cases). Even in the cases where the coefficient of variation of one or more ceramic types is above 10 percent, the majority of the ceramic types produced by the specialists are standardized and coefficients of variation are below 10 percent. The only case study for which this is not true is the Amphlett Island specialists (Stark 1995).

Amphlett Island producers are specialists but they produce only approximately 72 pots per year (about 6 pots per month). This low level of intensity may explain why the products made by these specialists are not consistently standardized—these potters may not make vessels frequently enough for standardization to occur. It should also be noted that, of the five ceramic forms made by the Amphlett Island specialists, two forms *do* have coefficients of variation below 10 percent. All of the ethnographic non-specialist cases are between 10 percent and 20 percent.

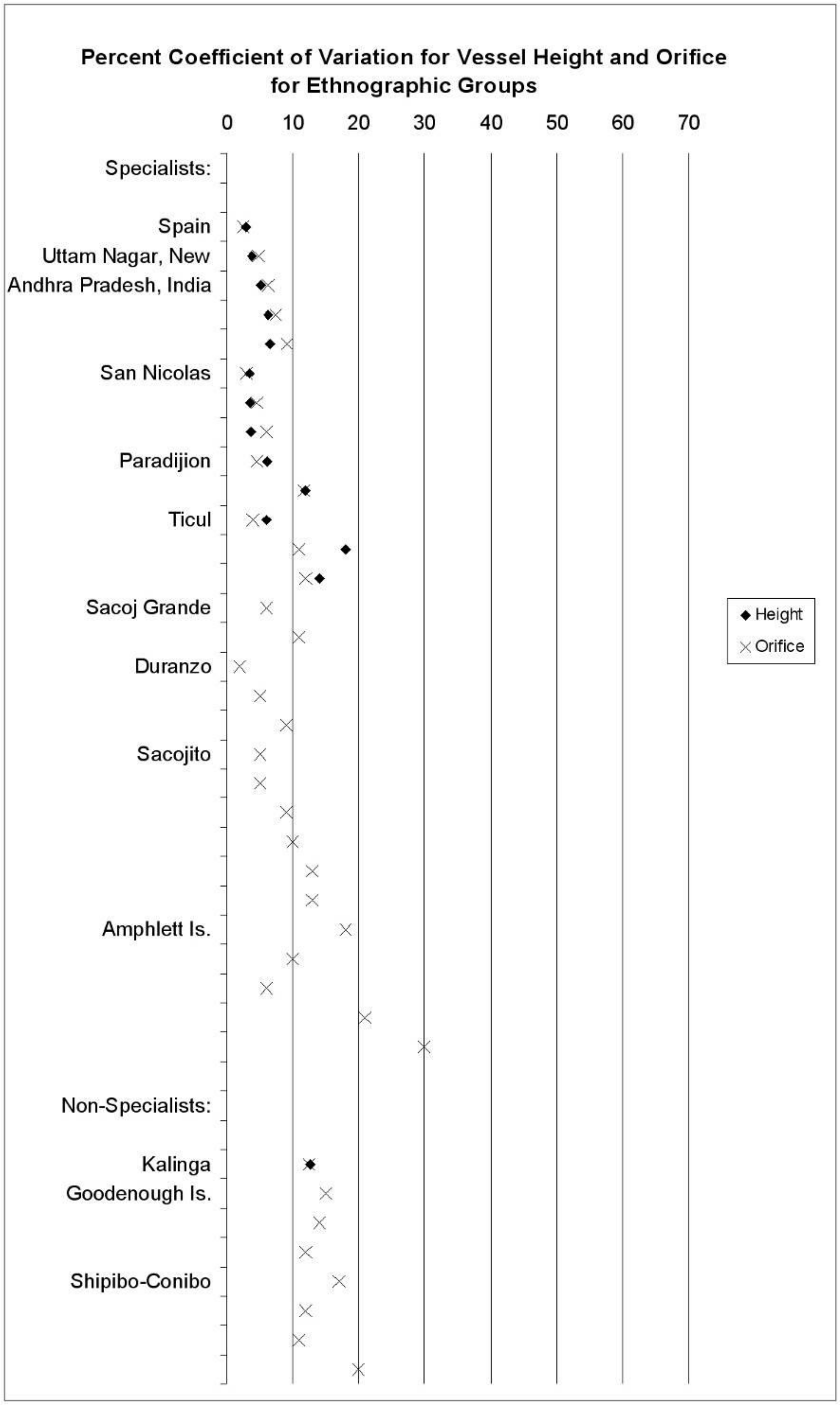


Figure 4.1. **Percent Coefficient of Variation for Vessel Height and Orifice for Ethnographic specialist and non-specialists. Data from: Longacre (1999), Arnold and Nieves (1992), Longacre et. al. (1988), Stark (1995), and Roux (2003).**

Table 4.3: ***Counts and percentages of ethnographically documented specialist and non-specialist data sets that are less than 10% C.V., between 10 and 30% C.V., and above 30% C.V.***

Specialists	**C.V. for Height**		**C.V. for Orifice/Aperture**	
	N	**%**	**N**	**%**
less than 10% C.V.	10	76.9	18	62.1
between 10 and 30% C.V.	3	23.1	11	37.9
above 30% C.V.	0	0	0	0
total # of data sets	13	100	29	100

Non-Specialists	**C.V. for Height**		**C.V. for Orifice/Aperture**	
	N	**%**	**N**	**%**
less than 10% C.V.	0	0	0	0
between 10 and 30% C.V.	1	100	8	100
above 30% C.V.	0	0	0	0
total # of data sets	1	100	8	100

Figure 4.2 shows the relationship between standardization and intensity for the few ethnographic cases where intensity is given. These data further support the correlation between increasing intensity of production and increasing standardization. The percent coefficient of variation decreases as intensity increases.

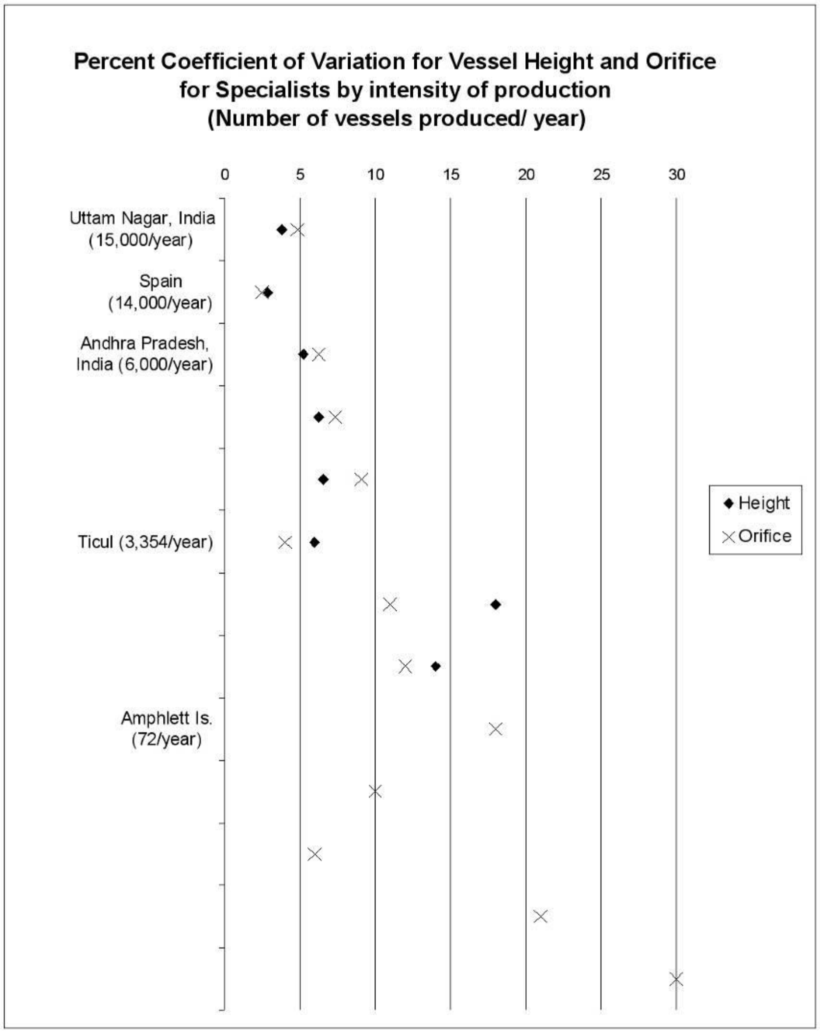


Figure 4.2. **Percent coefficient of variation for vessel height and orifice for specialists by intensity of production (number of vessels produced per year) for the few ethnographic cases where intensity of production was noted. Data from Arnold and Nieves (1992), Roux (2003), and Stark (1995).**

In contrast, the archaeological data from the American Southwest include very few coefficients of variation below 10 percent (Figure 4.3, Table 4.4). The majority of cases (69–76%) are between 10 percent and 30 percent, but a number are above 30 percent (14–19% of cases). These data suggest two possibilities: (1) the 10 percent coefficient of variation is not the upper limit for specialized production in the prehistoric Southwest or (2) specialized ceramic production occurred in only a few cases in the

prehistoric Southwest. Option 2 may be the case, but evidence for specialization in the other production organization parameters (Costin 1991) suggests otherwise. For example, Chacoan ceramics, for which we have evidence for specialized production through compositional studies, primarily have coefficients of variation above 10 percent. The significantly greater range of coefficients of variation for archaeological samples compared to ethnographic samples suggests that issues other than a direct link between standardization and specialization are at work.

The prehistoric state-level group included in Figure 4.3 also supports a less-than-direct relationship between standardization and intensity of production. Leilan, Syria exhibits other evidence, including production workshops, for high levels of specialization (Blackman et al. 1993). Even here the coefficients of variation are *above* 10 percent, except for the one case discussed below, suggesting that archaeological specialization has a more complex relationship to standardization of assemblages.

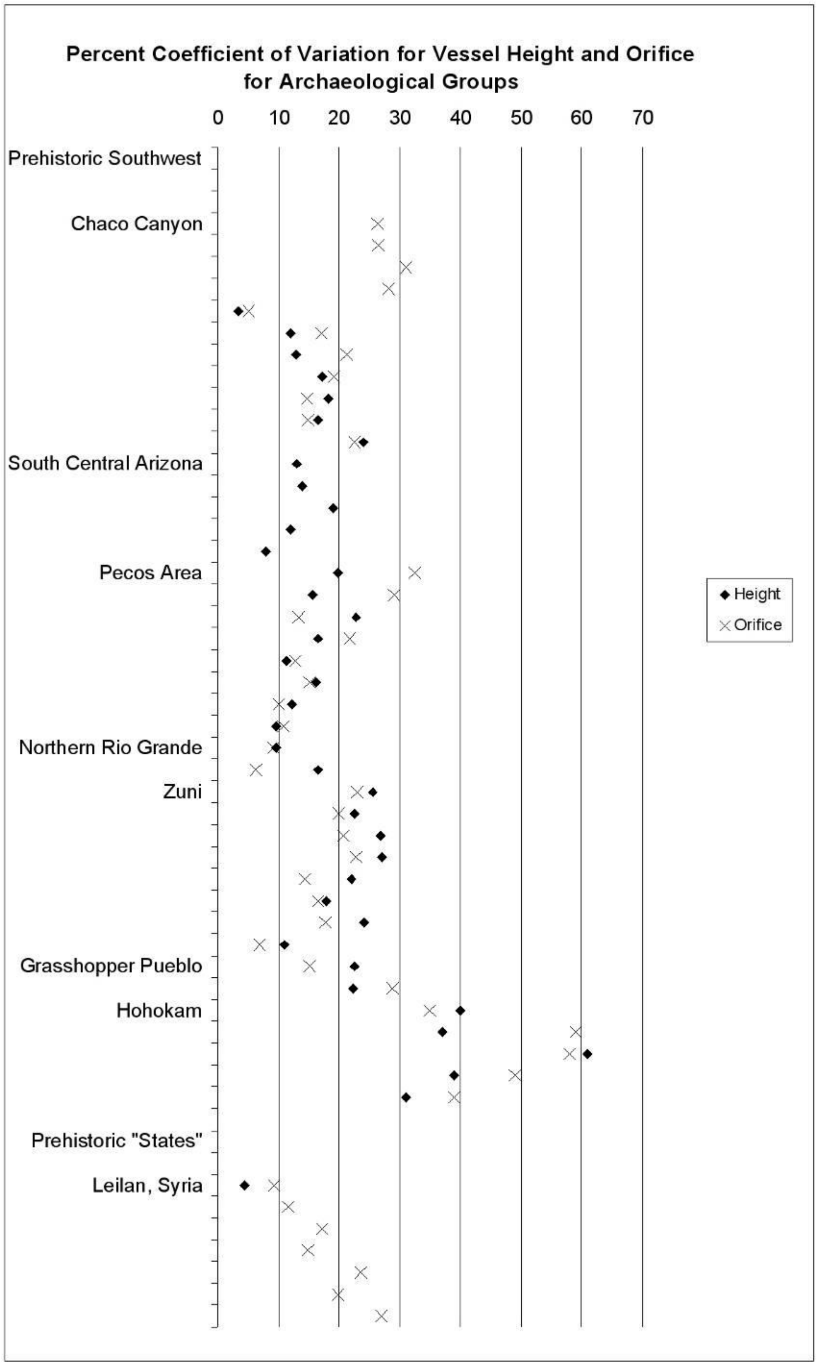


***Figure 4.3.* Percent Coefficient of Variation for Vessel Height and Orifice for Archaeological Ceramic Samples. Data from: Longacre et. al. (1988), Mills (1995), Crown (1995), Lindauer (1988), Powell (2002), Toll (1981, 1990, Hagstrum (1985), and Blackman et. al. (1993).**

Table 4.4: ***Counts and percentages of Southwestern archaeological data sets that are less than 10% C.V., between 10 and 30% C.V., and above 30% C.V.***

	C.V. for Height		C.V. for Orifice/Aperture	
	N	**%**	**N**	**%**
less than 10% C.V.	4	10.8	4	11.1
between 10 and 30% C.V.	28	75.7	25	69.4
Above 30% C.V.	5	13.5	7	19.4
total # of data sets	37	100	36	100

To sum up, the standardization hypothesis, that specialists produce more standardized products than non-specialists due to increased skill and efficiency (Rice 1992), is supported, for the most part, by ethnographic data. The relationship is less clear for archaeological samples.

Discussion of the ethnographic and archaeological cross-cultural comparison. The data presented above indicate that the majority of ethnographically documented specialist producers (69–76 percent of cases) manufactured assemblages with coefficients of variation below the 10 percent cut off discussed by Crown (1995). The Southwestern archaeological data on the other hand, are dominated by assemblages with coefficients of variation higher than 10 percent; only about 11 percent of cases are below 10 percent coefficients of variation. With this data in mind, I suggest, following other researchers, that the problematic relationships between ethnographic and archaeological data are based on five major variables: time scale, numbers of production episodes, ratio of producers to consumers, numbers of vessels examined, and the types of vessels examined. Although I discuss each of these variables separately, many of them are interrelated.

Time scale. Stark (1995:236) states that "current ethnographic data do not allow close control over production time or episodes, although the time spans represented are

far smaller than those that are typical in archaeological data." All of the ethnographic studies are based on pottery made within a short period of time, most often less than one year. This scale is drastically different from the time scale for all of the archaeological samples. Archaeological studies usually include samples made over hundreds of years. For example, a specialist producer from Spain produced 100 pots over a two day period with a coefficient of variation for vessel width of 1.7 percent, the lowest of the coefficients of variation presented in this chapter (Roux 2003). The largest coefficients of variation in the archaeological samples, 33 percent to 66 percent, are from the Hohokam ceramics, which were produced over a 150 to 250 year period (Lindauer 1988). Because this long time scale means that archaeological samples are produced over a number of generations of potters it also means that you incorporate the learning cycles of all those producers into your assemblage as well. Skilled potters did not start out that way, and their early periods of learning are included in this time scale variable. It is likely that a mix of skilled and unskilled labor is recorded in many archaeological assemblages.

Number of production episodes. There are also differences between the number of production episodes in ethnographic and archaeological samples. The archaeological record is a palimpsest. The assemblage of pottery that the archaeologist recovers is a collective record of a large number of production episodes that occurred over the entire time any one ceramic type was being produced at a particular site. The effect of production episode differences and time scale differences is supported by the archaeological work of Blackman et al. (1993:75) in Syria. They found that a waster stack of ceramics (presumably made in one production episode) exhibits a coefficient of variation of 9.19 percent for rim diameter; a sample of the same ware from multiple

contexts returns a coefficient of variation of 18.85 percent for rim diameter. Most archaeological samples are the result of hundreds of production episodes, likely contributing to the large coefficients of variation for these assemblages.

Ratio of producers to consumers. Longacre (1999) has documented that the number of producers in a group affects product standardization. For example, he describes variation among four specialists in San Nicolas, whose products range from 3 percent to 7.5 percent coefficient of variation for the same vessel type. This effect would be magnified when examining archaeological samples because tens to hundreds of producers—whether specialists or not—could have made the vessels over a 200-year period. In addition, this variable also can be affected by multiple producers working on a single pot. The incidence of "multiple hands," or more than one producer working individual pots, has been documented by Crown (2007) archaeologically in the Southwest. A number of different producers, possibly of different skill levels, working on vessels together can increase the variation of the assemblage produced.

Numbers of vessels examined. Another variable that contributes to the archaeological analysis of coefficients of variation is the number of vessels examined. A slight increase in coefficient of variation is seen as the number of vessels examined increases. For example, the lowest coefficient of variation (3.4 percent) in the Southwestern archaeological data is for Chaco redware cylinder jars, but only four vessels were examined (Toll 1990).

Vessel type. The fifth variable to consider is the vessel type—decorated serving or undecorated culinary. The comparison between ethnoarchaeological data and

archaeological data is also a comparison between undecorated culinary and decorated serving ceramics, as noted above (see Tables 4.1 and 4.2).

The problem with comparing standardization of undecorated culinary ware and decorated serving ware is affected by the nature of the archaeological record and the intent of the producer. With regard to the archaeological record, typology is often more difficult to distinguish with undecorated culinary wares because defining characteristics may be less obvious, and culinary ware styles commonly have much longer temporal spans than the majority of decorated wares in the Southwest. For example, in both the Pecos area (Powell 2002) and the Chaco Canyon area (Toll 1981, 1990), decorated wares are more highly standardized than the culinary wares. Pecos Striated (A.D. 1500–1838), a utility ware, is made for a much longer time span than Santa Fe Black-on-white (A.D. 1175–1350)—and Pecos Striated is less standardized (Powell 2002). This difference is also visible in the ethnoarchaeological sample. Arnold and Nieves (1992) found that the decorative tripod bowl is more standardized than any other form produced by the Ticul potters—a 6 percent coefficient of variation for height and 4 percent coefficient of variation for orifice for the decorated pots versus a minimum of 12 and 11 percent coefficient of variation for the undecorated culinary forms.

Variables related to production include the intentionality of standardization. Are potters trying to achieve different levels of standardization for the different types of wares? Possible reasons for intentional standardization include nesting ability (Whittlesey 1974) for decorated serving wares or standardized volumes for undecorated culinary ware.

These five variables, in addition to others such as overlapping ceramic classes (Longacre et al. 1988), likely work in combination to contribute to the large coefficients of variation seen in archaeological samples. The low coefficient of variation for the four Chaco redware cylinder jars (3.4 percent) is a function of the small sample size, but it also may be that these four pots were made by one potter during one short production episode. Thus, all the factors are interrelated. The opposite effect can also occur. For instance, the Hohokam samples, with the largest coefficients of variation, were made over a long period of time, probably during a large number of production episodes by a large number of potters.

Prehistoric ceramics with coefficients of variation below 10 percent. Of course, a few archaeological samples (11% of cases) from this analysis do not seem to be as greatly affected by these variables of long time span, number of producers, number of production episodes, type of vessel, or number of vessels examined. Some of the Salado polychrome type/form groupings, produced for approximately 150 years, have coefficients of variation below 10 percent (Crown 1995). Some Northern Rio Grande bowls, Zuni shouldered jars, Pecos area bowls, and Chacoan redware cylinder jars also have coefficients of variation below 10 percent (Hagstrum 1985; Mills 1995; Powell 2002; Toll 1990) It is interesting to note that all but two of these (the jar forms) are *large* bowls. These data support Crown's (1995) argument for fewer, more experienced potters specializing in large forms and suggest that, throughout the Pueblo IV and V periods in the northern Southwest, more large bowls than other ceramic forms were made by such potters.

In summary, this chapter has shown that the relationship between specialization and standardization holds in ethnographic societies. It is likely that this relationship may hold for archaeological societies for some ceramic classes, primarily large vessel forms, with coefficients of variation below 10 percent, but it is more difficult to identify in most archaeological cases. The specialization/standardization relationship is clouded by variables that obscure a direct relationship between intensity of production and standardization, making it difficult for archaeologists to interpret levels of production specialization from standardization data alone. These variables include long time scales, large numbers of producers, large numbers of production episodes, variation in sample size, and variation in the vessel type. In sum, the current research supports Bayman's (1999:254) contention that "Growing criticism of archaeologists' use of the ethnographic record…has compelled us to view direct ethnographic analogy with more care and to privilege the archaeological record." I do not suggest, however, that comparison of ethnoarchaeological and ethnological data is not fruitful. The current analysis demonstrates that the general patterns found in ethnoarchaeological data are useful for archaeological research. With care, constant comparison between ethnoarchaeological data and the archaeological record yields valuable information on a different scale. For example, in comparing data in this chapter, the problems that arise are often related to the variables discussed above. When these variables are carefully controlled for in the archaeological sample, ethnographic comparison can yield a greater understanding of the organization of production in the past.

This research has a number of significant implications. First, the evidence suggests that a coefficient of variation below 10 percent does indicate specialization

ethnographically and archaeologically, but coefficients of variation above 10 percent do not necessarily mean non-specialization in either case. The ethnographic, Southwestern archaeological, and state-level archaeological samples with coefficients of variation below 10 percent do seem to indicate that specialists produce wares with low coefficients of variation, but the archaeological samples with these low coefficients of variation seem to have fewer of the confounding variables discussed above. They all seem to have a reduced number of production episodes (Syrian bowls), a reduced number of producers (large southwestern bowls), or a small sample size (Chaco cylinder jars). Second, and related to the first implication, interpretations of archaeological coefficient of variation must consider the validity of direct analogy of production intensity with ethnographic coefficient of variation data. Third, because of the complicated relationship between ethnographic and archaeological data sets, perhaps future research should examine this problem using a purely archaeological sample to complement ethnoarchaeological data sets. I suggest that ideal case studies exist in the archaeological Southwest for examining this issue. Chaco Canyon and the Northern Rio Grande, areas where we have evidence of specialized production through analysis of concentration and scale (Neitzel and Bishop 1990; Shepard 1965; Warren 1969, 1979), are good locations in which to test the relationship between standardization and specialization, taking into account the problematic variables.

Ethnoarchaeological data provide archaeologists a starting point and yield hypotheses that can now be tested on a purely archaeological sample. This allows archaeologists to evaluate the "fit" of ethnoarchaeological data and use it to best advantage. Ceramic production at San Marcos Pueblo, where we have independent

evidence suggesting that production was specialized, is an informative case study with which to test the relationship between standardization and specialization.

Chapter 5

Methods and Models Used to Evaluate Standardization

Studies of the organization of production frequently involve analysis of both direct and indirect evidence for production and specialization. In the case of San Marcos, no production locales have been identified, so analysis is limited to the indirect evidence of production, the ceramic artifacts themselves. The Northern Rio Grande, and San Marcos specifically, is an ideal location to examine the organization of production and standardization in an archaeological middle-range society because we have independent evidence of specialized production in the geographically wide distribution of Glaze Ware ceramics made at San Marcos Pueblo (Warren 1979). Because I am *not* using standardization to identify whether or not specialization occurred, the question then can become how (or if) standardization occurred. By examining standardization in this known setting, this research may be helpful to other researchers pursuing issues of standardization and specialization in the Southwest and beyond. In this study, I examine the standardization of form, technology, materials, and decoration of sherds and whole vessels spanning the entire Glaze Ware sequence.

What is significant is change in the *degree of standardization* of attributes (Rice 1992, Stark 1995). The degree of standardization is a relative measure of the changes in amount of variation in the products manufactured by a particular group through time. It is this change through time that will be indicative of changes in the degree of standardization; thus, the Glaze Ware ceramic typology, with its established temporal framework, will be the means of providing temporal control over the sample.

In this chapter, I discuss intentional and mechanical standardization (Costin and Hagstrum 1995). Then the models used to address the relationship between standardization and intensity of production are laid out, the nature of the sample is discussed, and the sampling methods are described.

Intentional and Mechanical Standardization

Costin and Hagstrum (1995:622) differentiate between intentional and mechanical standardization. The distinction is based partially on the visibility of particular attributes (Carr 1995a, 1995b; Van Hoose 2000, 2008; Van Hoose and Schleher 2002). Intentional standardization is consciously controlled by the producer and reflects intended vessel function. The potter, through either consumer pressure or his/her own decisions, may standardize particular visible vessel attributes, such as vessel shape, rim profile, slip color, and style of decoration. Intentional standardization informs less on the organization of production because the standardization is a functional necessity based on the vessel’s use in the economic, social, or political realm (Costin and Hagstrum 1995:622). Mechanical standardization, on the other hand, is unintentional and reflects the organization of production. This type of standardization correlates with the “level and type of mass production technology employed, training, skill, experience, the amount of supervision or quality control, efficiency, motor habits, work habits, and idiosyncratic behavior” (Costin and Hagstrum 1995:622). In other words, mechanical standardization reflects the intensity of production, which in turn should result in greater standardization in the less visible attributes that are not easy to copy in a final product (Van Hoose 2000, 2008). Because potters are making more pots, attributes such as clay processing, paint composition, and forming methods unconsciously become more consistent. Although

attributes of mechanical standardization are unintentionally standardized, they are limited by functional constraints. For example, glaze paint composition must perform correctly (stay on the pot), and the possible range of mechanical variation must meet this criterion.

In the current research, I differentiate between intentional or mechanical standardization so that what is being examined reflects either functional constraints or the organization of production. Intentional standardization correlates with level of consumer, ritual, or ideological pressure to conform to specific canons, whereas mechanical standardization correlates more directly with intensity of production. Examination of these different types of standardization is accomplished through examination of attributes at various levels of visibility.

Models of the Relationship between Intensity of Production and Standardization

Three data sets, described in detail below, are used to evaluate the organization of production and standardization at San Marcos: (1) local Glaze Ware from San Marcos Pueblo, (2) Glaze Ware exported from San Marcos and recovered from other sites, and (3) complete Glaze Ware vessels recovered from San Marcos and other sites in north-central New Mexico. It is assumed that ceramic production at San Marcos was specialized, albeit at a low level of household industry specialization, during the period of Glaze Ware ceramic production (Habicht-Mauche 1995; Nelson and Habicht-Mauche 2006; Reed 1990). Although this is an assumption, the first phase of sample selection tests this assumption by examining the quantity of ceramics locally produced at San Marcos Pueblo. I further assume that production intensity increased from Glaze A to Glaze C and decreased from Glaze D to Glaze F (Shepard 1942, Warren 1969, 1979).

Two models are tested that relate to standardization and intensity among local and exported ceramics.

San Marcos local ceramics. In Model 1, standardization is a direct indicator of changes in intensity of production at San Marcos Pueblo. This model is correct if some or all attributes examined on Glaze Ware ceramics become more standardized with increasing intensity of production from Glaze A to Glaze C, as suggested by Shepard (1942, 1965) and Warren (1969, 1976, 1979). A decrease in standardization should also occur with decreasing intensity of production (from Glaze D to Glaze F).

It is expected that attributes related to intentional and mechanical standardization (*sensu* Costin and Hagstrum 1995) will change differently. These attributes also relate to the visibility of the attribute. Attributes that reflect intentional standardization include vessel form, size, decorative elements, and rim shape. These attributes have a higher visibility and thus can be copied from finished vessels, are more likely to reflect conscious choices made by potters, and are more likely to reflect consumer expectations. Increasing standardization of these attributes reflects changing societal expectations and does not necessarily correlate with increasing intensity of production. For example, changes in design elements or motifs may be indicative of changing preferences by the community rather than changes in the organization of production. Mechanical standardization, on the other hand, should be directly related to increasing production intensity because it occurs unintentionally. As noted above, mechanical attributes are expected to vary only across functionally effective options. Attributes that reflect mechanical standardization include framing line thickness, distance of framing line below rim, paint composition, aplastic processing, and vessel wall thickness/vessel size. These

attributes tend to have lower visibility (*sensu* Carr 1995a, 1995b) because they are difficult to copy from final products. Standardization of low-visibility attributes, such as clay composition or paint composition, may indicate that access to resources is more restricted with increasing production intensity or that a smaller group of potters is making the pots.

In Model 2, standardization is not a direct indicator of changes in intensity of production at San Marcos. For Model 2 to be supported, attributes of Glaze Ware ceramics will not increase in standardization with changes in production intensity. Either no change in standardization or a decrease in standardization should occur. In a Master's thesis conducted on sherds from a number of Galisteo Basin sites, Barbara Staley (1990) found little difference in standardization throughout the Glaze Ware ceramic sequence. Staley's research suggests that production centers changed throughout the sequence and that trade within the Galisteo Basin accounted for the presence at all sites of samples of each type that were relatively standardized; Staley did not distinguish production locale in her analysis. This research addresses this issue by separating out Glaze Ware made at San Marcos *prior* to the analysis of standardization.

Exported ceramics. The addition of sherds made at San Marcos found at locales outside of the Galisteo Basin will allow a comparison of ceramics exported from San Marcos with those that were locally used. The purpose of the comparison is to determine the extent of standardization of exported vessels versus those made for local use. These data will help answer questions regarding both intentional and mechanical standardization, as well as give a fuller picture of how ceramic production was organized at San Marcos Pueblo throughout the Glaze Ware sequence. Exported ceramic data will

either vary in the same manner as local San Marcos Glaze Ware ceramics or show distinct patterns. Exports may be more standardized in certain attributes than locally used wares because of higher consumer expectations for exported wares (intentional standardization), or because a smaller group of specialists made the wares that were exported (mechanical standardization). Motsinger (1997) has documented that some decorative elements of Glaze Ware exported from the general Galisteo Basin region to the Salinas region did change in standardization with changes in intensification. To evaluate these models, a sampling method was developed that accounts for time, through use of the Glaze Ware typology, and local production, through aplastic/temper analysis.

Whole vessels from San Marcos and other sites. Designs are clearly an intentionally produced attribute, and thus can reflect the nature of production, especially as production relates to the level of consumer, ritual, or ideological pressure to conform to specific canons. The whole-vessel sample is not restricted to production at San Marcos, but it is likely that most of the vessels from San Marcos were made there, given that the majority of the sherd sample suggests manufacture at the site (discussed later in this chapter). An increase in standardization in design layout, structure, or motifs on vessels from San Marcos during the intermediate Glaze Ware period, as compared to vessels from other sites, will support Model 1, whereas no change in standardization will support Model 2. To evaluate these models, I first turn to a re-evaluation of the research that has led to the assumption that specialized production occurred at San Marcos Pueblo.

A Reanalysis of the Helene Warren Collection and Interpretations

As discussed in Chapter 2, Helene Warren (1969, 1979) argued that two villages, San Marcos Pueblo and Tonque Pueblo, were major production centers for Rio Grande

Glaze Ware. Recent research on ceramic production in the Northern Rio Grande does not replicate Warren's findings and suggests that San Marcos was only *one* of many production locales for Glaze Ware (Creamer 2000a; Nelson and Habicht-Mauche 2006; Reed 1990). These studies suggest that production occurred at San Marcos, but at lower levels than indicated by Warren in the 1970s. Warren's conclusions (1969, 1976, 1979) cannot be compared to current researchers' work; she used the oil immersion petrographic technique and did not save the slides, so researchers cannot review and cross-check them (Habicht-Mauche 2002:54). Judith Habicht-Mauche addresses this concern with Helene Warren's petrographic analysis, in comparison to work done earlier by Anna Shepard:

> Unlike Shepard, Warren worked primarily with powdered samples rather than permanent thin sections. This technique was cheaper and less labor-intensive, and it allowed Warren to examine a larger sample of comparative material. It has been difficult, however, for later researchers to cross-check and compare Warren's results with their own without access to permanent petrographic slides or published photomicrographs. Warren's original index sherds, however, are on file at the Museum of New Mexico, Laboratory of Anthropology in Santa Fe, and a comparative reference collection of permanent thin sections could be produced from them in the future. [Habicht-Mauche 2002:53]

Having a clear view of Warren's research is essential for the current study, but her methods were destructive and her samples have not survived. Because of the issue of not being able to cross check her petrographic work and compare it to other samples, a first step in the current analysis was to confirm the replicability of Warren's (1969, 1979) results. The only way to evaluate her inferences is to follow Habicht-Mauche's (2002) suggestion and make new petrographic samples and re-evaluate Warren's results.

The Helene Warren type collection at the Laboratory of Anthropology in Santa Fe includes more than 200 sherds that are labeled (presumably by Warren) "San Marcos

latite" (temper type). In the reanalysis, I selected a sample of 32 of these sherds with an LA number from a site other than San Marcos (to be used in the exported sample discussed below). Thin sections were made of these 32 sherds to determine the replicablity of Warren's results and to determine how many actually are San Marcos augite monzonite. As a byproduct of this reanalysis, I have created a permanent reference collection of a part of the Warren collection that can be used by future researchers. Reanalysis of the Warren materials helps to justify the assumption of San Marcos as a production center and as a locale of changing production intensity. The results of this reanalysis were positive—all 32 of the sherds in the selected sample did prove to be tempered with San Marcos augite monzonite (the specific tempering material used by potters at San Marcos, to be discussed in the following section). Because my retest of Warren's sherds is positive, I argue that Helene Warren's research about the increasing amounts of Glaze Ware ceramics produced from Glaze A to Glaze C is valid. These results should not be seen as a wholesale acceptance of all of the temper identifications made through the oil immersion petrographic technique, but they are suggestive of the relative reliability of Warren's research results, especially as they relate to San Marcos. The addition of other temper types to this reanalysis would be helpful, although they were not undertaken here as they would not be applicable to this current study. Because all identifications of production locales, by Warren and all other researchers, begin with temper, I now turn to a discussion of the temper type used by potters at San Marcos Pueblo.

San Marcos Glaze Ware Pottery and Weathered Augite Monzonite

Numerous researchers have documented that prehistoric potters in the Northern Rio Grande region used regionally specific rock types as temper (Capone 2006; Dyer 2010; Eckert 2003, 2008; Habicht-Mauche 1993; Nelson and Habicht-Mauche 2006; Schleher and Boyd 2005; Shepard 1942; Warren 1969, 1970, 1976, 1979, 1981). Although the geology around San Marcos is diverse and a wide range of materials were accessible (Disbrow and Stoll 1957), the potters at San Marcos appear to have used only one material—a weathered augite monzonite—as the aplastic filler (temper) in their decorated pottery (utility wares may have been tempered with a slightly different rock type [Dyer 2010; Habicht-Mauche 1988]). Although other rock types are available in many locales of the Northern Rio Grande (Disbrow and Stoll 1957; Erskine and Smith 1993), potters in sub-regions and even at specific sites preferentially selected particular materials with which to temper their vessels.

Previous researchers have used different terms for similar rock types (Table 5.1). In this analysis, the rock type terms used follow the most recent research on ceramic tempering materials (Eckert 2003, 2008; Nelson and Habicht-Mauche 2006), following geologic distinctions from Disbrow and Stoll (1957). San Marcos Pueblo temper was grouped into Anna Shepard's (1942, 1965) general "andesite" category in her publications, but she called the San Marcos material "augite diorite" in her notes and thin sections. These thin sections are housed at the University Museum at the University of Colorado, Boulder. I have compared Shepard's augite diorite thin sections to the thin sections created for this project and found the material is identical to weathered augite monzonite. Other researchers, including those working as a part of the Salinas Pueblo

project directed by Dr. Katherine Spielmann from Arizona State University, also use Shepard's augite diorite to describe the temper type used by San Marcos potters.

Table 5.1. ***Temper types by geographic area.***

Geographic area	Nelson and Habicht-Mauche (2006), Habicht-Mauche (1993), Eckert (2003, 2008)	Warren (1969, 1979)	Shepard (1942, 1965)
Zia/Santo Domingo Basin	Intergranular Basalt	San Felipe Basalt	Crystalline basalt
San Marcos Pueblo	Augite Latite/Monzonite	San Marcos latite	Andesite
Galisteo Basin	Various Augite and/or Hornblende Latite Porphyries		Andesite
Tonque Pueblo	Hornblende Latite Ash	Tonque latite	Andesite
Pajarito Plateau	Rhyolite Tuff	Rhyolite tuff	Devitrified tuff
Bernalillo Area and/or Cochiti Area	Vitrophyric Basalt	Scoria basalt	Vitric basalt
Estancia Basin (Abó Pueblo)	Syenite	Syenite	n/a
Albuquerque Area	Sherd	Sherd	Sherd
Pecos Pueblo	Sandstone	Sandstone	Sandstone
Lower Rio Puerco Area	Olivine Diabase & Hidden Mountain Igneous Rock (primarily various types of intergranular and vitrophyric basalt)	n/a	n/a
Sandia Mountains	Quartz-mica Schist	Quartz-mica schist	n/a

* Table modified from Nelson and Habicht-Mauche 2006; Eckert 2003, 2008.

Attempts have been made, to no avail, to determine the geographic location of this rock. For example, Eric Blinman provided me with samples of a weathered rock material collected from the San Marcos Arroyo near Burnt Corn Pueblo that was a possible suspect, but after thin sectioning and petrographic analysis, this material was identified as a weathered latite with a much finer grained texture than the augite monzonite found in the majority of ceramics from San Marcos. For the current research, I must go with the Criterion of Abundance, over 80 percent of the Glaze Ware recovered

at San Marcos through UNM's work at the site are tempered with this specific type of weathered augite monzonite. It is likely that the source of augite monzonite is located in or near the Cerrillos Hills, although the specific location has not been identified (Dyer 2010:91–92).

Ancillary evidence also suggests the exclusive use of weathered augite monzonite by San Marcos potters. Potters at a nearby contemporaneous site, San Lázaro Pueblo, were not using this same aplastic material. Eric Blinman provided sherds from four unfired vessels recovered from San Lázaro. I fired them in a kiln to 700 degrees Celsius and had petrographic thin sections made. Petrographic analysis shows that the temper material in these sherds is clearly not the same weathered augite monzonite—two of the sherds were tempered with hornblende latite and two were tempered with a material closer to a basalt. That San Lázaro Pueblo, the contemporaneous site physically closest to San Marcos, was using a different tempering material in these unfired vessels indicates that they were most likely locally produced. This finding further supports the assumption that the use of augite monzonite was restricted to San Marcos Pueblo pottery. In addition, as shown in Table 5.1, much of the literature suggests that other sites in the Galisteo Basin were using varieties of hornblende latite and not augite monzonite as temper (e.g., Nelson and Habicht-Mauche 2006).

In summary, weathered augite monzonite temper has been tied to production at San Marcos. I identify this rock type in the sherd sample through binocular analysis for the entire sample, then by petrographic analysis for a large sub-sample. I now turn to the sampling procedures.

Sampling Procedures

The majority of the sample used for this study consists of sherds collected at San Marcos Pueblo during the 1999, 2000, and 2002 field seasons directed by Ann Ramenofsky of the University of New Mexico. In addition to this sample, sherds from the Anna Shepard collection at the University of Colorado at Boulder, the Helene Warren collection at the Laboratory of Anthropology at the Museum of New Mexico, and Dr. Katherine Spielmann's collection from the Salinas Pueblos housed at Arizona State University were included in the analysis. Whole vessels and large sherds used in the design analysis come from the Nels Nelson collection at the American Museum of Natural History, the Maxwell Museum of Anthropology at UNM, the Albuquerque Museum, and the Museum of New Mexico. The detailed sampling methodology used for each collection is described below.

Sampling the local collection (UNM). There are approximately 60,000 sherds in the UNM collections from San Marcos Pueblo; approximately 3,500 of these are decorated rim sherds that were used in the creation of the seriation presented in Chapter 2 (Figure 2.6; Ramenofsky 2001). Because the sherds came from the surface of the site, many are relatively small. For this reason, many of the attributes that deal primarily with technological and compositional standardization were examined on this collection. These low-visibility technological attributes are ideal for studying mechanical standardization. Wall thickness, rim thickness, rim diameter (when possible), firing technology, the composition and processing of glaze paint and aplastics, and some decorative attributes, including slip and framing line characteristics, are examined on a sample of these sherds.

A preliminary analysis of all diagnostic rim sherds from the University of New Mexico's work at San Marcos (Ramenofsky 2001) was conducted. The database of all rim sherds created by Ann Ramenofsky was used in the sampling methodology for the UNM collection. A two-step sampling method was employed. First, the rim sherd database was queried for normal bowl rim sherds from each Glaze Ware type more than 5 grams in weight. This size was selected as an arbitrary cut-off based on the judgment that most of the attributes of interest would be more difficult to examine on smaller sherds. Second, this query was imported into an MS Excel spreadsheet, where a random number generator was used to select the sherds to include in the sample.

The counts from the UNM collection for each Glaze Ware type vary significantly. There are 1,255 Glaze A Yellow rims, 790 Glaze B rims, 685 Glaze C rims, 384 Glaze D rims, 178 Glaze E rims, and 240 Glaze F rims in the collection (Ramenofsky 2001:42). Because some of these rims are smaller than the required size of 5 grams and because some samples were returned to the site after initial typing, I was not able to obtain the same sample size for each Glaze Ware type (Table 5.2). Late Glaze Ware sherds are not as well represented at San Marcos as earlier types, so I had fewer sherds to select my sample from for these late types. This is especially true for Glaze E. Many of the Glaze E sherds in the UNM San Marcos collection are shouldered bowls, which are not included in this analysis because of the difficulty in comparing attributes of shouldered bowls to those of unrestricted bowls. The percentage of the overall collection included in the analysis is significantly higher for the later types than for the early types. The inclusion of a larger percent of later sherds than earlier ones may have an effect on the results. More variation in the earlier samples may be due in part to drawing the sample from a larger

assemblage. The local sample of sherds was then examined for temper material (discussed in the petrographic analysis methodology section in Chapter 8). Only sherds tempered with the local tempering material, weathered augite monzonite, were used throughout the rest of this research.

Table 5.2: ***Sample of sherds from the UNM San Marcos Collection, showing the sample size selected for the current analysis as well as the total typed assemblage size, with the percent of the overall sample used.***

Glaze Type	Sample Size for Current Analysis	Total Collection Size, UNM San Marcos collection	% of Overall Collection Analyzed for this Analysis
A Yellow	79	1,255	6.29%
B	80	790	10.13%
C	78	685	11.39%
D	78	384	20.31%
E	68	178	38.20%
F	76	240	31.67%
Total	459	3,532	13.00%

Sampling the exported ceramics. The sampling of the exported ceramics was significantly more complicated and biased than the sampling of the materials from the UNM collection (Table 5.3). Because of time constraints I did not examine ceramic collections from excavated contexts from numerous sites in the Northern Rio Grande to locate sherds tempered with augite monzonite. Instead, I relied on previously analyzed collections. Initially, my goal was to use the Helene Warren type collections at the Laboratory of Anthropology to obtain a sample of sherds tempered with augite monzonite, but this collection did not contain a large enough sample of sherds across the Glaze Ware sequence; most sherds were the early types. I was able to select some of the exported sample from the Warren collections, but not a large sample (Table 5.3). All of

these sherds from the Warren collection were thin sectioned, with permission of the Museum of New Mexico, and as discussed above, all contained augite monzonite. I then examined the Anna Shepard type collections from University of Colorado at Boulder. I inspected Shepard's thin sections for augite monzonite temper (what she called augite diorite) and once located, I included the parent sherd from which the thin section was taken in my sample. I was able to obtain a number of sherds, again dominated by the earlier end of the Glaze Ware series. Dr. Katherine Spielmann allowed me to examine collections from her research in the Salinas area housed at Arizona State University. The ceramics had already been sorted by temper type (C. L. Herhahn, personal communication 2009). All sherds identified by Herhahn as tempered with augite diorite (the same material that I am calling augite monzonite; Herhahn, personal communication 2009), were selected for analysis. The sample from the Spielmann collections was also weighted toward the early Glaze Ware types. To attempt to increase the sample size for the latter end of the sequence, I included the data from six sherds from Jennifer Boyd Dyer's (2010) research, one sherd recovered at Pecos Pueblo and five from the Palace of the Governors in Santa Fe.

Table 5.3: ***Exported sample size and collection information.***

Glaze	**Total Exported sample**	**Warren (MNM)**	**Shepard (UC)**	**Spielmann (ASU)**	**Dyer Data (2010)**
A	**50**	13	19	18	
B	**37**	10	11	16	
C	**17**	5	7	5	
D	**10**	1	6	3	
E	**3**			2	1
F	**9**	3	1		5
Total	**126**	32	44	44	6

The field collection strategies used to recover these exported samples varied greatly. Dr. Spielmann's collection of ceramics was collected during a systematic research program, with spatial control over location of recovery within the sites sampled. The Shepard and Warren collections had less spatial control, as both collections were based primarily on unsystematic surface collections from a wide variety of sites.

In all, the exported sample consisted of 126 sherds recovered from 23 sites (Table 5.4). Over 58 percent of the sample was from Gran Quivira (n = 35), La Bajada (n = 19), San Cristobal (n = 12), and Pueblo del Encierro (n = 8). Glaze E is not well represented in the exported sample with a sample size of just three sherds, and is frequently excluded from graphs in the results chapters.

Although the sample is relatively large, the sites sampled are widely dispersed, and specific Glaze Ware types are not well represented. Ideally, I would have been able to locate larger samples from individual sites to determine if San Marcos potters were exporting specific products to villages to which they had closer ties. Even with these

limitations, the exported sample will yield information to address the models proposed above in that all the ceramics were exported from San Marcos.

Table 5.4: ***Recovery Sites for the exported sample.***

Site	LA #	Total Sherd Count	A	B	C	D	E	F
Gran Quivira	LA 120	35	17	15	2		1	
La Bajada Ruin	LA 7	19	8	7	4			
San Cristobal	LA 80	12	4	4	2	1		1
Pueblo del Encierro	LA 70	8	4	2	1	1		
Pueblo Colorado (Galisteo)	LA 62	6			2	4		
Pueblo Colorado (Salinas)	LA 476	6	1		2	3		
Palace of the Governors	LA 111322/4451	5					1	4
Espinoso Ridge	LA 278	4	2	1	1			
Pueblo Largo	LA 183	4	3		1			
Quarai	LA 95	3		1	1		1	
Chackam	LA 374	3	2	1				
Tonque	LA 240	3		3				
Pueblo Blanco	LA 51	4	3			1		
Galisteo	LA 26	2	2					
Unshagi	LA 123	2	1	1				
LA 64 (no site name)	LA 64	2		1	1			
Las Majadas	LA 591	2						2
Kuapa	LA 3444	1		1				
Old Kotyiti	LA 295	1						1
Cuyamongue	LA 38	1	1					
Pecos	LA 625	1						1
Zia	LA 28	1	1					
Alameda Pueblo	LA 421	1	1					

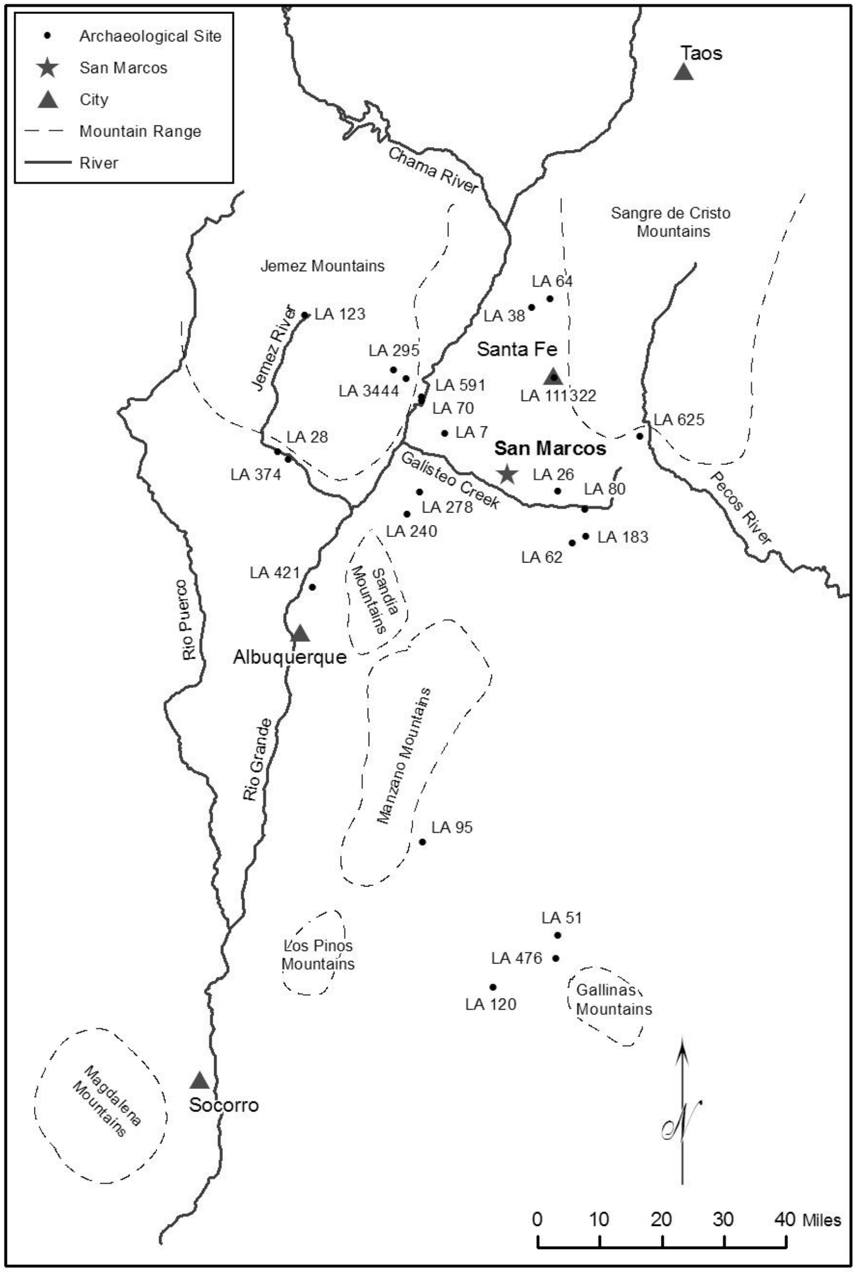


Figure 5.1: **Map showing the location of recovery sites for the exported sample.**

Whole vessel sample for the design analysis. Because of the small size of many of the sherds in both the local and exported samples, design analysis was conducted on a

separate sample of 140 whole or partial vessels from 15 sites and one unidentified location. The sample of whole vessels came from the Nelson collection at the American Museum of Natural History, the Maxwell Museum of Anthropology, the Albuquerque Museum, and the Museum of New Mexico. It is significant to note that temper and production locale could not be determined for most of these vessels unless a broken edge was clearly visible. The temper type was recorded whenever possible, but on the large majority of the vessels, especially the Nelson collections where many edges were coated in adhesive, identification of the temper was difficult or impossible. To obtain a large enough sample of whole vessels, I used all that were available, whether temper type could be identified or not. Because location of production is not controlled for, design analysis comparisons with the sherd samples were difficult, given the tight production control at San Marcos for the sherd samples. For this reason, the design analysis addresses relative patterns in design structure, iconography, motifs, and elements produced in the overall Northern Rio Grande region and includes a comparison of vessels from San Marcos with other sites, rather than the internal comparison of local and exported San Marcos vessels through time carried out for the sherds. Changes in design standardization on vessels from San Marcos was compared to design standardization on vessels from other sites to determine if San Marcos potters were using more standardized designs than potters in other villages. Vessels recovered from 15 sites are included in the analysis, the majority of them from San Marcos Pueblo, Puaray, Kuaua, Pecos, San Cristobal, and Pueblo Cieneguilla. Counts of the number of vessels from each site by Glaze Ware type are presented in Table 5.5. Vessels recovered at San Marcos were compared to vessels recovered at other sites to determine any differences in design

standardization, but it was not possible to be certain that all the vessels from San Marcos were manufactured at the site or that none of the vessels recovered at other sites were *not* made at San Marcos. Design analysis of the whole vessels is presented in Chapter 10.

Table 5.5*: Whole Vessel sample with Glaze Rim Type and Site of recovery.*

Site	LA #	Total Vessel Count	A	B	C	D	E	F
Kuaua Pueblo	LA 187	17	2	1	6	2	5	1
Los Aguajes Pueblo	LA 5	7		3	4			
Paa-ko Pueblo	LA 162	10	7			1	1	1
Pecos Pueblo	LA 625	14	5	4	1	4		
Pottery Mound Pueblo	LA 416	3	3					
Puaray Pueblo	LA 326	22			6	4	10	2
Pueblo Cieneguilla	LA 16	8	3	2	3			
Pueblo Colorado	LA 62	1				1		
San Cristobal Pueblo	LA 80	11	2		2		1	6
San Lázaro Pueblo	LA 91/92	4	2		1	1		
San Marcos Pueblo	LA 98	27	7	1	5	8	1	5
Sapawe Pueblo	LA 306	1				1		
Tijeras Pueblo	LA 581	2	2					
Tonque Pueblo	LA 240	10	3	1	1	3		2
Zia Pueblo	LA 28	1	1					
Unknown location		2				2		
	Total:	**140**	**37**	**12**	**29**	**27**	**18**	**17**

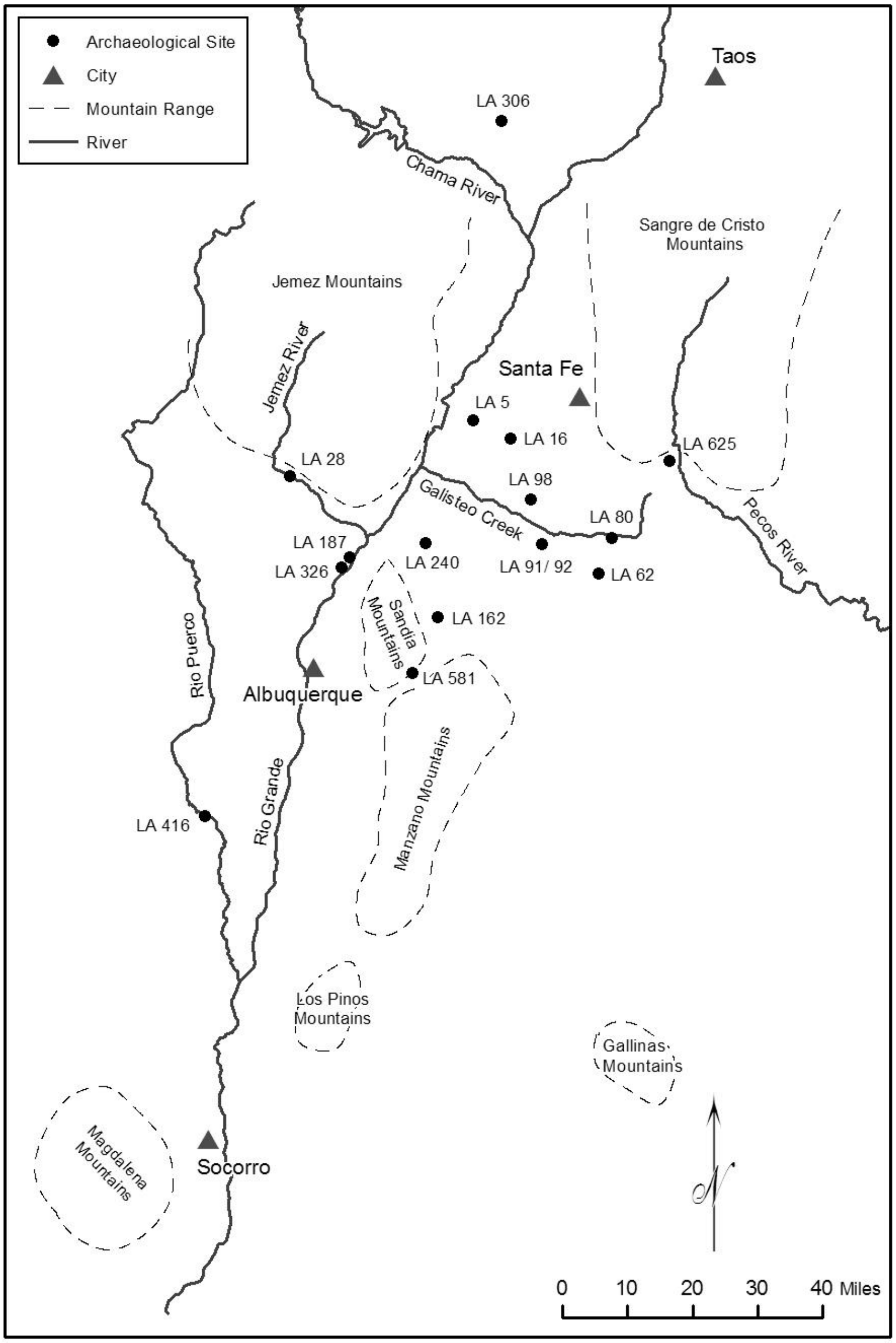


Figure 5.2: **Map showing the location of recovery of the whole vessel sample.**

Evaluating Specialization: General Data Presentation and Discussion of Statistical Measures

The first stage of data collection required determining which of the samples selected from the UNM collections were tempered with the specific weathered augite monzonite used at San Marcos. This portion of the dissertation will address concentration, the first organization of production parameter (Costin 1991). Concentration of production has already been suggested by previous research (Nelson and Habicht-Mauche 2006; Shepard 1942; Warren 1976, 1979) indicating relatively large amounts of exports from San Marcos, but my goal here is also to demonstrate conclusively that the local products that remained for use at the site were also predominantly locally made. For the local sample, temper was determined through petrographic analysis for 50 sherds of each Glaze Ware type and through binocular analysis for the remaining sample. For the exported sample, I undertook petrographic analysis on some and only binocular analysis of others. It is significant that earlier research on all of the exported sample collections involved petrographic analysis (Herhahn, personal communication 2009; Shepard 1942, 1965; Warren 1969, 1979).

Of the 459 sherds in the local UNM sample, 372 are tempered with the weathered augite monzonite, indicating production at San Marcos. The remaining sherds are tempered almost exclusively with other Galisteo Basin materials, primarily hornblende latites. The percentage of each Glaze Ware type tempered with the augite monzonite ranges from 60% (Glaze D) to 97% (Glaze B), for an average of 81% total (Table 5.6).

Table 5.6: ***Results of the temper analysis for the UNM sample showing the count and percent of the sample tempered with weathered augite monzonite.***

Glaze Type	Sample Size for Current Analysis	Sample with augite monzonite temper	Percent of sample tempered with augite monzonite
A Yellow	79	76	96.20%
B	80	78	97.50%
C	78	68	87.18%
D	78	47	60.26%
E	68	42	61.76%
F	76	61	80.26%
Total	459	372	81.05%

This overwhelming dominance of local production throughout the Glaze Ware sequence further supports the assumption, developed from Warren's (1979) and Shepard's (1942) research, that potters at San Marcos Pueblo were producing more ceramics than they were using at the site. This suggests that San Marcos Pueblo was one of the concentrated areas of production in the Northern Rio Grande for Glaze Ware ceramics. This is especially suggested for Glaze A, B, and C production, with the local assemblage predominantly manufactured at the site, little evidence of any import of wares made elsewhere, and export of ceramics from San Marcos to other sites, as seen in the exported sample.

For the exported sample, most of the data are presented as grouped Glaze Ware types because of the very small sample size for some of the intermediate and late sherds. Glazes A and B are discussed as the "Early" Glaze Ware, Glazes C and D as "Intermediate," and Glazes E and F as "Late."

All attributes examined are listed in Table 5.7, with the sample size taken from each of the collections (local, exported, and whole vessel). In addition, each attribute is

categorized as reflecting either intentional or mechanical standardization (*sensu* Costin and Hagstrum 1995). The attributes rarely are truly restricted to one of these dichotomous categories. Instead, the majority of attributes may reflect both types of standardization. For example, morphological attributes, including rim diameter/wall thickness and rim thickness, primarily would reflect mechanical standardization, yet they are also constrained by intentional factors. This is especially true for rim thickness, which is related to the Glaze Ware type. Thus, for Glazes C, D and E the potters applied an additional coil to the rim to make these thicker rim types, yet the degree of standardization of this thickness is mechanical.

A number of statistical measures are used to describe and interpret the data. Basic statistics, including mean, standard error of the mean, standard deviation, coefficient of variation, interquartile range, median, minimum, maximum, and sample size are presented for all of the metric data. For reasons discussed earlier, the coefficient of variation is preferred to standard deviation because it "describes relative variation by expressing the standard deviation as a percentage of the mean, thereby removing scale effects" (Longacre et al. 1988:103). Lower coefficients of variation indicate a more standardized assemblage. In addition to coefficient of variation, I use the Levene's test (Levene 1960), which assesses the equality of variance in different samples, to determine if differences between sample populations' variances are statistically significant. For non-metric data, I use bar charts to present the data visually and the Shannon diversity index to allow comparison of the amount of diversity through time and between samples. Keith Kintigh's (2002) Tools for Quantitative Archaeology statistical package is used to calculate the Shannon diversity index for all of the non-metric data.

Table 5.7: ***Attributes examined in the current study.***

Attribute to Be Analyzed	Type of Attribute	Sample Size			General Methods Used
		Local	Exported	Whole Vessels	
Material Selection and Processing : Petrographic Analysis (Chapter 6)					
Aplastic composition	Intentional	302	76		Petrographic thin section analysis in polarizing microscope
Aplastic/ Clay processing	Mechanical	121	14		Petrographic thin section analysis in polarizing microscope
Forming and vessel size: Morphological Attributes (Chapter 7)					
Wall thickness	Mechanical	372	126		Caliper measurement
Rim thickness	Mechanical/ Intentional	372	126		Caliper measurement
Rim Diameter	Mechanical	372	126	63	Rim diameter template
Compositional Attributes: Glaze Paint Analysis (Chapter 8)					
Glaze-paint composition	Mechanical/ Intentional	67			Electron microprobe analysis
Glaze-paint color	Intentional/ Mechanical	372	126		Visual color scale
Decorative and Design Attributes (Chapter 9)					
Framing line thickness	Mechanical	372	126		Caliper measurement
Distance of framing line below rim	Mechanical	372	126		Caliper measurement
Design Analysis	Intentional			140	Design analysis
Polishing	Intentional/ Mechanical	372	126		Visual scale
Slip color	Intentional	372	126		Munsell color
Firing Technology Attributes (Chapter 10)					
Firing technology	Mechanical	372	126		Core pattern
Original firing temperature	Mechanical	100			Refiring experiments

In summary, data collected from the weathered augite monzonite sherds in the local and exported samples was used to examine the organization of production and to

test models of the relationship between standardization and intensity of production at San Marcos Pueblo. In addition, designs on whole vessels recovered from San Marcos Pueblo were compared to vessels from other sites across the Northern Rio Grande to evaluate this relationship as well. The data presented in the following five chapters address all facets of production and standardization throughout the entire ceramic production process, following the order that the potter would have used. The selection and processing of clay and temper are explored in Chapter 6 through petrographic analysis. After material selection, the potter's next step would be to form the vessel; thus I address morphological vessel characteristics in Chapter 7. Decoration would be the next step and this process is divided into two chapters, one that explores the composition of the glaze paint used to decorate the vessel and one that explores the application of the paint and the designs used. The final data chapter presents the firing technology used by San Marcos potters to transform the clay into a durable vessel. Through these five chapters, any changes in the level of standardization illuminate differences in various production steps, which may elucidate not only the question of standardization and specialization, but also the characteristics of the production process by the native potters at San Marcos Pueblo.

Chapter 6

Methods, Data, & Results for Petrographic Analysis

Petrographic analysis is a technique commonly used by Southwestern archaeologists to reveal locations of ceramic production and distribution in the prehistoric and historic American Southwest (Abbott and Schaller 1991; Capone 1995, 2006; Eckert 2003, 2008; Garrett 1982, 1986; Habicht-Mauche 1993, 1995, 2002, 2006; Miksa and Heidke 1995, 2001; Schleher and Boyd 2005; Shepard 1942, 1965; Warren 1969, 1976, 1979). Indeed, it was Anna Shepard's (1942) first pioneering work using petrographic research that dispelled the notion that all Pueblo households made pottery only for their own use. On the other hand, the use of petrographic analysis to study temper material processing is less common (although see Capone 1995, 2006 for an exception).

The goals of the petrographic analysis in this study are two-fold and relate to both of the aforementioned uses of petrographic analysis in Southwestern ceramic studies. The first goal is to determine the general type of tempering material used in the local UNM sample in order to separate locally produced ceramics from imports. The methods employed to determine this general type of aplastic temper are described below, although the results of this first stage of the analysis have already been discussed in Chapter 5: over 80 percent of the local sample was made at San Marcos, as indicated by the use of San Marcos temper. This tempering material, a weathered augite monzonite, has been shown through extensive petrographic analysis of ceramics and the Criterion of Abundance principle to be the material used by San Marcos potters (Figure 6.1).

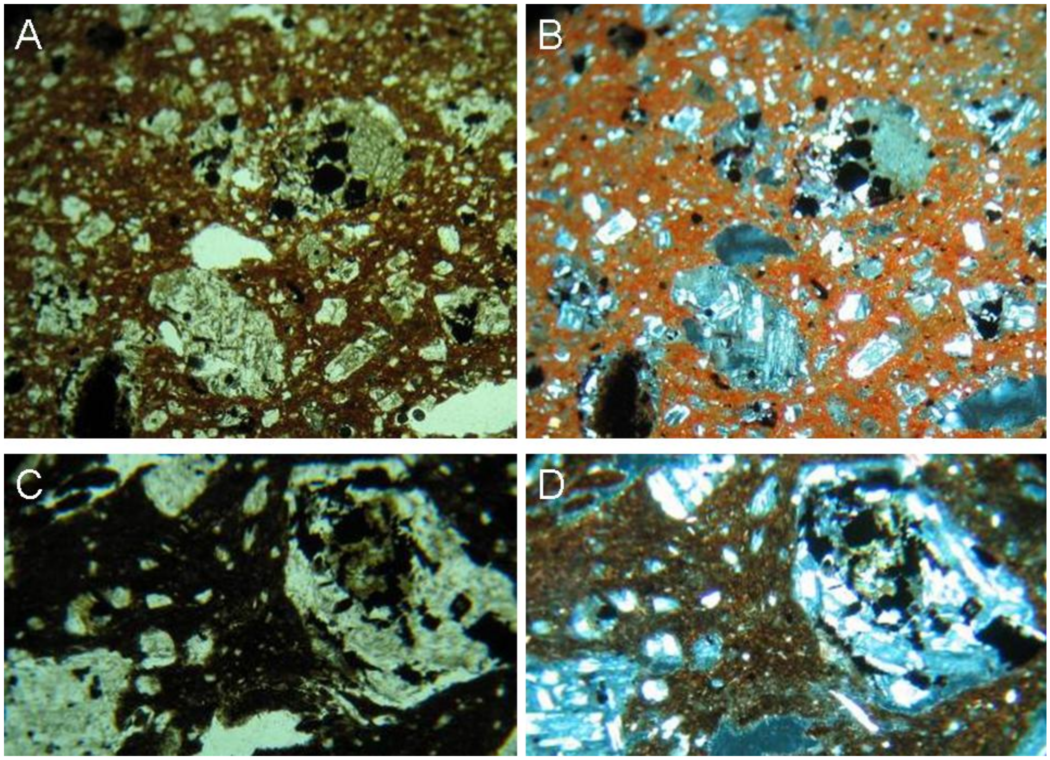


Figure 6.1: **Two examples of augite monzonite, weathered, coarse-grained rock fragments with equal amounts of potassium feldspar and plagioclase, also with augite and magnetite and occasionally with hornblende and/or biotite. A: San Marcos augite monzonite in sherd B5 at 4x (approximately 3 mm across) in plane-polarized light. B: same view of sherd B5 under crossed polars. C: San Marcos augite monzonite in sherd F5 at 10x (approximately 7 mm across) in plane-polarized light. D: same view of sherd F5 under crossed polars.**

The second goal of the petrographic analysis is to evaluate clay and temper processing. I examined the type, shape, size, shericity, and angularity of mineral grains to determine the extent of aplastic material addition and processing. The size and shape of voids was recorded to suggest the amount of processing of the clay during manufacture.

Aplastics Composition and Processing

Aplastic composition was determined in a two-stage approach. First, using a binocular microscope, I determined the general type of aplastic present in the entire local sherd sample. This method followed procedures established by Shepard (1942, 1965),

Habicht-Mauche (1993), Herhahn (1995), Capone (1995), and Eckert (2003, 2008). After the general type of aplastic was determined for all sherds binocularly, a sample of approximately 50 sherds tempered with augite monzonite from each Glaze Ware type was made into thin sections for the petrographic analysis.

Because all the ceramics were formed by coiling, the orientation of aplastic grains in the sherds was taken into account. With this in mind, I cut cross sections from each sherd perpendicular to the wall of the vessel. This procedure resulted in a constant orientation of aplastics, allowing comparison between sherds with different shapes and sizes of aplastic grains (i.e., differences in shape or size of grains will be indicative of differences in processing of clay or temper, not due to differences in the sherd orientation on the cross-section). In addition, controlling for standard orientation allows void analysis to be productive. Void size, shape, and orientation is controlled by the forming methods used (Rye 1981). The greater the amount of kneading during clay processing, the smaller and more similar in size the voids will be; little kneading results in a larger number of voids of various sizes (Rye 1981:40). The standard use of the cross-section orientation allows voids to be fruitfully examined to determine differences in clay processing. For example, if the amount of clay wedging and the size of the coils remain constant throughout the Glaze Ware sequence, the number and size of voids should also remain relatively constant. Thin sections were prepared by Quality Thin Sections in Tucson, Arizona. I then examined all of these thin sections on a Nikon LABOPHOT2-POL polarizing microscope in the Laboratory for Ceramic Analysis at the University of New Mexico.

Because the goal of the petrographic analysis was to view variation in one temper type (weathered augite monzonite), the second step required development of an intensive point-counting methodology. This protocol was developed to examine aplastic sorting or processing by potters at San Marcos. The methodology developed included elements of procedures from Josephs (2005), Stoltman (1989, 1991), and Carpenter and Feinman (1999). Twenty sherds from each Glaze Ware type (A through F) for the local sample and 15 sherds (approximately 5 from early, intermediate, and late Glaze Ware types) from the exported sample were randomly selected for this stage of the in-depth point counting petrographic analysis (Table 6.1).

Table 6.1: ***Point counting sample for the local and exported sherds by Glaze Ware rim type.***

Point counting sample	
Glaze Ware Type & data source	**No. of sherds**
A Local	20
B Local	20
C Local	20
D Local	20
E Local	20
F Local	21
A Exported	5
B Exported	0
C Exported	5
D Exported	1
E Exported	0
F Exported	3
Total	**135**

In the point-counting analysis, a minimum of 150 points (0.4 mm apart lengthwise and 1.2 mm apart in width) was recorded for each thin section. The Nikon LABOPHOT2-POL polarizing microscope is equipped with a grid template visible

through the viewfinder and a stage advance of 0.2 mm per click of the advance wheel. The dimension of 0.4 mm for each row, or two clicks of the stage advance wheel, was selected because this allowed for approximately 4 passes (with the rows separated by 6 clicks, or 1.2 mm) over the thin section to be sure that the entire cross section of the sherd was sampled evenly and thoroughly. The material or void under the cross-hairs was recorded each time the microscope stage was advanced. For each mineral grain or lithic fragment, the material was identified and the size, shape, sphericity, and angularity were recorded. Size was recorded in one dimension for equilateral shapes, such as circles and squares, and in two dimensions for non-equilateral shapes, such as rectangles or ovals. An Access database query was set up to calculate the area for each mineral or void, based on the shape of that fragment or mineral. Shape recorded was round, square, oval, rectangular, diamond, needle-like, triangular, hexagonal, octagonal, or irregular. Sphericity, the amount of equilaterality, was recorded as high or low. Angularity was recorded following the Powers' roundness scale (Powers 1953), as very angular, angular, subangular, subrounded, rounded, or well rounded (Figure 6.2).

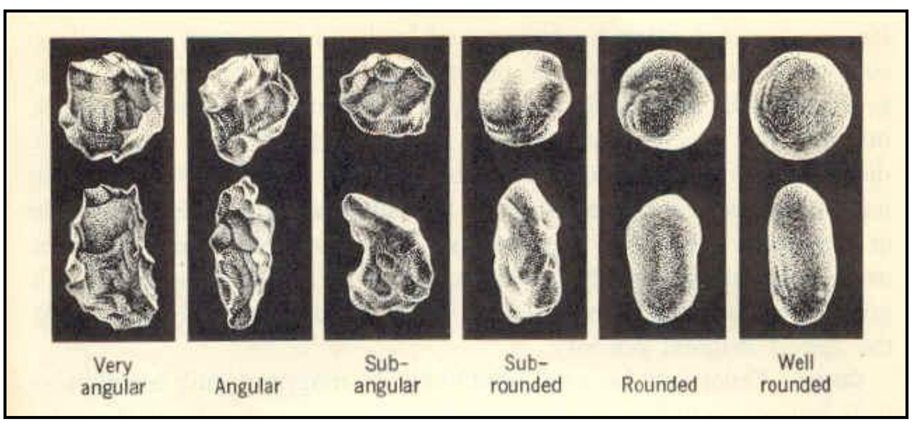


Figure 6.2: **Powers' roundness scale, modified from Powers 1953, with high shpericity on top and low sphericity on bottom.**

Because the goal of this method was to determine the degree of processing, test tiles of known amounts of temper processing were used as a comparative sample. To create this baseline for comparison, test tiles that were made during part of a pilot study (Schleher et al. 2002) were also analyzed using these methods. The test tiles were made of local clays and added latite rock that was extensively ground in a mortar and pestle; thus, the size, shape, edge morphology, sphericity, and angularity of the latite grains in the test tile provided a baseline for comparison of possible processing of aplastics added to the archaeological ceramics. Although the latite rock is much harder than the weathered augite monzonite temper used by San Marcos potters, it still provided a baseline for what heavily processed crushed rock looks like petrographically.

Technological Attributes: Aplastics Composition and Processing

The ternary plot (Figure 6.3) shows the relative proportions of clay, void, and minerals in each of the sampled sherds (Appendix B, Table 1 lists the proportions for all sherds). The general trend suggests strong similarities for the six Glaze Ware types in relation to amount of clay, voids, and minerals. All are within a range of 0–13 percent voids, 20–60 percent minerals, and 40–75 percent clay. Furthermore, the plots for each Glaze Ware type overlap. The exported sherd sample, although very small, suggests overlap similar to the local sherds. A box plot of these results (Figure 6.4) shows the range of clay, void, and mineral frequencies. As in the ternary diagram, the general trend suggests strong similarities for the six types in relation to relative amounts of clay, voids, and minerals.

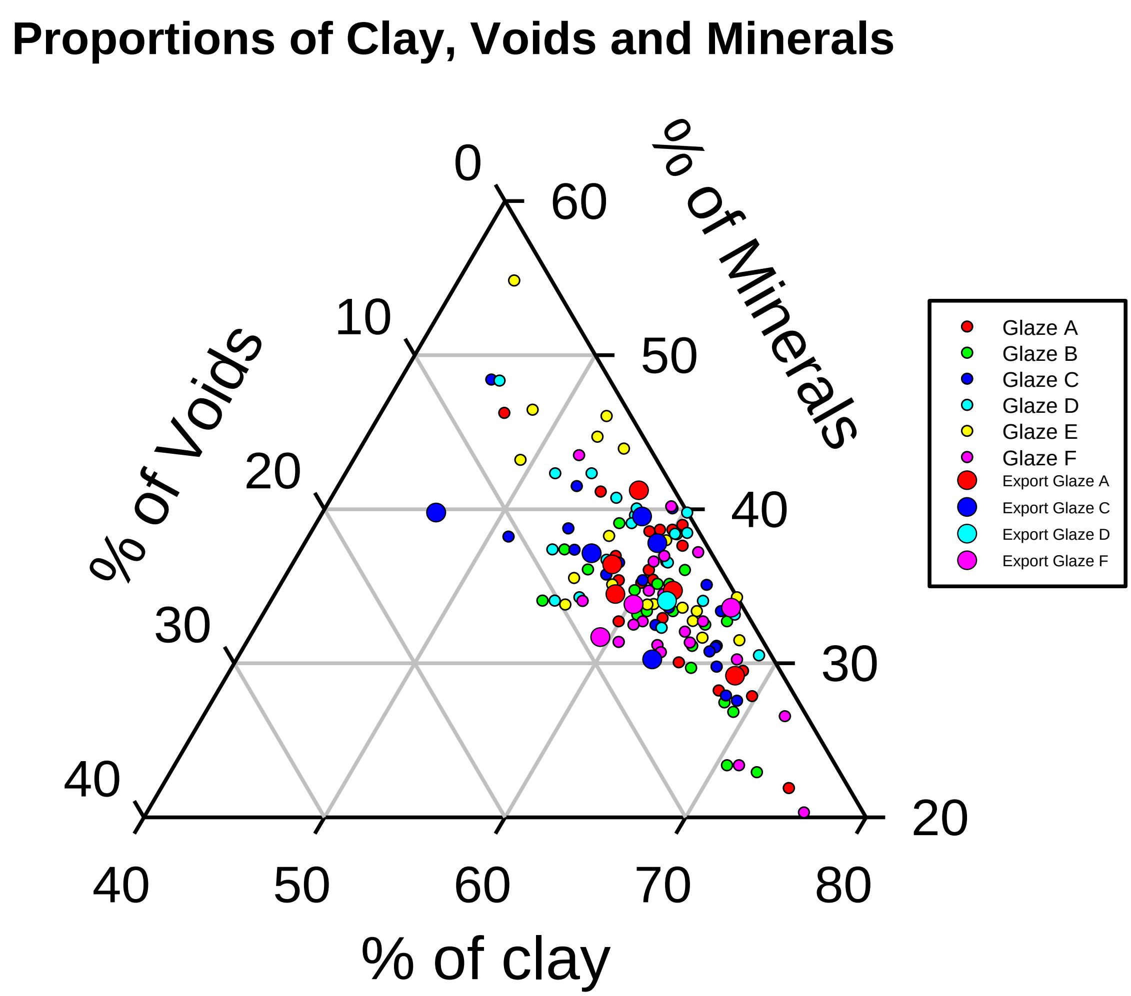


Figure 6.3: **Ternary plot showing the proportion of minerals, voids, and clay for the point-counted sample (n = 135 sherds) by Glaze Ware rim type.**

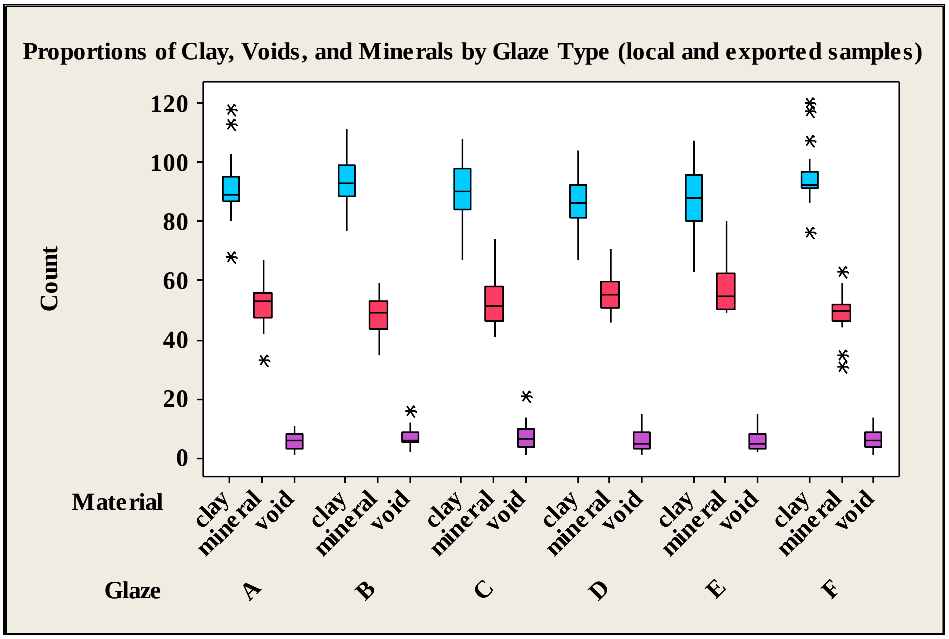


Figure 6.4: **Box plot showing the combined proportions of clay, minerals, and voids by Glaze Ware rim type for all sherds in the sample (e.g., For the Glaze A sherds, this box plot shows the range for all the 25 sherds—20 local and 5 exported—combined).**

The similarities in the clay body in relation to proportions of clay, voids, and minerals suggest continuity in the recipe used to make ceramics, although this recipe is clearly not standardized. The range in mineral frequencies especially is quite high, from approximately 30 to 50 percent. Void percentage is a bit more standardized, ranging from approximately 0 to 10 percent (although "zero" voids in the point counting does not actually suggest there were no voids present, just that they were not sampled). These sample variability patterns also occur for the size of minerals and voids. Large mineral grains are present in ceramics throughout the sequence. These large outliers preclude the comparison of coefficient of variation—looking at the coefficient of variation (Table 6.2) it is clear that the huge numbers are due to the very large outliers for both monzonite grain area and void area. If we set aside these large grains and compare the interquartile

range (Table 6.3), we see that there are relatively minor diachronic differences. Glaze A has the least variation (i.e., is more standardized) for monzonite area but almost the highest variation for void area. Glaze F has the most variation for both attributes. Glaze E is the most standardized for void area, but is not at the more standardized end for the monzonite area attribute. The intermediate Glazes, C and D, are most definitely not the most standardized of the Glaze Ware types in the sequence.

Table 6.2: ***Area of augite monzonite grains statistics and area of voids statistics by Glaze Ware rim type. These statistics are based on all of the grains of monzonite or voids recorded in the entire sample of each Glaze Ware rim type. For example, the n = 462 for monzonite grains indicates that there are 462 fragments of monzonite in the 25 Glaze A sherds analyzed. The mean (in μm^2) is the average size of all of the 462 fragments in the Glaze A sherds.***

Area of Augite Monzonite Grains Statistics by Glaze Ware Type									
Glaze Type (# of sherds)	**N**	**Mean (μm^2)**	**SE Mean**	**Standard Deviation**	**Coefficient of Variation**	**Interquartile Range**	**Median**	**Min**	**Max**
Local & Exported Sample									
A (n = 25)	462	1130.55	65.95	1417.64	125.39	1128.50	695.58	11.78	12000.00
B (n = 20)	388	1477.50	83.86	1651.76	111.79	1626.36	836.00	10.50	8500.00
C (n = 25)	466	1691.68	146.04	3152.65	186.36	1750.00	750.00	20.00	30000.00
D (n = 21)	497	1200.99	57.98	1292.63	107.63	1269.39	706.86	9.00	7000.00
E (n = 20)	467	1728.29	98.78	2134.75	123.52	1670.57	1040.00	28.27	14000.00
F (n = 24)	507	1723.20	91.10	2051.16	119.03	1982.69	1000.00	0.00	20106.19
Levene's Test P-Value (between all types) = 0.000									

Area of Voids Statistics by Glaze Ware Type									
Glaze Type	**N**	**Mean (μm^2)**	**SE Mean**	**Standard Deviation**	**Coefficient of Variation**	**Interquartile Range**	**Median**	**Min**	**Max**
Local & Exported Sample									
A (n = 25)	125	517.61	118.96	1330.02	256.95	563.58	230.00	1.50	14000.00
B (n = 20)	138	496.33	95.84	1125.90	226.84	358.50	150.00	0.79	7500.00
C (n = 25)	188	381.09	47.06	645.27	169.32	351.50	139.00	3.00	4500.00
D (n = 21)	121	356.97	50.49	555.38	155.58	388.50	136.00	1.50	3000.00
E (n = 20)	119	358.66	70.42	768.15	214.17	275.00	130.00	2.00	7068.58
F (n = 24)	155	780.81	140.22	1745.68	223.57	568.00	180.00	3.00	10000.00
Levene's Test P-Value (between all types) = 0.007									

Table 6.3: ***Ranking of interquartile range by Glaze Ware rim type.***

Glaze Ware Type (lowest to highest IQR)	Monzonite Area IQR
A	1128.50
D	1269.39
B	1626.36
E	1670.57
C	1750.00
F	1982.69

Glaze Ware Type (lowest to highest IQR)	Void Area IQR
E	275.00
C	351.50
B	358.50
D	388.50
A	563.58
F	568.00

It is also possible to use Levene's Test to compare the variances (Table 6.4). In comparing all of the Glaze Ware types to one another, the variances for area of all monzonite grains are below the 0.05 level, indicating that each type is statistically significantly different from the other Glaze Ware types. But, if we examine this measure of variance *within* each Glaze Ware type, we also see the same pattern—for each Glaze Ware type's thin sections, there are significant differences *within* each type as well as *among* all of the types. Thus, all of the variances for monzonite area within each Glaze Ware type are statistically different, indicating that variation is acceptable throughout the sequence and that there is not a change in the size of monzonite grains in the ceramics throughout the Glaze Ware sequence.

Table 6.4: ***Levene's Test P-Values for void area within Glaze Ware types, with local and exported samples combined.***

Levene's Test P-Values within Glaze Ware Type Local and Exported Samples				
Glaze	**Monzonite Area P-Value**	**Void Area P-Value**	**Void Area P-Value with Outliers Removed**	**Void Area P-Value with C18 Removed**
A	0.000	0.022	0.895	
B	0.000	0.106	0.077	
C	0.000	0.002	0.002	0.689
D	0.000	0.376	0.328	
E	0.000	0.183	0.096	
F	0.000	0.000	0.064	

The opposite pattern is true for void area. Table 6.4 shows three columns of p-values for void area. The first column includes the entire sample of voids. The p-values here go back and forth above and below the 0.05 level. Because this pattern was difficult to interpret, I removed sherds with 3 or fewer voids per thin section and the two thin sections with voids larger than 10,000 μm^2. The result of these removals is that with the exception of Glaze C, all of the variances for void area are statistically similar. The third column shows the p-value for Glaze C sherds with the additional removal of one more thin section that was very different from the others. In examining Glaze C, the p-value is 0.002, which suggests that there are differences within the Glaze C thin sections, but with removal of one thin section (C18), the p-value changes to 0.689. These overall results for voids suggest that clay processing does not change significantly over the entire Glaze Ware sequence.

Monzonite grain angularity may reflect the degree of processing of the monzonite temper. There are changes in the ratio of angular to rounded grains through time, with angular grains decreasing in frequency throughout the Glaze Ware sequence (Figure 6.5

and Table 6.5). Glaze A sherds contain approximately 58 percent angular grains, whereas Glaze F sherds contain only 47 percent angular grains. A chi-square suggests statistically significant differences through the Glaze Ware sequence, with most of the significance contributed by Glaze A, with more angular grains than the norm, and Glaze E, with more rounded grains than the norm. As a comparison, I examined the angularity of a test tile made with crushed latite (Schleher et al. 2002). Although this test tile was made with latite, a much harder rock than the weathered augite monzinite in the San Marcos sherds, I argue that examination of the relative proportions of angular to rounded grains in a well-ground example can serve as a standard for assessing the effect of intensive processing on crushed-rock temper. The weathered monzinite likely was friable and did not require much, if any, grinding to get to the size required for tempering. Consequently, slight changes in the ratio of angular to rounded grains may be significant. The test tile latite grains are slightly more rounded than angular. This is not surprising, because I ground the latite extensively. I would assume that greater amounts of processing would yield a higher percentage of rounded grains, and this assumption was confirmed by the test tile. Thus, the data for angularity of the augite monzonite in my sample suggest a consistent, and relatively high, amount of processing.

In addition, comparison of the Glaze Ware types to the test tile suggests that Glaze E, with increased amounts of rounded grains, may be the most processed. Although the angularity data show only a gradual change through time, the Glaze E sherds seem to reflect the greatest amount of processing. It is possible that this minor variation in processing of monzonite temper for Glaze E reflects a smaller population at the site during this period. It is during the Glaze E period that Ramenofsky et al. (2009) identify a

period of abandonment or drastic decrease in population at the site. It is possible that this petrographic evidence may be related to a decrease in the number of potters; perhaps only a few skilled potters were still making pots at the site.

The monzonite grain sphericity varies somewhat over the sequence, with the percentage of spherical shapes (basically, more equal length of sides of whatever the shape of the material) ranging from a Glaze B with the lowest amount of highly spherical grains at 28.7 percent to Glaze D with the highest amount of spherical grains at 39.4 percent (Table 6.6 and Figure 6.6). In comparison to the archaeological sample, the test tile had significantly fewer highly spherical grains. Although this difference might suggest differences in temper processing, with my intensive processing of the temper yielding grains less spherical in shape, I believe it actually relates more to the differences in the clay processing and forming methods. Grains in the archaeological sample are oriented more lengthwise due to wedging, coiling, and thinning of the vessel by scraping. In the test tile, I simply mixed the temper into the clay, loosely rolled a thick coil, and pressed this coil loosely into a rectangular mold. In the test tile, the grains would not have been oriented as a result of working the clay and thinning the vessel. This manipulation of the clay that would have gone into the making of a vessel by a potter at San Marcos would have resulted in a greater degree of temper-particle orientation than would my less skilled manufacture of a test tile. In other words, the comparison of the test tile to the archaeological sample suggests differences in the processing of the two samples, which seems likely.

The Shannon diversity index for monzonite grain angularity, shape, and sphericity throughout the Glaze Ware sequence does not suggest any major changes in the amount

of diversity in any of these attributes through time (Table 6.7 and Figure 6.7). So, although the chi-square test points to greater numbers of rounded grains for Glaze E sherds, the diversity does not seem to be less than in other periods.

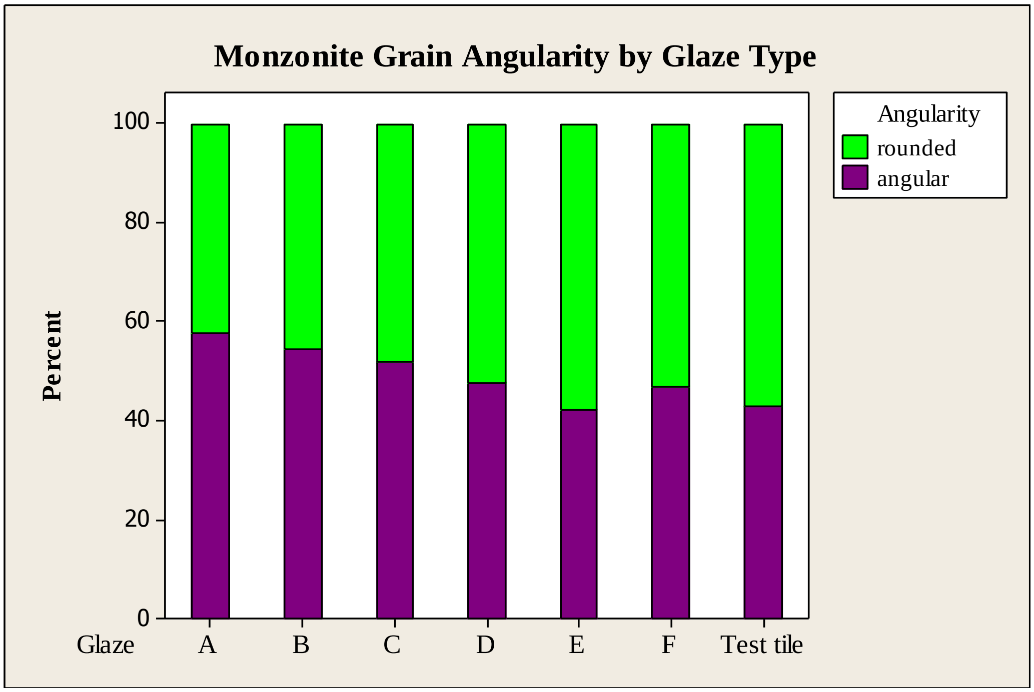


Figure 6.5: **Monzonite grain angularity by Glaze Ware rim type. All grains found in all sherds for each type are included here (e.g., the 462 grains of augite monzinite in all of the Glaze A sherds are compared here for their amount of angularity).**

Table 6.5: ***Percent of the total number of augite monzonite grains that are angular or rounded by Glaze Ware rim type.***

	Percent of Monzonite Grain Angularity	
	Angular (%)	**Rounded (%)**
A	57.8	42.2
B	54.4	45.6
C	51.9	48.1
D	47.7	52.3
E	42.2	57.8
F	46.8	53.3
Test tile	42.9	57.1

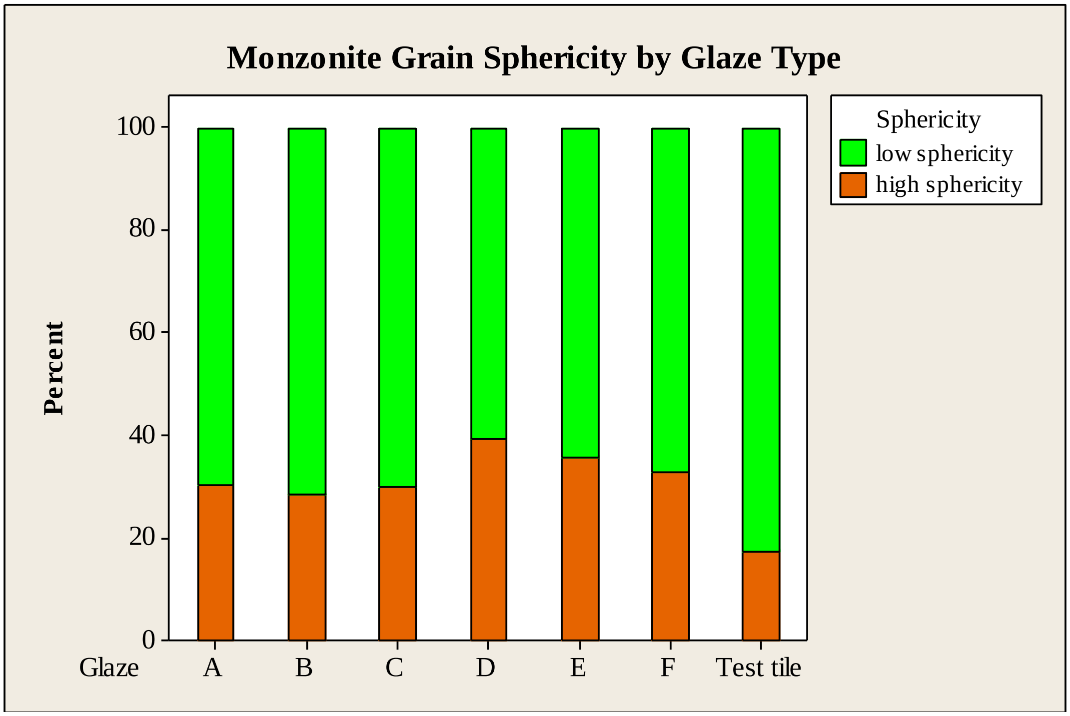


Figure 6.6: **Monzonite grain sphericity by Glaze Ware rim type. All grains found in all sherds for each type are included here (e.g., the 462 grains of augite monzinite in all of the Glaze A sherds are compared here for their degree of sphericity).**

Table 6.6: ***Percent of the total number of augite monzonite grains with high sphericity or low sphericity by Glaze Ware type.***

	Percent of Monzonite Grain Sphericity	
	High Sphericity (%)	**Low Sphericity (%)**
A	30.2	69.9
B	28.7	71.4
C	29.8	70.2
D	39.4	60.6
E	35.8	64.2
F	32.9	67.1
Test tile	17.1	82.9

Table 6.7: ***Scaled Shannon diversity index for monzonite grain attributes by Glaze Ware rim type.***

Scaled Shannon Diversity Index for Monzonite Grain Attributes						
Attribute	**A**	**B**	**C**	**D**	**E**	**F**
Monzonite Grain Shape	0.8009	0.8684	0.925	0.8725	0.8391	0.8567
Monzonite Grain Sphericity	0.9098	0.8642	0.897	0.9719	0.9407	0.9235
Monzonite Grain Angularity	0.9112	0.9554	0.9265	0.9434	0.9437	0.9411

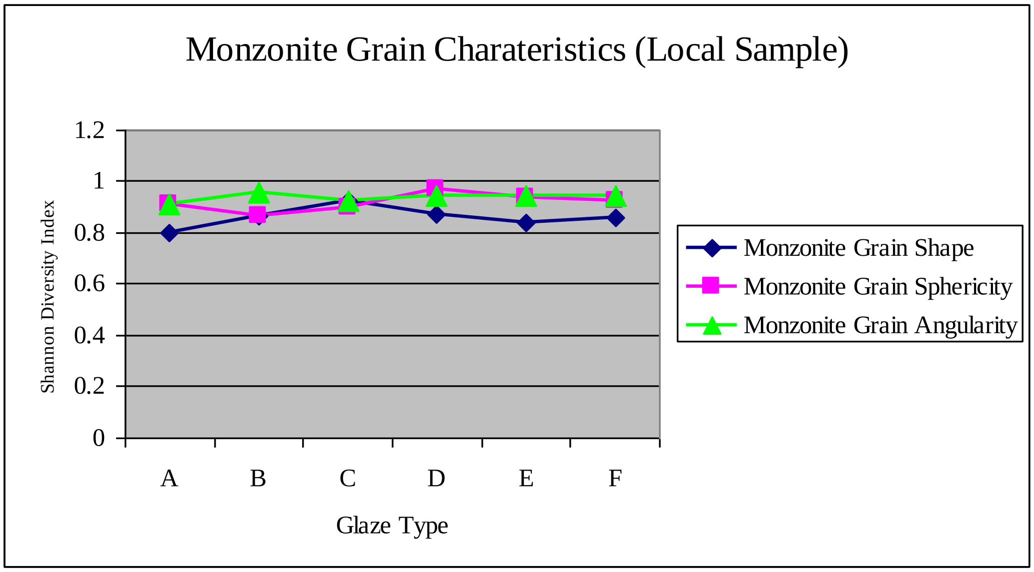


Figure 6.7: **Shannon diversity index for all monzonite grain characteristics for the local sample. Note that changes in the diversity index are minor, suggesting stability in the amount of variation present, throughout the sequence.**

Another aspect of the point-count data that may inform on the processing of the clay or temper is the distribution of mineral size within each thin section. Other researchers have used bimodal size distributions to suggest differences in the natural inclusions in the clay and the materials added as temper (e.g., Stoltman 1989). Although these methods can be useful, they are more difficult to implement in analysis of the San Marcos ceramics because of the friable nature of the weathered augite monzonite temper. This friability leads to the presence of many small fragments of minerals and lithic fragments from the augite monzonite material. For example, many of the small fragments

within the clay matrix are weathered and fragmented grains of plagioclase or potassium feldspar, two of the major components of augite monzonite. These histograms (Figures 6.8–6.10), selected randomly to illustrate one a thin section, show the distribution of all minerals, and then the distribution of just augite monzonite grains and just plagioclase grains, for the same thin section. The example, for sherd B21, shows first that the overall distribution of grain size in the thin section is quite variable, with no clearly bimodal distribution (Figure 6.8). The next graph, of only the grains of augite monzonite in sherd B21, shows why there is no clearly bimodal distribution of grain size in these ceramics (Figure 6.9). The added augite monzonite temper grains are present in a wide range of sizes; the unique texture and composition of the material allows it to be identified in very small fragments. Finally, Figure 6.10 shows just the identifiable plagioclase grains, which might be naturally occurring in the clay or might have been removed from larger augite monzonite lithic fragments during temper processing.

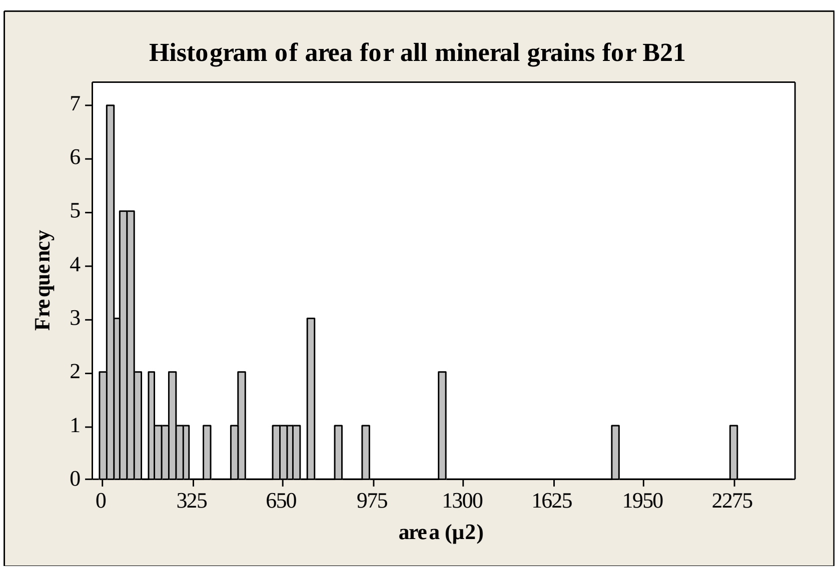


Figure 6.8: **Histogram of the frequency of mineral grains in sherd B21 by their area, or size, in μm^2. Note the large number of grains of small size and that there is not a clear bimodal pattern in the distribution.**

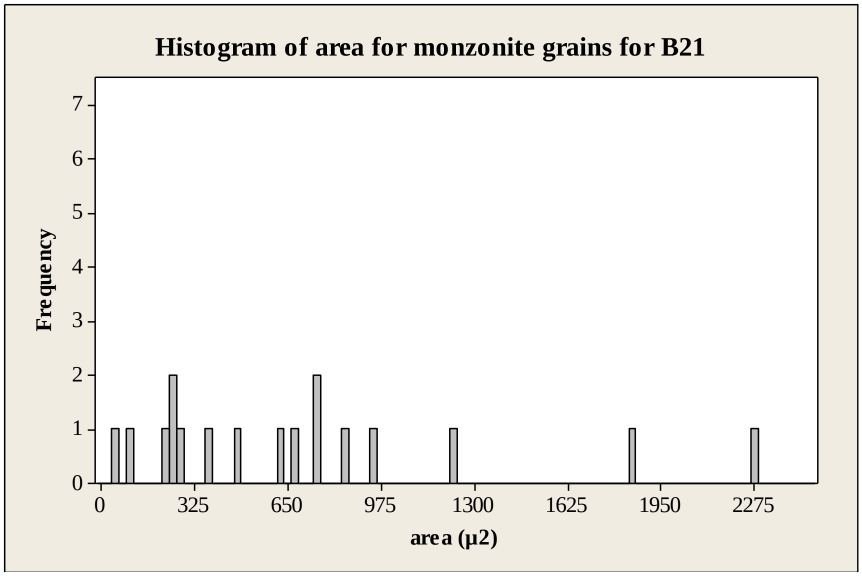


Figure 6.9: **Histogram of the frequency of monzonite grains in sherd B21 by their area, or size, in µm^2. Note the relatively even distribution of small and large grains.**

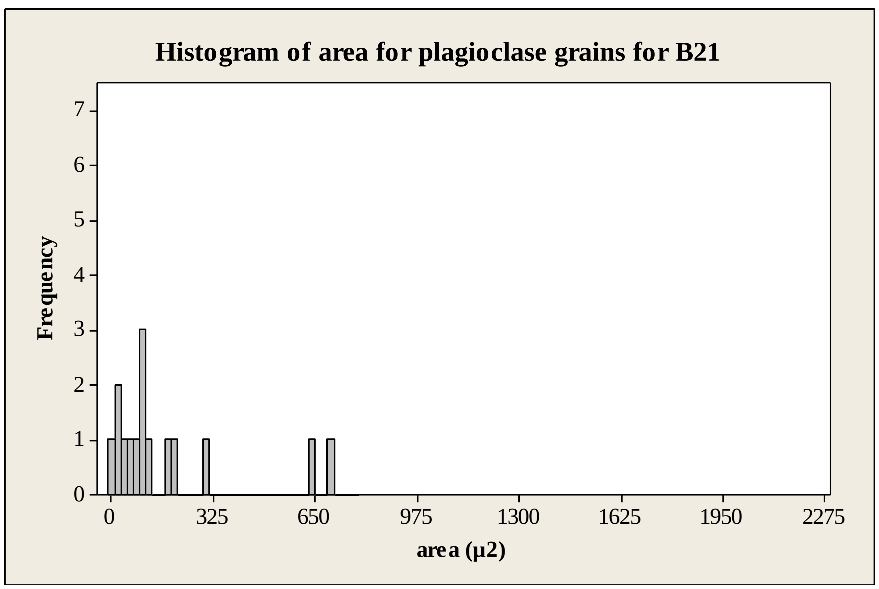


Figure 6.10: **Histogram of the frequency of plagioclase grains in sherd B21 by their area, or size, in µm^2. Note the dominance of relatively small grains, which may be naturally occurring in the clay or may have been removed from the monzonite rock fragments during processing.**

Petrographic Data Summary

In conclusion, the results suggest a general trend of continuity in temper amount, size, and processing across all Glaze Ware types. The data do not indicate an increase in standardization in temper processing with increased specialization intensity during the Glaze C or D production periods. Although the size of monzonite grains is highly variable throughout the sequence, the same level of variability seems to occur both within each of the Glaze Ware types and between them. This information, in addition to the lack of any differences in void size through the sequence, suggests a stable production system as it related to temper addition and clay processing. The angularity, shape, and sphericity of the added monzonite grains are also relatively constant. There are slightly more rounded grains in Glaze E sherds and slightly more angular grains in Glaze A sherds. The implications of these patterns are addressed in comparison to the other attributes for the Glaze Ware types in the final chapter.

Chapter 7

Methods, Data, and Results for Morphological Attributes

Vessel morphology tends to be very stable in many pottery production systems (Rice 1987). For this reason, morphological attributes may inform on any changes in the production group and on the level of standardization, especially unconscious mechanical standardization, within an assemblage. If the intensity of production increases, with potters making more vessels or spending more of their time making vessels, mechanical standardization may be reflected in more standardized vessel morphology. On the other hand, it is possible that, due to the stable nature of morphological attributes in pottery production, they may vary only slightly with changes in the intensity of production.

Methodology for Measurement of the Morphological Attributes

The morphological attributes used for this part of the study were rim diameter, average wall thickness, and maximum rim thickness. I measured and recorded these on both local and exported sherds and on whole vessels in the sample. More in-depth descriptions of the methods and the rationale for the measurement of many of the morphological and technological attributes examined in this dissertation were developed jointly for the larger San Marcos Ceramic Project with Jennifer Boyd Dyer and are included in Appendix C. Appendix D includes all categorical (Appendix D, Table 1) and metric (Appendix D, Table 2) data for all sherds in the local and exported samples.

Rim diameter was measured in centimeters at the thickest part of the rim using rim diameter templates to obtain a true orifice diameter. Thickness measurements were obtained using a Mitutoyo digital caliper or, for the whole vessels, a Fowler external arm caliper. Average wall thickness for each sherd represents an average of three to five

measurements of thickness taken at the bottom of the sherd, opposite the rim. Maximum rim thickness is an average of three measurements along the thickest point of the rim, one measurement on each edge of the sherd and one in the center.

Morphological Attributes: Average Wall Thickness

Average sherd wall thickness is one of the most stable of the attributes examined (Table 7.1). The coefficient of variation is also very stable throughout the sequence. The p-values for Levene's test for both the local and exported samples are above 0.05, further evidence that there are no statistically significant differences for variation in wall thickness among the types. Overall, the coefficient of variation is low throughout the sequence, with no indication of increase in the amount of standardization during the intermediate Glaze Ware production period. The exported sample duplicates the local sample in amount of variation present (Figures 7.1 and 7.2). The coefficient of variation (CV) of the exported Glaze E sample is left off of the graph of CV because of the small sample size (n = 3) (Figure 7.3). If this CV had been included, the CV for the exported Glaze E would have been higher than all of the other CVs for either local or exported types.

The average sherd thickness for all types changes very little over the sequence for the local and exported samples, when Glaze Ware type data are collapsed into the early/intermediate, and late designations for the exported sample. The small Glaze E and F exported samples make these averages inappropriate for comparison with the local samples. It is important to keep in mind that average wall thickness is a stable attribute in pottery production in general. Vessel thickness is partially controlled by the materials

used; for the San Marcos Glaze Ware types, the clay and aplastic materials remained stable throughout these six types.

Table 7.1: ***Statistics for sherd thickness by Glaze Ware rim type for the local and exported samples.***

Sherd Thickness Statistics by Glaze Ware Type									
Glaze Type	**N**	**Mean (mm)**	**SE Mean**	**Standard Deviation**	**Coefficient of Variation**	**Interquartile range**	**Median**	**Min**	**Max**
Local Sample									
A	76	5.33	0.08	0.72	13.54	0.77	5.28	3.92	7.58
B	78	5.04	0.11	0.94	18.56	1.43	4.96	3.12	7.21
C	68	5.28	0.10	0.82	15.56	1.10	5.35	3.43	7.47
D	46	5.03	0.13	0.91	18.14	0.95	4.93	3.32	8.71
E	42	5.05	0.10	0.65	12.89	0.80	5.12	3.70	6.66
F	47	4.91	0.13	0.90	18.40	1.45	4.84	3.03	6.33
Levene's Test P-Value = 0.051 (not significant)									
Exported Sample									
A	50	5.36	0.08	0.58	10.83	0.82	5.30	3.76	6.47
B	37	5.41	0.16	0.97	17.83	1.53	5.23	3.37	7.40
C	16	5.23	0.16	0.64	12.30	0.87	5.21	4.39	6.75
D	9	5.72	0.34	1.02	17.86	1.28	5.39	4.81	7.98
E	3	4.31	0.51	0.89	20.56	1.55	4.80	3.28	4.83
F	9	5.62	0.34	1.01	17.99	0.88	5.30	4.75	8.09
Levene's Test P-Value = 0.161 (not significant)									

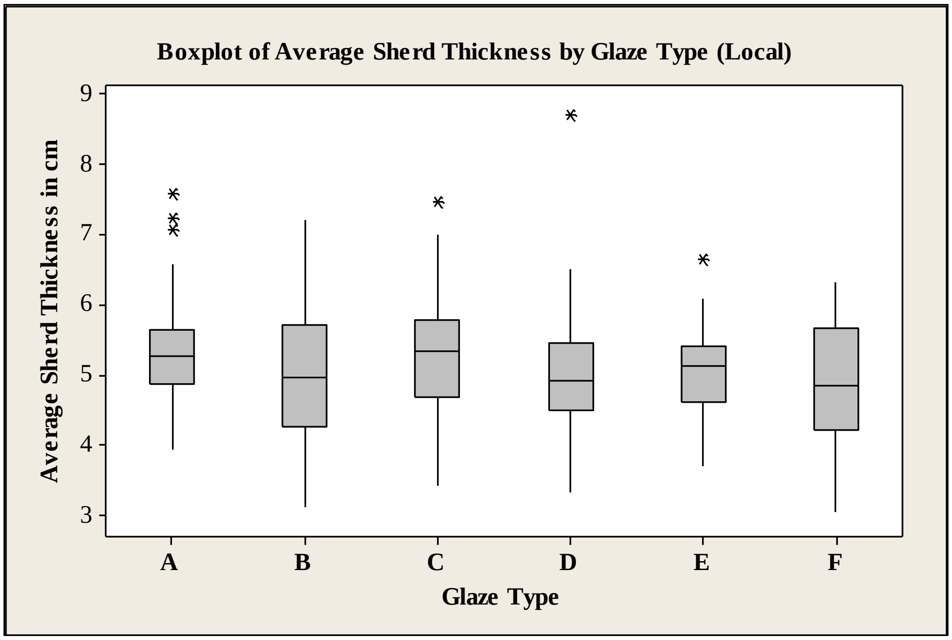


Figure 7.1: **Boxplot showing average sherd thickness by Glaze Ware rim type for the local sample.**

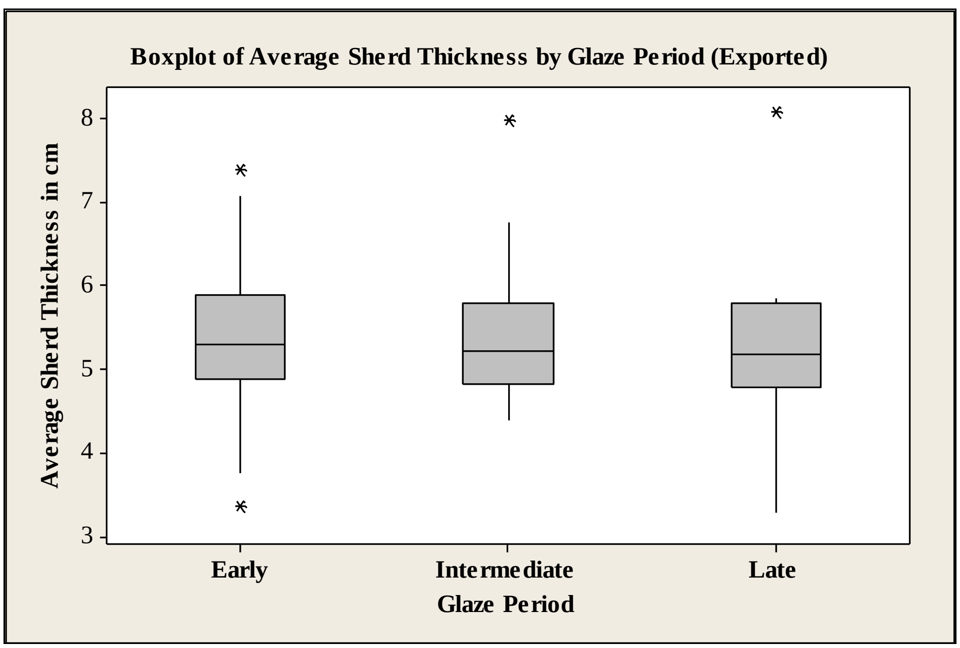


Figure 7.2: **Boxplot showing average sherd thickness by grouped Glaze Ware rim type for the exported sample.**

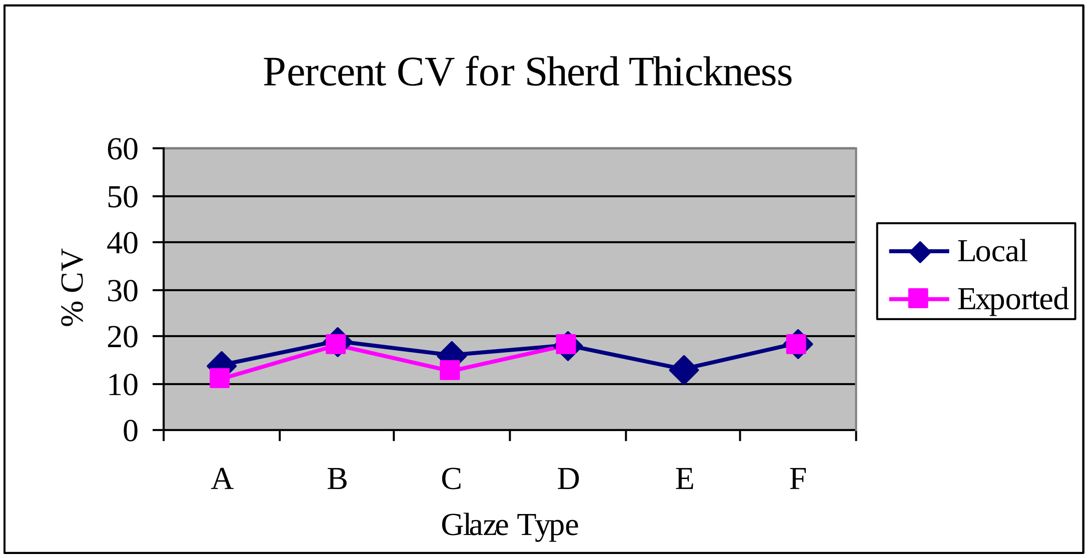


Figure 7.3: **Graph showing the coefficient of variation for sherd thickness by Glaze Ware rim type for both the local and exported samples.**

Morphological Attributes: Maximum Rim Thickness

Maximum rim thickness changes throughout the sequence with modifications in the way the rim was formed, but the range of variation is just as stable for rims as for wall thickness (Table 7.2). The percent coefficient of variation for maximum rim thickness ranges from 10 to 15 percent (with Glaze E exported removed because of the small sample size), suggesting a relatively well standardized attribute (Figure 7.4). Levene's test also shows no statistically significant difference through time in the variance of this attribute (again excluding Glaze E exported due to small sample size).

This is a significant finding for the question of standardization, perhaps even more so than the results for wall thickness. The average wall thickness itself did not change significantly throughout the sequence. However, the maximum rim thickness value *does* change significantly over time, yet the degree of standardization *does not* change significantly. This finding suggests that while potters may have been innovative

in developing new rim forms, once a new type of rim was accepted by the community of potters, the acceptance was relatively wholesale—everyone began making rims the same way. It is likely that these rim changes occurred between generations or between cohorts of potters at the site. The data suggest that the intentional nature of a change in the rim form does not modify how standardized the attribute is on the vessels. It may be that the change simply becomes internalized very quickly and thus continues to reflect the mechanical nature of standardization we see in the wall thickness attribute.

Table 7.2: ***Statistics for maximum rim thickness by Glaze Ware rim type for the local and exported samples.***

Maximum Rim Thickness Statistics by Glaze Ware Type									
Glaze Type	**N**	**Mean (mm)**	**SE Mean**	**Std. Dev.**	**CV**	**Interquartile range**	**Median**	**Min**	**Max**
Local Sample									
A	14	5.84	0.21	0.78	13.38	1.42	5.87	4.555	7.06
B	78	8.04	0.12	1.06	13.25	1.35	7.93	5.19	11.8
C	66	7.43	0.14	1.11	15.00	1.36	7.38	4.915	11.5
D	47	7.73	0.15	1.05	13.54	1.79	7.67	5.423	9.84
E	38	8.66	0.17	1.04	12.02	1.16	8.52	6.78	12.4
F	18	6.70	0.24	1.02	15.29	1.13	6.67	5.11	9.38
Levene's Test P-Value = 0.633 (not significant)									
Exported Sample									
A	1	6.50					6.50	6.5	6.5
B	37	7.84	0.18	1.07	13.68	1.32	7.79	5.358	10.4
C	17	7.55	0.25	1.04	13.72	1.41	7.62	5.18	8.92
D	9	8.57	0.31	0.94	10.97	1.72	8.70	7.185	9.89
E	7	9.71	0.98	2.58	26.58	4.63	10.40	5.987	13
F	10	7.42	0.26	0.83	11.21	1.51	7.40	6.443	8.8
Levene's Test P-Value (for all types) = 0.002 (significant)									
Levene's Test P-Value (with Glaze E removed) = 0.912 (not significant)									

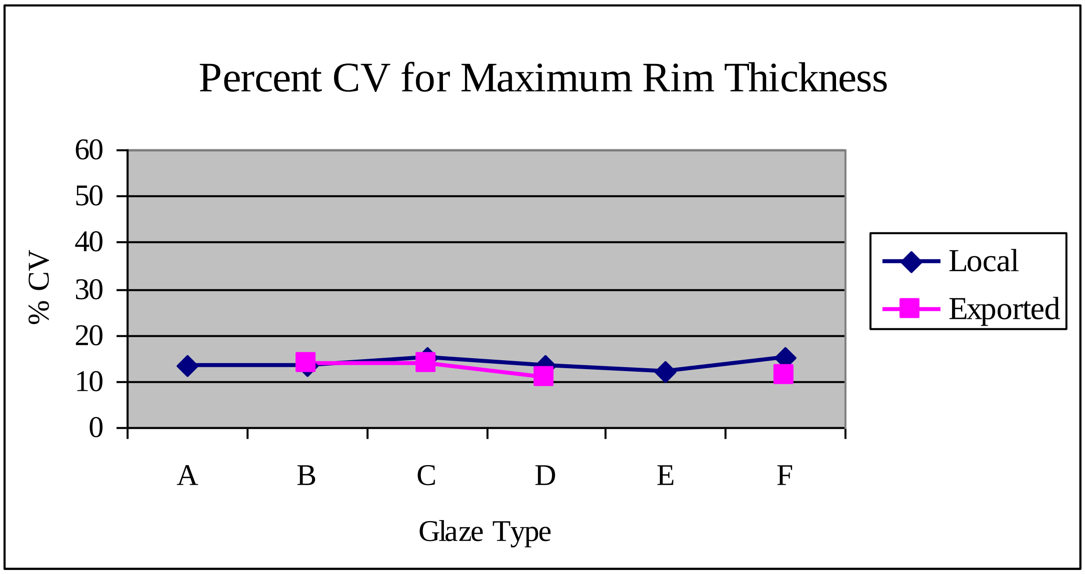


Figure 7.4: **Graph showing the coefficient of variation for maximum rim thickness by Glaze Ware rim type for both the local and exported samples.**

Morphological Attributes: Rim Diameter

Rim diameter was measured using rim diameter templates on all sherds and 63 of the whole vessels from the American Museum of Natural History (AMNH) and the Maxwell Museum. Rim diameter was difficult to measure on some of the sherds because of their small size. This was especially true for the local sample, which consisted of primarily of surface-collected sherds. Thus, the results should be taken with this caution in mind. In the future, instead of including all sherds, I would use a minimum of a 10 degree arc as a cut-off for inclusion—although in the current sample only a few sherds would have been left in the sample.

It is also significant to note that I did not find clear size classes in my samples of either sherds or whole vessels. This is significant because grouping multiple size classes can distort measures of standardization (Crown 1995; Longacre et al. 1988). Other researchers *have* found size classes in Northern Rio Grande Glaze Ware samples. At

Pecos, Kidder noted small (18–21 cm) and large (30 cm) bowl classes (Kidder and Shepard 1936:4–5). Graves and Eckert (1998) found a clearly bimodal size distribution, with small vessels having diameters of 25 cm or less and large vessels having diameters of more than 25 cm (1998:267). Spielmann (1998) compiled mean bowl diameters for Agua Fria Glaze-on-red Glaze A vessels that ranged from 18 to 30 centimeters. Spielmann also found, through measurement of whole vessels at the Museum of New Mexico, that histograms of Glaze A bowls peaked at 26 to 30 centimeters in diameter, whereas Glaze D bowls peaked at a smaller 21 to 25 cm range. Glaze E vessels at the Museum of New Mexico peaked at 31 to 35 cm, a larger size than either the Glaze A or Glaze D vessels in the museum collections (Spielmann 1998:257).

Figure 7.5 depicts the range of rim diameters in the current sample for both the local and exported sherds. There are no clear bimodal patterns in the data. Glaze C has a bit of a break at approximately 30 cm, but there is also a break at 37 centimeters. Because the pattern is unclear and because the range of all of the Glaze Ware types runs from very small to very large, the discussion of rim diameter results is presented in two ways. First, I separate size classes into groups based on the subtle pattern seen in Glazes C through F of breaks at 30 cm and at 40 cm (i.e., my large size class is 31 to 40 cm in diameter, which excludes some of the larger outliers; my small size class ranges from 14 to 30 cm and includes all rim diameters under 31 cm). I will discuss only the local sherds in term of these size classes because the sample size for exported sherds is too small to yield meaningful results. Second, I present the data for all the sherds in the sample, with no size class separation.

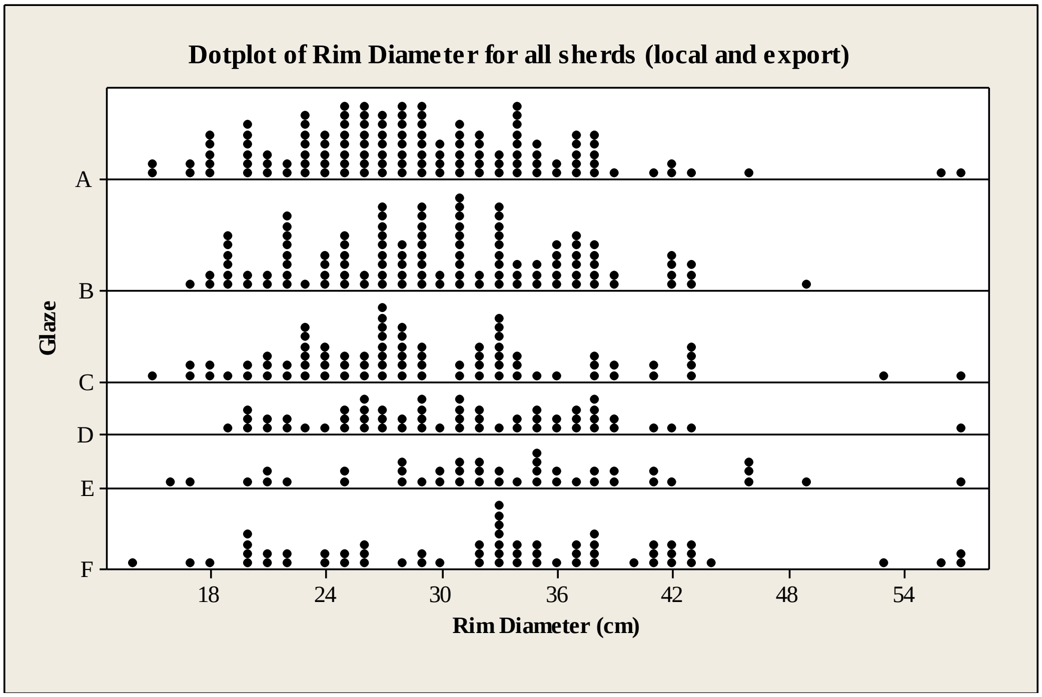


Figure 7.5: **Dotplot of rim diameters for both local and exported sherds.**

Table 7.3: ***Table of rim diameter statistics by Glaze Ware rim type for the local sample, divided by size class (small = 14–30 cm, large = 31–40 cm)***

Glaze Type	N	Mean (cm)	SE Mean	Standard Deviation	Coefficient of Variation	Interquartile Range	Median	Min	Max
Rim Diameter Statistics by Glaze Ware Type for the local sample by size class (small = 14–30 cm, large = 31–40 cm)									
Small Size Class									
A	41	23.3	0.6	4.1	17.6	6.5	23.0	15	30
B	34	24.4	0.7	4.0	16.3	7.3	24.5	17	30
C	37	24.3	0.6	3.6	15.0	5.0	25.0	15	29
D	23	25.0	0.7	3.2	12.8	5.0	26.0	19	30
E	12	24.5	1.5	5.1	20.8	8.5	26.5	16	30
F	19	23.1	1.0	4.4	19.1	6.0	24.0	14	30
Levene's Test P-value = 0.222 (not significant)									
Large Size Class									
A	27	34.6	0.5	2.7	7.7	5.0	34.0	31	39
B	34	34.2	0.5	2.7	8.0	6.0	33.5	31	39
C	19	34.7	0.6	2.5	7.2	5.0	34.0	32	39
D	21	35.1	0.6	2.6	7.3	5.0	35.0	31	39
E	20	34.6	0.6	2.7	7.8	4.8	35.0	31	39
F	22	34.7	0.5	2.3	6.5	4.0	34.0	32	40
Levene's Test P-value = 0.786 (not significant)									

When separated by size class, a number of patterns emerge in the data (Table 7.3), the most obvious of which is that the vessels in the large size class are significantly more standardized than those in the small size class. This is not surprising, given the possible range of each class; the small size class has a range of 17, from 14 to 30, whereas the large size class has a possible range of only 10, from 31 to 40. For the goals of this research, however, it is notable that Levene's test has p-values over the 0.05 level for both size classes, suggesting that there are no statistically significant differences in the range of variation throughout the Glaze Ware sequence.

When we look at the combined data, the local sherd sample shows a pattern of average rim diameter increasing through time (Table 7.4). The exported sherd sample n the whole shows a similar pattern, with Glazes A, B, and C rim diameters smaller than Glazes D and F. The value for Glaze E in the exported sample is quite small, although it is biased by the small sample size (n = 2).

These average measurements are not significantly different than average rim diameter measurements from other Glaze Ware–producing sites. For Glaze A to C rim sherds from the Montaño Bridge site Franklin (2008:34) notes that the largest rim diameters are 39 cm and the majority of vessels fall between 28 and 32 cm. Glaze Ware rim sherds from Tonque Pueblo range from 8 to 50 cm, with most rim diameters between 26 and 34 cm (Morales 1997:780). The San Marcos rim diameters in the local sample fall within this range. The exported sample has a slightly wider range. However, this is due largely to the two Glaze E sherds an inadequate sample size, averaging a small 23 cm. The exported vessels were generally smaller than the local vessels (Table 7.4).

Table 7.4: ***Table of rim diameter statistics by Glaze Ware rim type for the local and exported samples.***

Glaze Type	N	Mean (cm)	SE Mean	Standard Deviation	Coefficient of Variation	Interquartile Range	Median	Min	Max
Rim Diameter Statistics by Glaze Ware Type for the local and exported sample									
Local Sample									
A	74	29.41	0.99	8.55	29.07	12	29	15	57
B	76	30.79	0.82	7.14	23.19	9.75	31	17	49
C	64	30.05	1.04	8.33	27.73	10	28	15	57
D	47	30.94	1.07	7.36	23.81	10	31	19	57
E	40	33.85	1.35	8.56	25.29	9.5	33.5	16	57
F	53	33.26	1.36	9.94	29.87	13.5	33	14	57
Levene's Test P-value = 0.482 (not significant)									
Exported Sample									
A	47	28.28	0.74	5.05	17.85	7	28	17	42
B	36	27.89	0.95	5.69	20.41	8.75	27	18	38
C	14	26.07	1.35	5.06	19.41	8.75	27.5	17	33
D	8	30.25	2.57	7.27	24.02	13.25	30	20	41
E	2	23.00	2.00	2.83	12.30		23	21	25
F	8	32.75	3.20	9.05	27.64	17.25	35.5	20	44
Levene's Test P-value = 0.126 (not significant)									

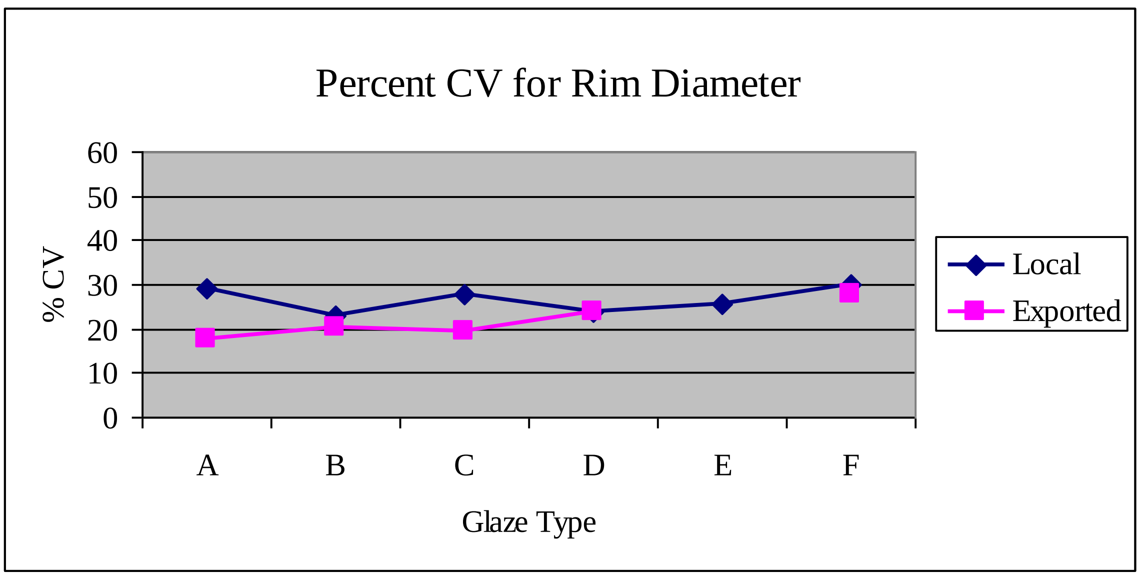


Figure 7.6: **Graph of the coefficient of variation for rim diameter for both local and exported sherd assemblages.**

Table 7.5: ***Table showing Levene's test p-values for the comparison of rim diameter for local and exported samples.***

Levene's Test P-value: Comparison of local versus exported samples	
Glaze Type	**P-value**
A	0.001
B	0.207
C	0.148
D	0.71
E	NA
F	0.991

The mean rim diameter goes up slightly through the Glaze Ware sequence. This is interesting, especially in comparison with the whole-vessel sample, where the average rim diameter is at its smallest for Glaze F vessels (Table 7.6). For the sherd sample overall, there is a large amount of variation for this attribute, as seen in high coefficients of variation for all of the types (Figure 7.6), although there are not any dramatic changes in the amount of variation throughout the Glaze Ware sequence. The increase in rim diameter at San Marcos is a bit different than what has been seen at other Glaze Ware sites. For example, at Montaño Bridge, Valencia, and Nuestra Sonora in the Albuquerque Basin, average rim diameter decreases from Glaze A to Glaze C (Franklin 2008). This pattern for Glaze A to Glaze C may also be present at San Marcos, but the later types show an increase in rim diameter.

The pattern of larger Glaze F vessels, especially in the local sample, seems unlikely, given the smaller sizes seen in the whole vessels (Table 7.6, Figure 7.7–7.9). It may be that the inclusion of small sherds is biasing the sample. Another possible explanation is that the later Glaze Ware vessels tend to be more asymmetrical. Figure 7.10 shows a vessel with a rim with a very flat segment. If a sherd from a flatter area of

the vessel was measured, the diameter would look much larger than the vessel actually is. It is likely that some of these asymmetrical vessels occurred in all of the Glaze Ware types—note that the maximum rim diameter recorded for all of the local types is 57 cm. It is unlikely that any vessels were actually that large—the largest vessel in the whole vessel sample was 36 cm. The small size of the sherds made it very difficult to tell if the sherd being measured was slightly warped, so the possibility of an exaggerated rim diameter could not be taken into consideration.

It is also possible that the smaller bowl size for whole vessels is based on differences in use of the whole vessels, some of which came from burials, and sherds, which likely represent vessels used more in day-to-day activities. Burial vessels may be smaller than vessels used for food consumption or even feasting events, in the case of the largest vessels. Some of the whole vessels did have location of recovery noted in their museum records, although the vessels from the Nelson collections at the AMNH are identified primarily by the room and room block where there were recovered, with no information regarding context of recovery. Of the whole vessels, 57 were from room blocks, 3 were from middens, and 2 were identified as burial goods (Table 7.7). If most of these vessels were not associated with burials, then this explanation of the smaller size of the whole vessels compared to the sherd sample is not valid.

Table 7.6: ***Orifice/rim diameter statistics for the whole vessel sample from multiple locales.***

Orifice/Rim Diameter Statistics for Whole Vessels from multiple locales									
Glaze Type	**N**	**Mean**	**SE Mean**	**St. Dev.**	**C.V.**	**Interquartile Range**	**Min**	**Max**	**Median**
A	30	26.07	1.16	5.56	21.32	8.80	12.7	31.8	28.1
B	8	21.23	1.47	3.61	16.98	7.20	18.3	26.1	19.4
C	17	22.53	1.42	4.72	20.97	6.80	12.6	29.4	22.2
D	20	28.06	1.49	5.16	18.38	9.73	21.2	35.8	29.6
F	12	19.05	1.76	5.84	30.65	11.20	12.1	27.1	18.2

Levene's Test P-value = 0.624

Table 7.7: ***Whole vessel sample within-site location data.***

Whole Vessel Within-site location data	
# of vessels	**Location**
57	Room block
2	Burial
3	Midden

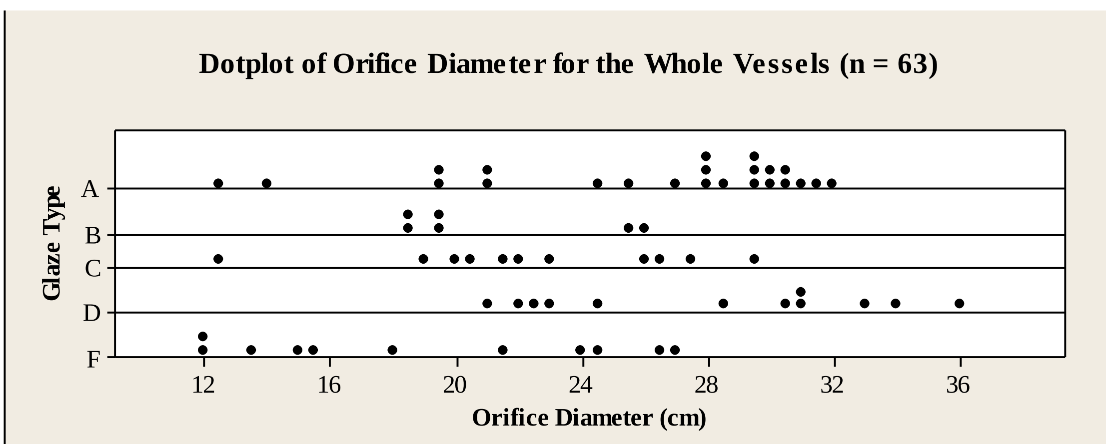


Figure 7.7: **Dotplot of orifice/rim diameter for the whole vessel sample.**

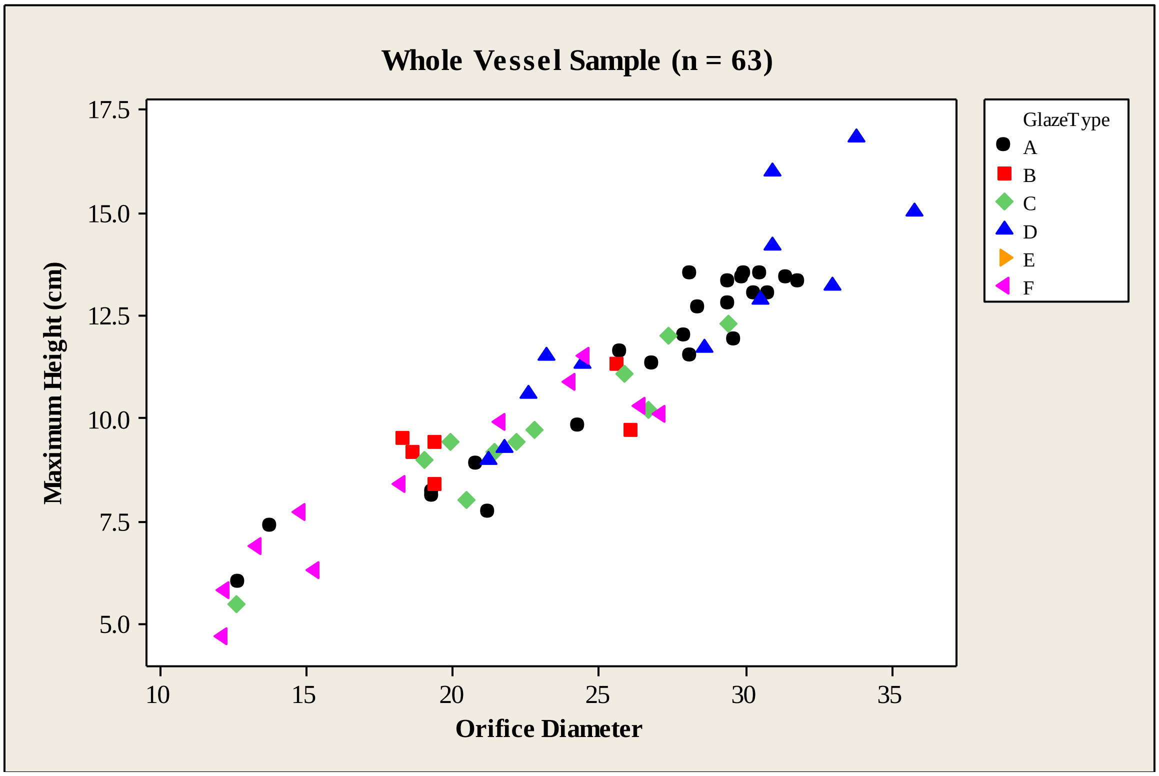


Figure 7.8: **Scatterplot of maximum height versus orifice diameter for the whole vessel sample.**

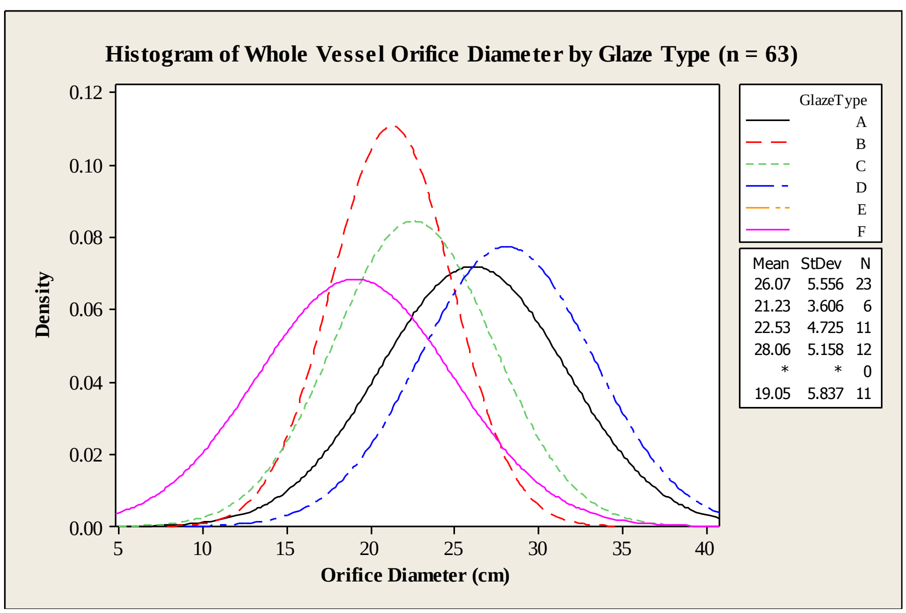


Figure 7.9: **Histogram of whole vessel orifice/rim diameter by Glaze Ware rim type.**

Although the sample is likely skewed to larger averages than were actually present in the samples, the same methods were used for all the sample populations, so I believe that statistical comparisons are valid. In looking at the coefficients of variation and Levene's tests, there are no statistically significant differences in the variation through time within either the local or the exported samples. The only statistically significant difference is in the amount of variation for Glaze A (Table 7.5). The local Glaze A sample is more variable than the exported Glaze A sample, with a p-value for the Levene's test of 0.001. Given that this is the only difference in the Glaze Ware sequence, it may not be a significant finding. It is possible that exported Glaze A vessels were more standardized than those made for local consumption. Rim diameter is may be a significant factor for exported vessels—having a smaller range of vessel sizes may have made transport easier, due to nestability (Whittlesey 1974). It is possible that I am not separating out size classes in all of the vessel types, and this may be a more significant factor for Glaze A, especially considering earlier researchers documentation of small and large size classes for these bowls (e.g., Kidder and Shepard 1936; Spielmann 1998). If only one of the size classes was exported, then my local sample may conflate the variation in the two size classes.

Figure 7.10: **Example of a warped partial vessel from the American Museum of Natural History with flattened areas of the rim. Photo by Kari Schleher. (Vessel Number A04 – see Appendix F, Table for museum information).**

Overall, the rim diameter range of variation does not change significantly throughout the sequence. For the local assemblage, percent coefficient of variation ranges from 23 to 30. The Levene's test of differences in variance does not suggest differences within rim diameters for the local and exported Glaze Ware types, with the exception of Glaze A. Although this range of variation (with CVs from 17 to 30) is not nearly as standardized as those for wall thickness and maximum rim thickness, it may be that separating out different size classes would make this attribute appear more standardized.

Summary of Morphological Attributes

The results for these three morphological attributes, wall thickness, maximum rim thickness, and rim diameter, clearly reflect mechanical standardization and the highly stable nature of morphological features of pottery production at San Marcos. No overwhelmingly significant differences in standardization are seen among the Glaze Ware types through time or between the Glaze Ware types made for local consumption and those made for export. Significant stability in the organization of production is

suggested by the data presented in this chapter. The data show little or no change in the range of variation throughout the Glaze Ware series and thus support Model 2, that standardization is not a direct indicator of intensity of pottery production at San Marcos Pueblo.

Chapter 8

Methods, Data, and Results for Glaze Paint:

Characteristics and Composition of Glaze Paint

Glaze paint is the defining attribute of Northern Rio Grande Glaze Ware. Only a few other ceramic types made by Pueblo potters were ever decorated with glaze paint, and the end of this ceramic tradition marks the halt of glaze paint use in the Southwest (Eckert 2006). Paint is likely an intentionally produced substance; potters attempted to produce certain colors, luster, and mechanical characteristics when preparing glaze paint. In addition, composition and preparation of the paint are not the only factors that influence the final color of a glaze. The firing temperature and atmosphere have a significant impact on the end result. Because of both the intentionality and complexity of glaze paint production, it is a significant attribute of the pottery from San Marcos that can inform on the nature of the organization of production and standardization in pottery making.

In this chapter, I review previous studies of glaze paint, describe the components of a glaze, and present the methods used in the current analysis. I then present the data on color and composition of glaze on ceramics from San Marcos and compare these to data produced in earlier research from other Central and Northern Rio Grande sites. I then discuss multivariate data on the relationship among glaze color, composition, slip color, and firing atmosphere. Finally, I will discuss the implications for these results as they relate to the question of organization of production and standardization at San Marcos.

Previous Studies of Glaze Paint Composition in the American Southwest

The glaze paint on ceramics in the American Southwest has been a focus of study for over 80 years. Most early researchers thought the early Glaze Ware types, especially Glaze A were the "pinnacle" of the types (Kidder and Shepard 1936), with detailed design, sharp edges, and dark black glaze paint. The late Glaze Ware types, especially Glaze E and F, were seen as "degenerative types," in which the methods of production of the earlier non-runny and deep-colored glaze had been lost. These late Glaze Ware types, with thick, runny, and often greenish glaze, were hypothesized to represent changes that occurred due to Spanish pressure on the Pueblos (Nelson 1914). Others have hypothesized that the glaze was intentionally made to be runny to hide religious images from the critical Spanish friars (Spielmann et al. 2006) or that the Spanish consumer, used to a fully glazed product, desired a more fully glazed native made vessel as well (Creamer 2000b).

A number of compositional analyses of Southwestern glaze paint have been conducted, including spectrographic and microchemical analysis (Shepard 1936, 1942), inductively coupled plasma mass spectroscopy analysis (Duwe and Neff 2007), and electron microprobe analysis (Bower et al. 1986; De Atley 1986; Fenn et al. 2006; Herhahn 1995, 2006; Herhahn and Huntley 1996; Huntley 2006; Huntley et al. 2007; Jones 1995). Shepard's analysis showed the major components to be silica and lead, results that have been confirmed by all subsequent researchers. Jones (1995) examined the number of glaze recipes used at Quarai and found that the number of recipes did not decrease with increased production, suggesting that all potting groups continued to participate in pottery production even as the organization of production changed.

Herhahn's research suggests experimentation early in Glaze Ware production and increased standardization of the glaze recipe by the mid A.D. 1400s (Herhahn 2006). Herhahn and Huntley (1996) also suggest increased levels of specialization based on the increased standardization of glaze paint recipes used by potters beginning in the A.D. 1400s. Herhahn and Huntley (1996), looking at ceramics recovered in the Salinas district, found that the amount of lead in glazes on ceramics with augite diorite (monzonite) temper (indicating production at San Marcos) became more standardized during the intermediate Glaze Ware period. Because the sample size used was small, one goal of the current research is to determine if these trends hold for additional samples made at San Marcos.

Recent innovative research by Judith Habicht-Mauche, Deborah Huntley, and their colleagues (Habicht-Mauche et al. 2000; Habicht-Mauche 2002; Huntley et al. 2007) demonstrates that lead used to make the glaze paints came from a few locales. A particularly dominant source is in the Cerrillos Hills just a short distance from San Marcos. In addition, lead isotope studies combined with petrography of the temper material used suggest that glaze materials may have been distributed in different exchange networks than tempering materials (Nelson and Habicht-Mauche 2006; Huntley et al. 2007). For example, pots tempered with local materials may have used multiple, or even mixed, distant sources for glaze paints (Huntley et al. 2007). San Marcos potters apparently exclusively used the nearby Cerrillos Hills source for galena, the lead sulfide used to make the paint.

These previous studies of glaze material and composition suggest that there may be standardization in composition and that the potters at San Marcos likely had easy

access to, if not control over, the sources of materials needed to make the glaze paint. The goal of this chapter is to take these studies one step further and examine a larger sample of glaze paint made at San Marcos to determine the degree of standardization attained by potters there.

Glaze Technology

Before I address the methods used to determine the glaze composition, it is important to discuss the different components that made up a glaze. Ceramic glazes are composed of three major components: network formers, network modifiers, and intermediates (Rice 1987:98–100). Network formers function to create the structure of the glass. The most important network former is silica (SiO_2). Network modifiers are oxides that enter holes in the network of SiO_2 tetrahedrons and weaken the bonds of the network. They function as fluxes by lowering the high melting point of silica, approximately 1710ºC (Rice 1987:99). Common network modifiers are oxides of sodium, potassium, lead, calcium, and magnesium (Na_2O, K_2O, PbO, CaO, and MgO) (Rice 1987:99). In the prehistoric American Southwest, prehistoric potters likely never reached 1710ºC in their pottery firing, making the use of a flux essential for making glaze paint. Lead was the primary network modifier, or flux, used in the Northern Rio Grande Valley (Shepard 1936, 1942). Intermediates are materials added that function to increase the viscosity, to keep the flux from being too runny, and to strengthen the glaze in firing. Some common intermediates, include oxides of aluminum, lead, zinc, and silica (Al_2O_3, PbO, ZnO, and SiO_2). SiO_2 and Al_2O_3 give properties of hardness and durability to glazes, so they should be included in large amounts to be effective (Rhodes 1973:166). Intermediates can also be in the form of other metallic oxides added to influence the final

color of the glaze. Iron, copper, manganese, cobalt, and chromium are some of the common materials added as colorants (Rice 1987:100). The color of the final glaze is dependent on a number of factors, but these intermediate metallic materials can greatly influence the color. Lead glaze without any colorants tends to be almost clear. In lead glazes, iron can result in a light yellowish brown to dark brown or black color when large amounts are present (> 7%) (Rice 1987:338). Copper added to a lead glaze can give a greenish color. Manganese, in 2–6% concentrations, yields a dark black (Rice 1987:339). Most compositional studies of the Northern Rio Grande Glaze Ware paint, including a small pilot study conducted by the author prior to the current analysis (Schleher 2002), suggest decreases in the amount of manganese and increases in the amount of lead through time (see also Herhahn 2006). The methods used in the current research include examination of all network formers, modifiers, and intermediaries.

Another recent study has shed further light on some of the materials and methods used to make glaze paint. Working in conjunction with Eric Blinman of the Office of Archaeological Studies, I was granted access a unique archaeological sample—an unfired sample of powdered glaze paint recovered from inside a bowl in a room excavated at San Lázaro Pueblo. We believe this powdered sample was a glaze paint and not just powdered galena because the chemical composition of this material after firing on a sherd fell within the same range of chemical composition as the paints present on sherds from San Marcos. This sample is the only known example of unfired glaze paint from the Northern Rio Grande culture area. This is significant because firing pottery with glaze paint decoration chemically modifies the glaze in such a way as to make it difficult to determine the exact constituents of the paint. The process of glaze formation is much like

baking a cake—you add flour, butter, sugar, extracts, and so forth in varying amounts, but in the final baked cake, you are not able to distinguish individual parts. Similarly, when making a glaze, you need some form of silica as the network modifier, intermediate colorants such as manganese or copper, and network modifying fluxes to make the glaze melt at a temperature low enough that potters using open firing methods could reach it. However, it is difficult to identify the different parts that were combined to give a certain chemical composition in the final product because during firing the glaze has vitrified and become homogeneous. Thus, the sample of raw, powdered glaze provided an unprecedented picture prior to vitrification of what minerals and rocks went into the glaze paint recipe.

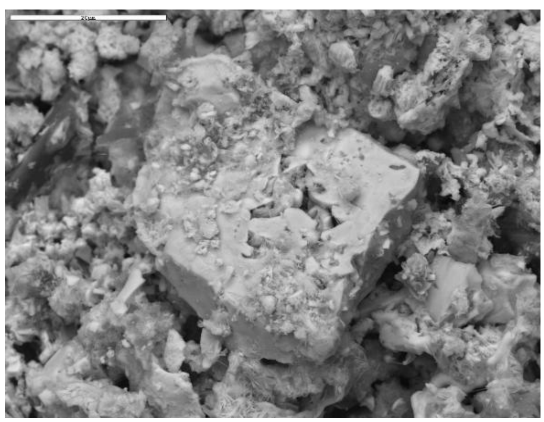


Figure 8.1: **Secondary electron view in the scanning electron microprobe of the raw paint sample. Note the cube-like structure of this small crystal (approximately 20 μm in diameter) of galena.**

To make this paint, potters first used a crushed galena, a lead sulfide rock, as the source of the lead in the paint. Galena has a unique cubic structure that is possible to identify using the scanning electron microscope in secondary electron view (Figure 8.1). Second, the galena ore was finely crushed and roasted *prior* to being used as a paint. Only small amounts of sulfur were present in the raw powdered sample, suggesting such

processing. Pre-roasting would have removed the sulfur possibly preventing bubbles caused by sulfur gases being released in firing. Although bubbles are occasionally visible on Glaze Ware vessels, this pre-roasting technique may have been developed to avoid them. Evidence of pre-roasting is preserved in the sample in the distribution of sulfur across the sample. Figure 8.2, a compositional map of a section of the raw glaze, shows that small amounts of sulfur are present in the larger crystals of galena and that roasting removed sulfur from the edges of the larger pieces of galena. This also suggests that the potters' goal would have been to grind the galena to a very fine particle size so that most of the sulfur could be removed by the pre-roasting (Blinman et al. 2009).

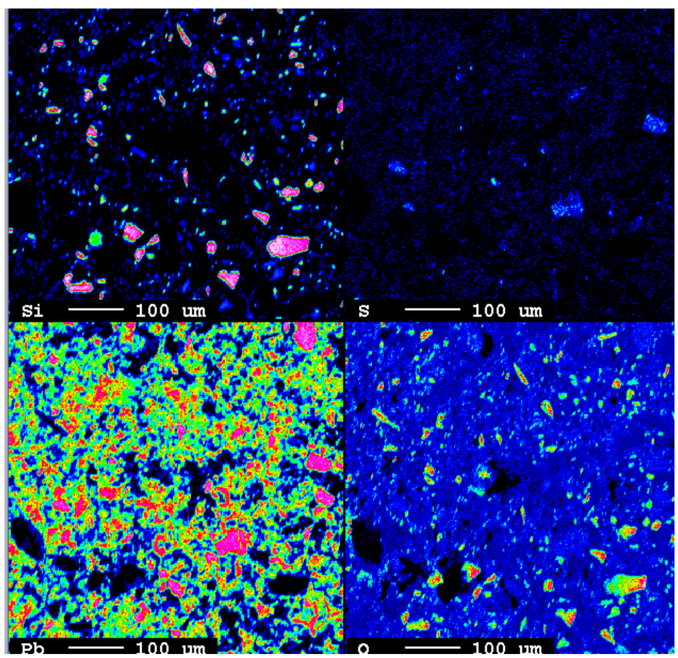


Figure 8.2: **Each of these squares shows the distribution of one element across the surface of the raw glaze sample – the brighter the color, the more dominant that element is in that area. Note the S (sulfur) distribution in the top right corner, where very little sulfur is present. The places that have more sulfur are in the middle of the large galena crystals (you can determine that these are galena crystals by comparison with the lead [Pb] distribution in the bottom left corner).**

Methods Used to Determine Glaze Paint Composition

Glaze paint composition was determined in a two-stage approach. First, the glaze color was recorded using a color template created for the project. The template was created by going through all the sample sherds to understand the range of variation in glaze color and then selecting samples of sherds to be used as a template for each possible glaze color represented. These 10 colors are listed in table 8.1. For simplification in discussion, the colors have been grouped into five color categories. Both the ungrouped and grouped color categories are used to characterize the assemblage.

Table 8.1: ***Glaze Color Categories***

Glaze Color Categories	Grouped Color Categories
Black with green	Green
Brown	Brown
Brown with green	Green
Brownish black	Brown
Brownish Grey	Brown
Dark black	Black
Green	Green
Gray	Gray
Oxidized, unclear color	Unclear
Reddish Brown	Brown

After glaze color was determined, 10 to 12 sherds were selected from each Glaze Ware type were selected to represent the range of glaze colors for that type. Because of this sampling method, there may actually be more variation in the glaze composition for each Glaze Ware type than would have been obtained through a more random sampling.

The 67 selected sherds were prepared by the author into epoxy-block thick sections, polished, and carbon-coated for electron microprobe analysis.

Microprobe analysis allows for very small amounts to be analyzed and gives major, minor, and trace elements present (Rice 1987:375), as long as appropriate standards are used. Because the glaze is only one small component of each ceramic sherd, microprobe analysis was selected as the best method for determining composition of the glaze paint on the sample sherds. I conducted the analysis on the JEOL 8200 Electron Probe Microanalyzer at the Earth and Planetary Sciences/Institute of Meteoritics Electron Microbeam Facility on the UNM campus. Methods used for the microprobe analysis primarily follow Herhahn (1995, 2006) and Herhahn and Huntley (1996), although some modifications were required because a different instrument was used than in these earlier studies. The JEOL 8200 Electron Probe Microanalyzer Lab is run by Michael Spilde, who helped determine the appropriate methods for the analysis. The UNM microanalyzer is equipped with five wavelength-dispersive spectrometers. Appropriate crystals were selected for each spectrometer for the L value of each of the 13 elements to be analyzed. Up to 10 data collection points were analyzed on each sherd. Many of the samples selected had glaze paint present on both the interior and exterior, and in these cases both interior and exterior sides were sampled. A 15 KV accelerating voltage was used, with the beam diameter at 10 µm. This size was found to capture most of the thickness of the glaze, without getting too close to the edge of the sherd or the edge of the sample.

Glaze Paint Color Categories

All sherds in the local and exported samples were put into glaze color categories. Figures 8.3 to 8.8 are bar charts of glaze color variation through time and among samples for both interior and exterior surfaces. Figures 8.3 and 8.4 show the local sample with 10 color categories. These graphs clearly demonstrate an increase in the number of different colors of glaze paint through time, with all 10 colors being present on the Glaze F sherds and fewer colors used earlier in the Glaze Ware sequence. For the earlier types, the trend is for darker, blacker glazes. On the Glaze F sherds the range of colors represented includes many variants of green (brown with green, black with green, green). These bar charts do not show a reduction in variability with the C and D Glazes. If any of the Glaze Ware types have less variability, it is Glaze A sherds with black as the dominant color. Color changes appear to be temporally linked, with an increase in the number of colors used later in the sequence.

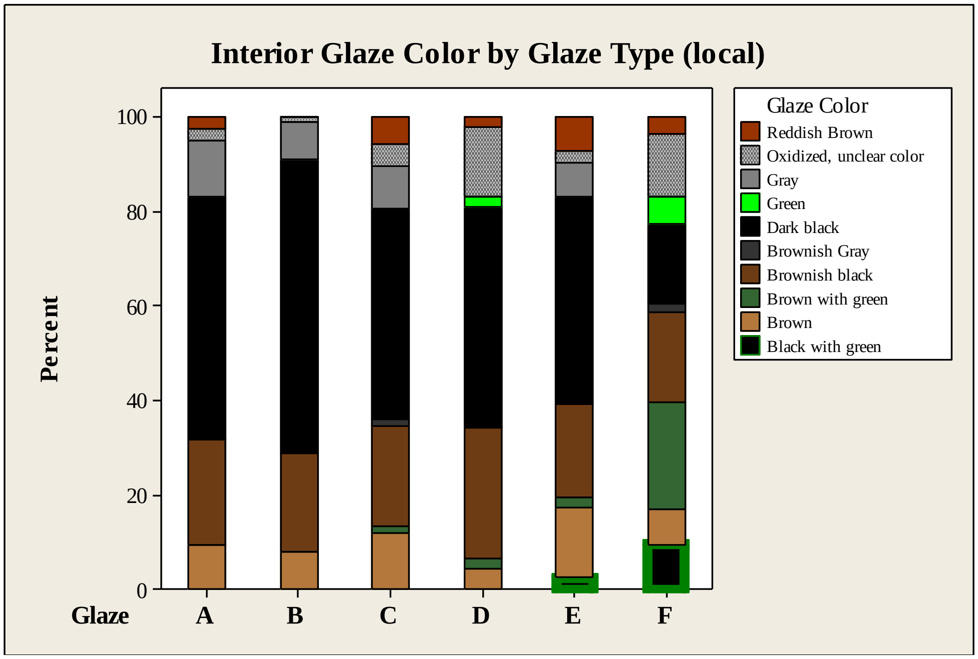


Figure 8.3: **Bar chart showing interior glaze color by Glaze Ware type for the local sherd sample.**

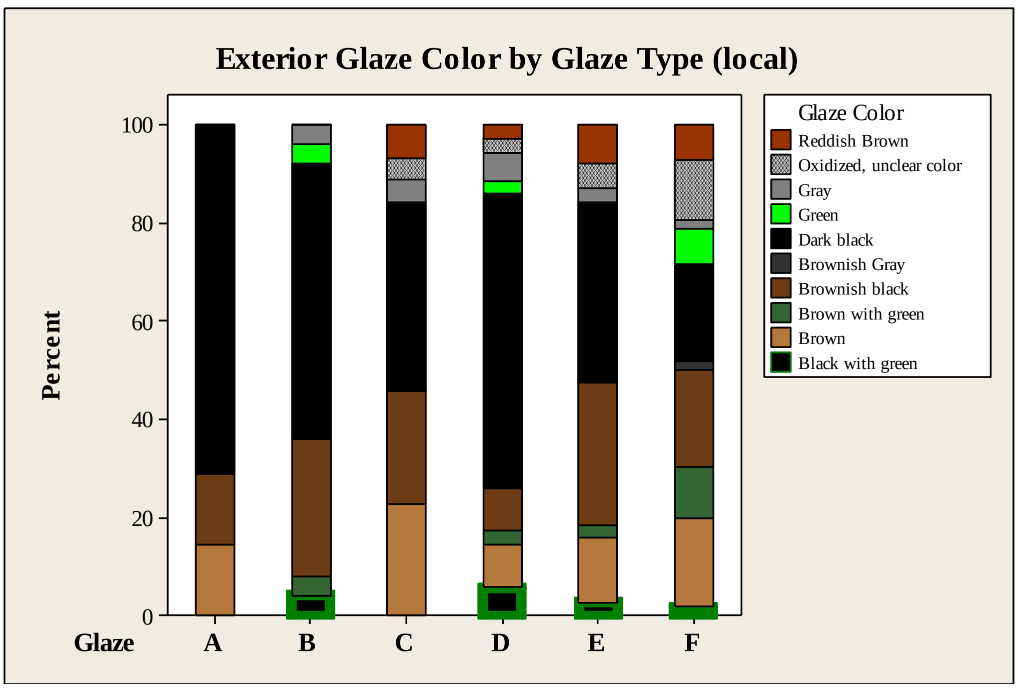


Figure 8.4: **Bar chart showing exterior glaze color by Glaze Ware type for the local sherd sample.**

If we use the grouped glaze color categories, the picture is even clearer (Figures 8.5 to 8.8). When we consider just the general color of the glaze, approximately 80 percent or more of the sample has some variation of black or brown throughout the Glaze Ware sequence, excluding Glaze F. For Glaze F, we see a significant increase in the dominance of green colored glazes, especially on the interior of the bowls.

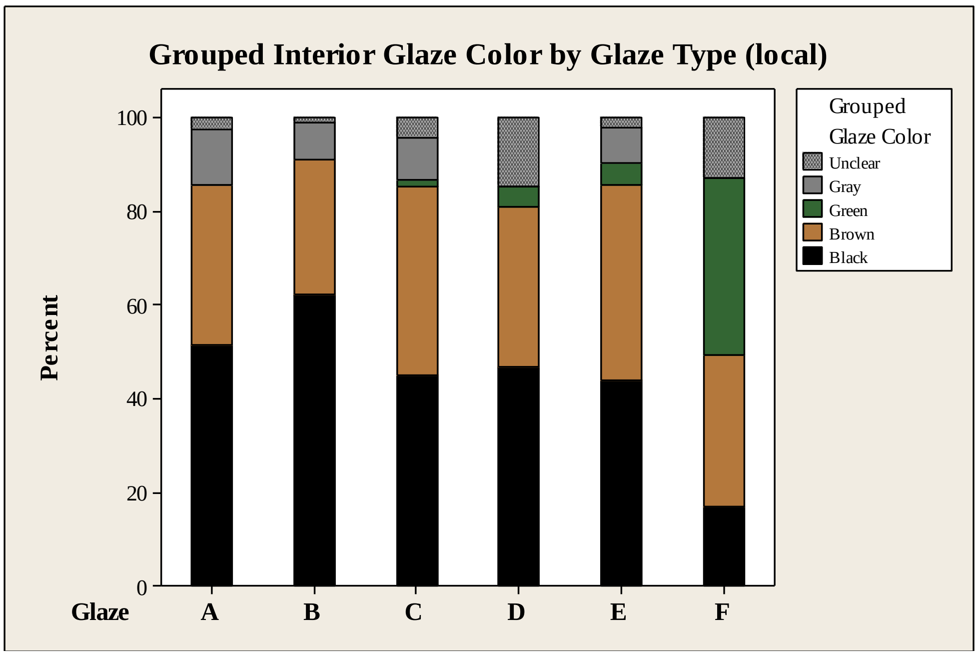


Figure 8.5: **Bar Chart of interior glaze color by Glaze Ware type for the local sample using the grouped glaze color categories.**

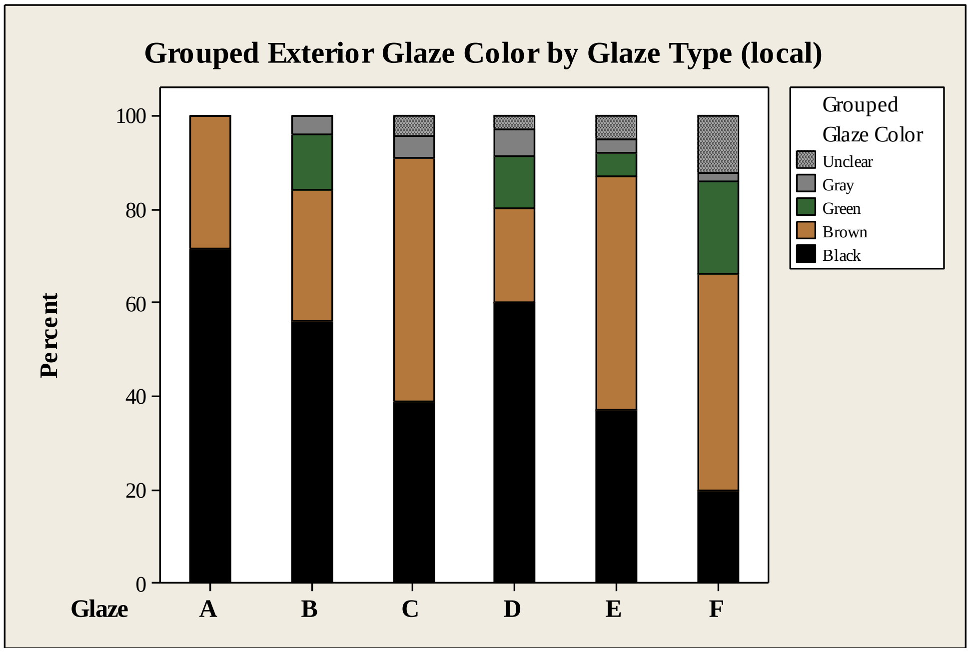


Figure 8.6: **Bar Chart of exterior glaze color by Glaze Ware type for the local sample using the grouped glaze color categories.**

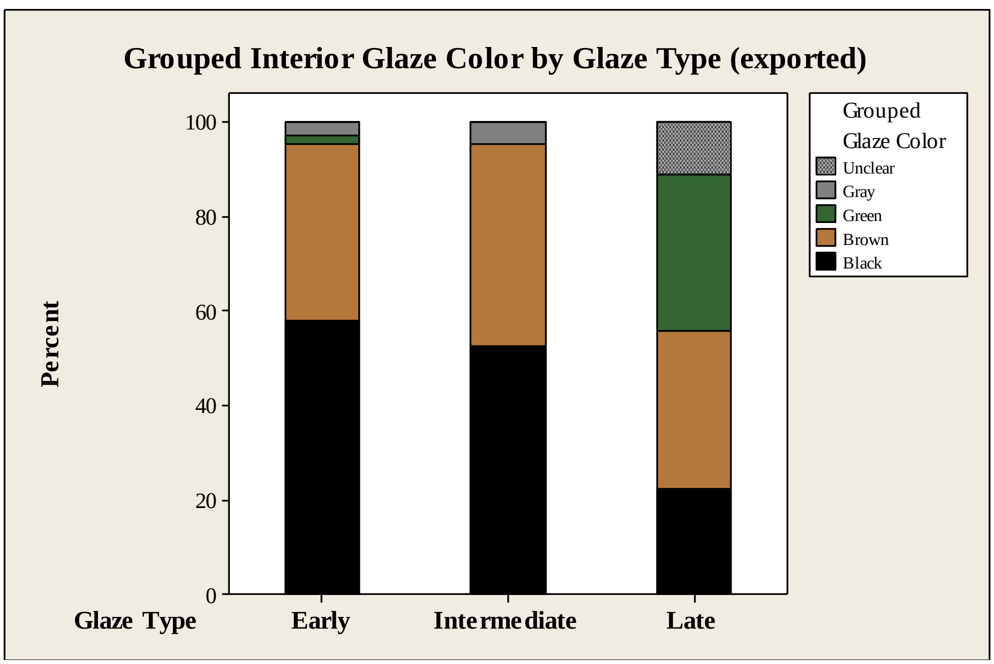


Figure 8.7: **Bar Chart of interior glaze color by Glaze Ware type for the exported sample using the grouped glaze color categories.**

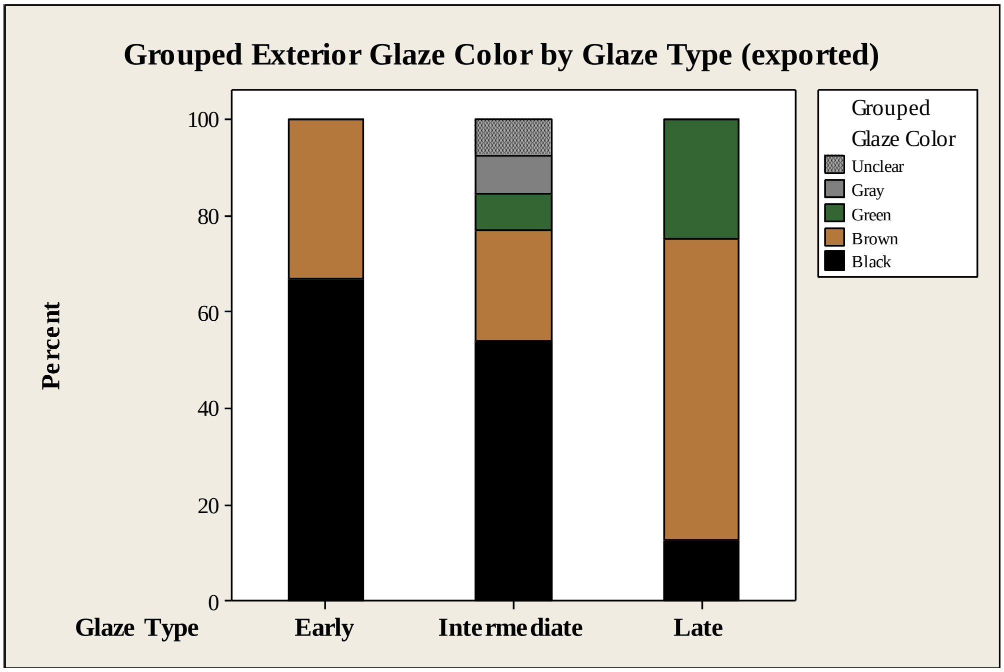


Figure 8.8: **Bar Chart of exterior glaze color by Glaze Ware type for the exported sample using the grouped glaze color categories.**

In comparing the local and exported sample for glaze paint color, we see similar patterns (Figures 8.7 and 8.8). Between 80 and 100 percent of the early and intermediate Glaze Ware types are black or brown, whereas the late types tend to have higher amounts of green glazes.

The Shannon diversity index (Figure 8.9 and Table 8.2), using the grouped colors, shows the overall temporal pattern statistically—in general, the index increases throughout the Glaze Ware sequence, indicating increasing diversity in glaze color. The pattern of range of diversity for exported sherd glaze color seems to mirror the local sherd pattern. The range of variation, or diversity, increases later in the sequence. Now that the patterning in color change through time is clear – with increase in diversity of

glaze color through time, we can move on to the chemical composition of the glaze paint and the electron microprobe analysis.

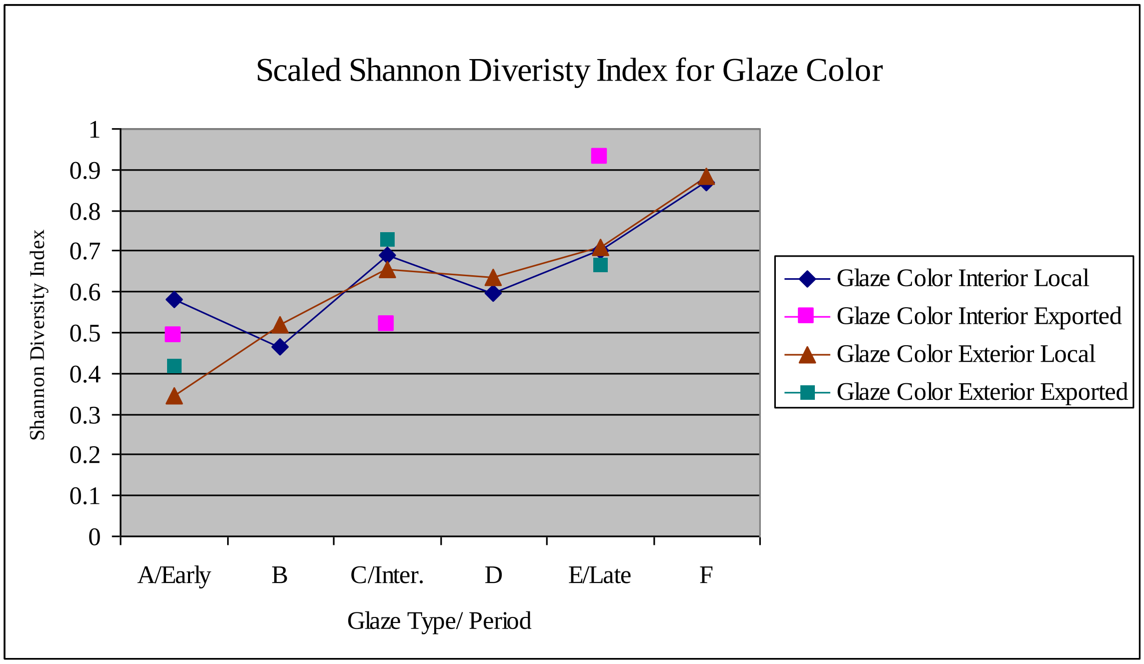


Figure 8.9: **Graph showing the scaled Shannon diversity index for glaze color by Glaze Ware type.**

Table 8.2: ***Scaled Shannon diversity index for grouped glaze color.***

Scaled Shannon Diversity Index for Glaze Color						
Attribute	**A/Early**	**B**	**C/Inter.**	**D**	**E/Late**	**F**
Glaze Color Interior (grouped) Local	0.5824	0.467	0.6904	0.5969	0.7018	0.8679
Glaze Color Interior (grouped) Exported	0.4935		0.5194		0.9299	
Glaze Color Exterior (grouped) Local	0.3458	0.5195	0.6536	0.6345	0.7106	0.8855
Glaze Color Exterior (grouped) Exported	0.4172		0.7296		0.6667	

Glaze Paint Composition: Electron Microprobe Analysis

After all sherds were classified by glaze color, a smaller sample was analyzed for glaze paint composition. I present results of the compositional analysis in three sections. The first section deals with the composition of the San Marcos glaze in isolation. The second section compares the current San Marcos sample to other compositional data for

glaze paints produced by Cynthia Herhahn and Deborah Huntley (Herhahn and Huntley 1996). The third section ties together the compositional data with firing and slip color data from Chapters 9 and 10 to attempt to address the relationship between composition and final glaze color.

San Marcos glaze composition data. As did previous research (e.g., Herhahn 1995, 2006) on Northern Rio Grande Glaze Ware ceramics, my research shows that San Marcos glaze paint was dominated by lead (Table 8.3) (Appendix E includes glaze paint compositional data by sherd). The mean weight percentage for lead oxide (PbO) for each of the types ranges from 51.69 to 62.53 percent of the total concentration. Silica (SiO_2) is the next most dominant, ranging from 23.62 to 29.42 percent, followed by alumina (Al_2O_3) and manganese oxide (MnO). These oxides comprise of about 92 to 95 percent of the total glaze composition. PbO, SiO_2, and Al_2O_3 are relatively standardized, with coefficients of variation ranging from about 8 percent to 28 percent (Table 8.4 and Figure 8.10). These three oxides represent the essential elements of the glaze, with the lead as flux to allow the glaze to vitrify at the low temperatures (as low at 532ºC [Shepard 1995]) used by prehispanic Southwestern potters, the silica to form the structure of the glaze, and the alumina to keep the glaze from running. Potters would have found it essential to have relatively constant amounts of these three materials to make the glaze successful. The most significant change is a reduction in MnO in the late Glaze Ware types, although it is lower for Glaze C as well. Alumina (Al_2O_3) is slightly higher for Glaze A and B types, where the edges of the painted elements are sharper than in the other glaze types. PbO is at its most standardized level at Glaze C with a CV of only 7.98 percent, but none of the other constituents (the other three dominant oxides and colorants) are at their most

standardized during Glaze C. This finding suggests that the glaze recipe is not any more standardized overall during the Glaze C production period.

Table 8.3*: Means for the four dominant oxides by Glaze Ware type.*

Means for the four dominant oxides by Glaze Ware Type					
	PbO	**MnO**	**SiO_2**	**Al_2O_3**	**Sum of 4 dominant elements**
A (n = 11)	51.69	7.21	29.42	6.51	94.83
B (n = 12)	53.50	7.74	26.95	5.77	93.96
C (n = 12)	62.53	3.52	23.62	5.03	94.70
D (n = 10)	55.06	5.77	26.11	4.54	91.48
E (n = 11)	60.45	2.64	23.62	4.94	91.65
F (n = 11)	59.97	2.03	24.66	5.26	91.92

Table 8.4: ***Percent Coefficient of variation for the four dominant oxides by Glaze Ware type.***

CV for the four dominant oxides by Glaze Ware Type				
	PbO	**MnO**	**SiO_2**	**Al_2O_3**
A (n = 11)	14.16	36.01	13.41	25.67
B (n = 12)	18.20	80.75	14.02	16.16
C (n = 12)	7.98	53.16	14.89	19.18
D (n = 10)	22.57	134.34	15.92	28.30
E (n = 11)	10.44	50.76	17.18	24.33
F (n = 11)	8.65	77.14	13.34	25.79

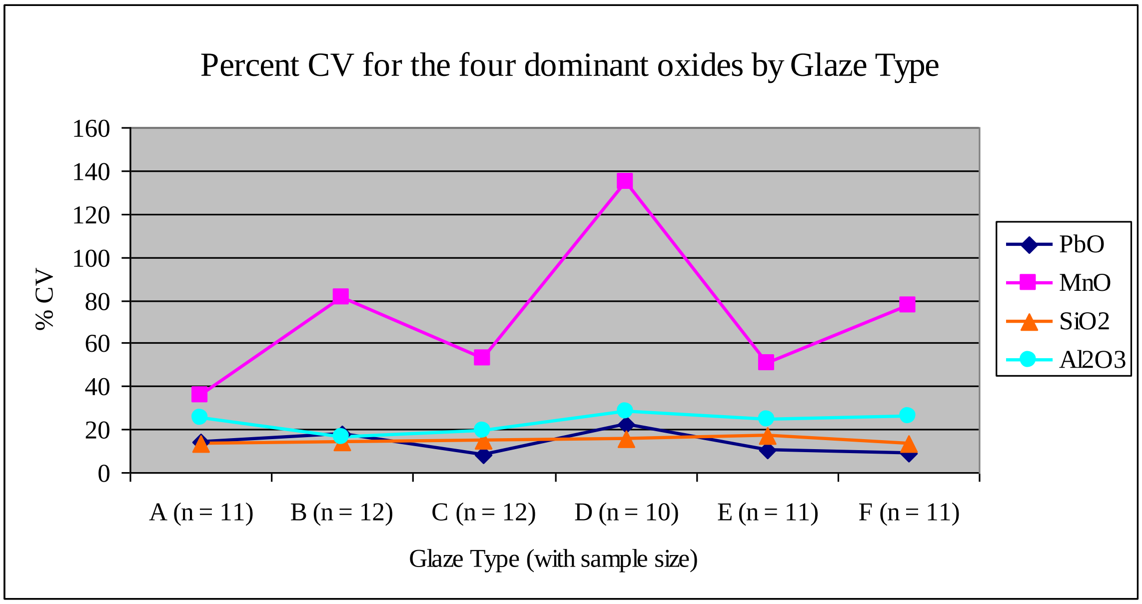


Figure 8.10: **Graph of the percent coefficient of variation for the four dominant oxides by Glaze Ware type.**

Oxides that functioned primarily as colorants are not as standardized as the four dominant oxides (Table 8.5 and 8.6). Although they are relatively low in concentration (excluding MnO), they are all have relatively high coefficients of variation. Whereas the coefficients of variation for PbO, SiO_2, and Al_2O_3 were primarily below 25 percent (Table 8.4), few of the colorants are that standardized for any of the Glaze Ware periods. In addition to high CVs, which suggests unstandardized use of particular colorants within each period, the CVs change significantly throughout the sequence as well.

Coefficient of variation data for the glaze paint compositions by oxide type suggest relative stability in the basic components of the glaze (PbO, SiO_2, and Al_2O_3), but variability for the colorants. Although the colorant means for each Glaze Ware type do not change significantly through time (except for MnO), there is a good deal of variability, as seen in the CVs. Potters appear to have been working within a system that communicated information about what had to go into a glaze, but accepted variety in

colorants and experimentation in the addition of these colorants. It is also possible that the mixture of slip clays of difference compositions with the glaze paint may have contributed to the overall glaze paint compositional variability. This is one possible explanation for the slight increase in iron (Fe) through time—red slips are more common in the later Glaze Ware types.

Table 8.5: ***Means for the colorant oxides by weight percent of composition.***

Means for the colorant oxides by weight percent of composition						
	MnO	**CuO**	**FeO**	**MgO**	**TiO_2**	**ZnO**
A (n = 11)	7.2	0.1	1.2	0.7	0.2	0.9
B (n = 12)	7.7	0.2	1.3	0.6	0.2	1.4
C (n = 12)	3.5	0.1	1.4	0.6	0.2	0.9
D (n = 10)	5.8	0.2	1.9	0.6	0.2	2.9
E (n = 11)	2.6	0.2	2.0	0.6	0.2	2.4
F (n = 11)	2.0	0.1	2.3	0.8	0.2	1.3

Table 8.6: ***Percent Coefficient of variation for the colorant oxides by Glaze Ware type.***

CV for colorant oxides by Glaze Ware Type						
	MnO	**CuO**	**FeO**	**MgO**	**TiO_2**	**ZnO**
A (n = 11)	36.01	60.99	34.90	30.29	40.61	49.92
B (n = 12)	80.75	161.66	47.07	19.78	44.35	86.71
C (n = 12)	53.16	78.24	44.20	28.51	47.11	142.81
D (n = 10)	134.34	68.68	64.53	31.73	76.05	52.76
E (n = 11)	50.76	33.72	33.19	31.48	24.77	38.06
F (n = 11)	77.14	42.24	28.65	30.08	34.96	60.44

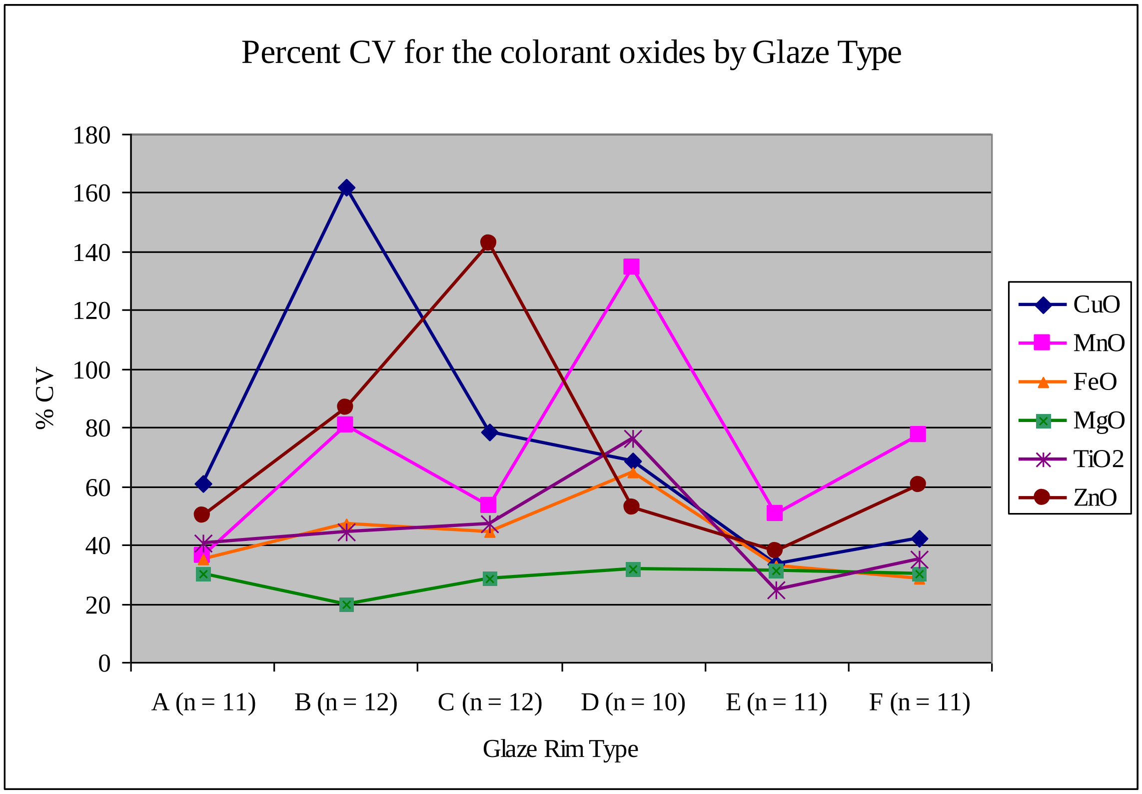


Figure 8.11: **Graph of the percent coefficient of variation for colorant oxides by Glaze Ware type.**

A number of researchers have documented glaze paint recipes for potting groups located in different sites or regions across the Southwest (e.g., Fenn et al. 2006; Herhahn 1995, 2006; Huntley 2006, 2008). Herhahn (2006) suggests that there was a relatively standardized recipe used by all potters in the Northern Rio Grande after the Glaze A period (i.e., Glazes B through F). Her research suggests close ties and one community of practice in the production of the later Glaze Ware types throughout the Northern Rio Grande, including San Marcos Pueblo. My goal is to further reconstruct this recipe at the site of San Marcos. I examined the glaze paint composition on pots from San Marcos to determine if any differences existed within the assemblage using principal component analysis. Because of the relatively small sample sizes, the 67 sherds analyzed for glaze

paint composition have been grouped into early (Glaze A and B), intermediate (Glaze C and D), and late (Glaze E and F) samples for the multivariate statistical analyses.

The bivariate plot of principal components 1 and 2 shown below (Figure 8.12 and Table 8.7) demonstrates some differences between the glaze paint recipes used at different stages of the Glaze Ware typological sequence. The early types are dominated by slightly higher levels of Al and Mn, with slightly lower levels of Na and Zn. The late types have slightly lower levels of Mn and Al and higher levels of Na and Zn. The intermediate types fall between these two extremes and overlap with both the early and late glaze recipes. The higher the amount of Mn used as a colorant, the darker black the glaze. This colorant is more dominant in the earlier glazes, which correlates with the dominance of black glazes in that time. Alumina helps the glaze to be less runny and the later glazes that tend to run contain smaller amounts of this oxide.

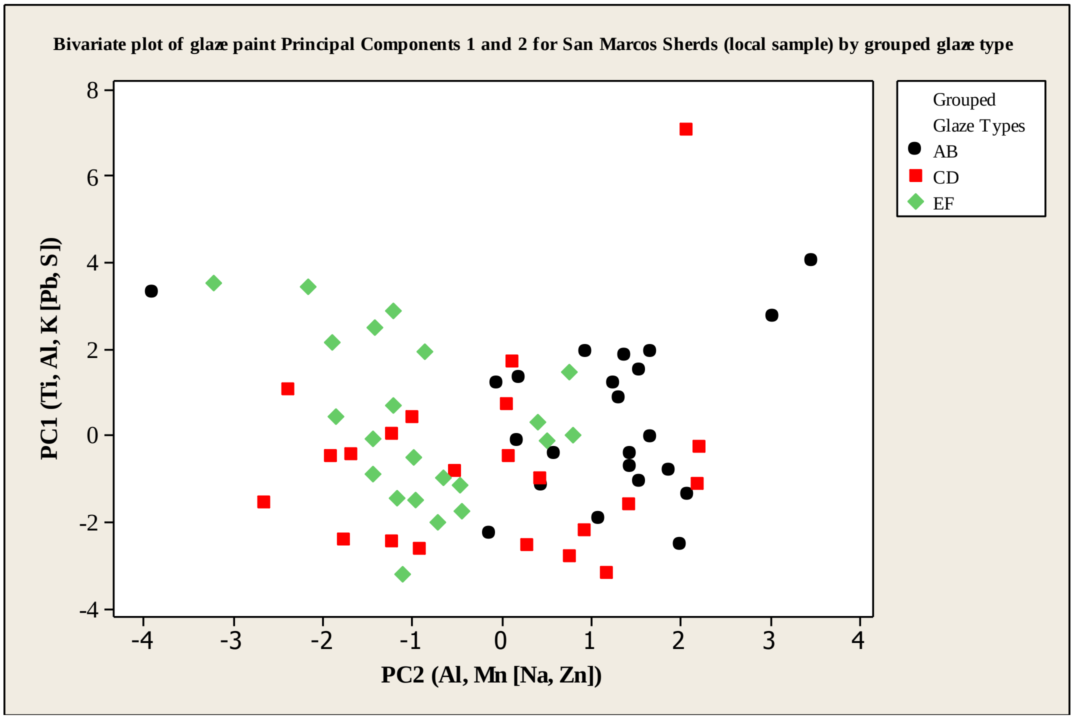


Figure 8.12: **Bivariate plot of glaze paint composition principal components 1 and 2 for San Marcos Sherds from the local sample by grouped Glaze Ware type.**

Table 8.7: ***Total Variance Percentage Explained and Component Matrix for the Principal Component Analysis of Results Plotted in Figure 8.12.***

Total Variance Explained			
Component	**Initial Eigenvalues Total**	**Percent of Variance**	**Cumulative Percent**
1	3.9536	32.90%	32.90%
2	2.3786	19.80%	52.80%
3	1.5212	12.70%	65.40%
4	1.0557	8.80%	74.20%
5	0.8441	7.00%	81.30%
6	0.7678	6.40%	87.70%
7	0.6461	5.40%	93.10%
8	0.3509	2.90%	96.00%
9	0.2350	2.00%	97.90%
10	0.1328	1.10%	99.00%
11	0.0608	0.50%	99.60%
12	0.0535	0.40%	100.00%

Table 8.7 Continued

	Component Matrix *			
Oxide	Component 1	Component 2	Component 3	Component 4
Al_2O_3	0.360	0.242	0.039	-0.486
SO_3	-0.286	-0.087	0.146	0.190
Na_2O	0.189	-0.527	-0.100	-0.085
MnO	0.224	0.377	-0.423	0.253
K_2O	0.345	-0.213	0.238	0.438
PbO	-0.391	-0.188	0.401	0.028
MgO	0.314	-0.023	0.318	-0.503
FeO	0.286	-0.188	-0.057	0.294
CaO	0.309	-0.366	0.246	0.010
CuO	0.036	-0.318	-0.422	-0.140
TiO_2	0.385	0.159	0.096	0.298
ZnO	-0.075	-0.468	-0.129	0.319

* Only components with an eigenvalue greater than one were extracted

It is interesting to compare these data from San Marcos Pueblo with the data published by other researchers (Herhahn 1995, 2006; Herhahn and Huntley 1996; Huntley et al. 2007; data provided in raw form by Cynthia Herhahn and Deborah Huntley). These researchers looked at glaze paint recipes on ceramics recovered from villages in the Salinas district and manufactured at a number of other villages throughout the central and northern Rio Grande Valley. In comparison with their findings, the San Marcos Pueblo glaze paint recipe is significantly more standardized (Figure 8.13), suggesting that the San Marcos potters followed a more standardized recipe than contemporary potters elsewhere. In the bivariate plot below of principal components 1 and 2, San Marcos sherds form a very tight, standardized cluster compared to data from sherds recovered at other sites along the North and Central Rio Grande from the early Glaze A to Glaze F production periods.

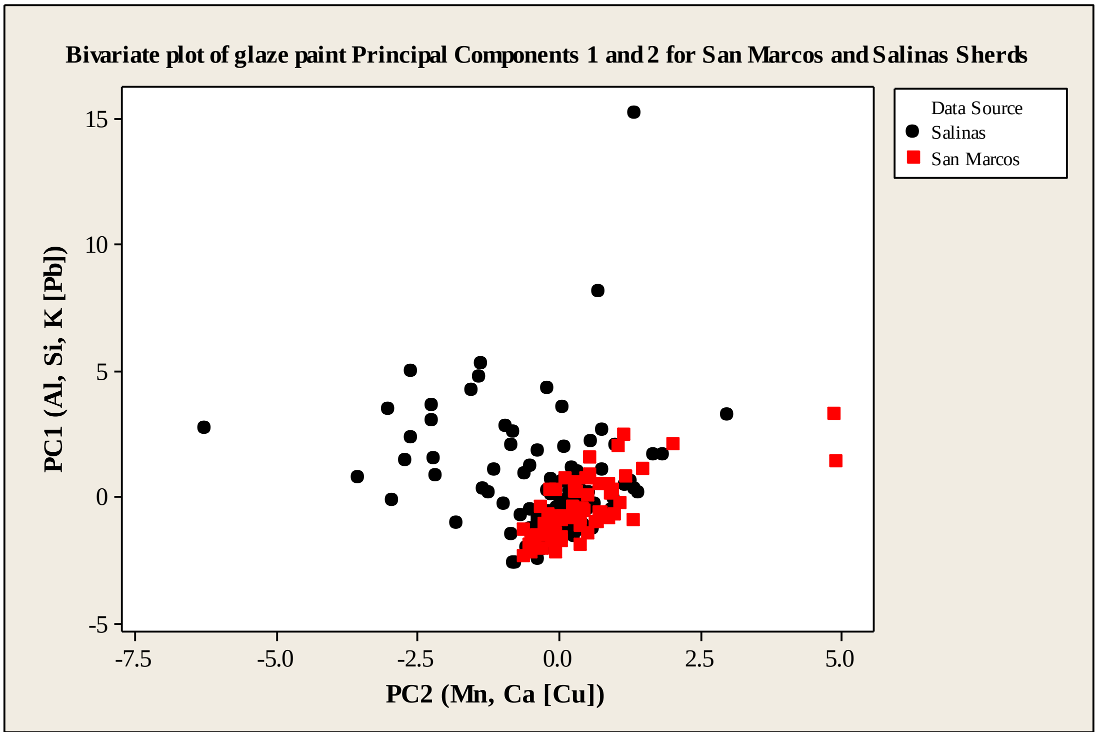


Figure 8.13: **Bivariate plot of glaze paint principal components 1 and 2 for San Marcos and Salinas Sherds.**

Table 8.8: ***Total Variance Percentage Explained and Component Matrix for the Principal Component Analysis of Results Plotted in Figure 8.13.***

Total Variance Explained			
Component	**Initial Eigenvalues Total**	**Percent of Variance**	**Cumulative Percent**
1	3.9757	49.70%	49.70%
2	1.2642	15.80%	65.50%
3	1.1964	15.00%	80.50%
4	0.486	6.10%	86.50%
5	0.4676	5.80%	92.40%
6	0.3536	4.40%	96.80%
7	0.2565	3.20%	100.00%
8	0	0.00%	100.00%

Table 8.8 Continued

Component Matrix*			
Oxide	**Component 1**	**Component 2**	**Component 3**
Al_2O_3	0.430	-0.059	0.085
SIO_2	0.437	0.071	0.164
K_2O	0.411	0.025	-0.187
CAO	0.253	0.339	-0.547
MNO	-0.014	0.644	0.583
FE_2O_3	0.378	-0.077	-0.247
CUO	0.180	-0.664	0.372
PBO	-0.464	-0.121	-0.304

* Only components with an eigenvalue greater than one were extracted

The data produced by Herhahn and Huntley can be broken down by temper type and, thus, probable site of manufacture (Herhahn and Huntley 1996). Figure 8.14 shows the same PCA plotted above with the samples identified to temper type. What becomes clear is that many of the villages that produced glaze paint wares, including San Marcos, Tonque, Abo, and Quarai, were using very similar recipes. However, it is significant to note that these are the only sites for which we have data; future research that examines the composition of other sites may show that many sites were using very similar recipes.

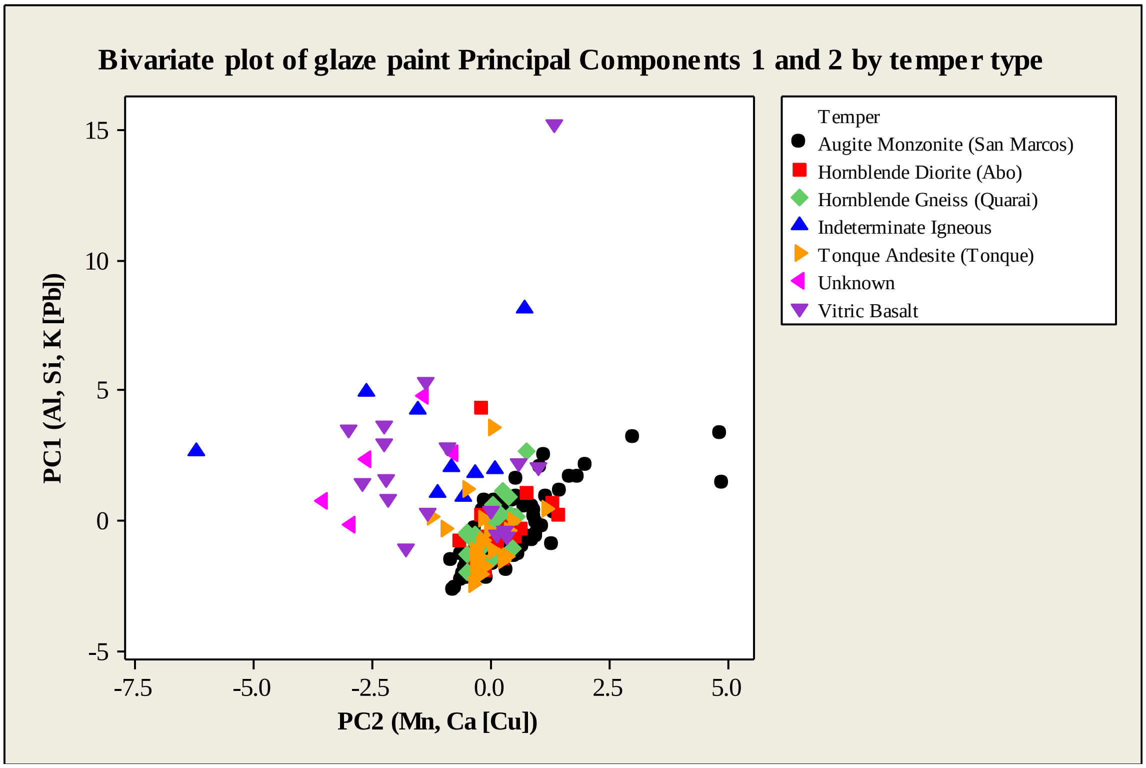


Figure 8.14: **Bivariate plot of glaze paint composition principal components 1 and 2 for San Marcos and Salinas Sherds plotted by temper type and likely production locale.**

Summary of the glaze paint composition results. In summary, the glaze paint recipes used by San Marcos potters vary slightly through time. Earlier glazes tend to have more Al and Mn than the later glazes. The level of standardization, however, does not change drastically through the glaze sequence at the site, especially as it relates to three of the major components of the glaze (PbO, SiO_2, and Al_2O_3). These basic constituents are relatively stable through time; the other elements, especially oxides representing colorants, are significantly more variable. Although the colorants are all relatively minor components of the glazes, the range of variation seen within and among glaze types is high. In comparison to glaze paint recipes used at other glaze ware producing sites in the Rio Grande Valley, San Marcos potters glaze recipe is more standardized. Taken as a

whole, these data indicate that San Marcos potters followed a relatively consistent glaze recipe, which would have required close communication within a community of practice. Colorants, the minor components of the glaze, allowed for some experimentation, perhaps by potters attempting to attain certain glaze colors, but the basic recipe and major constituents were held constant. The variation in color on the later glazes may be related more to increasing firing temperatures or to slip color than to composition.

Multivariate Data of the Relationships Among Glaze Color, Slip Color, and Core Pattern

The compositional data do not suggest a drastic change in glaze recipe for the late Glaze Ware types in comparison to the earlier types, yet a wider range of glaze paint colors is present on Glaze F sherds. In this section, I explore the relationships among glaze color, slip color, and core pattern in an attempt to sort out the relationship between composition and color. This multivariate approach may help explain the interaction of a number of production variables to give a better picture of how potters attempted to produce certain end products with regard to glaze paint color. In this section, I examine three questions:

1. How closely tied to composition is the final color of the glaze?
2. What is the relationship between the underlying slip color and the glaze color?
3. How closely tied is glaze color to the firing atmosphere, as viewed via the core color near the surface, with the glaze paint color?

Relationship Between Glaze Color and Composition

The earlier PCA graph of glaze composition (Figure 8.12) shows little change in the range of variation in glaze color from the early to the late glaze paints, yet the number

of different glaze colors represented on the sherds is much higher for the late Glaze Ware types. These late glazes have increasing amounts of green-colored glazes. Figure 8.14 and Table 8.8 below indicates that the relationship between composition and color is not direct—a range of colors is represented across the PCA graph. Black and brown glazes are not tied directly to compositional variation. Green glazes are more common with compositional recipes lower in manganese, but occur with a wide range of compositional variability.

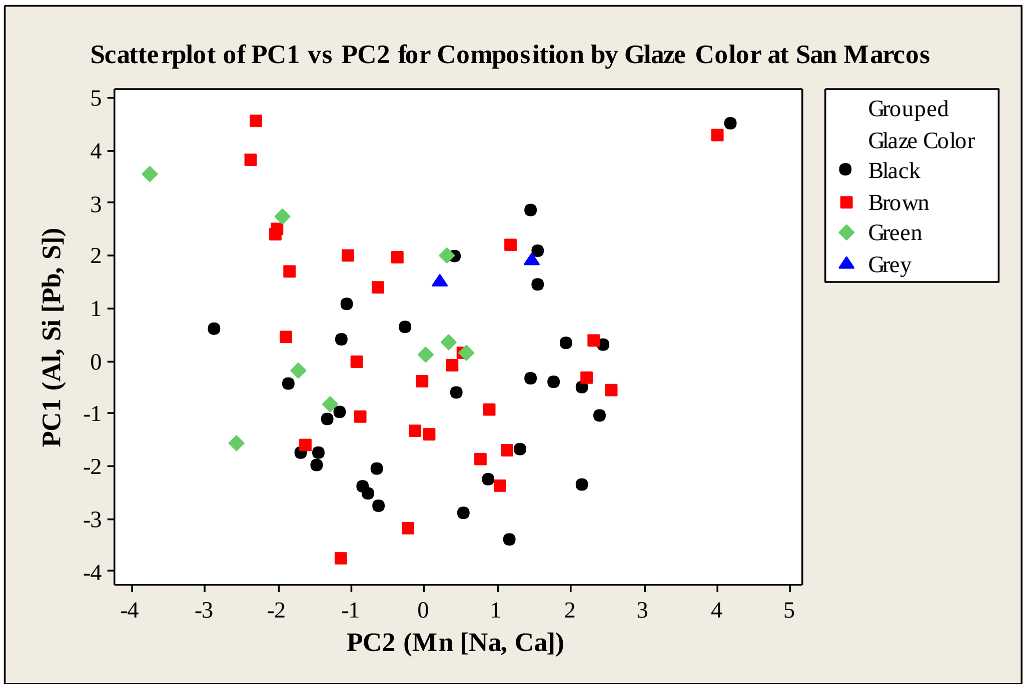


Figure 8.15: **Bivariate plot of glaze paint principal components 1 and 2 for San Marcos Sherds by glaze color.**

Table 8.9: ***Total Variance Percentage Explained and Component Matrix for the Principal Component Analysis of Results Plotted in Figure 8.15.***

Total Variance Explained			
Component	**Initial Eigenvalues Total**	**Percent of Variance**	**Cumulative Percent**
1	3.997	30.70%	30.70%
2	2.745	21.10%	51.90%
3	1.835	14.10%	66.00%
4	0.998	7.70%	73.70%
5	0.874	6.70%	80.40%
6	0.769	5.90%	86.30%
7	0.581	4.50%	90.80%
8	0.444	3.40%	94.20%
9	0.345	2.70%	96.80%
10	0.210	1.60%	98.40%
11	0.140	1.10%	99.50%
12	0.063	0.50%	100.00%
13	0.000	0.00%	100.00%

Component Matrix*			
Oxide	**Component 1**	**Component 2**	**Component 3**
Al_2O_3	0.389	0.202	0.109
SO_3	-0.307	-0.080	0.080
Na_2O	0.161	-0.465	-0.243
MnO	0.158	0.435	-0.191
K2O	0.277	-0.301	0.244
SiO_2	0.367	0.224	-0.265
PbO	-0.406	-0.233	0.285
MgO	0.303	-0.099	0.247
FeO	0.177	-0.319	-0.003
CaO	0.304	-0.388	0.122
CuO	0.078	-0.176	-0.484
TiO_2	0.322	0.060	0.319
ZnO	-0.039	-0.235	-0.513

* Only components with an eigenvalue greater than one were extracted

Because of this indirect relationship between color and composition, I now turn to a comparison of glaze color with other attributes that may have affected the final glaze color: the color of the underlying slip and the firing atmosphere.

Slip color and glaze paint color. Slip color may effect the color of the glaze by dissolving into the glaze during firing so that elements from the slip are incorporated into

the glaze. In comparing glaze color and slip color, there does not seem to be a direct relationship between the two (Figures 8.16 and 8.17). The individual slip color attribute is discussed in more detail Chapter 9. The most common slip color, tan, and the most common glaze color, black, occur with all other categories of slips and glazes. Tan is the most dominant slip color for all of the glaze colors. On the other hand, all of the glaze colors are found, at least in small numbers, on most of the slip colors. Green glazes are more limited than the others, as they do not occur on red/orange colored slips.

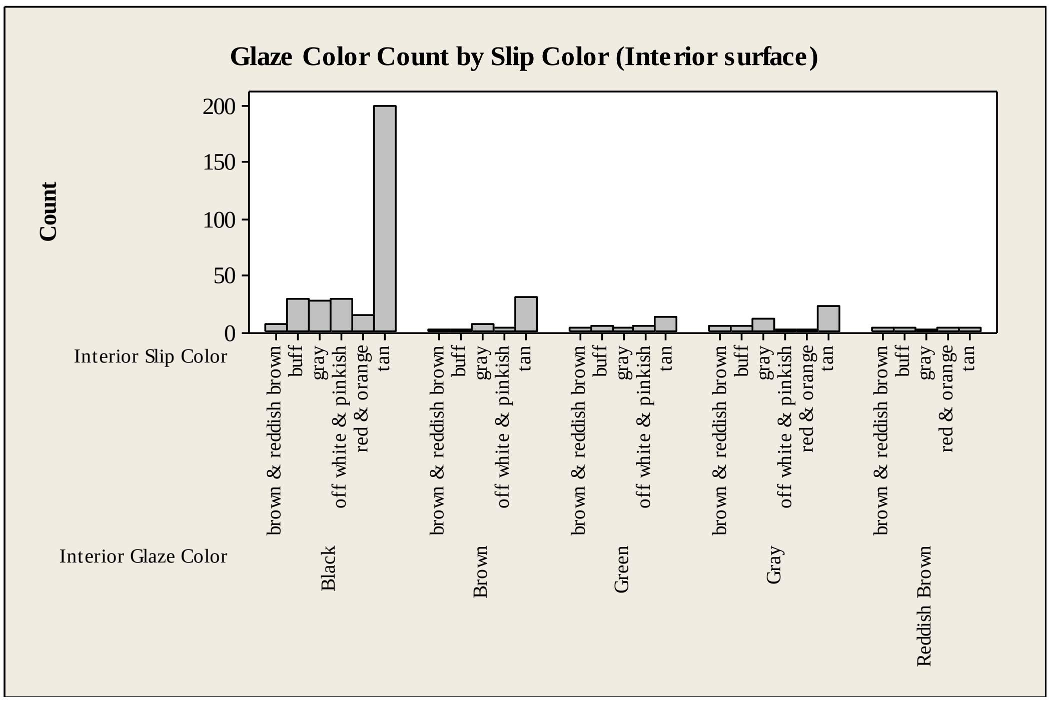


Figure 8.16: **Bar Chart showing the count of sherds with particular interior slip and glaze color combinations on the local sherd sample.**

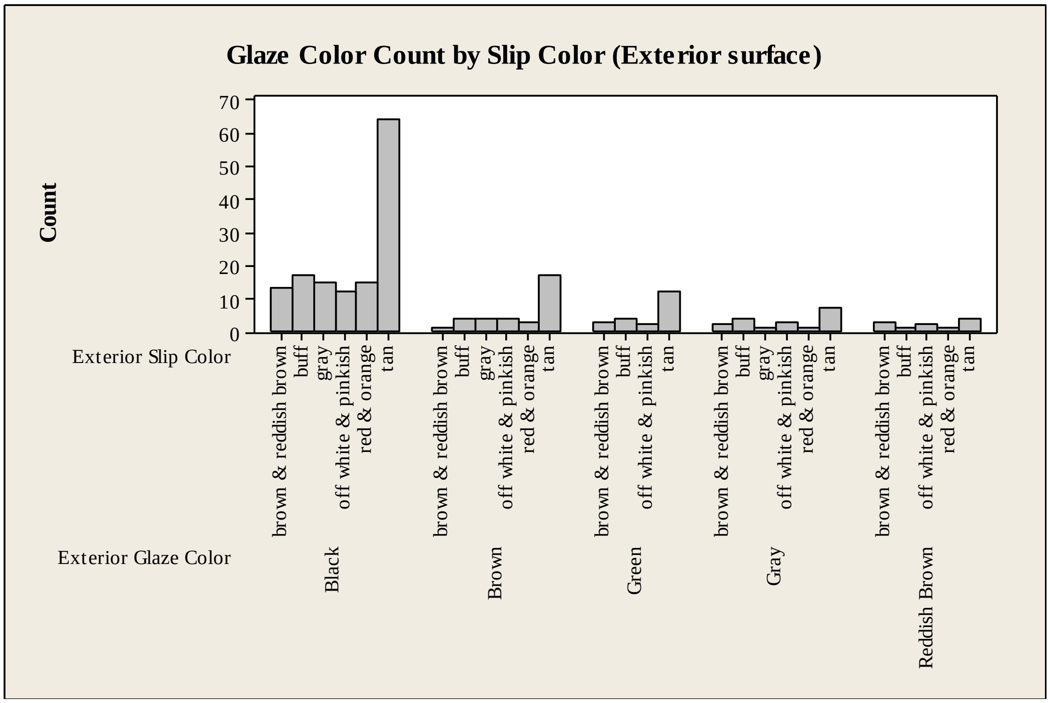


Figure 8.17: **Bar Chart showing the count of sherds with particular exterior slip and glaze color combinations on the local sherd sample.**

Firing condition, slip color, and glaze color. The relationship between firing condition and slip color on the surface of interest is also relatively straightforward. Although "core pattern" is discussed in depth in Chapter 10, I have separated out here the firing condition on the surface of interest (i.e., interior or exterior). The core pattern must be either "light" or "dark" on the surface of interest. Light indicates an oxidized surface and dark reflects either an incompletely oxidized or a reduced surface. Figures 8.18 and 8.19 clearly show that, whatever the firing condition on the surface of interest, the dominant slip color is still tan. In addition to this pattern, some other interesting relationships are shown by the chart. Red- and orange-colored slips almost always occur on a light, or oxidized, surface. This is not unexpected, since the oxidized atmosphere would be needed for the iron in the slip to oxidize into a reddish color. This is also the

case with buff-colored slips, which also occur most commonly on oxidized surfaces. Not surprisingly, gray slips are more dominant on dark surface that are reduced or incompletely oxidized.

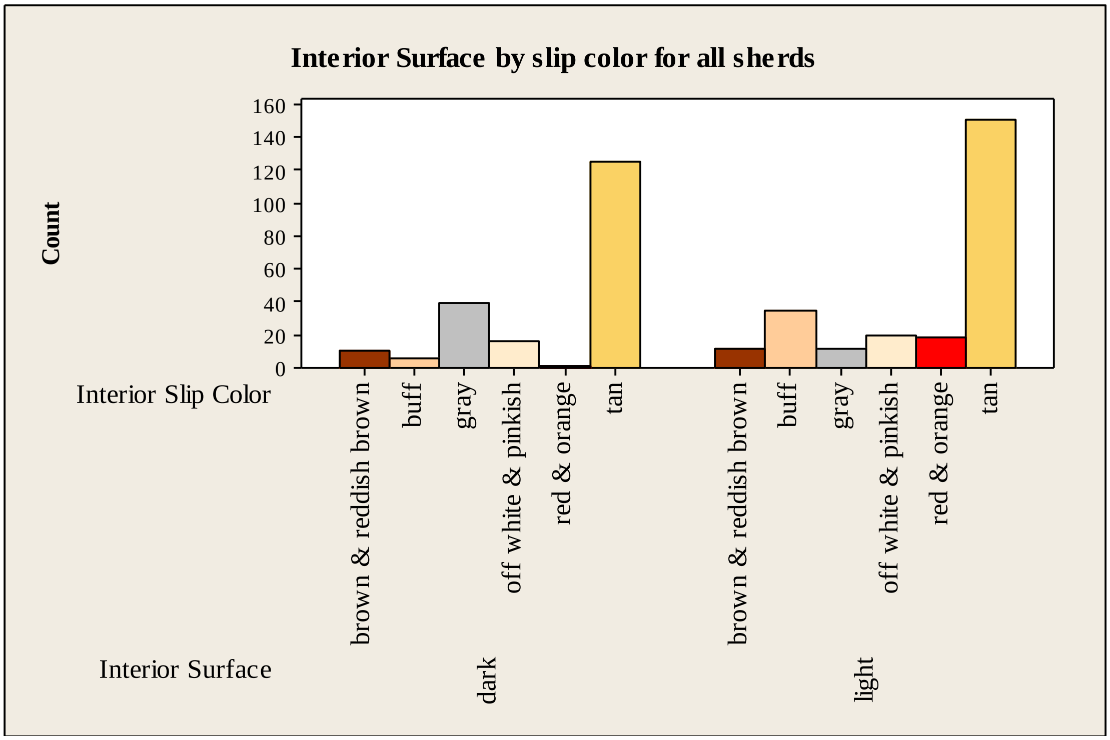


Figure 8.18: **Bar Chart showing the count of sherds with particular interior slip and surface color combinations on the local sherd sample.**

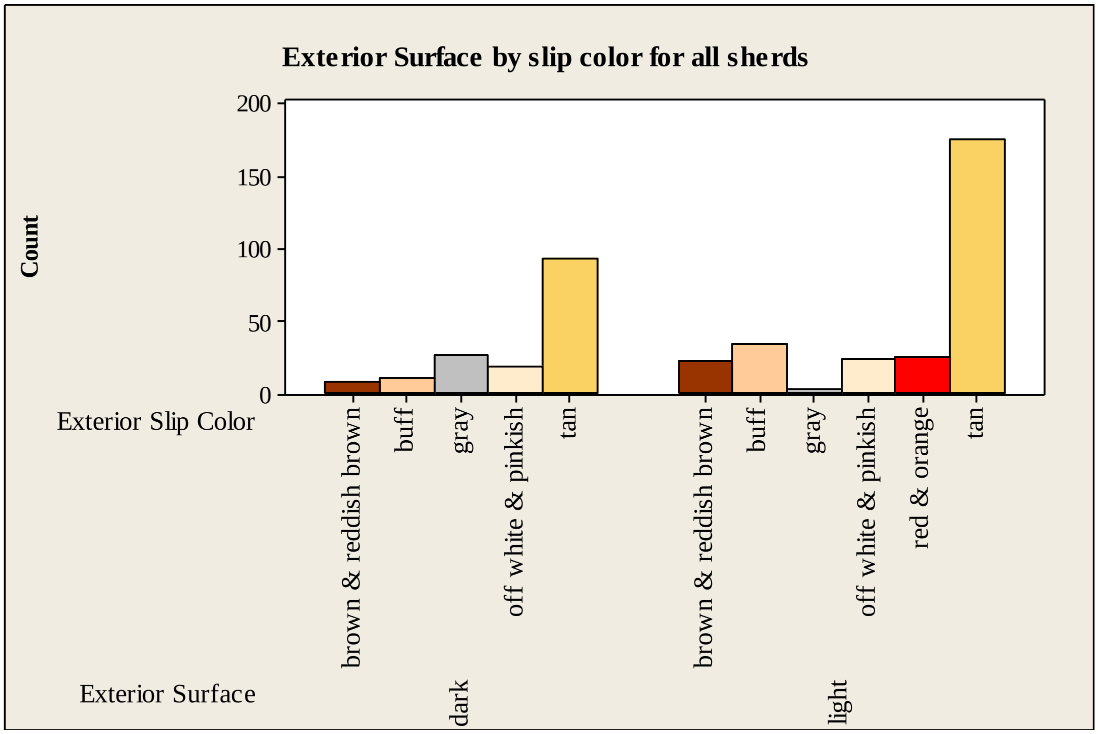


Figure 8.19: **Bar Chart showing the count of sherds with particular exterior slip and surface color combinations on the local sherd sample.**

If we look at all three attributes, glaze color, slip color, and surface color, a number of patterns emerge, especially related to the green-colored glazes. There are 52 instances of green glazes in the sample, 69 percent (n = 36) of which occur on Glaze F sherds. Further patterns are illustrated by the chart of slip color, glaze color, and surface color for Glaze F sherds (Figures 8.20 and 8.21).

Green glazes occur on a number of different slip colors, but most commonly on dark (reduced or incompletely oxidized) surfaces. Only 11 of the 36 instances of green glaze paint on Glaze F sherds occur on an oxidized surface. In addition, black glazes are more common on light colored or oxidized surfaces, for any slip color. This pattern holds for both interior and exterior surfaces.

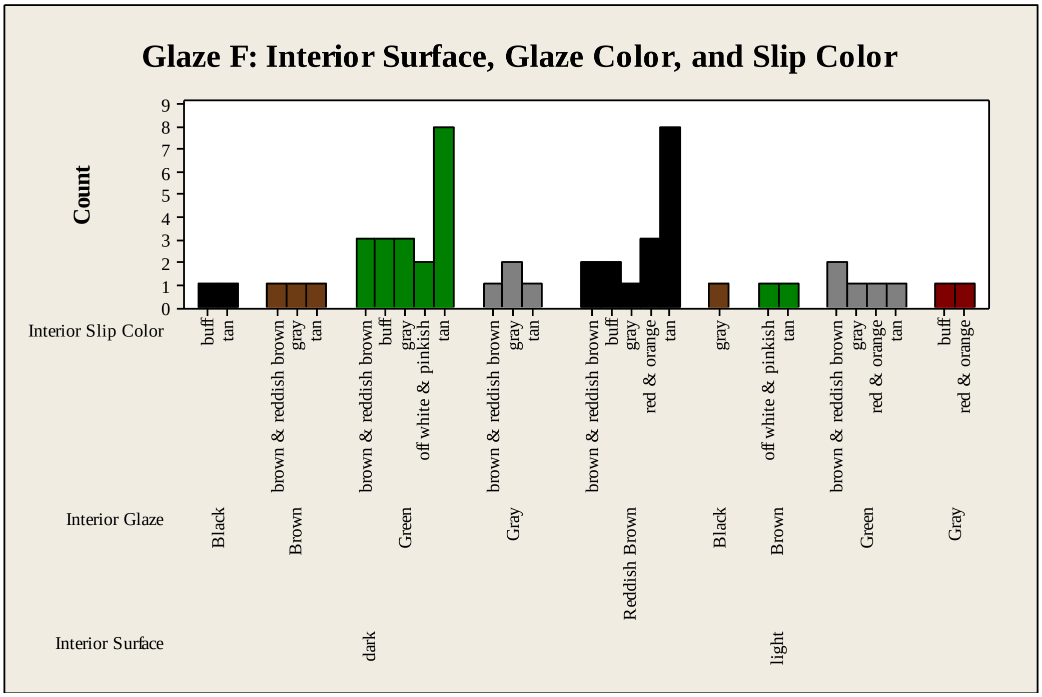


Figure 8.20: **Bar Chart showing the count of Glaze F sherds with particular interior slip, glaze, and surface color combinations from the local sherd sample.**

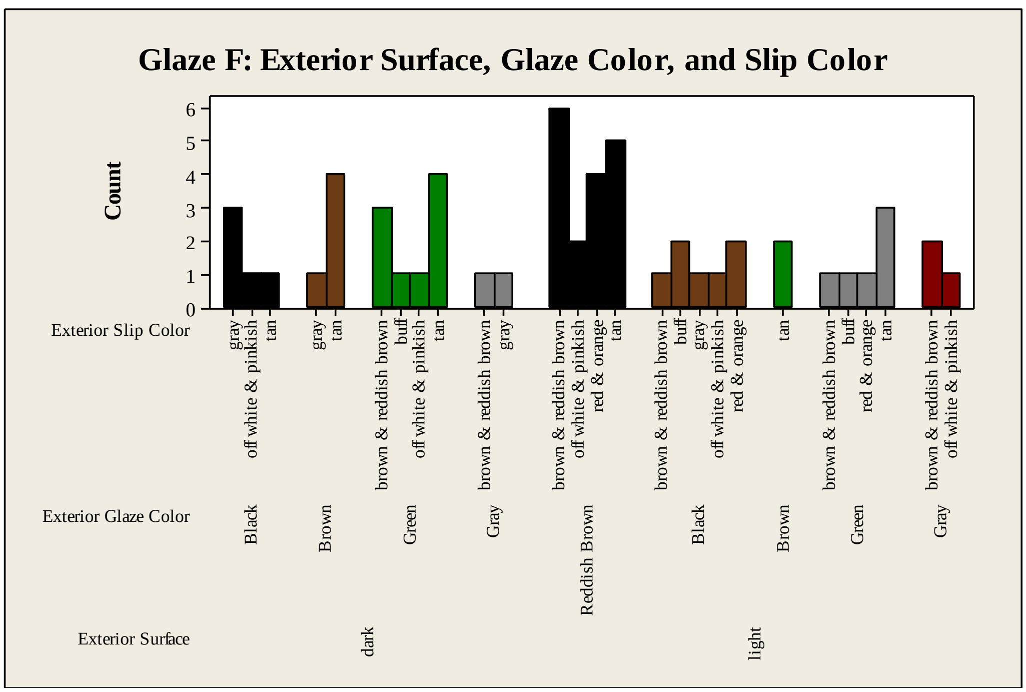


Figure 8.21: **Bar Chart showing the count of Glaze F sherds with particular exterior slip, glaze, and surface color combinations from the local sherd sample.**

The relationship between surface color and glaze color is even clearer when we group all of the slip colors together for Glaze F sherds. Figures 8.22 and 8.23 again show the dominance of green glazes on dark, reduced or incompletely oxidized surfaces, and the dominance of black glazes on light, oxidized surfaces.

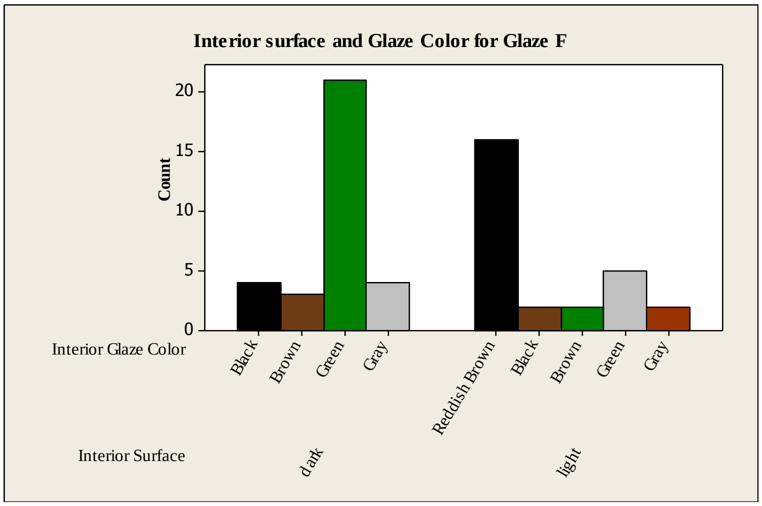


Figure 8.22: **Bar Chart showing the count of Glaze F sherds with particular interior glaze and surface color combinations from the local sherd sample.**

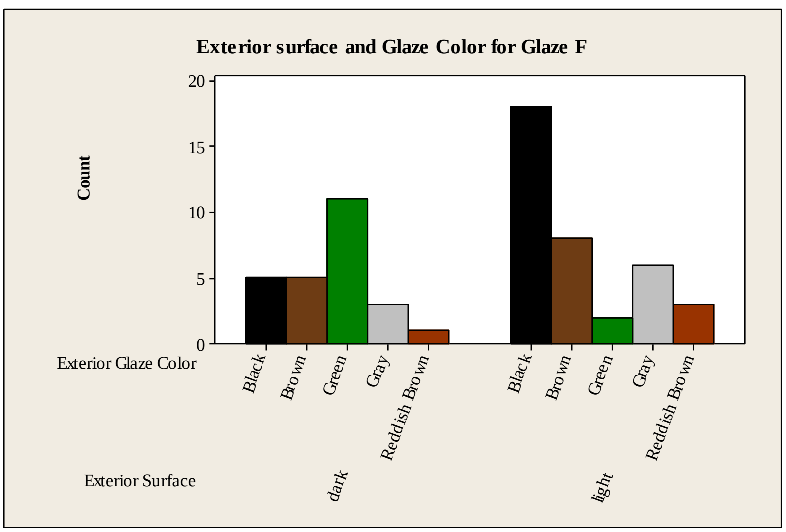


Figure 8.23: **Bar Chart showing the count of Glaze F sherds with particular exterior glaze and surface color combinations from the local sherd sample.**

If we look at green glazes prior to Glaze F, the pattern is different (Figure 8.24). The few green-colored glazes on types A through D occur more commonly on light, oxidized surfaces. Although there are more instances of green on a dark surface overall (29 on dark and 23 on light), the Glaze F sherds are the only ones with dark dominant surface colors.

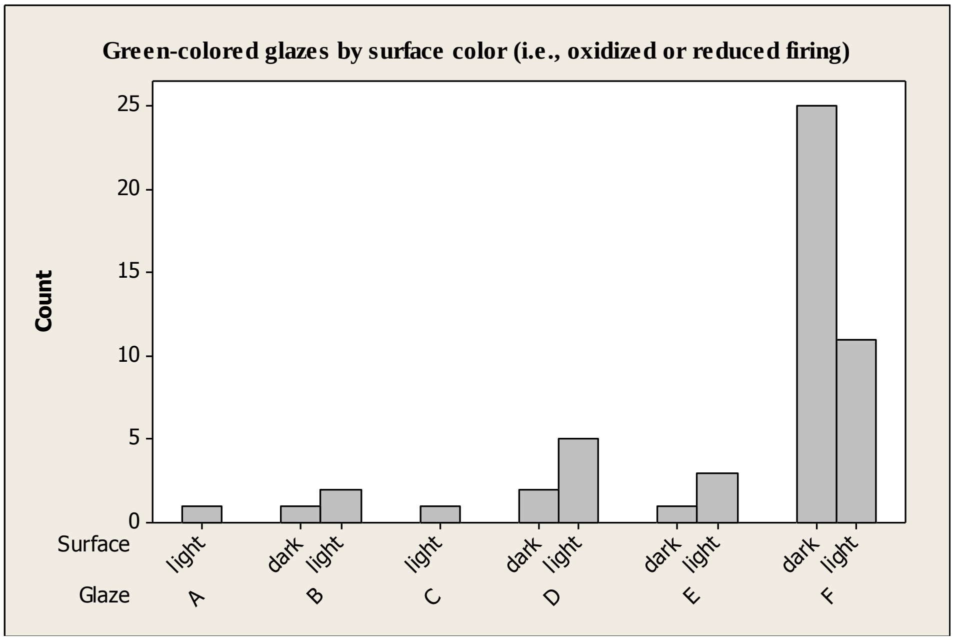


Figure 8.24: **Bar Chart showing the count of sherds with green-colored glaze by Glaze Ware type and surface color.**

To attempt to sort out the relationship between firing atmosphere and color, I refired five chips removed from Glaze F sherds with green glaze paint. These chips were fired in a kiln for 30 minutes at 900ºC in an oxidizing atmosphere. The results are shown in Table 8.10.

Table 8.10: ***Refiring experiment results for a sample of five green glazes on different-colored surfaces refired in an oxidizing atmosphere***

Sherd Number	Glaze Color	Surface (on side of sherd with green glaze)	Refire Glaze Color
F78	Black with green	Dark	Black with green
F47	Green	Light	Green (brighter)
F44	Brown with green	Light	Brown (darker) with green
F74	Brown with green	Light	Brown with green
F49	Green	Dark	Green (brighter)

The results are mixed for these small chips as well. When refired, the dark surfaces with green glaze become light surfaces, yet the glaze remains green, although in one instance it brightened significantly to an almost apple green. When refired, the light surfaces do not change (or they become slightly lighter); the glaze colors follow suit and also do not change significantly. This very small refiring experiment suggests that it is possible to produce green glazes in an oxidizing atmosphere and that the color does not drastically change regardless of the firing atmosphere. This suggests a closer tie between color and composition than the data presented above suggest. It is possible that the small sample size (n = 67) for glaze paint composition analysis compared to the much larger sample size for the glaze paint color analysis (n = 372) is not representing as much variation as the larger sample. Rather than clearing up the relationship among glaze color, composition, slip color, and firing, these data have only led to additional questions. The relationship between composition and color is an important one that should be studied further in the future.

Summary of the Glaze Paint Color and Composition Analysis

Glaze paint was a complex technological innovation that involved close communication with potters at other sites, perhaps with San Marcos potters as a main

source of knowledge of how to make a successful glaze. The relationship between composition and color is a complex one that needs further exploration. It is likely that the firing methods, and perhaps, the slip or clay used for the vessel, played an important role in the resulting color. Color does not seem to be directly correlated with composition.

Glaze paint color diversity increases for Glaze F sherds, but is relatively stable for Glaze Ware types A through E. Glaze paint composition changes only slightly through the Glaze Ware sequence, primarily in the increase in the amount of lead after Glaze A. Neither composition or color suggests any greater or lesser degree of standardization for Glaze C or D production. This corroborates the findings from the other attributes examined. The glaze paint production step is similar to the morphology and temper attributes, in that no drastic changes in standardization of the assemblage occurred during the Glaze C and D production periods. These data continue to add support to the apparent stability of production and continuity in learning and teaching networks at the site during the intermediate Glaze Ware period; these data, with the inclusion of data from sherds manufactured at other Glaze Ware producing sites, suggest a high degree of continuity within the wider Glaze Ware producing region as a whole. In the next chapter, I continue to examine glaze paint by examining the standardization of its application as decoration on the sherd and whole vessel samples.

Chapter 9

Methods, Data, and Results for Decorative Attributes and Design Analysis

Decoration and design are significant components in any craft production system. Many decorative aspects of pottery are highly visible and often signal social meaning to both the maker and the viewer (e.g., Carr 1995; LeBlanc and Henderson 2009). In the current analysis of decoration and design, I examine a number of attributes with varying degrees of visibility, from the degree of polishing, to painted line thickness, to decorative elements and motifs. Standardization of these attributes may represent either mechanical and intentional factors, but in general, highly visible decorative attributes, such as slip color or design elements or motifs, result from *conscious* or *intentional* choices between socially acceptable alternatives. Other low visibility decorative attributes, such as range of variation in line thickness, represent more mechanical factors.

Variation in decoration and design may largely reflect *habitus*— "the way things are done," (Bordieu 1977; Dietler and Herbich 1998; or "isochrestic variation" [Sackett 1977, 1985, 1990]; or *chaînes de opératoire* [Dobres and Hoffman 1994; Lemmonier 1986]). Alternatively, variation may result from potters actively signaling more detailed information about social or political life (e.g., Wiessner 1983, 1984, 1985, 1990; Wobst 1977). Regardless of the degree of intentionality of the potter in communicating socio-political messages, the amount of standardization in these attributes informs on the level of social control over potters or how much consumer or social demands required them to hold to certain stylistic canons.

I present the analysis of decorative elements in two parts. The first section discusses the decorative elements on the local and exported sherd samples. Attributes

easily examined on sherds are included here, such as slip color, luster intensity, framing-line thickness, and distance below the rim of the framing line. The second section deals with the whole vessel sample and examines the structure and elements used in the painted decoration on San Marcos vessels in comparison to vessels from other sites.

Decorative Analysis on Sherds

I recorded a number of decorative attributes on the relatively small sherds of the local and exported samples, including framing-line measurements, slip color, and luster intensity. Two different framing-line attributes were recorded: thickness of the line and the distance of the line below the rim (following Motsinger 1992, 1997). Up to five measurements of the framing line thickness were recorded. When a sherd was not large enough for five measurements to be taken, at least three measurements were taken, one at each end of the line at the edges of the sherd and one in the center of the sherd. On the small sherds in the sample it was often difficult to tell if a line was a framing or decoration line, so the uppermost line was always recorded unless it was obviously part of the field of decoration. Occasionally whole vessels did have two or three framing lines, so lower lines that might be framing lines were also recorded, although these were so few that quantitative analysis was limited. For the distance of the framing line below the rim, up to five measurements were also taken from the top of the rim to the top of the framing line.

Accuracy in identification of slip color, glaze paint color, and luster intensity is dependent on a constant light source. For these attributes a standard 50-watt, 120-volt light source with UV filter was used.

Using a Munsell Soil Color Chart, up to four attributes of slip color were recorded for each sherd: interior and exterior slip color and interior and exterior slip paint color. One Munsell number for the most dominant color was recorded for each attribute that was present, and the Munsell colors were grouped into more general color categories for ease of comparison.

Luster intensity was measured on both the exterior and interior of the sherd, in one of three categories: high, medium, and low. High luster indicated a shiny or glossy finish. Medium luster was less shiny, with some shiny areas and other areas that were more matte in appearance. On sherds with low luster the overall surface was matte, with little or no shine evident. Any markings on the surface, such as striations, crazing, or wipe marks were also noted.

Decorative attributes: Framing lines. The average framing line thickness for the local sample, 6.4 mm, was a bit smaller than the exported sample mean, of 6.9 mm. The boxplots and table below (Figures 9.1 and 9.2, Table 9.1) show that the averages for all local and exported Glaze Ware types ranged from 5.8 to 7.7 mm. The coefficient of variation for both local and exported Glaze Ware types ranged from approximately 20 to 40 percent (Table 9.1 and Figure 9.3). These high coefficients of variation suggest that framing-line thickness is not particularly standardized throughout the sequence. The Levene's test shows p-values above the 0.05 level indicating that the variance throughout the Glaze Ware sequence for each sample set does not change. In comparing the Levene's test p-values between the local and exported sample, the Glaze B sherds have statistically significant variances, with a p-value of 0.009 (Table 9.2). This can be explained by the differences in the statistics used here; the coefficient of variation, which

does not show much difference for Glaze B local and exported sherds, is determined by taking into account the mean as well as the standard deviation. The Levene's test is based on the variance of the samples only. We have a fairly large difference in the means between the local and exported Glaze B samples for framing-line thickness, so the Levene's test, which did not take the differences in the mean into account, is likely less reliable.

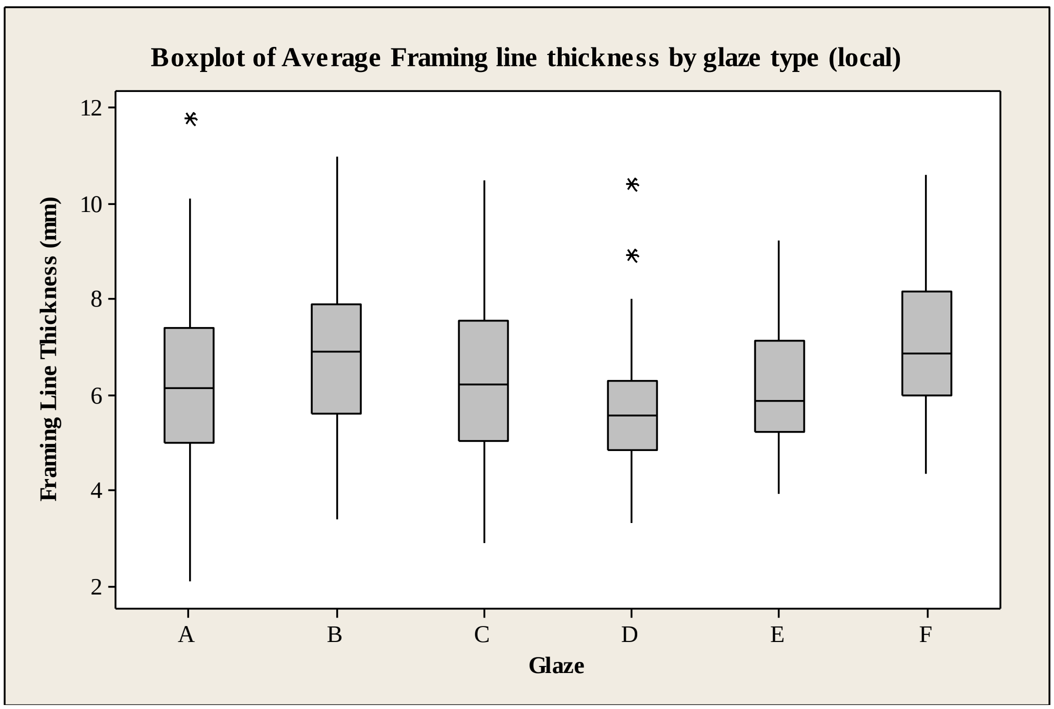


Figure 9.1: **Boxplot of the average framing-line thickness by Glaze Ware type for the local sample.**

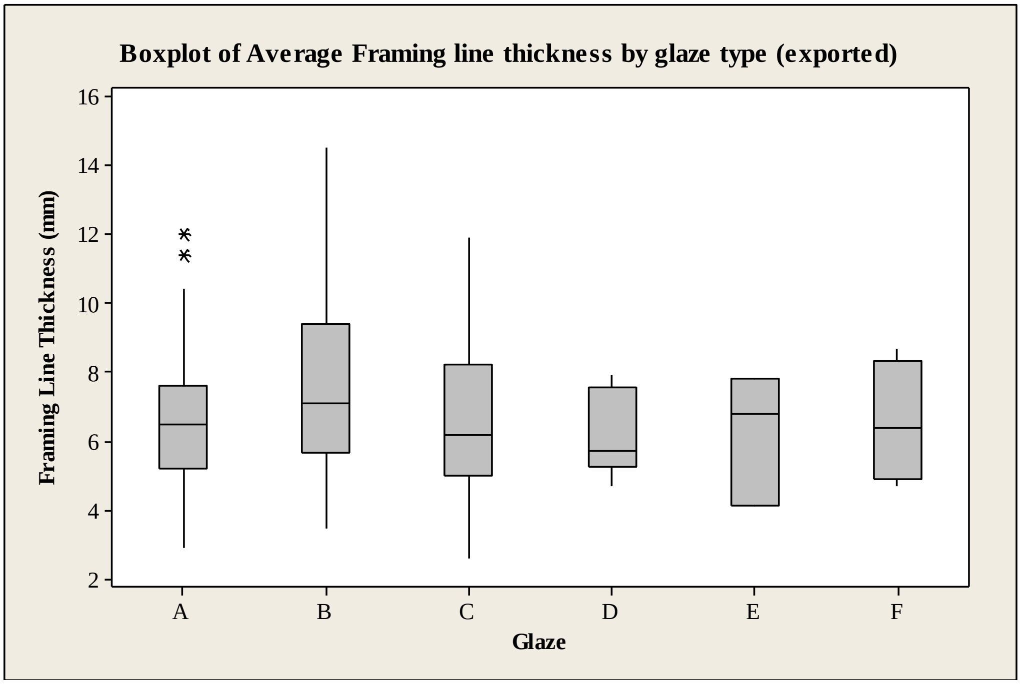


Figure 9.2: **Boxplot of the average framing line-thickness by Glaze Ware type for the exported sample.**

Table 9.1: ***Statistics for framing-line thickness by Glaze Ware type for both local and exported samples.***

Framing Line Thickness Statistics by Glaze Ware Type									
Glaze Type	**N**	**Mean (mm)**	**SE Mean**	**Standard Deviation**	**Coefficient of Variation**	**Interquartile Range**	**Median**	**Min**	**Max**
Local Sample									
A	76	6.19	0.19	1.70	27.43	2.39	6.13	2.1	11.8
B	65	6.81	0.20	1.63	23.98	2.25	6.89	3.4	11
C	53	6.47	0.25	1.79	27.72	2.52	6.21	2.9	10.5
D	37	5.81	0.24	1.46	25.09	1.45	5.56	3.3	10.4
E	25	5.99	0.26	1.30	21.71	1.89	5.86	3.9	9.21
F	10	7.14	0.55	1.74	24.34	2.15	6.87	4.4	10.6
Levene's Test P-Value = 0.402									

Table 9.1 Continued

Glaze Type	N	Mean (mm)	SE Mean	Standard Deviation	Coefficient of Variation	Interquartile Range	Median	Min	Max
Framing Line Thickness Statistics by Glaze Ware Type									
Exported Sample									
A	47	6.57	0.31	2.10	31.98	2.42	6.49	2.9	12
B	34	7.67	0.44	2.57	33.53	3.74	7.10	3.5	14.5
C	16	6.44	0.68	2.56	39.76	3.23	6.16	2.6	12
D	8	6.16	0.43	1.22	19.75	2.32	5.69	4.7	7.91
E	3	6.25	1.10	1.91	30.53	3.71	6.77	4.1	7.84
F	4	6.53	0.89	1.78	27.19	3.41	6.36	4.7	8.7
Levene's Test P-Value = 0.440									

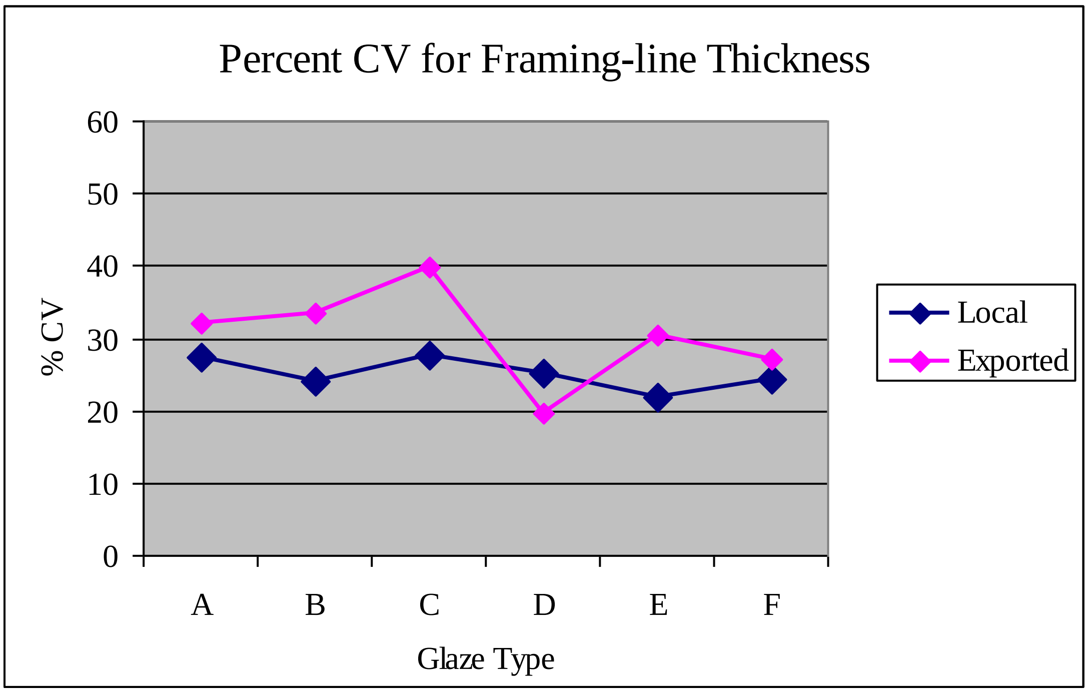


Figure 9.3: **Graph of the percent coefficient of variation for framing-line thickness for the local and exported samples.**

Table 9.2: ***Levene's Test p-value comparison of the local and exported samples.***

Levene's Test P-value: Comparison of local versus exported samples	
Glaze Ware Type	**P-value**
A	0.223
B	0.009
C	0.188
D	0.770
E	0.664
F	0.808

There are several possible implications from the unstandardized nature of framing-line thickness. Because many of the morphological attributes are more standardized than this decorative attribute, it is possible that we have evidence of multiple hands working on the pots. If different people, with a lower skill level, decorated the vessels, that might explain the lower levels of standardization. Crown (2007) has documented multiple hands on pots—with finely shaped pots with a lack of precision in the decoration—as evidence of learners working with more skilled potters. Another possible explanation for these unstandardized framing lines is in the nature of glaze paint itself. Glaze paint application could be done with great care and precision, but often the glaze would run or expand slightly (or, occasionally, significantly), which would obscure any possible standardization in the attribute. My results contrast with those of Motsinger (1992, 1997), who found that in pottery exported from the Galisteo Basin to the Salinas region, there was an increase in standardization from Glaze A through D for framing line thickness and distance of the framing line below the rim (Motsinger 1992:65–66).

Decorative attributes: The distance of the framing line below the rim. The distance of the framing line below the rim is an even more variable attribute than the

framing-line thickness. The average distance of the framing line below the rim increases throughout the Glaze Ware sequence, while the coefficient of variation generally decreases (Figures 9.4, 9.5, and 9.6 and Tables 9.3 and 9.4). Levene's test p-values show significant differences within the samples, which seems likely with the rather drastic changes in the coefficient of variation. The local and exported samples are not significantly different within the Glaze Ware types, indicating no change in standardization for the two groups.

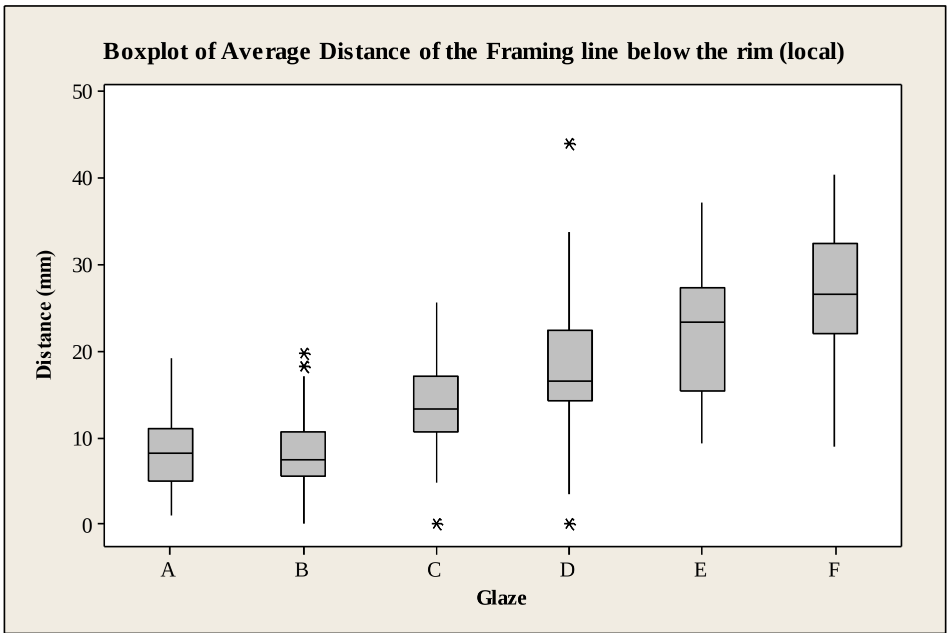


Figure 9.4: **Boxplot of the average distance of the framing line below the rim for the local sample.**

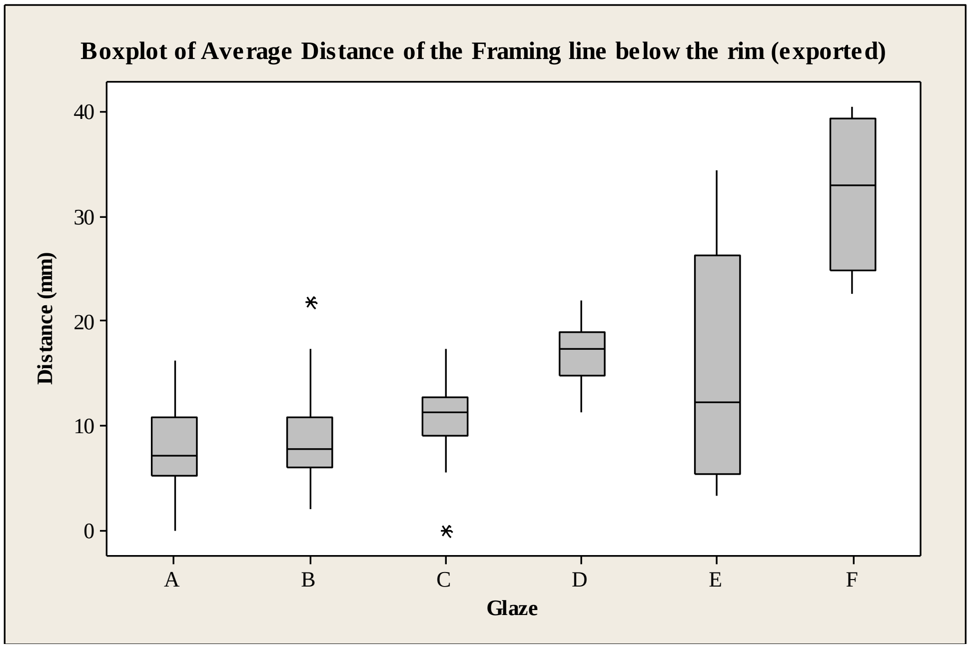


Figure 9.5: **Boxplot of the average distance of the framing line below the rim for the exported sample.**

Table 9.3: ***Statistics for distance of the framing line below the rim by Glaze Ware type for both local and exported samples.***

Glaze Type	N	Mean (mm)	SE Mean	Standard Deviation	Coefficient of Variation	Interquartile Range	Median	Min	Max
Framing Line Distance Below the Rim Statistics by Glaze Ware Type									
Local Sample									
A	76	8.65	0.48	4.17	48.24	6.01	8.26	1.03	19.17
B	72	8.58	0.51	4.32	50.32	5.04	7.49	0.00	19.75
C	56	13.55	0.63	4.64	34.21	6.37	13.38	0.00	25.65
D	44	18.29	1.16	7.69	42.03	8.25	16.49	0.00	44.02
E	29	22.14	1.34	7.22	32.61	11.86	23.27	9.36	37.23
F	25	26.88	1.59	7.93	29.51	10.55	26.62	8.98	40.50
Levene's Test P-Value = 0.001									

Table 9.3 Continued

Framing Line Distance Below the Rim Statistics by Glaze Ware Type									
Glaze Type	**N**	**Mean (mm)**	**SE Mean**	**Standard Deviation**	**Coefficient of Variation**	**Interquartile Range**	**Median**	**Min**	**Max**
Exported Sample									
A	48	7.88	0.54	3.72	47.19	5.47	7.10	0.00	16.22
B	36	8.81	0.72	4.32	49.06	4.87	7.78	2.08	21.71
C	16	10.63	1.06	4.09	38.51	3.56	11.32	0.00	17.37
D	9	17.00	1.08	3.23	18.99	4.12	17.31	11.22	22.00
E	6	15.27	4.75	11.63	76.17	20.76	12.23	3.33	34.30
F	7	32.25	3.01	7.37	22.85	14.43	32.96	22.63	40.36
Levene's Test P-Value = 0.000									

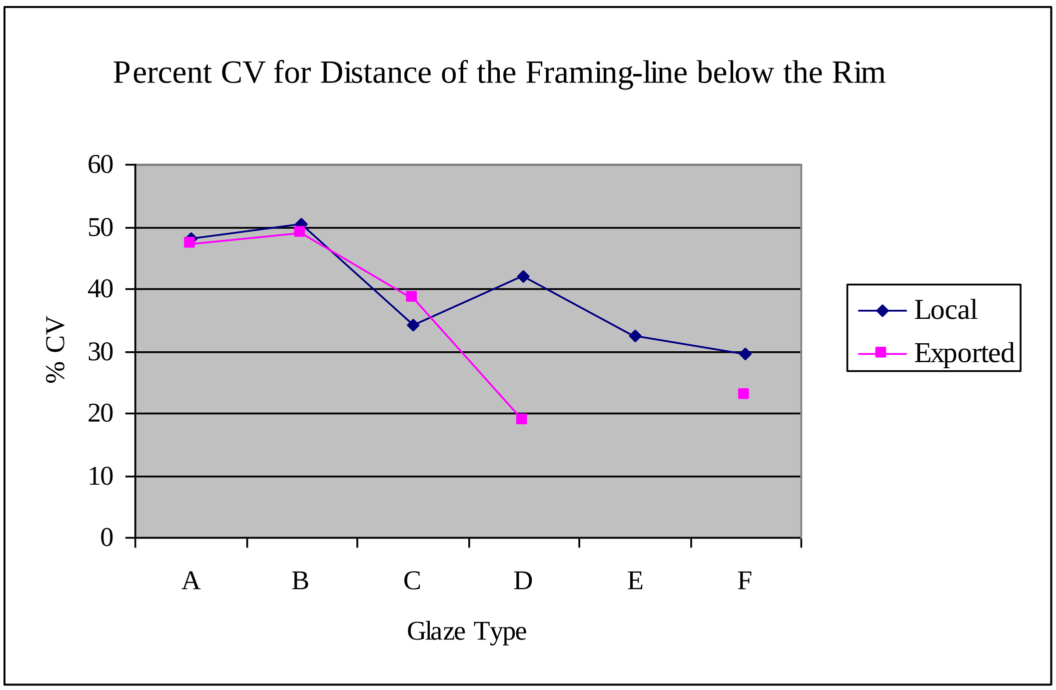


Figure 9.6: **Graph of the percent coefficient of variation for distance of the framing line below the rim for the local and exported samples.**

Table 9.4: ***Levene's Test p-value comparison of the local and exported samples.***

Levene's Test P-value: Comparison of local versus exported samples	
Glaze Ware Type	**P-value**
A	0.48
B	0.811
C	0.253
D	0.085
E	0.284
F	0.893

Although there is a reduction in variability, as seen in the general decrease in the coefficients of variation through time, this trend does not indicate any changes in the organization of production over the Glaze Ware sequence. I suggest that the results for this attribute indicate more about changes in the vessel form, or more specifically rim form, than about the decorative line itself. The later types, especially Glaze F, have a pronounced lip (or carination), giving the potter a map of where to put the framing line. For Glaze A vessels, with a direct rim and no defining shoulder or rim extension, the potter has no clear guide as to where to paint the framing line, hence the range of variation for its placement is very high on these early vessels.

Decorative attributes: Slip color. Initially, slip color was recorded using the Munsell soil color chart, which yielded over 100 different Munsell codes. I decided to group the Munsell codes into nine general color categories that more closely reflect the colors commonly used to describe Glaze Ware (e.g., Eckert 2006): brown, buff (light brown with a pinkish tone), gray, off-white, orange, pinkish, red, reddish brown, and tan (light brown with a yellowish tone). These nine groups were further combined into six categories to facilitate discussion: brown and reddish brown, buff, gray, off-white and

pinkish, red and orange, and tan (see Appendix A, Table 2). Table 9.5 shows that the dominant slip color for the entire sample (local and exported sherds combined) is tan, at 62 percent of the sample. This yellowish color is what is traditionally thought of as typical of the Galisteo Basin (e.g., Shepard 1942; Warren 1969, 1979), so this dominance is not surprising. However, other slip colors, such as buff and gray, are also quite common. This variability may relate to differences in firing conditions, especially in the case of "gray" slips that may just be misfiring, or fireclouds.

Table 9.5: **Counts for sherd interior and exterior slip colors in the grouped categories.**

Slip Color Category	Count (Interior)	Percent	Count (Exterior)	Percent	Overall Count	Overall Percent
Tan	275	61.94%	269	61.42%	544	61.68%
Buff	41	9.23%	44	10.05%	85	9.64%
Gray	51	11.49%	29	6.62%	80	9.07%
Off white and Pinkish	36	8.11%	41	9.36%	77	8.73%
Brown and Reddish brown	21	4.73%	30	6.85%	51	5.78%
Red and Orange	20	4.50%	25	5.71%	45	5.10%
	444	100%	438	100%	882	100%

The slip colors used change significantly through time (Figures 9.7–9.11). Tan slips are the most common throughout, but they dominate during the first half of the Glaze Ware sequence. Glazes D through F have higher percentages of other colors of slip. The decrease in tan slips through time occurs on both the interior and exterior of both the local and exported samples.

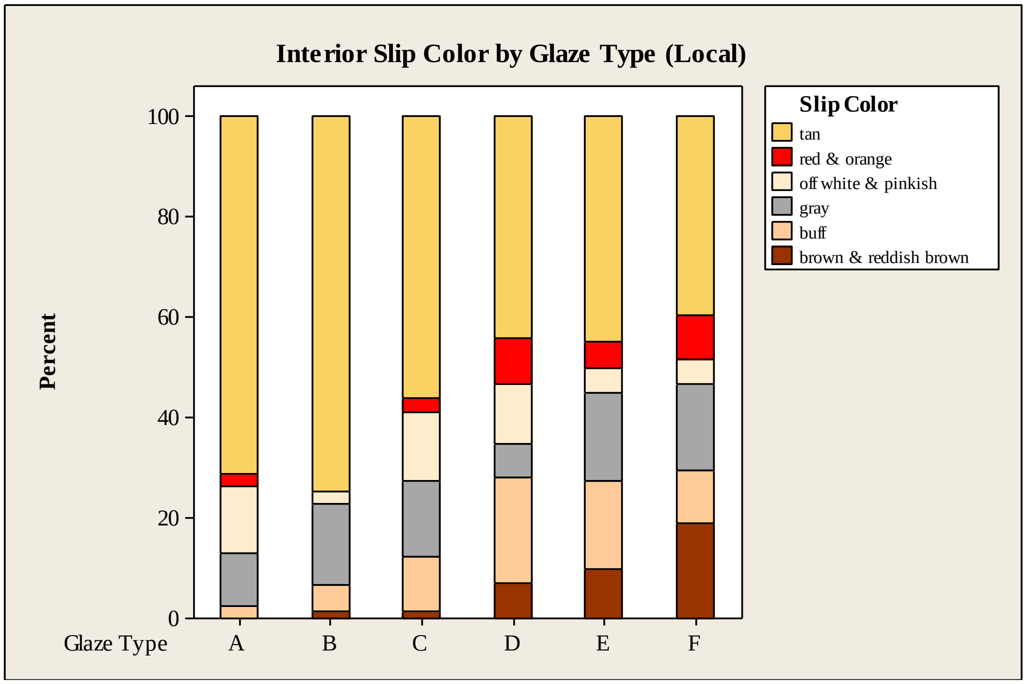


Figure 9.7: **Interior slip color by Glaze Ware type for the local sample.**

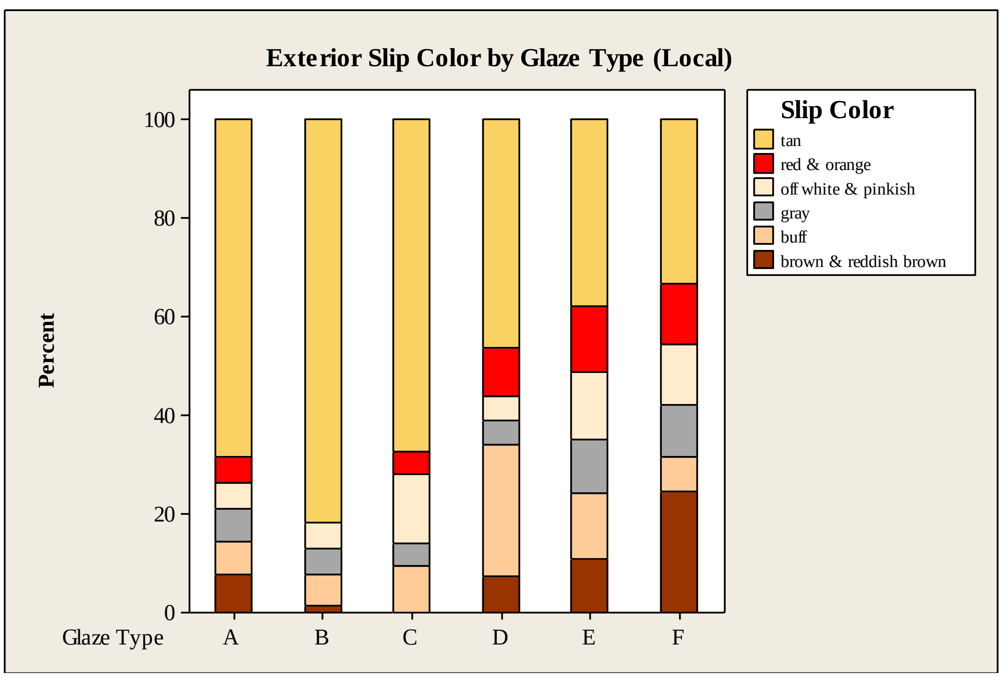


Figure 9.8: **Exterior slip color by Glaze Ware type for the local sample.**

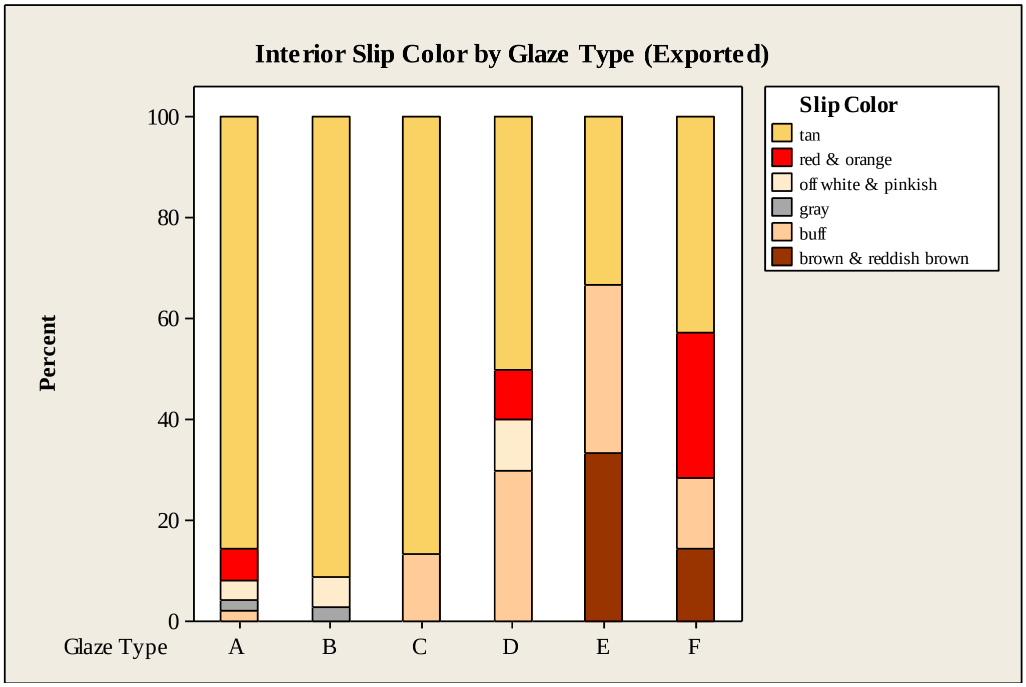


Figure 9.9: **Interior slip color by Glaze Ware type for the exported sample.**

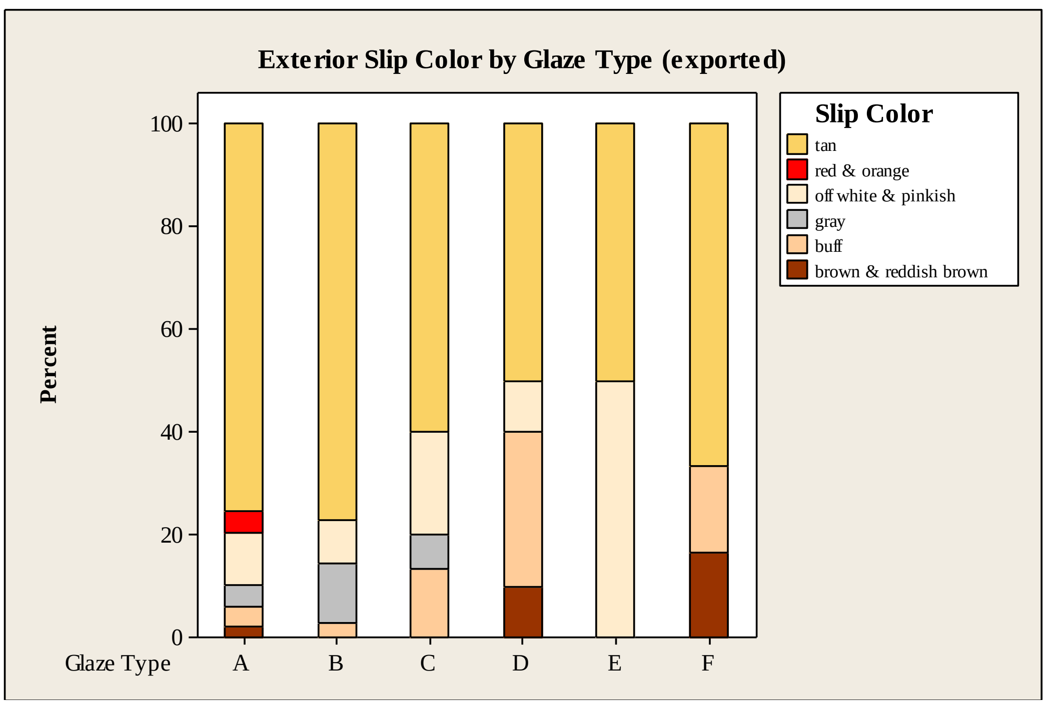


Figure 9.10: **Exterior slip color by Glaze Ware type for the exported sample.**

Changes in the diversity of the assemblage occur with the temporal changes in the slip colors for both the local and exported assemblages (Table 9.6 and Figure 9.11). The least diverse assemblages for both samples are with the Glaze B sherds (i.e., Glaze B is the most standardized in terms of slip color used). Glazes D through F are very diverse, unstandardized assemblages when it comes to slip color. This suggests that for potters at San Marcos variation in the slip color was more acceptable during the later half of the Glaze Ware sequence. This may not have been intentional, but due to the minor changes in firing temperature noted in Chapter 10. On the other hand, the changes in slip color may relate to changes in the designs used, which do change through time, as discussed later in this chapter. The variation present on the intermediate Glaze Ware types, Glazes C and D, are not any more or less standardized than the other Glaze Ware types—the pattern seems to be more of a temporal one than one related to changes in the intensity of production that occurred during the intermediate period. The diversity of slip color, much like the diversity of glaze paint color, increases with time. It may be that these changes simply reflect changing canons of style and market demands.

Table 9.6: ***Scaled Shannon Diversity Index Values for Slip Color by Glaze Ware Type.***

Scaled Shannon Diversity Index for Slip Color						
Attribute	**A**	**B**	**C**	**D**	**E**	**F**
Slip Color Interior (grouped) Local	0.5799	0.3994	0.598	0.7959	0.7307	0.7335
Slip Color Interior (grouped) Exported	0.4548	0.4347	0.5182	0.8155		0.7453
Slip Color Exterior (grouped) Local	0.6763	0.5186	0.6002	0.8079	0.8055	0.7866
Slip Color Exterior (grouped) Exported	0.5412	0.439	0.5687	0.699		0.5396

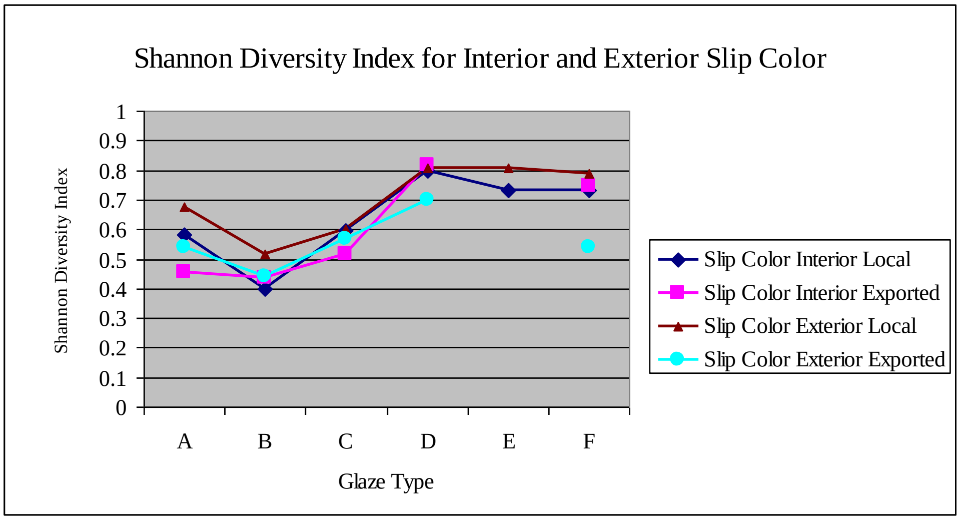


***Figure 9.11:* Graph of the Shannon diversity index for slip color for the local and exported samples.**

Decorative attributes: Luster. The luster visible on sherds is reflective of a number of variables. The most direct variable is the degree of polishing, but factors such as clay and slip mineral size, shrinkage due to firing temperature, and use wear also play a role. If there are differences in the clay and slip minerals used, the slip clay minerals may shrink more or less than the clay underneath, reducing the luster. Larger clay particles may result in lower levels of luster compared to small clay particles. Shrinkage due to firing temperature causes the realignment of clay particles. Vessels made by Santa Clara potters are fired at low temperatures so that the high luster is not reduced during firing (Shepard 1956). Use wear also reduces the original luster. These factors are discussed further after the presentation of results.

The local sample reveals a lower level of luster on both interior and exterior surface for Glaze A, then relative consistency throughout the rest of the sequence (Figures 9.12 and 9.13). Glaze F also shows lower levels of luster, but the decrease is not

significantly different than the levels for Glaze B and D. For the exported sample, interior and exterior degree of luster is slightly different (Figures 9.14 and 9.15). Interior polish shows a pattern similar to that for the local sample, with lower luster for the early types, slightly higher luster for the intermediate types, and lower luster again for the late types, which, for the exported sample are dominated by Glaze F sherds. The exterior luster for the exported sample shows a slightly different pattern, with the early types having just slightly higher luster than the intermediate and late types. Overall, the slight differences do not suggest major changes in luster or level of polishing through time or between the local and exported samples.

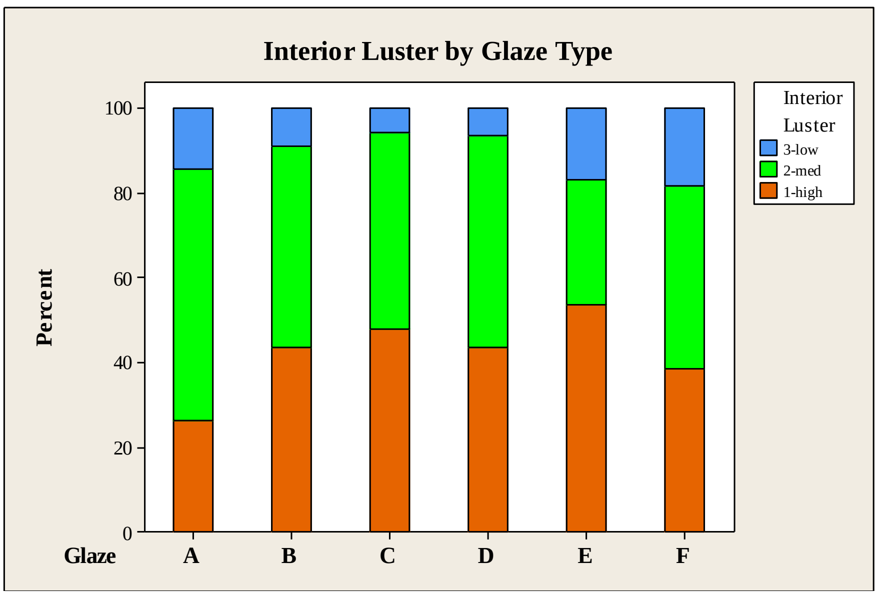


Figure 9.12: **Bar Chart of interior luster by Glaze Ware type for the local sample.**

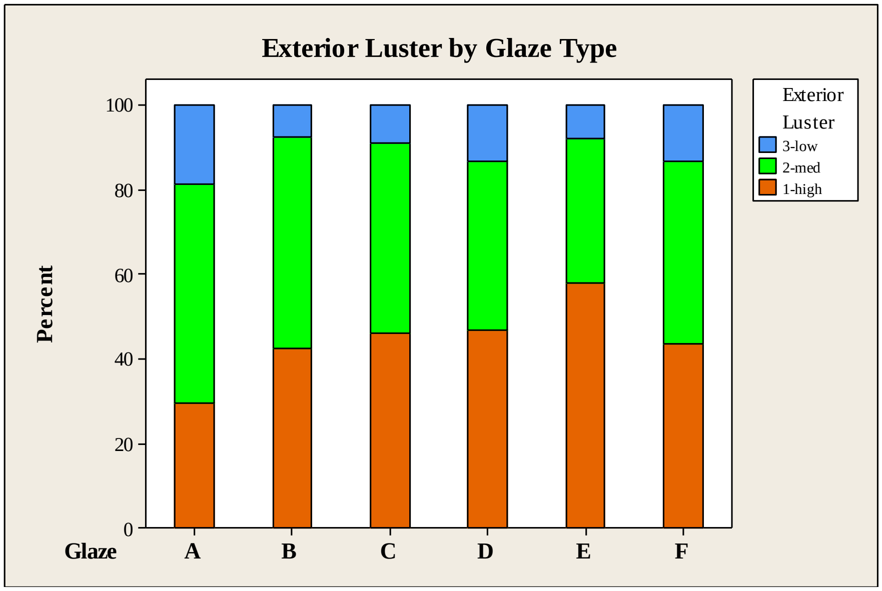


Figure 9.13: **Bar Chart of exterior luster by Glaze Ware type for the local sample.**

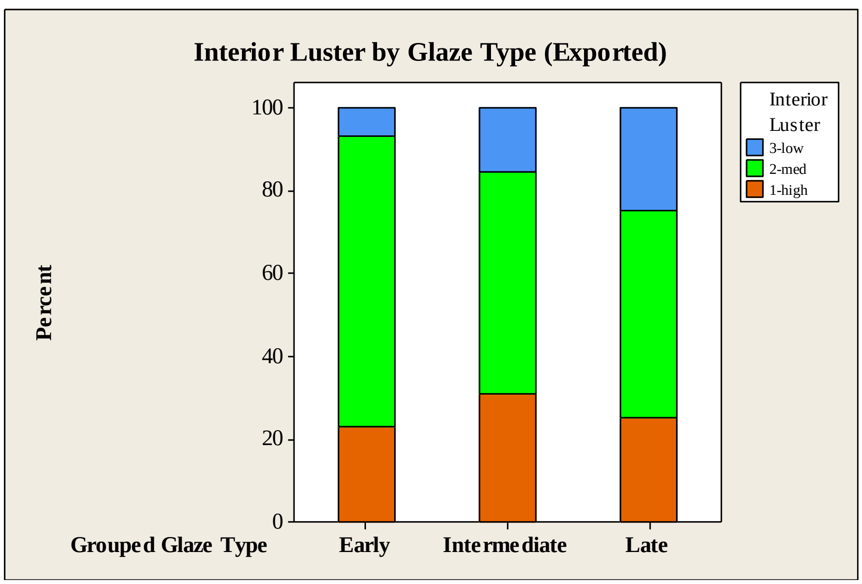


Figure 9.14: **Bar Chart of interior luster by Glaze Ware type for the exported sample.**

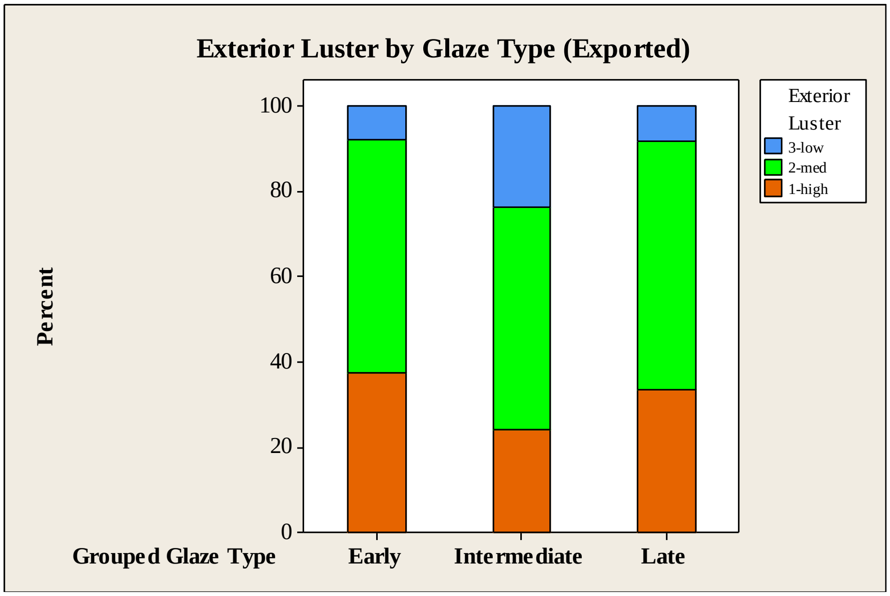


Figure 9.15: **Bar Chart of exterior luster by Glaze Ware type for the exported sample.**

The Shannon diversity index also shows few changes in diversity through time for level of luster (Table 9.7 and Figure 9.16). The local assemblage reveals little change in diversity, whereas the exported sample slightly increases in diversity. The intermediate Glaze Ware types do not show any reduction in diversity for either sample. The minor changes in firing temperature discussed in Chapter 7 do not reflect any corresponding changes in degree of luster visible on the sherds. It may be that the change in firing temperature was not significant enough to create a change in the level of sintering (vitrification), which would change the level of luster possible. One interesting item in these data is the increase in high luster during the Glaze E production period; this period also saw an increase in the level of processing of temper, as seen in more rounded grains of augite monzonite (Chapter 8).

Table 9.7: ***Scaled Shannon Diversity Index Values for Luster by Glaze Ware Type.***

Scaled Shannon Diversity Index for Luster Amount						
Attribute	**A**	**B**	**C**	**D**	**E**	**F**
Luster Interior Local	0.8569	0.8484	0.799	0.8072	0.9061	0.9475
Luster Interior Exported	0.6793	0.6768	0.8388	0.8587	Na	1
Luster Exterior Local	0.9222	0.8263	0.8528	0.9019	0.8045	0.9042
Luster Exterior Exported	0.859	0.7257	0.919	0.9372	0.5794	0.8528

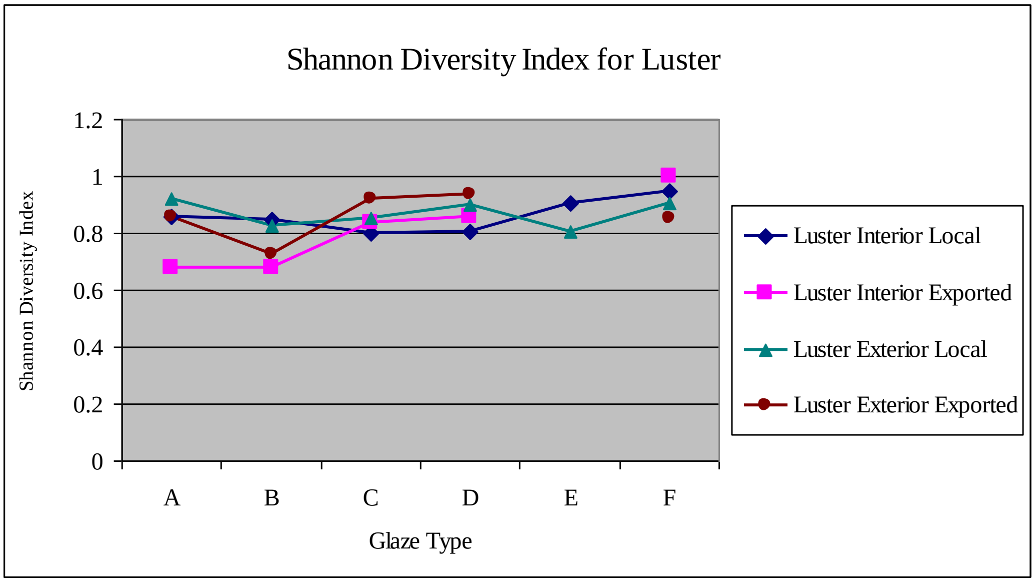


Figure 9.16: **Graph of the Scaled Shannon Diversity Index for Luster for the local and exported samples.**

The above sections have shown a range of variation for the decorative attributes on the local and exported sherd samples, especially changes through time. In the following section I address issues of design structure, layout, and elements used through time and through space on Northern Rio Grande Glaze Ware whole vessels from San Marcos and beyond.

Designs on Northern Rio Grande Glaze Ware

For this part of the study, I examined decorative designs on a sample of 140 whole and partial vessels from the Northern Rio Grande Region (Appendix F, Table 1 includes

a list of all whole vessels). The sample used for this analysis is different from those used for all of the other analyses, as discussed in Chapter 5. The most significant difference is that only approximately one third of the sample comes from San Marcos Pueblo; the other vessels were recovered from other sites in the Northern Rio Grande.

Design reflects a different aspect of production than many of the other attributes, as designs are obvious visual signals of social identity (e.g., Friedrich 1970; Wobst 1977). Design standardization, therefore, may be related to intentional decisions by potters to adhere to common stylistic canons rather than represent simply the unintentional, mechanical standardization that may result in uniformity in the morphological or technological features of vessels. The discussion that follows includes previous research on Rio Grande Glaze Ware designs, the methods used in the current analysis, and the results and implications of the design analysis. Because of the differences in the sample for this part of the study, I discuss first the overall patterns in the sample, the differences in the vessels recovered from San Marcos compared to the vessels made at other sites.

It is first necessary to define basic terms used in design analysis to help the reader understand the analysis that follows. Design elements are the "the smallest self-contained component of a design that is manipulated or moved around as a single unit" (Rice 1987:248) and are the building blocks used to create motifs, which can be simply defined as combinations of elements that the potter typically uses to compose the overall design on a vessel (Shepard 1956:267). Icons are defined as representational or naturalistic elements or motifs (Graves and Eckert 1998). Design structure addresses the way the design is laid out on the vessel (Shepard 1956:264). Symmetry motion is the motion

employed to repeat a design, examples of which are shown later in this chapter (Shepard 1956:269). Other terms will be defined within the chapter as they are discussed.

Previous design analysis of Rio Grande ware. Few researchers have analyzed designs on Rio Grande Glaze Ware (Barnett 1969; Brody 1964; Graves and Eckert 1998; Kidder and Shepard 1936; Lambert 1954; Shepard 1948; Spielmann et al. 2006). The majority of this previous research focused on descriptive treatments or iconography. Quantitative analysis of all element or motifs present has not been conducted.

Previous research suggests that there were preferences for certain design elements, motifs, and structures on vessels manufactured in different areas of the Northern Rio Grande region (Brody 1964:26). Brody argues for preferential use of the birdlet and stemmed oblique key figure motifs at Pecos, whereas Paa-ko potters often included the oblique key figure but used the birdlet rarely, and these motifs were not used at all by potters at Pottery Mound (Brody 1964:26).

Brody examined design structure, elements, and motifs on 97 whole vessels and 494 sherds classified as Glaze A from Pottery Mound Pueblo. He notes that “most designs are made of combinations of ten or fewer parts” (1964:35). The most common design structure for these Glaze A vessels was the paneled band, divided into four (Figure 9.17), or more rarely two or three, panels (1964:46). A “slung triangle” structural form (see example in Figure 9.18) is noted on a small number of the vessels and sherds from Pottery Mound; this structural form is more common at Pecos and in the Galisteo Basin (Brody 1964:76).

Figure 9.17: **An example of the four panel division common on Glaze A and B vessels. Vessel is a Glaze B vessel from the site of Pueblo Cieneguilla in the collections at the American Museum of Natural History. Photo by Kari Schleher. (Vessel Number B05 – see Appendix F, Table for museum information).**

Figure 9.18: **An example of the slung triangle structural form on a Glaze A vessel from San Cristobal in the Galisteo Basin in the Nelson Collection at the AMNH (Vessel Number A11 – see Appendix F, Table for museum information).**

Brody identified a number of motifs that are common on Glaze A style pots from Pottery Mound (Sikyatki [Hopi polychrome] style is also identified on 37 percent of the sample, but that style is not discussed here; Brody 1964:133). A large majority of the motifs are abstract and geometric. The most common motifs are triangles, followed by keys or stepped figures (1964:63). The most common key motifs are simple, right angle

keys (see Figure 9.19) without a base, in contrast to the oblique stemmed keys that are most common at Pecos and in the Galisteo Basin (Brody 1964:66).

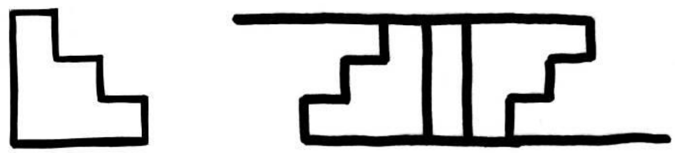


Figure 9.19: **Examples of simple, right-angle key motifs (often referred to as "steps") on Glaze A vessels.**

Other, less common Pottery Mound motifs include various forms of checkerboards and a simple "X" cross, although the latter is most commonly used in the center of bowl interiors or on unpaneled exteriors, not in the banding (Brody 1964:69). Life forms appear on less than 3 percent of Brody's sample (1964:74). Life forms depicted include reptiles and amphibians, other animals, and birds (Brody 1964:97). Brody (1964:69) notes that many design features used in earlier Southwestern black-on-white pottery traditions, included the use of scrolls, fine hatching, and complex negative patterning are lacking in the Glaze A design style.

William Graves and Suzanne Eckert (1998) compared Rio Grande Glaze Ware designs to those on Jemez Black-on-white and Biscuit Ware. Through a limited analysis of 22 icons and design motifs that Graves and Eckert (1998:271) define as "units of decoration that are visually distinctive and consistently rendered," they found differences in the icons and motifs favored by potters who made Jemez Black-on-white, Biscuit Wares, and Rio Grande Glaze Ware. Glaze Ware potters most frequently used hooked triangles, birds or bird variants, crosses, double key figures, dragonflies, and eyes to decorate their vessels. Biscuit Wares predominantly include swooping triangles, Awanyus (stylized feathered serpents), and opposed triangular units, whereas Jemez

Black-on-white vessels often have step feathers, banded triangles, hooked triangles and birds (Graves and Eckert 1998:271). The authors also see temporal differences in the designs on Glaze Ware types. Early Glaze Ware vessels show a wide range of the motifs and icons recorded, whereas the intermediate and late Glaze Ware vessels show preferential use of the hooked triangles, birds or bird variants, crosses, and double key figures (Graves and Eckert 1998:275). The results of the current design analysis will be presented below and compared with these previous studies.

Design analysis methods. The design analysis was conducted in three steps: (1) design structure and layout, (2) element and motif, and (3) iconography. The analysis was developed to be as quantitative as possible so that I could compare the variation found on the early, intermediate, and late vessels. Many of the vessels are incomplete or heavily reconstructed, which often involved "touching up" or continuing the design based on the archaeologist's or curator's interpretation. Because of this issue, my goal was to document as much as possible, without including any of the modern design reconstructions.

The method used to determine the design structure and layout follows Hegmon (1995b), Shepard (1948), and Washburn (1977). Hegmon (1995b:165) addresses problems inherit in conducting design analysis on Southwestern ceramics, including the lack of well-defined rules of structure in the designs themselves and the focus of ethnographic studies on linking design structure directly to cognitive structures that potters follow. Hegmon's (1995b:165) method allows for determination of "loose and strict rules of design" and facilitates characterization of structural variation. This method is ideally suited for the analysis of Glaze Ware design structure and layout because of

"looser" rules that may have been applied by Glaze Ware potters as difficulty in painting designs increased (or, at a minimum, difficulty in having their designs stay clear even after firing of the rather unpredictable glaze paint).

The following 11 attributes of structure and layout were recorded for the overall interior design on each vessel: type of layout, spatial division of the paneled band, overall symmetry motion, amount of rotation, presence of top and bottom framing lines, number of design fields, presence of a finite center design, presence of a break in the design or in the framing line, and number of lines dividing panels.

The four possible types of layout are slung triangle band, center only, band only, and center and band (Figure 9.20). The slung triangle band, described in Brody (1964), is often a standard paneled design that is "pinched" into a point at one end. Whenever possible, other layout attributes, such as panel division lines, are recorded on slung triangle bands as well as for traditional paneled bands.

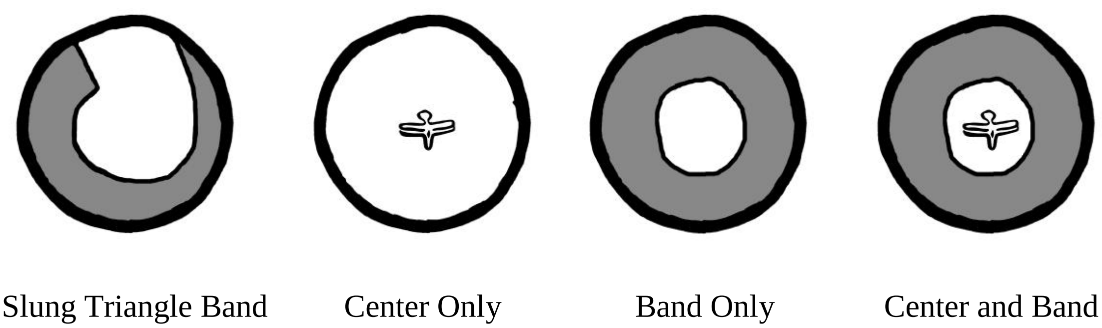
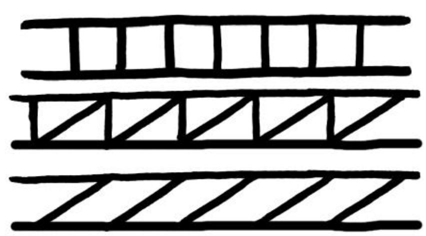


Figure 9.20: **Types of design layout.**

Following Shepard (1948:246), spatial division of the paneled band was recorded as square/rectangular, diamond, triangular, or crossed (Figure 9.21). Basic symmetry motion of the overall design included translation, reflection, rotation, and slide reflection (Hegmon 1995b:161–164, Shepard 1948:246) (Figure 9.22). Rotation describes the

number of repetitions of the overall design; Rio Grande Glaze Ware vessel designs included in this sample range from 2-fold to 4-fold rotation (Figure 9.23). To be considered a framing line (Figure 9.25), a line cannot be a part of the design field, it cannot be a filled line, and it cannot be one of a series of parallel lines. All of these line types are considered part of the design field. Five types of panel divisions were recorded (Figure 9.25). These include one line that simply divides the panels, two lines that separate as well as border the panels, three lines that border the panels with an additional line in the center, three lines that separate the panels with a thicker or black filled center line, and four lines with lines that border the panels with two additional center lines.



Rectangular

Triangular

Diamond

Figure 9.21: **Spatial division of the band.**

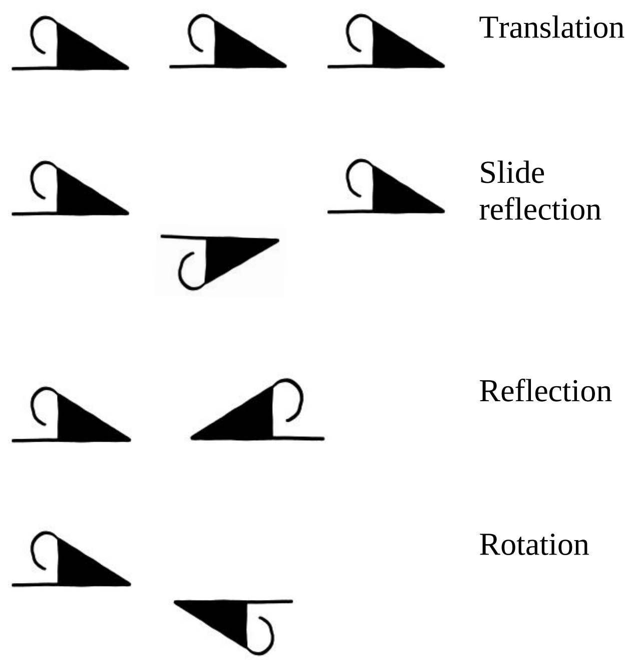


Figure 9.22: **Basic symmetry motion of overall design.**

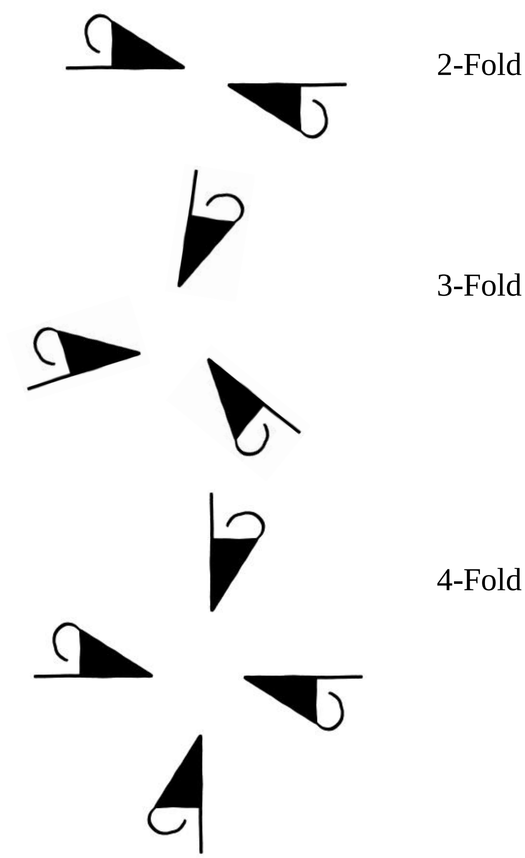


Figure 9.23: **Rotation amount of overall design.**

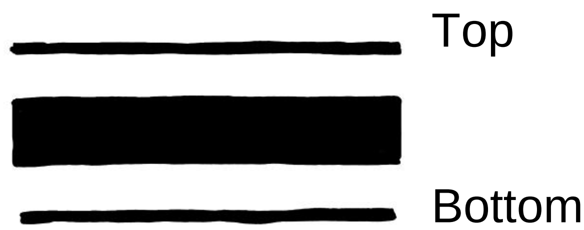


Figure 9.24: **Top and bottom framing line.**

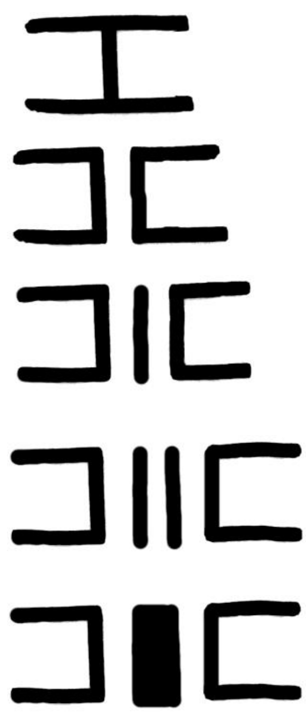


Figure 9.25: **Types of panel divisions.**

The second stage of the analysis was to quantitatively examine elements and motifs. The methods for this portion of the design analysis loosely follow Hegmon (1995b), but because I wanted to examine all possible elements and motifs present, I have added substantially to the number described by Hegmon. All elements and motifs for

both the interior and exterior surfaces were recorded. Approximately 80 elements and motifs were recorded (see Appendix F, Table 2 for a complete list, with example drawings and photos for each). Many are various combinations of steps, triangles, and lines. Because of the large number of elements and motifs recorded, a second step in this phase of the analysis was to group them into clusters of similar types (e.g., all triangle combinations were grouped into one "triangle" group) to facilitate discussion of the results. Grouped categories are also listed in Table 3 in Appendix F.

The third phase of the design analysis was to record iconography on all of the vessels. The method used is a variant of the methods used by Graves and Eckert (1998). In the element and motif analysis, motifs that were clearly representational were coded as such and are discussed within the element and motif analysis.

Design Analysis Results

In this section, I describe the general characteristics of design and variation in design through the Glaze Ware sequence on my sample of vessels. I then discuss how the trends in the design analysis fit into the models of standardization discussed in Chapter 5.

Characteristics of design layout and symmetry. In general, the majority of vessels in the study sample have a rectangular paneled band layout with translation symmetry and 2-fold rotation. Not all attributes of layout and symmetry could not be examined on all vessels. This is especially true for the 41 vessels from the Museum of New Mexico, which I studied via photographs provided by Dorothy Larson. For the majority of these vessels, the entire design field was not completely visible on either the interior or the exterior. I recorded an attribute only when I was sure it could be accurately characterized.

There is very little variation in the method of interior design layout on vessels throughout the sequence. The band-only layout was present on 75 percent of the vessels and was dominant throughout the Glaze Ware sequence. The combination of band and center, the next most common layout, was present on only 18 percent of vessels (Figure 9.26 and Table 9.8). More than half of the vessels were paneled (Figure 9.27 and Table 9.9) and the majority of these panels were divided into rectangles or squares (Figure 9.28 and Table 9.10). Glazes A through D were from 59 percent to 83 percent paneled, whereas Glazes E and F were dominated by unpaneled layouts. Many of these late vessels, especially Glaze F, were dominated by a band-only decoration consisting of a single line or a series of parallel line. These characteristics of design motif are discussed below in the design motif section.

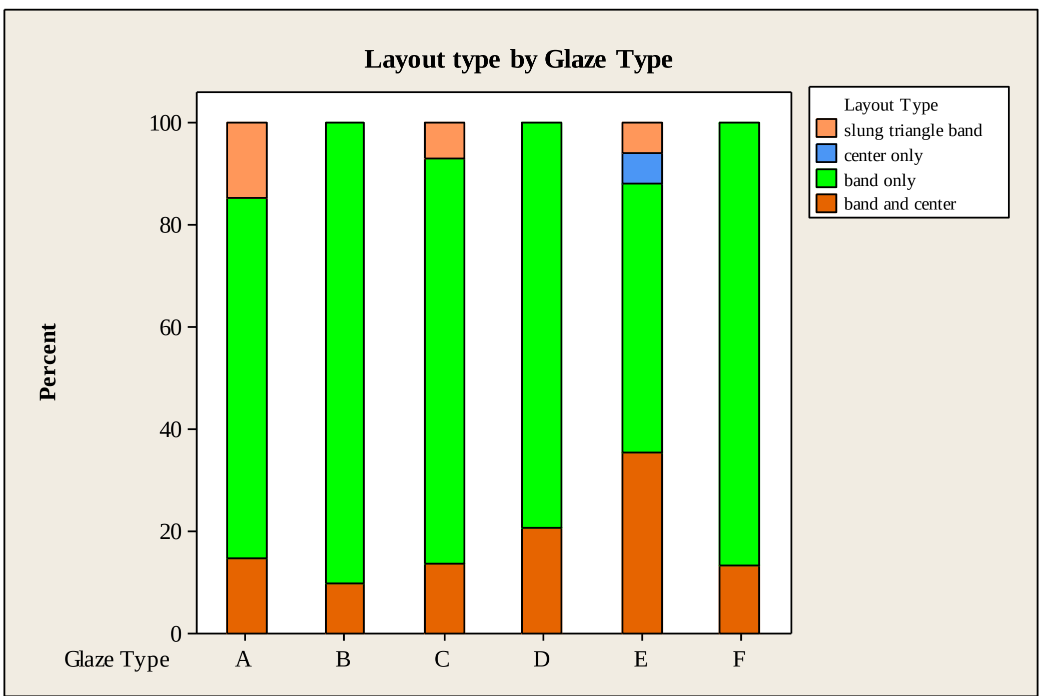


Figure 9.26: **Bar chart showing layout type by Glaze Ware rim type.**

Table 9.8*: Percentages and counts for layout type by Glaze Ware rim type.*

	Layout Type for all vessels													
Layout Type	**All**	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
slung triangle band	8	6	5	15	0	0	2	7	0	0	1	6	0	0
center only	1	1	0	0	0	0	0	0	0	0	1	6	0	0
band only	97	75	24	71	9	90	23	79	19	79	9	53	13	87
band and center	23	18	5	15	1	10	4	14	5	21	6	35	2	13
Total	**129**		34		10		29		24		17		15	

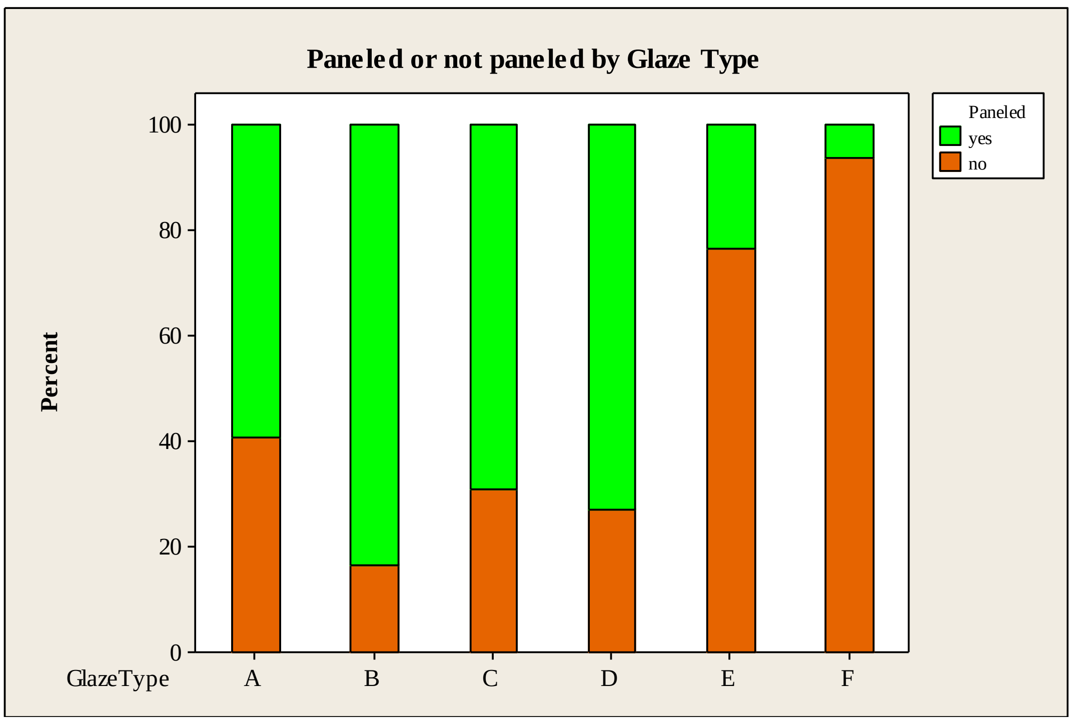


***Figure 9.27:* Bar chart showing percentage of paneled and nonpaneled vessels by Glaze Ware rim type.**

Table 9.9: ***Percentages and counts of paneled and nonpaneled design layout by Glaze Ware rim type.***

Paneled versus not paneled by Glaze Ware type														
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
Paneled	76	55	22	59	10	83	20	69	19	73	4	24	1	6
Not Paneled	61	45	15	41	2	17	9	31	7	27	13	76	15	94
Total	137		37		12		29		26		17		16	

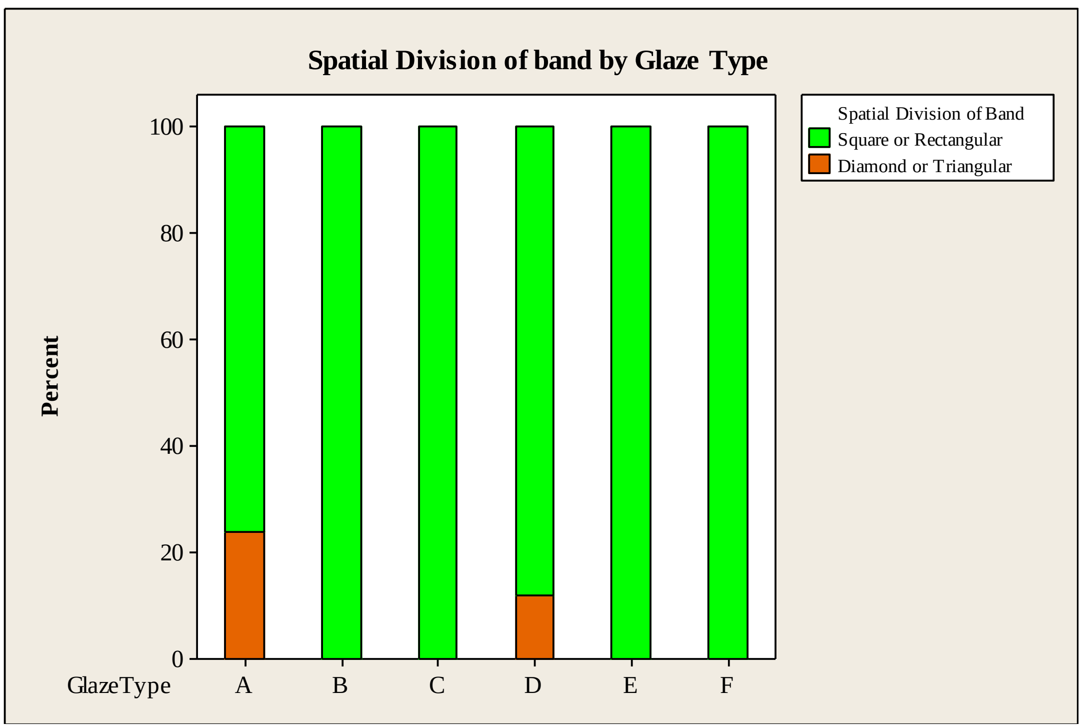


Figure 9.28: **Bar chart showing the percentage of square/rectangular or diamond/triangular divisions of the band on vessels by Glaze Ware rim type.**

Table 9.10: ***Percentages and counts by Glaze Ware type of the spatial division of the band on vessels.***

Spatial Division of band by Glaze Ware type														
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
Square/ Rectangular	66	90	16	76	10	100	20	100	15	88	4	100	1	100
Diamond/ Triangular	7	10	5	24	0	0	0	0	2	12	0	0	0	0
Total	73		21		10		20		17		4		1	

Framing lines were present on some vessels, but were not overwhelmingly dominant. Just over half the vessels had a top framing line, although there was quite a bit of variation in this attribute throughout the sequence (Figure 9.29 and Table 9.11). Glaze B vessels almost always had a top framing line, whereas Glaze E vessels had one infrequently. Bottom framing lines occurred much less frequently than top framing lines, on only 28 percent of all vessels, but more common on Glaze C and Glaze D vessels than other types in the sequence (Figure 9.30 and Table 9.12).

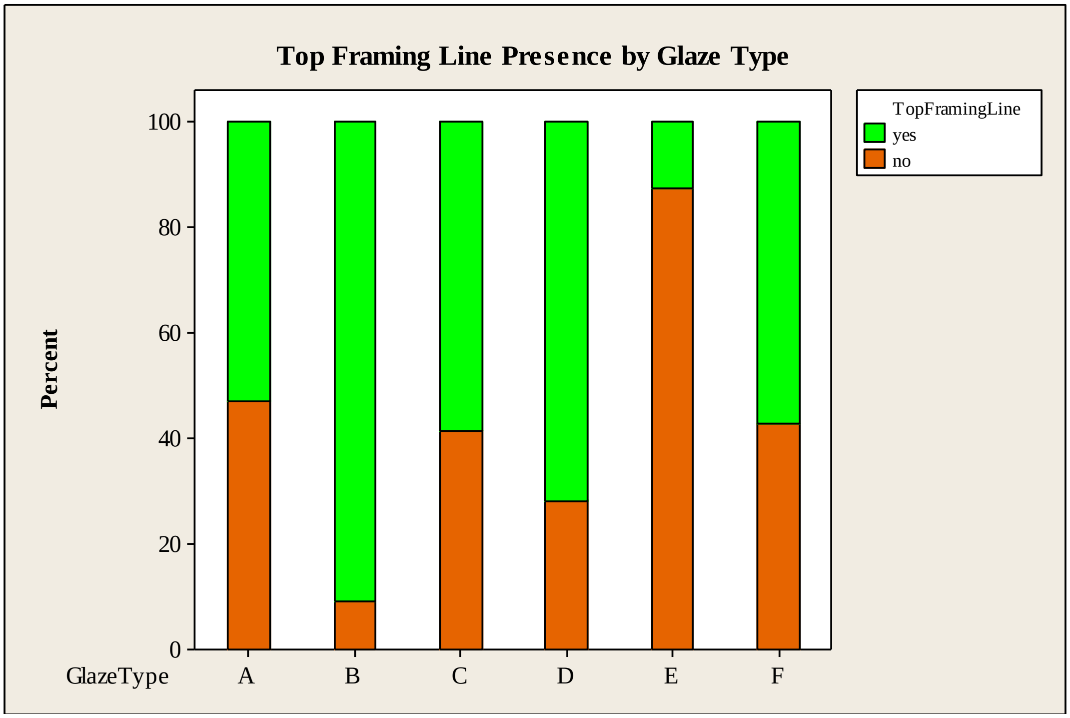


Figure 9.29: **Bar chart showing the percentage of vessels with and without a top framing line by Glaze Ware rim type.**

Table 9.11: ***Percentages and counts for presence or absence of a top framing line by Glaze Ware rim type.***

	Top Framing Line for all vessels													
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
Present	73	56	18	53	10	91	17	59	18	72	2	12	8	57
Absent	57	44	16	47	1	9	12	41	7	28	15	88	6	43
Total	**130**		34		11		29		25		17		14	

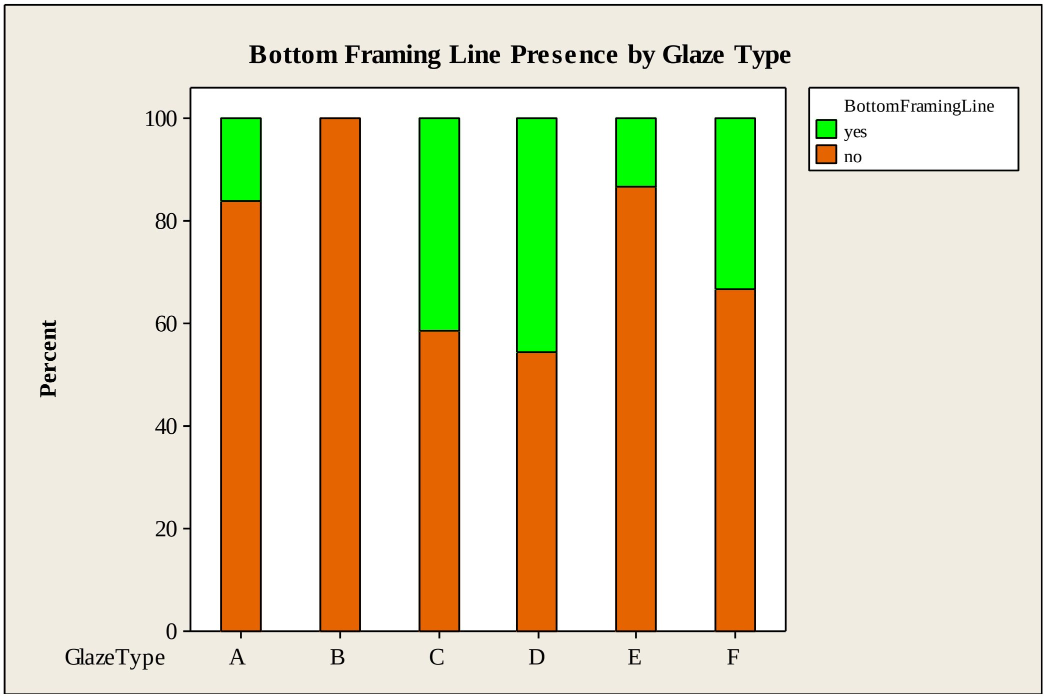


Figure 9.30: **Bar chart showing the percentage of vessels with and without a bottom framing line by Glaze Ware rim type.**

Table 9.12: ***Percentages and counts for presence or absence of a bottom framing line by Glaze Ware rim type.***

	Bottom Framing Line for all vessels													
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
Present	33	28	5	16	0	0	12	41	10	45	2	13	4	33
Absent	86	72	26	84	10	100	17	59	12	55	13	87	8	67
Total	**119**		31		10		29		22		15		12	

Symmetry and rotation vary only slightly throughout the sequence. Rotation in even numbers was the most common, with 2-fold rotation on 83 percent of vessels with rotation in the design and 4-fold a distant second at 10 percent (Figure 9.31 and Table 9.13). Three-fold rotation was present on only four vessels. Two have very similar "double opposed triangle" motifs (see Appendix F, Table 2 for illustrations of each type

of motif), though they were recovered at the relatively distant sites of Zia and Los Aguajes. Glaze F vessels again were a little different. Both of the two vessels I was able to code with 4-fold symmetry were Glaze F. The difficulty in recording symmetry for Glaze F vessels is partly due to the prevalence of parallel line based designs on Glaze F vessels, where rotation is impossible to determine. Symmetry (Figure 9.32 and Table 9.14) was dominated by translation for the entire sequence except for Glaze F, which has a larger percentage of vessels with rotational symmetry (although again this represents only 2 Glaze F vessels, so this may not be a significant difference).

Figure 9.31: **Bar chart showing percentages of vessels with 2-, 3-, or 4-fold rotation by Glaze Ware rim type.**

Table 9.13: ***Percentages and counts of vessels with 2, 3, or 4-fold rotation by Glaze Ware rim type.***

	Amount of Rotation for all vessels													
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
2-fold	43	83	15	88	6	100	9	69	10	100	3	75	0	0
3-fold	4	8	1	6	0	0	3	23	0	0	0	0	0	0
4-fold	5	10	1	6	0	0	1	8	0	0	1	25	2	100
Total	**52**		17		6		13		10		4		2	

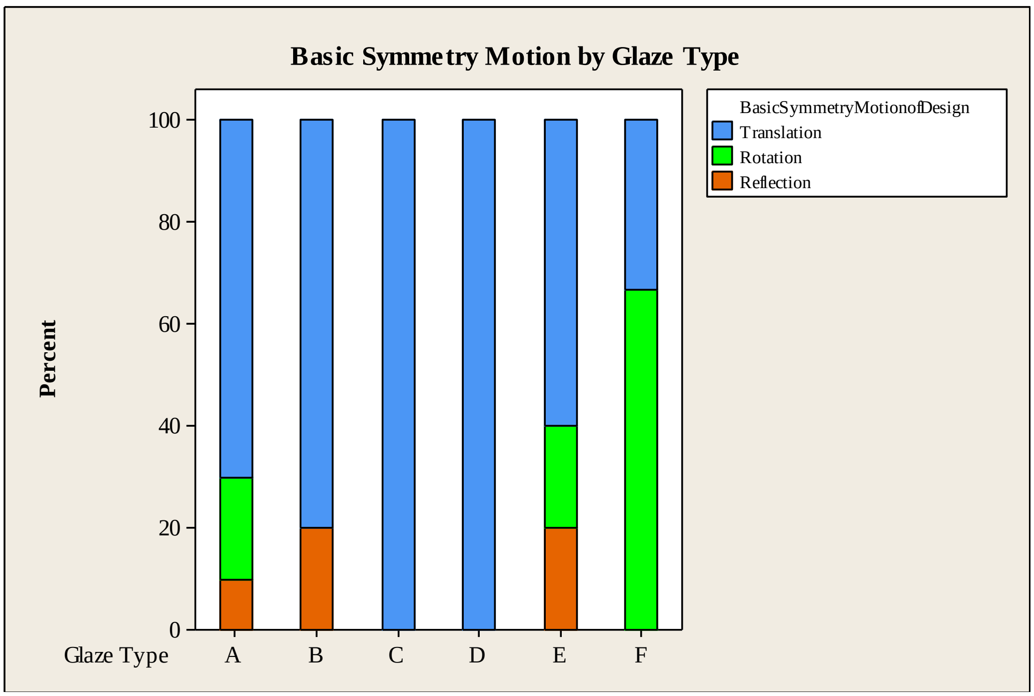


Figure 9.32: **Bar chart showing the basic symmetry motion on vessels by Glaze Ware rim type.**

Table 9.14: ***Percentages and counts of vessels with basic symmetry motion types by Glaze Ware rim type.***

	Basic Symmetry Motion of Design for all vessels													
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
Reflection	4	7	2	10	1	20	0	0	0	0	1	20	0	0
Rotation	7	12	4	20	0	0	0	0	0	0	1	20	2	67
Translation	49	82	14	70	4	80	15	100	12	100	3	60	1	33
Total	60		20		5		15		12		5		3	

The method of panel division was the most variable characteristic of design structure and layout (Figure 9.33 and Table 9.15). The most common type of panel division was one of the most simple: two lines bordering the panel with no further elaboration. This two-line division was present on 35 percent of all vessels and was dominant for Glazes B through D. Glaze A vessels showed nearly equal numbers of vessels with two lines and with three lines with a thick, filled center line. For Glaze D, three lines were more common. Glazes B and C had the most variation in panel division method, with Glaze C vessels showing at least one example of each of the five types of panel division.

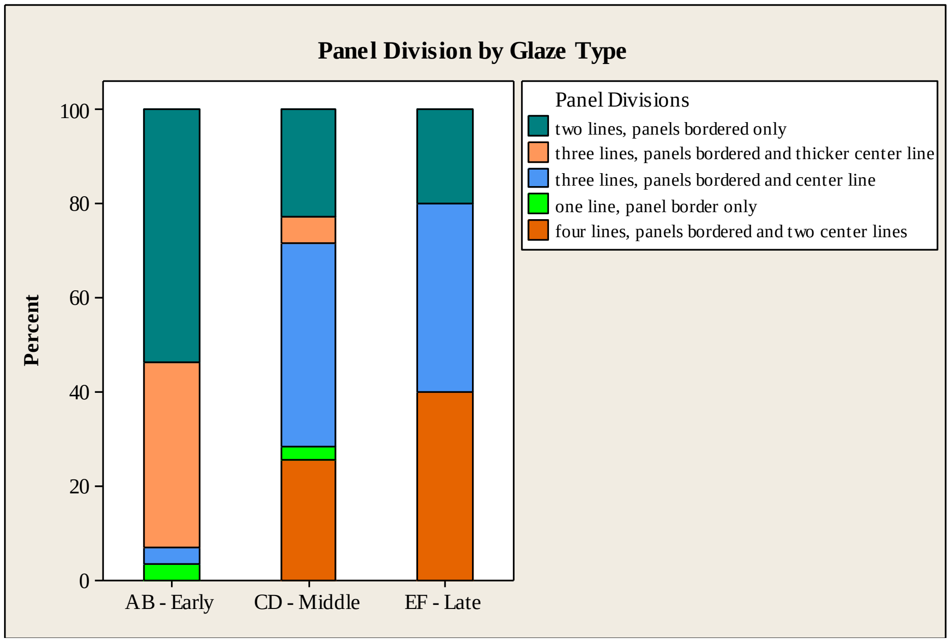


Figure 9.33: **Bar chart showing the percentages of types of panel divisions used on vessels by grouped Glaze Ware rim type.**

Table 9.15: ***Percentages and counts of types of panel divisions used on vessels by Glaze Ware rim type.***

	Panel Division Method for all vessels													
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
one line, panel border only	2	3	0	0	1	11	1	5	0	0	0	0	0	0
two lines, panels bordered only	24	35	9	47	6	67	7	37	1	6	1	25	0	0
three lines, panels border and center line	18	26	0	0	1	11	5	26	10	63	1	25	0	0

Table 9.15 Continued

Panel Division Method for all vessels														
	All	**% for all**	**A**	**% for A**	**B**	**% for B**	**C**	**% for C**	**D**	**% for D**	**E**	**% for E**	**F**	**% for F**
three lines, panels border and thicker center line	13	19	10	53	1	11	1	5	1	6	0	0	1	100
four lines, panels bordered and two center lines	11	16	0	0	0	0	5	26	4	25	2	50	0	0
Total	68		19		9		19		16		4		1	

Although there are changes through time in the various structural and layout design attributes, there is not any overriding trend in diversity as seen in the Shannon diversity index for any one design structure and layout. None of the Glaze Ware types have the most or least diversity in more than one attribute (Figure 9.34 and Table 9.16). For example, Glaze C is the most diverse type for the number of lines dividing panels, and Glaze A is the least diverse (or most standardized), but Glaze A is most diverse (or least standardized) for the number of design fields. There are no clear patterns related to standardization in the Glaze Ware types for design layout and symmetry. This finding indicates that potters had some flexibility in how they laid out their designs and that rules do not seem to have been rigid for the layout or structure of designs during any one period.

Table 9.16: ***The scaled Shannon diversity index for design layout and structure by Glaze Ware rim type.***

Shannon Diversity Index (Scaled) for Design Layout and Structure							
General Category	**Attribute**	**A**	**B**	**C**	**D**	**E**	**F**
Structure & layout	type of layout	0.584	0.2345	0.4628	0.3691	0.7485	0.2833
	spatial division of the band	0.6081	0	0	0.4039	0	0
	overall symmetry motion	0.7298	0.4555	0	0	0.865	0.5794
	amount of rotation	0.4039	0	0.7193	0	0.5119	0
	number of design fields	0.8181	0.5334	0.6888	0.5115	0.3869	0
	number of lines dividing panels	0.4298	0.623	0.8577	0.6132	0.646	0

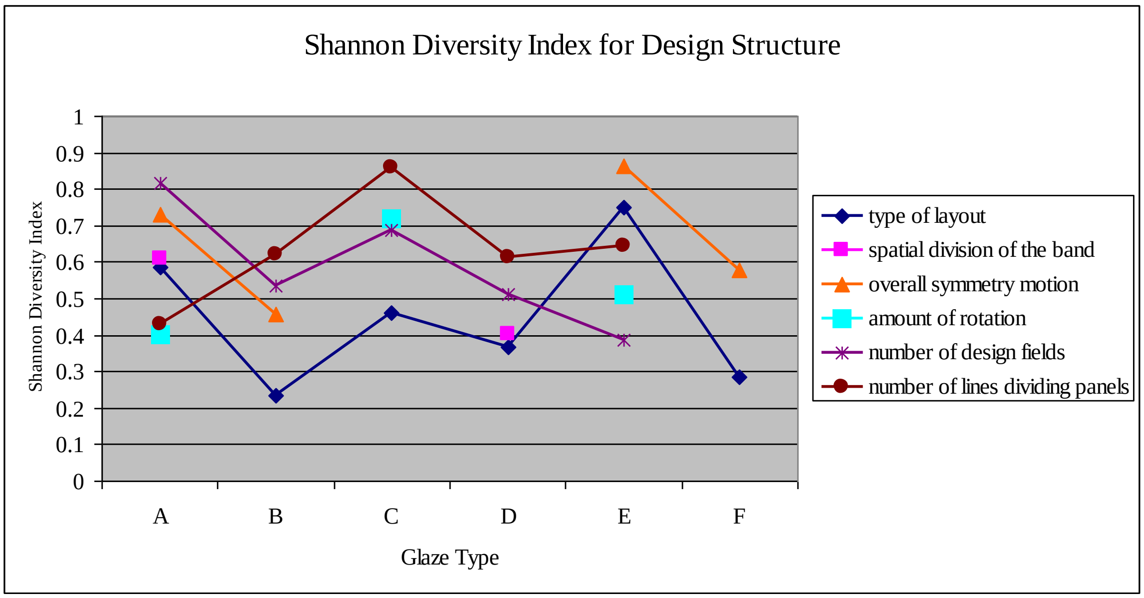


Figure 9.34: **Graph showing the scaled Shannon diversity index for design layout and structure by Glaze Ware rim type.**

Characteristics of design motifs on Rio Grande glaze ware. The goal of the motif analysis was two-fold. First, I wanted to document the variation present in the sample to understand the range of elements/motifs present. Second, I wanted to compare the range of elements/motifs present on each of the Glaze Ware types in the sequence to

address the issue of standardization of the intermediate Glaze Ware types compared to the early and late types. For the first phase of the element/motif analysis, all elements/motifs present on each vessel were recorded. Over 500 examples of approximately 70 elements/motifs were identified (see Appendix F, Table 2 for images of each), although the most prevalent 26 made up 80 percent of the sample (Table 9.17). To facilitate comparison across the types to address the second goal of the analysis, the 70 elements/motifs were grouped into seven general categories based on the major feature of the element/motif, such as containing primarily triangular features or being composed of varieties of line combinations (grouped categories are listed in Appendix F, Table 3).

Table 9.17: ***Counts and percentages of use of the top 80% of elements/motifs identified on the whole-vessel sample.***

Elements/Motifs that make up 80% of those used		
Element/Motif	**count**	**percent**
line with elaboration	7	1.33
circle, half	8	1.52
icon, capitan head	8	1.52
icon, dot in circle/square (eye?)	8	1.52
steps, forward-facing	8	1.52
icon, triangle, hooked, tail, legs (bird)	9	1.71
lines, 2	9	1.71
lines, 3	10	1.9
triangles, back-facing, with step	10	1.9
line	12	2.28
steps, back-facing	12	2.28
icon, square bird with step(s)	13	2.47
icon, triangle, hooked, tail (bird)	13	2.47
rectangle series	13	2.47
steps, interlocking	14	2.66
triangles, right, opposed	14	2.66
tick mark	15	2.85
triangle, series	17	3.23
icon, cross	19	3.61

Table 9.17 Continued

Elements/Motifs that make up 80% of those used		
Element/Motif	**count**	**percent**
steps	19	3.61
steps, opposed, separated	19	3.61
line with dot elaboration	21	3.99
rectangle	26	4.94
triangles, right, opposed, filled	26	4.94
triangles	35	6.65
line, filled	58	11.03
Total of top 80% elements/motifs	423	80.38
Total of all elements/motifs	526	100

Of the 526 examples of element/motifs recorded, 63 percent are from the interior band area of the vessel, approximately 30 percent are on the exterior, and the remaining 9 percent are on the rim or the center of the vessel (Figure 9.35). All of the seven grouped element/motif categories are present on all vessel areas except the rim. Elements/motifs on the rim are limited to simple forms, including lines, tick marks, simple triangle bird forms, "eyes" formed from squares or circles with a dot in the center, crossed lines, half circles, and diamonds.

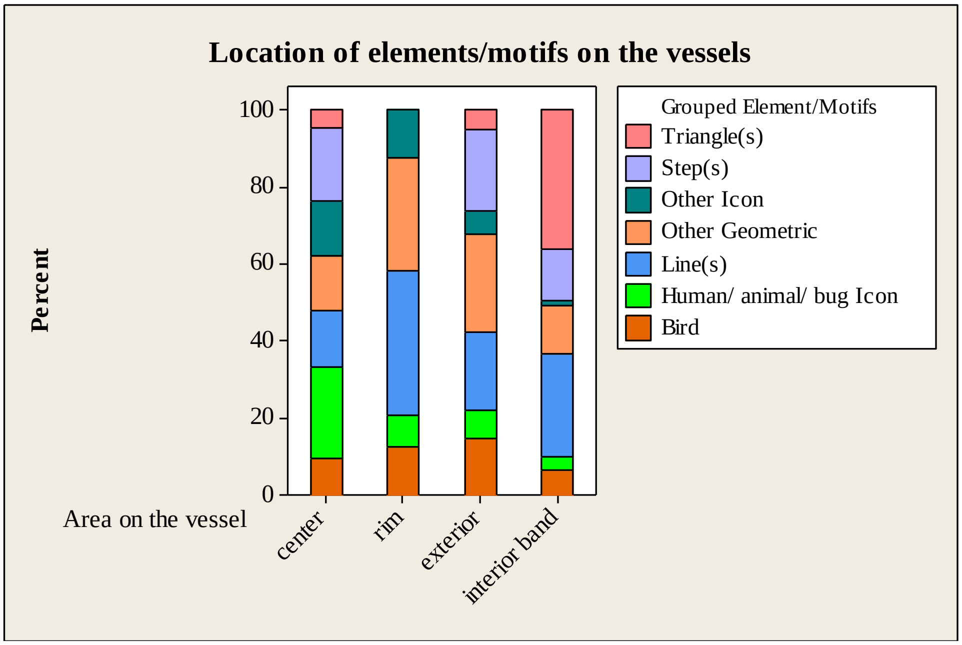


Figure 9.35: **Bar chart showing percentage of the location on the vessel of recorded elements/motifs.**

The most common motif was the filled band (Table 9.16 and Figure 9.36). This motif is a thin band that often circles the interior or the exterior of the vessel and often used as a base or ground line for other motifs to hang off of or sit on. This motif is most common on the interior band and exterior of Glazes C through F.

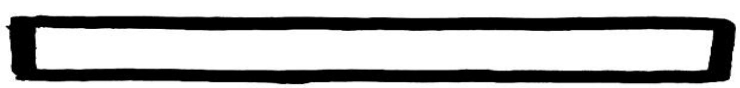


Figure 9.36: **Example of the filled band motif, the most frequently used motif in the sample.**

Other common motifs are various kinds and combinations of steps and triangles. A common motif is the opposed right triangle motif (Figure 9.37), which has a number of variants, including the double right opposed triangle, the off-set with breaks opposed right triangle, and the filled opposed right triangle motifs. These motifs are present on 31 percent of the sample (43 of the 140 vessels). If we look at the distribution of this motif

throughout the sequence, there is an increase from Glaze A to Glaze C and then a decrease from Glaze C to Glaze F. This motif occurred on 16 (55 percent) of Glaze C vessels (Table 9.18).

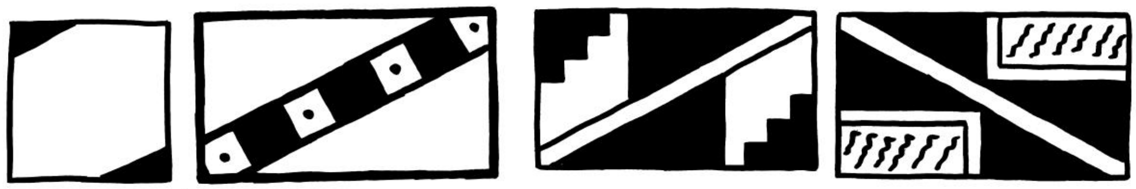


Figure 9.37: **Examples of the opposed right triangle motif. The first example is a simple form of the opposed right triangle motif. The other three examples show versions filled with other motifs or motif combinations.**

Table 9.18: ***Counts and percentages of vessels with the opposed right triangular motifs. Note that 55 percent of Glaze C vessels have a variant of this motif.***

Vessels with Opposed Right Triangular Motifs			
Glaze Type	**# of vessels with opposed right triangular motifs**	**% of vessels with opposed right triangular motifs**	**Total number of vessels**
A	12	32	37
B	5	42	12
C	16	55	29
D	7	26	27
E	3	17	18
F	0	0	17
	43	31	140

Glaze C vessels had the largest variety of different motifs, with 45. Glazes A, D, and E had approximately 35 motifs, and Glazes B and F had only 21 and 15, respectively. There are a number of trends in the general motifs throughout the sequence (Figure 9.38). Triangle motifs decrease through the sequence and line motifs increase. Although the trend is less clear for step motifs, they also decrease slightly through the sequence. Bird

motifs, which include stylized birds based on steps or triangle elements, peak in prevalence on intermediate Glaze Ware vessels.

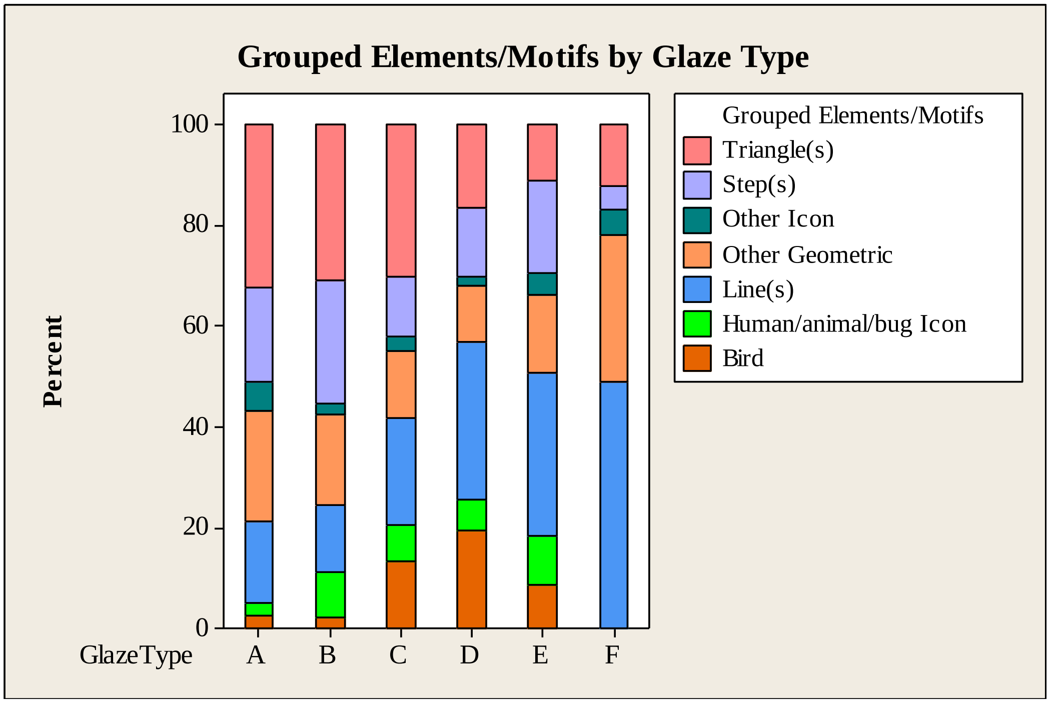


Figure 9.38: **Grouped elements/motifs on the vessels by Glaze Ware type.**

There are no significant differences between sites in elements/motifs used (Figure 9.39). All of the grouped categories are found on vessels from all of the five sites represented by at least 12 vessels in the sample: San Marcos, Puaray, Kuaua, Pecos, and San Cristobal. If we compare a few of the sites with the largest samples, it is clear that the potters at each site used similar motifs during the same Glaze Ware type production periods (Figure 9.40–9.43). For example, potters at San Marcos, Puaray, and Pecos used triangle and step motifs most frequently during the first half of the sequence, with other geometric and line motifs more common during the later types.

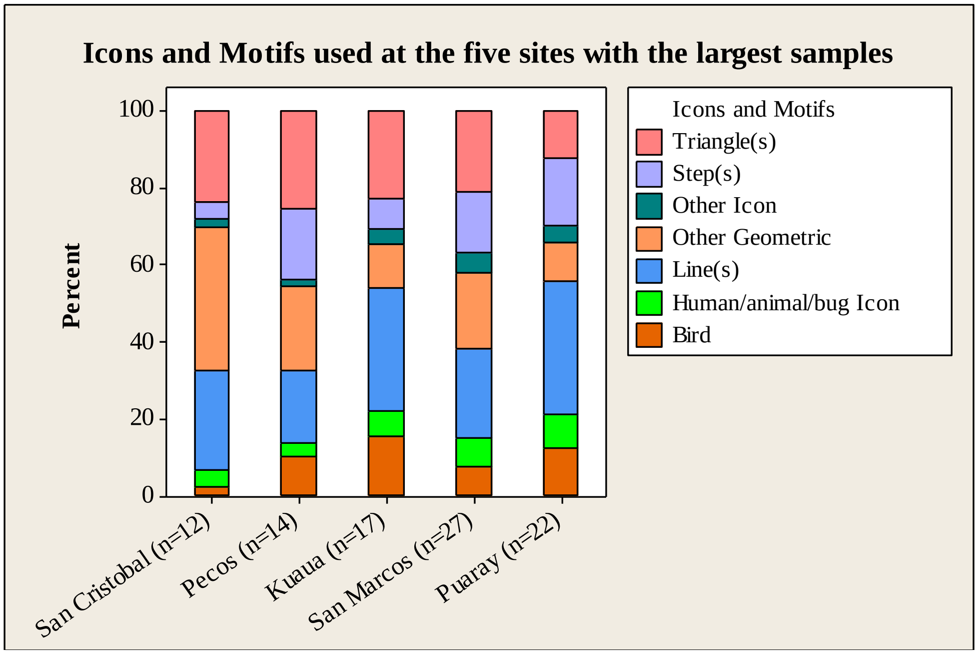


Figure 9.39: **Bar chart showing the percent of motifs used at the five sites with the largest sample sizes. Vessel sample sizes are shown for each site, but the actual count of motifs used is much larger than the number of vessels because the majority of the vessels had multiple motifs.**

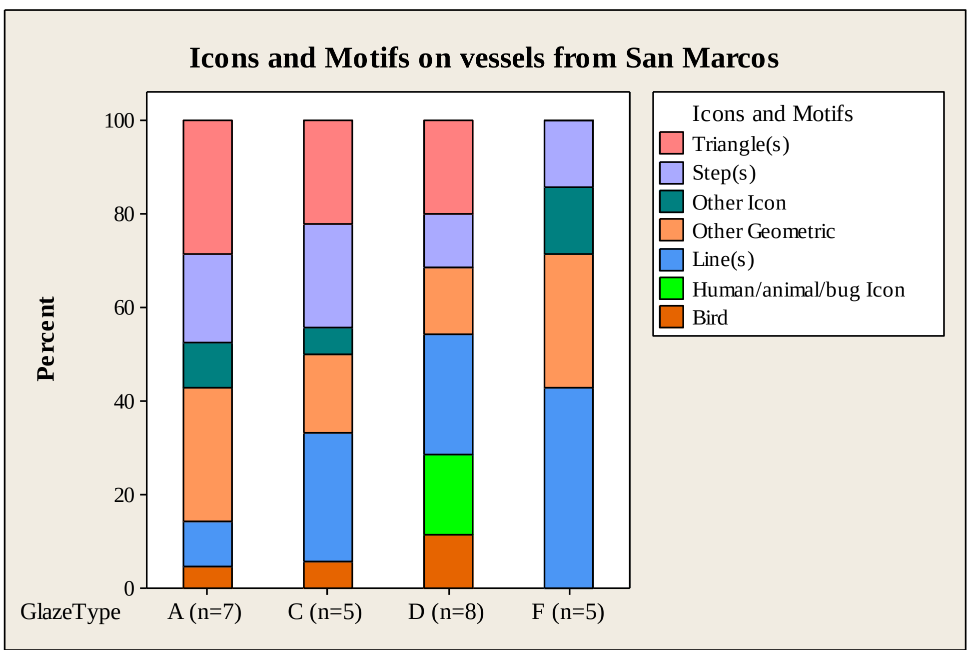


Figure 9.40: **Bar chart showing the percent of motifs used on vessels from San Marcos by Glaze Ware rim type.**

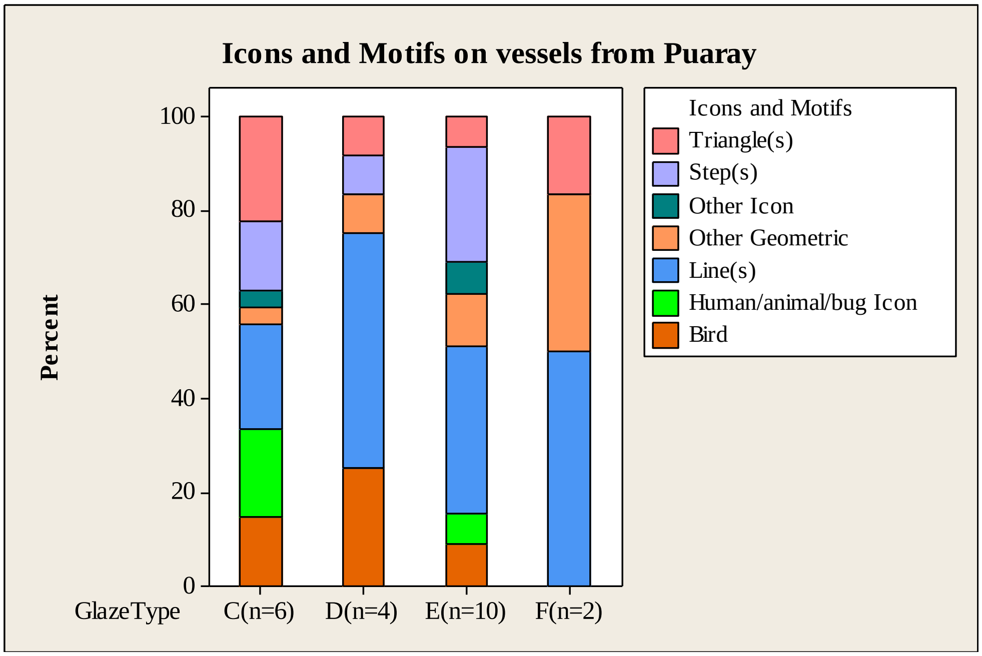


Figure 9.41: **Bar chart showing the percent of motifs used on vessels from Puaray by Glaze Ware rim type.**

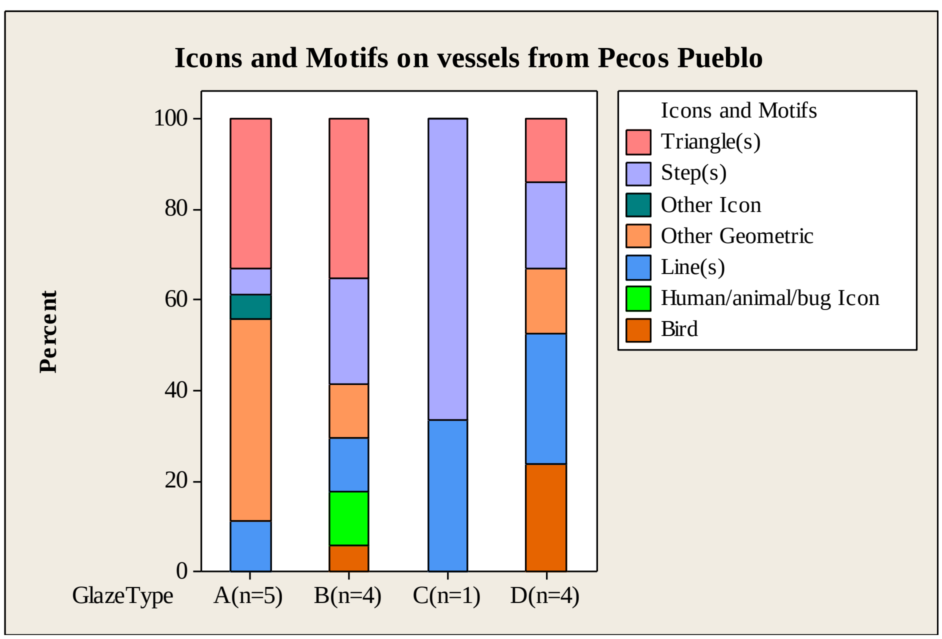


Figure 9.42: **Bar chart showing the percent of motifs used on vessels from Pecos by Glaze Ware rim type.**

Although there are differences in the assemblage in the kinds of motifs that dominate during any of the Glaze Ware periods, the scaled Shannon diversity index

shows that, excluding Glaze F, the motifs used were both very diverse and at about the same level of diversity (Table 9.19 and Figure 9.43). The elements/motifs used to decorate the intermediate Glaze Ware types are no more standardized than those used to decorate the earlier types at San Marcos or for the overall sample. In Figure 9.43, I have looked at three groupings of vessels. The line in blue represents data for motifs on all the vessels. The lines in pink and yellow, respectably, represent vessels recovered at San Marcos and vessels recovered at all sites other than San Marcos. Each data set is at about the same level of diversity. Vessels made at San Marcos are not more or less standardized (less diverse) than those vessels made elsewhere. The pattern for the intermediate types also holds for this comparison of San Marcos to other areas. San Marcos pots are not more standardized than other intermediate Glaze Ware vessels. Thus, as I have shown for other morphological and technological attributes, the model of standardization correlating with intensity of production at San Marcos does not hold for the design data.

Table 9.19: ***The scaled Shannon diversity index for motif for all vessels from all sites and comparing diversity of San Marcos vessel motifs to all other vessels in the sample.***

Shannon Diversity Index (Scaled) for Motifs/Icons						
Attribute	**A**	**B**	**C**	**D**	**E**	**F**
grouped motifs for all vessels	0.6685	0.6496	0.7123	0.6928	0.7114	0.4932
grouped motifs (San Marcos)	0.7066	Na	0.6463	0.7092	Na	0.5447
grouped motifs (other areas)	0.6589	0.6496	0.7107	0.6415	0.7114	0.4647

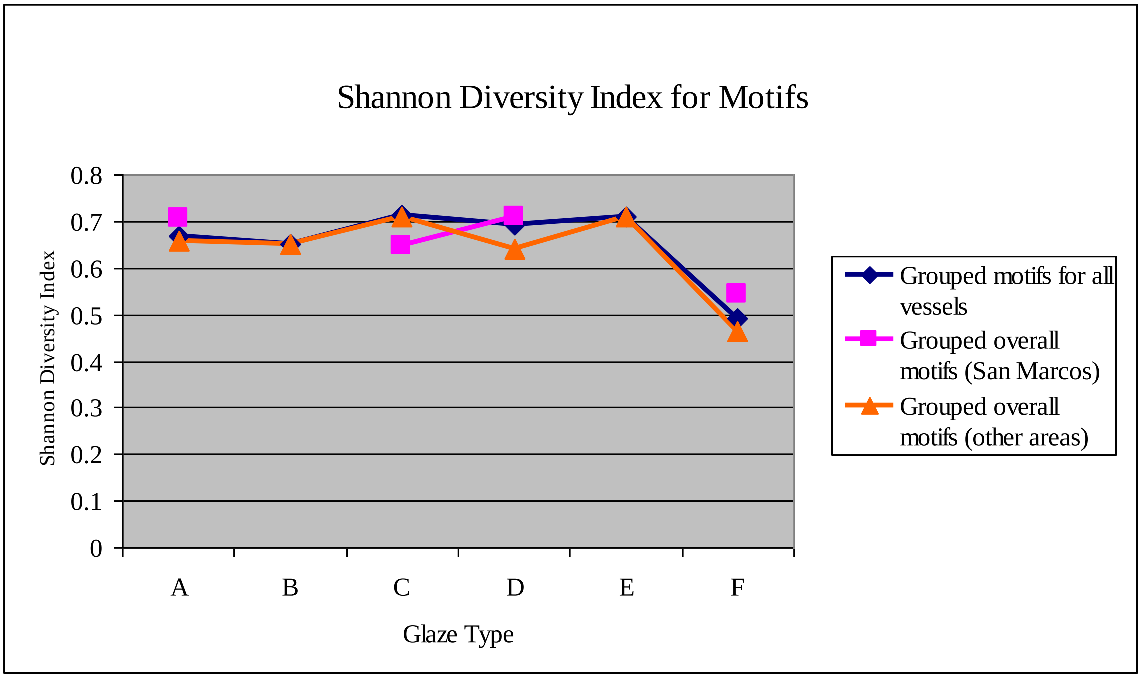


Figure 9.43: **Graph showing the scaled Shannon diversity index for motifs for all vessels from all sites and comparing diversity of San Marcos vessel motifs to all other vessels in the sample. Note the drastic decrease in diversity that occurs with Glaze F vessels for all the groupings.**

The difference in the Glaze F diversity level does warrant further discussion. Glaze F vessels seem to have been decorated using a smaller selection of motifs, and thus production is more standardized for design elements in this period than in any other. There are several possible explanations for this standardization. Glaze F vessels were made post–Spanish contact and it may be that potters were using a reduced number of motifs to decorate pots as a means of increasing efficiency of production. This sort of increase in efficiency and expediency has been documented for clay and temper processing in other Pueblo sites by Patricia Capone (1995, 2006). Although we do not have evidence for this sort of efficiency of processing in temper materials at San Marcos, it is possible that potters at different villages developed different means to reduce the

time needed to make pots. Alternatively, Spielmann and others (2006) suggest that Salinas area potters deliberately obscured ritual imagery on their pots by using very runny glazes. It is possible that potters in the Northern Rio Grande used a slightly different method to obscure designs, such as simplifying iconographic images to such a degree that it is not possible to recognize them as icons. Icons on Glaze F vessels, as few as they are, are discussed in the next section.

Icons on Rio Grande glaze ware. Although the relative abundance of icons was discussed above, here I separate out any possibly representative motifs to determine variation in representational figures on vessels throughout the sequence. My methods here loosely follow Graves and Eckert (1998), who examined common motifs and icons on Glaze Ware to compare with other common Northern Rio Grande ceramic types, Biscuit Wares and Jemez Black-on-white. The Glaze Ware iconographic motifs considered here have been grouped into eight categories: naturalized animal, human face/mask, human arm/hand, feather/bird tail, eye, dragonfly/moth/butterfly, cross, and bird. All of these icons occur on other prehispanic pottery types in the Southwest (see Crown 1994), as is discussed below.

Table 9.20*: Counts and percentages of icons used on vessels of each Glaze Ware type. Also shows the number of different categories of icons used on each Glaze Ware type. Glazes C, D, and E had the largest numbers of different types of icons.*

Icons by Glaze Ware Type								
Icon	**A**	**B**	**C**	**D**	**E**	**F**	**Total instances of use of icon**	**Percent**
Bird	3	1	19	18	5		46	46
Cross	7	1	4	2	3	2	19	19
Human face/mask/"capitan"			3	4	4		11	11
Eye	2	3	2	2			9	9

Table 9.20 Continued

Icons by Glaze Ware Type								
Icon	**A**	**B**	**C**	**D**	**E**	**F**	**Total instances of use of icon**	**Percent**
Dragonfly/moth/butterfly	1	1	3		1		6	6
Feather/bird tail				3	1		4	4
Human arm/hand			2	1			3	3
Naturalized animal					2		2	2
Total Count of Icons on Glaze Ware Type	13	6	33	30	16	2	100	
Number of different types of icons used for each Glaze Ware type	4	4	**6**	**6**	**6**	1		

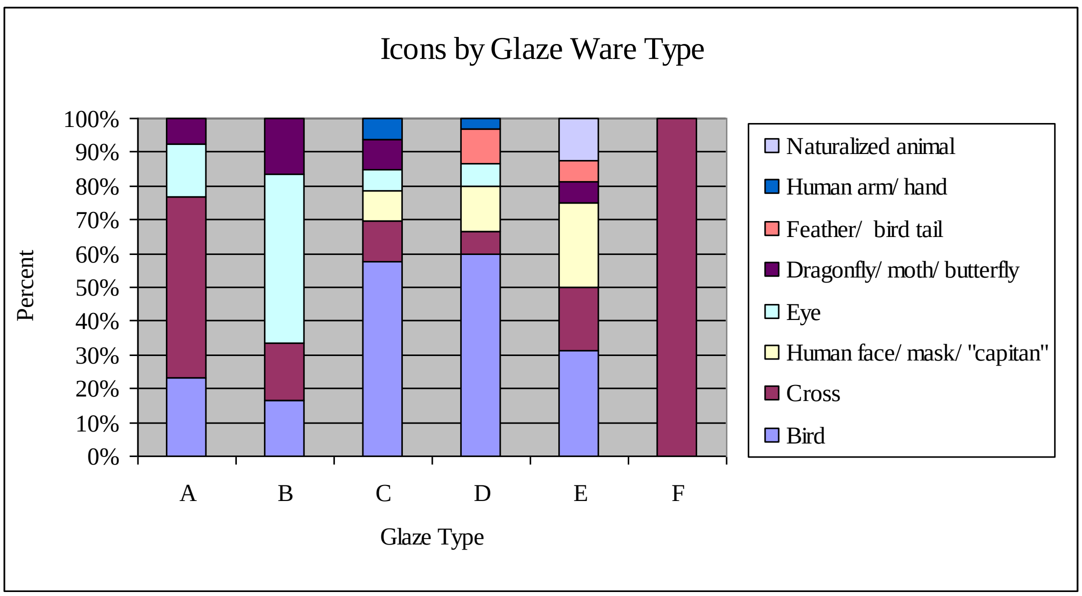


Figure 9.44: **Percentages of icons used on vessels of each Glaze Ware type.**

There are 100 examples of icons on the 140 vessels in the sample (Table 9.19 and Figure 9.44). Many of the icon categories listed are used only a few times, such as naturalized animals with two examples and three examples of hands/arms. The most common icon, accounting for 46 percent of the icons used, was the bird (Figure 9.45). The bird icon was often a simple triangle with the addition of a hook to represent the

head of the bird. Other elaborations on the bird icon are the use of steps with fringe to represent feathers, lines at the base of a triangle to represent feet, and dots as eyes. Birds were present on all Glaze Ware types in the sequence except for Glaze F.

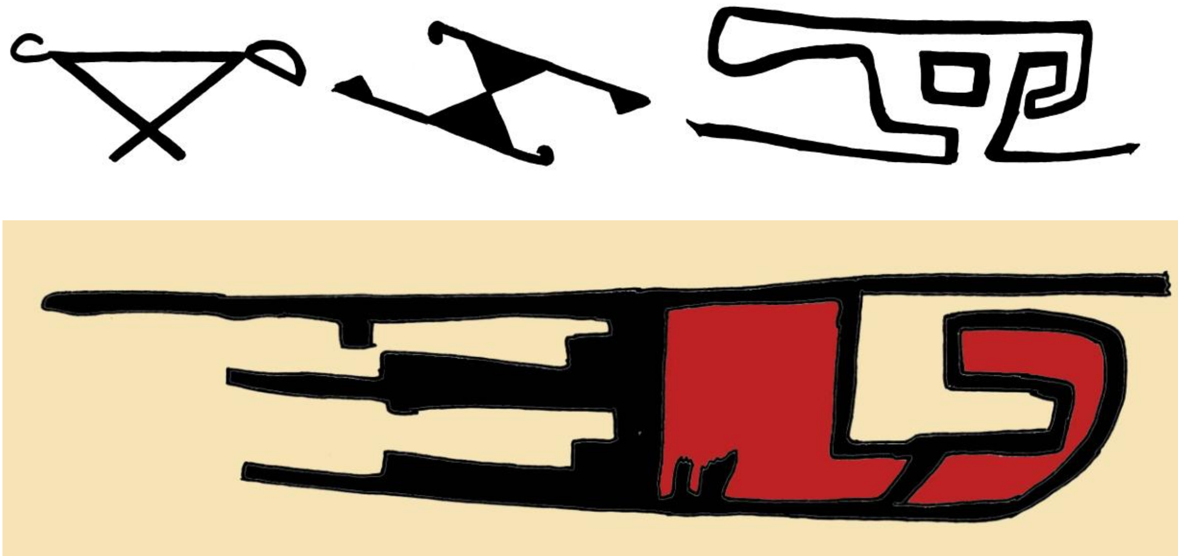


Figure 9.45: **Example of bird icons in the sample.**

Crosses are the next most common icon, at 19 percent, and were used on 16 different vessels in the sample. The cross is represented on every Glaze Ware type and is the only icon present on Glaze F vessels (although only on two). Crosses are sometime interpreted as stars. Crown (1994:159) documents crosses on Salado Polychrome vessels, although these crosses are often included in motifs that make them appear more star-like, such as within a circle or diamond, whereas crosses on Glaze Ware vessels are more often isolated. Human faces, masks, or “capitans” are present on 9 vessels (Figure 9.46). These motifs are unique in that they are used more often on the exterior of the vessel (6 of the 11 uses) (Figure 9.47) suggesting that the visibility of this icon was important. Human faces, masks, or “capitans” were found only on Glaze C, D, and E vessels. Other

human representations, arms and hands, are used rarely and only on Glazes C and D. It seems that the intermediate and early part of the late Glaze Ware sequence are the only times we see human representations.

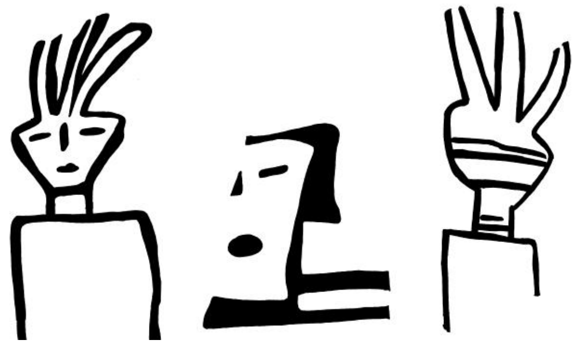


Figure 9.46: **Examples of Human faces, masks, or "capitans" in the sample.**

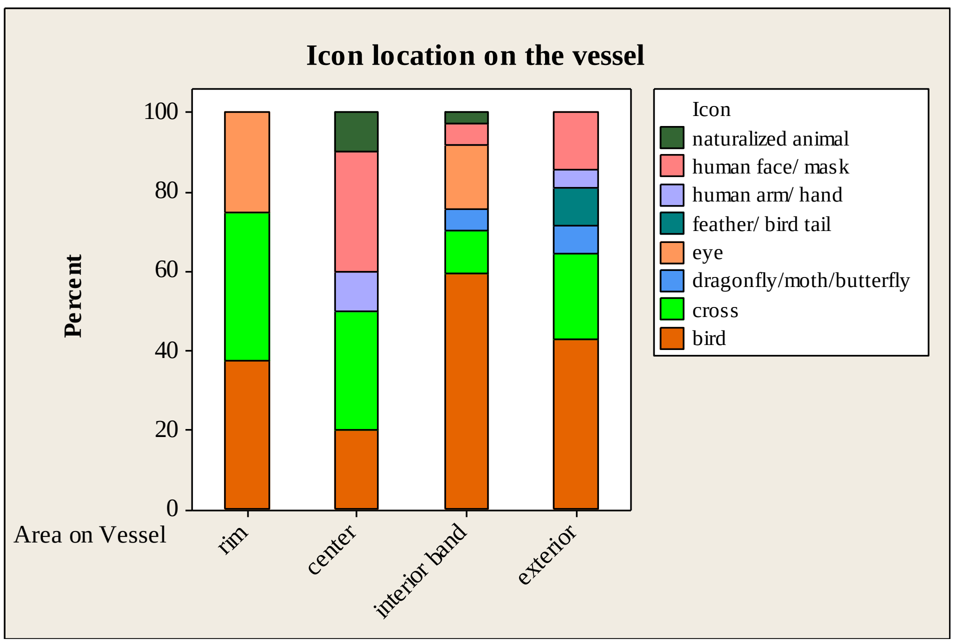


Figure 9.47: **Bar chart showing the percentages of different icons on various parts of the vessels by Glaze Ware rim type.**

Because of the small sample size, I offer only tentative interpretations of any differences in icon use by region (Figure 9.48). Comparing the five sites with the largest numbers of vessels shows only relatively minor differences, many of which are explained

by small sample size or dominance of later Glaze Ware types. For example, the vessels from San Cristobal have only four types of icons, but there were only twelve vessels from this site, and six of these were Glaze F vessels, which had only cross icons (Table 9.18). San Marcos Pueblo vessels depict five of the eight types of icons, with only the least common types of icons are not used. Overall, none of the sites have different types of icons being used. No single icon appeared to be exclusively used at any one village in the North Central Rio Grande.

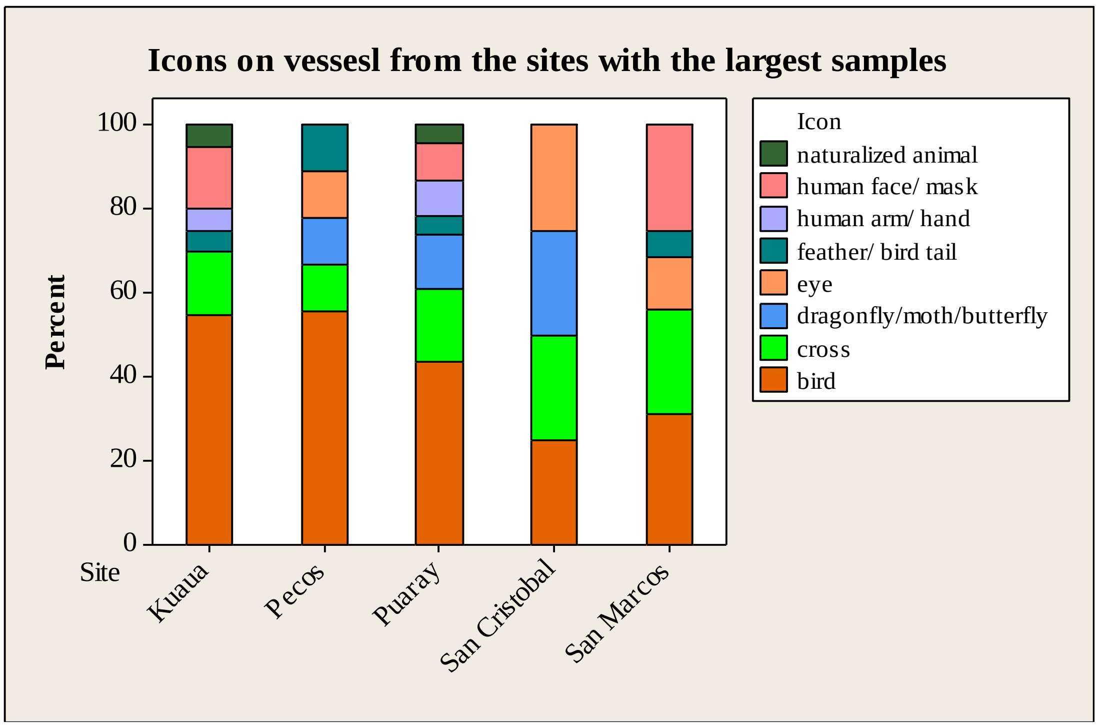


Figure 9.48: **Percent of icons used on vessels from the sites with largest samples.**

Implications of design analysis. The design analysis is very different from all of the other portions of this dissertation in that production of these whole vessels is not controlled for manufacture at San Marcos Pueblo (or really for production anywhere, due to the difficulty in viewing temper). The location of recovery is the only spatial control I

had. With that said, there are still a number of major trends in the designs that are of relevance to the question of standardization. The first of these trends is in the overall similarity of design motifs used for the entire sequence. Except for Glaze F, all of the motif categories were used for each Glaze Ware type. The second trend is that no drastic differences are apparent in the motifs used at different sites, although my small sample size allowed me to examine this issue only for San Marcos, Puaray, Kuaua, Pecos, and San Cristobal. All of the seven motif categories were present on vessels from all these sites. The third major trend is that changes in prevalence of particular motifs seem to be primarily temporal, not spatial, which is in contrast to trends noted by Brody (1964).

A fourth trend is that, although Glaze C vessels do not exhibit any differences in diversity, as shown by the Shannon diversity index, they do show an increase in the opposed right triangle motifs. More than half of the Glaze C vessels have this motif, which is often filled in with other elements or motifs, so that it functions as a structural feature of the design; this may suggest a somewhat more planned use of particular motifs during the Glaze C production period, even though the diversity index does not change. This is significant because though potters during this period used about the same variety of motifs, their use of this particular motif is suggestive of uniformity in the layout and structure of the design, with the opposed right triangle motif placed in the rectangularly divided paneled band. This indication of standardization may be indicative of the increase in production assumed for potters in the Galisteo Basin, the origin of a large percentage of my sample. It is also interesting that vessels from San Marcos do not stand out in any way from other sites or the sample as a whole as far as design motifs or icons used. The

diversity of designs on vessels from San Marcos equals that of designs being used by potters across the entire Glaze Ware production region.

Summary For All Design and Decoration Attributes

A number of temporal trends appear in the decorative and design attributes of the sherds and whole vessels. Changes in slip color, framing line distance below the rim, and design motifs used occur throughout the Glaze Ware sequence. Accompanying these attribute changes are changes in the assemblage standardization: the diversity increases with the increase in slip colors during the late Glaze Ware period, while diversity decreases and the assemblage becomes more standardized with the reduction of number of designs used to decorate Glaze F vessels. On the other hand, a number of the design and decoration attributes do not change dramatically or consistently throughout the Glaze Ware sequence. Luster amount does not show major changes (nor do the related categories of firing and slip/clay composition). The differences between the local and exported samples are minor, so no major differences in the potting group making vessels for these two different markets is indicated in the design or decorative attributes.

In addition, the whole-vessel analysis is suggestive of a larger issue of Glaze Ware production in the wider region. Since the whole vessel sample is not restricted to production at San Marcos it allows a view of what potters at other villages were doing. And yet, what we see reflected in the designs on vessels produced at a wide range of sites mirrors the same pattern shown in the attributes examined on San Marcos sherds: there is little difference in standardization throughout the Glaze Ware sequence (excluding Glaze F designs). All motif classes were used to decorate Glaze A through E vessels. There are no greater levels of standardization of designs on vessels made at San Marcos than on

vessels produced at other sites, and the patterns, especially the temporal trends in design use, seem to occur across a wide area. Potters at a number of sites were all using similar designs and, as far as the data collected here suggest, particular sites did not have any particular claim on particular certain design motifs.

The results of the design analysis, which suggest that San Marcos designs are at about the same level of standardization as designs on vessels produced at a wide range of sites, is an intriguing direction for future research. Perhaps the production of the majority of Northern Rio Grande Glaze Ware throughout the region is at about the same level of standardization as production at San Marcos, suggesting that not only are there no changes in the level of standardization at San Marcos through time, perhaps there was never a change in standardization. It may be that producers at widely dispersed sites were in very close contact with one another and that the complex system of exchange of ceramics also included interaction networks that transmitted information about how to make the pottery.

Chapter 10

Methods, Data, and Results for Technological Attributes: Firing

Characteristics of firing technology used to produce ceramic vessels are difficult to interpret from the final product, especially in the case of the typical non-kiln, open firings used in the Northern Rio Grande (Shepard 1956). It is also possible that firings did not take place within the community. A number of factors come into play when attempting to understand firing technology and its relationship to standardization. One of these factors is that firing may have been supra-household. Bernardini (2000) found evidence for multiple households firing in trench kilns in the Mesa Verde area. It does not necessarily follow that potters at San Marcos in the Northern Rio Grande, who may not have been using trench kilns, were firing in supra-household groups, but it is a possibility. Additional research has located firing areas in various parts of the northern Southwest (Maxwell et al. 1994; Post and Lakatos 1995; Wilson and Blinman 1995), but none near San Marcos. As a possible factor affecting standardization, a supra-household or household group firing pottery outside the community may not have been visible to other potters in the village.

Because bonfire firings can yield a range of temperatures and firing atmospheres during a single firing, any reconstruction of the original firing atmosphere or original firing temperature should be accepted only tentatively (Gosselain 1992). Due to the difficulty in controlling firing temperatures and atmosphere during a bonfire firing, it is also difficult to classify firing attributes as mechanical or intentional. Although the skill involved may primarily reflect mechanical, repetitive aspects of standardization, potters

were likely consciously trying to control factors that may have been out of their control, such as wind or other weather conditions.

In this analysis, I attempt to mediate the problems in reconstructing firing technology by using relatively large sample sizes and carefully controlled analysis with only one analyst to avoid any possible inter-observer error. Firing technology was examined in two ways: core pattern identification and refiring analysis. Core pattern, the pattern of light or dark areas in the cross-section of the sherd, was examined on all sherds in the sample. Core pattern is a reflection of firing conditions, but also is related to clay composition (including the presence or absence of carbonaceous materials and iron) and cooking use. Refiring analysis is used to determine approximate original firing temperature.

The refiring analysis was conducted during an earlier pilot study (Schleher et al. 2002). In this study, a sample of 102 sherds were refired, 34 sherds each from three different middens at San Marcos Pueblo. The middens selected were from the early (Midden 14, with high frequencies of Glaze A Yellow), intermediate (Midden 4, with high frequencies of Glaze C and D), and late (Midden 6, with high frequencies of Glaze E and F) areas of use at San Marcos, as determined by seriation (Ramenofsky 2001; see Figure 2.7 in this volume). Refiring was done in a digital display PMC 703-059 programmable kiln. A small chip was removed from each of the 102 sherds using a diamond saw. These chips were fired at 50ºC intervals from 500ºC to 900ºC for 20 minutes at each interval. At each 50ºC interval, the chips were examined for changes in color (using a Munsell color chart) and hardness (using the Mohs' hardness scale). When these variables changed on the chip, original firing temperature had been passed.

Although there are critics of this technique because of the subjective nature of determining changes and the variation in firing temperature in open pit firings (see Gosselain 1992), use of a large sample size allows for general determinations of firing temperatures (Chambliss 2003; Shepard 1956; Tite 1969). Firing atmosphere was determined by visual determination of core color pattern (Rye 1981), based on Pierce's (1999) coding system (Figure 10.1).

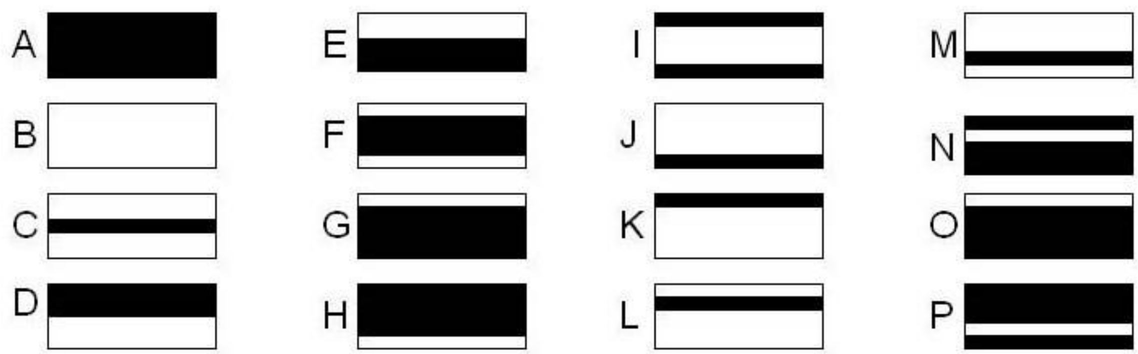


Figure 10.1: **Core patterns recorded in this study, modified from Pierce (1999). The top of the cross section represents the exterior of the sherd and the bottom represents the interior.**

These core patterns have been grouped into five more general categories, arranged from oxidized to reduced/incompletely oxidized:

1) Core pattern B represents 100 percent oxidized
2) Core patterns I, J, K, L, and M represent more than 50 percent oxidization
3) Core patterns D and E represent half oxidized and half reduced/incomplete oxidation
4) Core patterns C, F, G, H, N, O, and P represent more than 50 percent reduced/incomplete oxidation
5) Core pattern A represents 100 percent reduced/incomplete oxidation

This comparison allows further determination of the reduced or oxidized nature of the original firing. In addition, each cross section edge surface was categorized as "light," suggesting an oxidized surface, or "dark," suggesting a non-oxidized surface. The dark

surface could result from incomplete oxidation, a reduced firing, or cooking soot buildup. A light surface indicates oxidation. An example of a light surface in the core patterns depicted in Figure 10.1 would be core pattern F. Although this pattern is more incompletely oxidized/reduced than oxidized in the grouped category, both surfaces are light, which suggests at least a short period of oxidation during the firing of the vessel.

Technological Attributes: Firing Technology Results

Firing technology was examined by analysis of core pattern and original firing temperature. The dominant core patterns show that the majority of the local and exported samples are mostly or completely dark in color, which likely means reduction in the firing and reduced iron content in the clay, or high carbonaceous content in the clay with incomplete oxidation (Figures 10.2 and 10.3). The test sample, which included all of the local and exported Glaze Ware types, ranged from approximately 70 to 80 percent in the "greater than 50 percent reduced" category, which could indicate either incomplete oxidation or reduction. There is no decrease in variability in firing as seen in core pattern for any Glaze Ware production period.

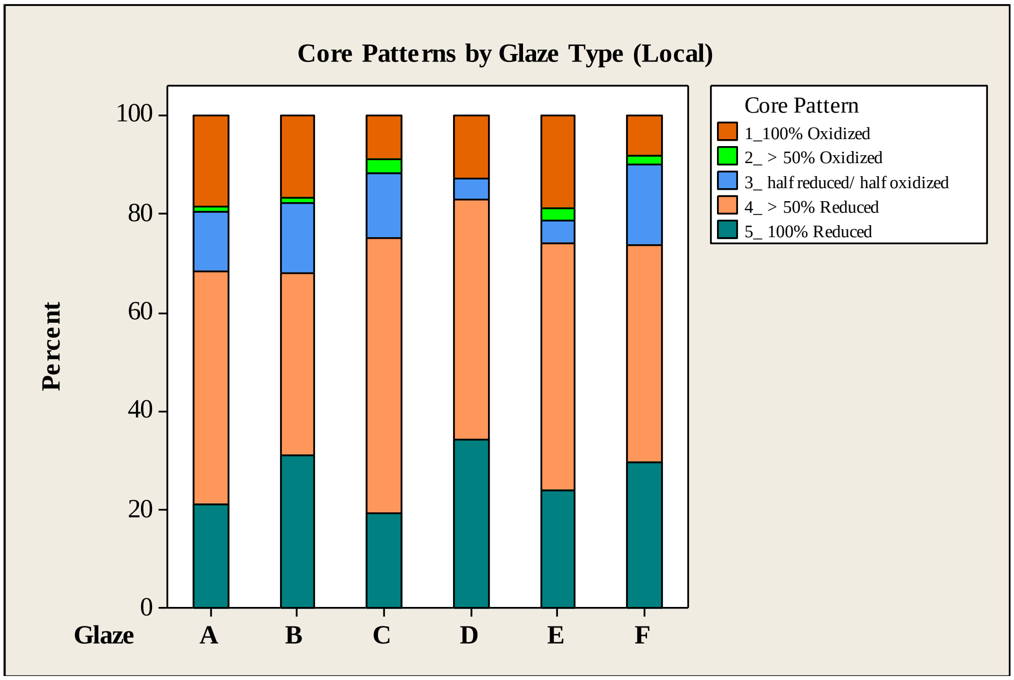


Figure 10.2: **Bar chart showing the core patterns in the local sample by Glaze Ware rim type.**

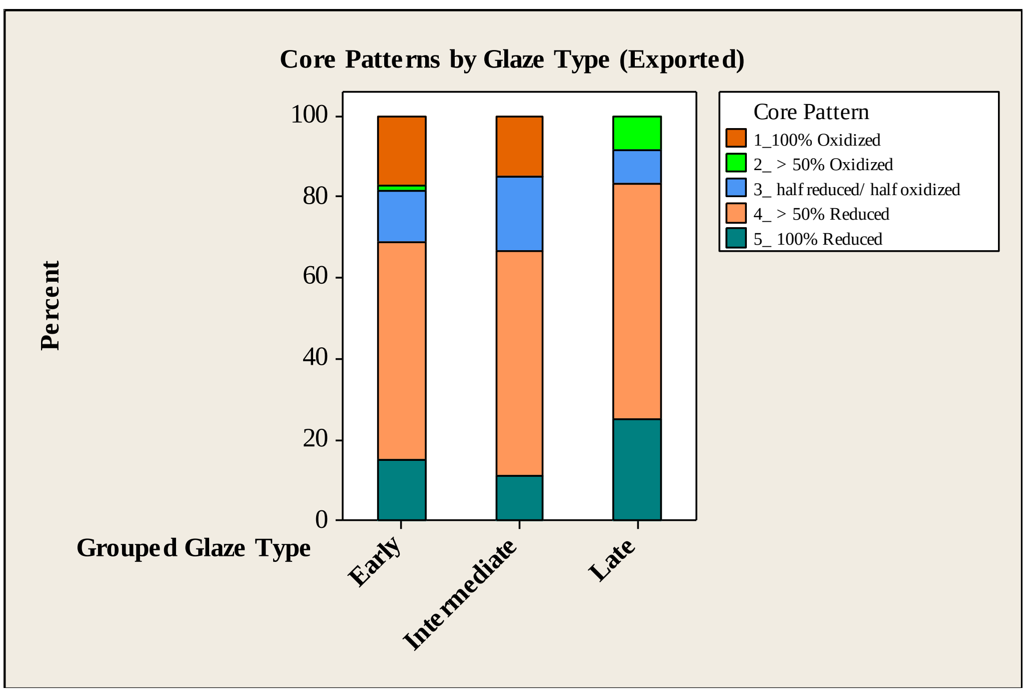


Figure 10.3: **Bar chart showing the core patterns in the exported sample by Glaze Ware rim type combined into early, intermediate, and late categories.**

The core patterns were also coded for the color closest to the edge at the interior and exterior surface of the sherds. A light-colored edge suggests oxidation and a dark edge suggests incomplete oxidation or reduction. Looking at just the edge color gives another view of the firing methods. Light edges dominated in the sample throughout the Glaze Ware sequence (Figures 10.4 and 10.5). This suggests that, although many of the core patterns are largely dark in color, the firings were at least partially oxidizing or vessels were cooled in the open air (Rye 1981). Recent research suggests that the clay used by San Marcos potters was highly carbonaceous (Dyer 2010), so these light edges likely indicate that the firing was oxidizing, but that the firing was not long enough to fully oxidize the interior of the vessel wall.

The exterior surface has a higher percentage (average of 63 percent) of light-colored surfaces than the interior surfaces with an average of 54 percent. This result further supports the argument that the majority of vessels were fired upside down, creating different atmospheres inside and outside the pots. This trend supports an inference we have made based on the runs of glaze paint "down" to the rims that are visible occasionally on sherds and whole vessels.

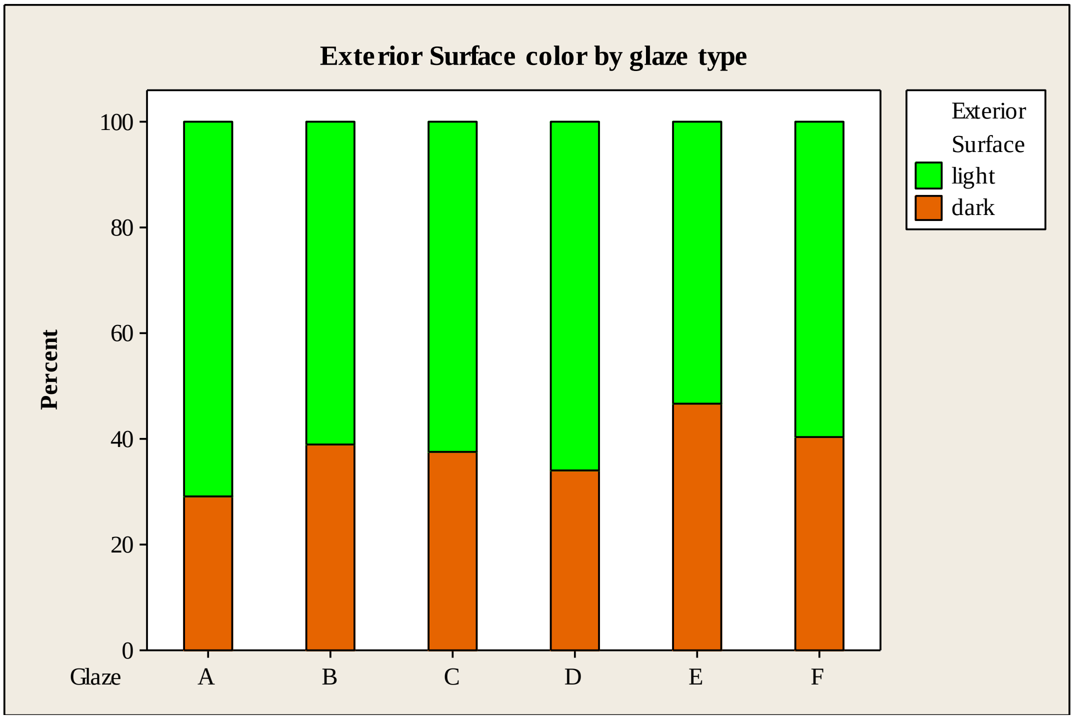


Figure 10.4: **Bar chart showing the exterior surface color by glaze rim type.**

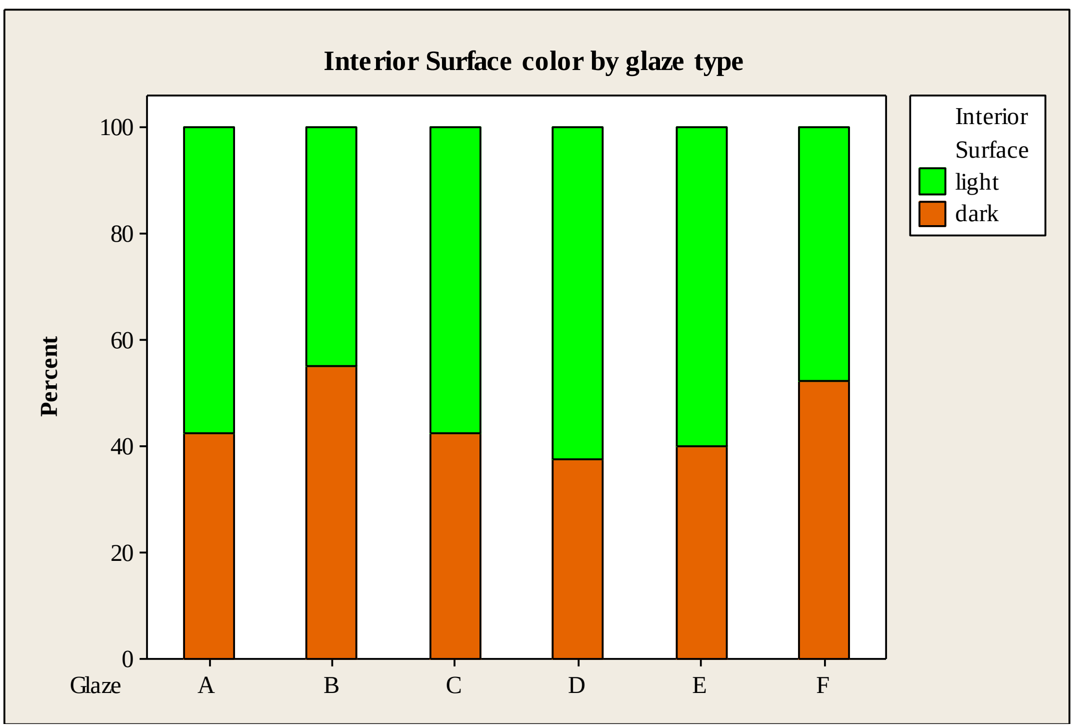


Figure 10.5: **Bar chart showing the exterior surface color by glaze rim type.**

The Shannon diversity index for core pattern shows little change in the amount of diversity through time. The range is only from 0.7 to 0.8, suggesting a relatively constant range of diversity throughout the Glaze Ware sequence for the local sherd sample. The exported samples have a larger range in the diversity index—from 0.6 to 0.9—but the low diversity for the late Glaze Ware types may be a factor of the small sample size.

Refiring Results

Original firing temperature, in degrees Celsius, was determined by incremental refiring. When changes in color and hardness have occurred, the original firing temperature has been exceeded. Figure 10.6 shows the results from the refiring. In general, the hottest two temperature categories increase through time. Many of the late Glaze Ware ceramics seem to have been fired a bit hotter than many of the early Glaze Ware ceramics. Although there seems to be an increase in the average temperature, the diversity of firing temperatures used does not change drastically over the time of Glaze Ware production (Table 10.1 and Figure 10.7). All three periods show a diversity index of 0.9 or higher, suggesting equally high levels of diversity throughout the sequence.

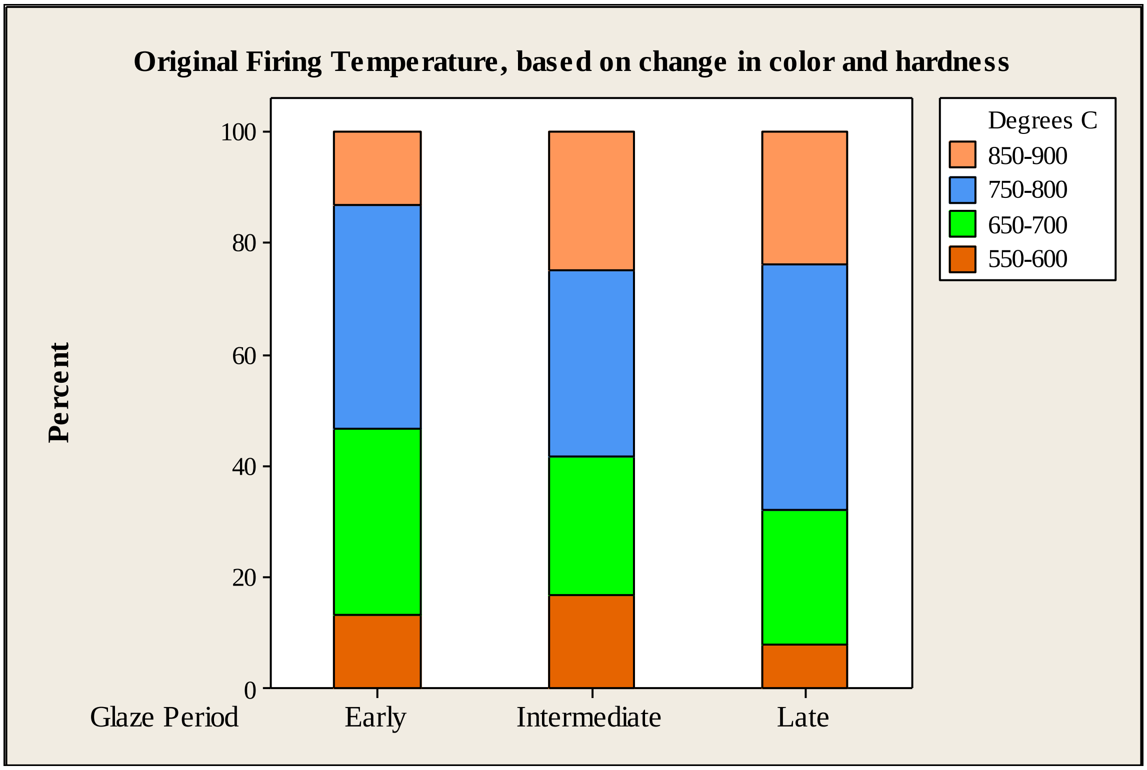


Figure 10.6: **Bar chart showing original firing temperature by grouped Glaze Ware type.**

Table 10.1: ***Table with the scaled Shannon diversity index for firing technology attributes, comparing core pattern index for local and exported sherds.***

Scaled Shannon Diversity Index for Firing Technology						
Attribute	**A/Early**	**B**	**C/Inter.**	**D**	**E/Late**	**F**
Core Pattern Local	0.8097	0.8458	0.7624	0.692	0.7693	0.8014
Core Pattern Exported	0.8966	0.8728	0.8623	0.68	0.5	0.6667
Refiring	0.9161		0.9796		0.9005	

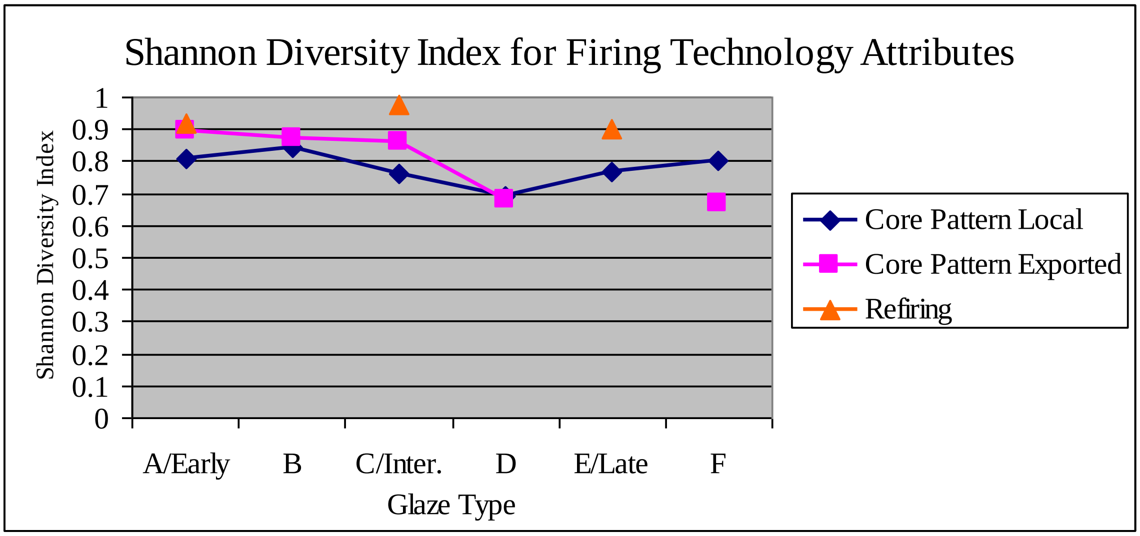


Figure 10.7: **Graph showing the scaled Shannon diversity index for the firing technology attributes, comparing core pattern index for local and exported sherds.**

Discussion and Summary of the Firing Technology Data

The results allow a possible reconstruction of how pottery firing occurred at San Marcos. The data suggest that firing occurred in shallow pits, which would allow the potter to control the firing process and create either an oxidizing or a reducing atmosphere by controlling air flow (Rye 1981:98). The fuel used in firing may have been agricultural waste, perhaps corn husks, which fire relatively quickly and at lower temperatures than wood fuel (Rye 1981). Vessels may have been removed when still hot, allowing the surface to oxidize, while leaving the center color reduced or incompletely oxidized. Data on pottery-firing features from other sites in the Northern Southwest support these interpretations. A recent survey by Orcutt (Blinman et al. 2009) located an area of burned rock platforms, overlying charcoal-stained soil, near San Lázaro Pueblo. These features have not been excavated, but they are similar to the shallow firing basins documented by Post and Lakatos (1995) that were used to fire Santa Fe Black-on-white vessels. If these features are firing areas, they may have given the potter greater control

of the firing temperature and atmosphere than an open, bonfire type of firing. Given recent research by Dyer (2010), which suggests that the dark interior cores of sherds from San Marcos are not due to a reduced firing, but are more likely due to incomplete oxidation of carbonaceous clay, it is likely that most of the firings were oxidizing with a short duration.

The evidence of firing technology encoded in the core pattern and the original firing temperature suggests little change in variation throughout the Glaze Ware sequence. Much like the morphological attributes, firing technology seems to have changed somewhat through time, especially with the slightly higher average temperature used in firing the intermediate and late types, but the amount of variation does not appear to change. The higher temperatures in the late period may have been due to the introduction of dung as the fuel, which fires hotter than wood. This again suggests stability in production and close communication among all potters working in the community at San Marcos. When technologies changed, all potters adapted to those new methods quickly, and the level of variation did not rise in pots produced across the site.

Chapter 11

Evaluation of Models and Conclusions

Archaeologists have explored the relationship between specialization and standardization and used the presumed relationship as an interpretive tool for a number of decades (e.g., Arnold and Nieves 1992; Balfet 1965; Bowser 2000; London 1991; Longacre et al. 1988; Longacre 1999; Mills 1996; Roux 2003; Stark 1995), particularly in the American Southwest (e.g., Crown 1995; Hagstrum 1985; King 2003; Lindauer 1988; Mills 1995; Toll 1990). This dissertation explores the validity of the tie between two aspects of specialized production (*sensu* Costin 1991): intensity of production and standardization. Two models of the relationship between intensity of production and standardization were presented for evaluation through morphological, technological, compositional, and decorative analyses. The results suggest that there is not a direct tie between intensity of production and product standardization at San Marcos Pueblo. This outcome has significant implications for researchers using standardization to view intensity of production in general, as well as for illuminating the great stability in the network of pottery producers at San Marcos throughout the occupation of the site.

Summary of the Results

My research is based on pottery made at San Marcos Pueblo and, to a limited extent, at other sites in the Northern Rio Grande region. Three samples were included in the analysis: sherds from local vessels made at San Marcos and recovered from the site; sherds from exported vessels made at San Marcos and recovered from other sites in the Northern and Central Rio Grande Valley; and whole vessels recovered from various sites in the Northern and Central Rio Grande Valley, including San Marcos, that were not

controlled for production locale. Statistical measures, including coefficient of variation, Levene's test of equal variances, and the Shannon diversity index, were used to examine temporal changes in standardization through the use of the Rio Grande Glaze Ware typological sequence. The expectation of the standardization hypothesis would be that standardization would change with changing intensity of production, if the number of potters was held constant. Although it is not possible for research at San Marcos to hold the number of potters constant, the spatial division of the site using the ceramic seriation (see Chapter 2) does not suggest drastic differences in the areas of use during the early, intermediate, and late Glaze Ware production periods at the site. Increased intensity of ceramic production was documented previously for San Marcos during the intermediate Glaze Ware period (Glaze C and D production periods) (Shepard 1942; Warren 1979). The overall results of the dissertation research are that no significant temporal trends were found in the data to suggest increasing or decreasing levels of standardization for pots produced during this intermediate Glaze Ware period. In addition, there are no significant differences in the level of standardization for vessels in the local or exported samples. These results inform on the high level of stability of the pottery production group at San Marcos through time; there is little evidence for any dramatic restructuring throughout the entire Glaze Ware production sequence at the site. In addition, the lack of differences between the local and exported samples suggest that there were no differences in the production group that made ceramics for local use and those that made the vessels for export.

Three attributes were analyzed to address morphological standardization: wall/sherd thickness, maximum rim thickness, and rim diameter. Wall/sherd thickness

was stable, showing little variation in standardization throughout the Glaze Ware sequence or between the local and exported samples. Maximum rim thickness showed significant change through time, with thickness varying with the type of rim used for that particular Glaze Ware type, but no corresponding changes in standardization. Again, the level of standardization stayed constant throughout the sequence. Both wall thickness and maximum rim thickness exhibited low coefficients of variation throughout the sequence. Rim diameter was much less standardized overall, with higher coefficients of variation throughout the sequence, but no drastic changes in standardization through time. Overall, the morphological attributes were very stable throughout the sequence and did not exhibit any changes in standardization.

A number of technological attributes were examined, separated into three categories for ease of discussion: firing technology, aplastic composition and processing, and glaze paint color and composition. Firing technology was examined through analysis of two attributes: core pattern and original firing temperature. For these categorical attributes, bar charts and the Shannon diversity index were used to present and examine changes in the attribute state and variation through time. Core pattern did not change significantly through time. In addition, the Shannon diversity index is relatively stable throughout the sequence, suggesting little change in the level of standardization. This is true for both the local and exported samples. Original firing temperature showed a slight increase, with higher temperatures through time. The Shannon diversity index did not change drastically throughout the sequence, again suggesting little change in standardization for either the local or exported samples. Overall, firing technology seems to have been relatively stable and at the same level of standardization for the entire

production period of Glaze Ware at San Marcos, with the possible exception of changes in the fuel used or technological changes that may have allowed for a slightly higher firing temperature.

Aplastic composition and processing were examined through an intensive point-counting methodology. The first step in the process was to determine the general composition of aplastic material added to the sherds in the sample. Only sherds tempered with a specific weathered augite monzonite, indicating production at San Marcos, were included in any of the other analyses. The results from this step, presented in Chapter 5, indicate that 80.05 percent of the Glaze Ware ceramics at the site were locally made. The percentage of locally made Glaze Ware ceramics was highest during the Glaze A and B periods, with 96.2 and 97.5 percent local ceramics, respectively. The lowest periods of production were Glaze D and E, with only 60.26 and 61.76 percent of the ceramics made at San Marcos. The second stage in the petrographic analysis was an intensive point counting, with size, shape, angularity, and sphericity recorded for each mineral grain and void. The results suggest that proportions of minerals, voids, and clay in ceramics were similar throughout the sequence, suggesting stability in clay processing and in the amounts of temper added to the clay. The results for monzonite grain size, shape, angularity, and sphericity show variability, suggesting less concern for temper processing—the same amount of material was added, but processing of that material was not of primary concern. High variability among Glaze Ware types was coupled with high variability within types.

Glaze paint was examined through evaluation of the color of the final glaze on all sherds and through electron microprobe compositional analysis on a sample of sherds.

Glaze paint color showed increasing diversity throughout the sequence. Glaze A was the most standardized with fewer colors used, and Glaze F was the least standardized, with a wide range of colors in the glaze paint. The same pattern is seen in the local and exported samples. The early Glaze Ware types are dominated by darker glazes in black or brown, and the later types, especially Glaze F, show more use of a wider range of glaze colors, including green, reddish brown, black, and brown. Glaze paint composition changed very slightly through time, as seen in a principal component analysis. The range of variation does not appear to change throughout the sequence, although the coefficient of variation data for lead are lowest during the Glaze C production period. Because no other elements are more standardized during Glaze C, I argue that this is not evidence for an increasing level of standardization in the glaze paint recipe.

I discussed a number of decorative and design attributes in Chapter 9. Polishing amount, slip color, and framing line thickness and distance below the rim were recorded for all the sherd samples. Design layout, structure, and elements were recorded for the whole vessels sample. The framing thickness changed slightly throughout the sequence, with no real temporal trend. It is relatively unstandardized, with high coefficients of variation throughout the Glaze Ware sequence and no change during the intermediate Glaze Ware production period. However, the distance of the framing line below the rim changed drastically throughout the sequence. The distance increased through time, and the level of standardization increased along with the increasing distance. This finding is likely related to a correlation of distance with rim form—it is easier for a potter to put the framing line in the same place when the vessel profile has a sharp turn or other marker as a guide. While this result indicates standardization in rim form, it does not clearly

indicate standardization in painted decorations that follow the rim form. Polishing was relatively stable throughout the sequence, with the exception of slightly higher amounts of polishing on Glaze E vessels. Standardization, measured through the Shannon diversity index, changed little over the sequence for the local sherd sample, but the exported sherd sample did slightly increase in diversity (or decrease in standardization) throughout the sequence. The intermediate Glaze Ware types do not show any increase in standardization for the amount of polishing. Slip color changed in both frequency and diversity across the sequence; for the most part, diversity increased (standardization decreased). Tan was the dominant slip color for the earliest Glaze Ware types and decreased in use throughout the sequence. Darker colors became more prevalent during the latter half of the sequence. The intermediate types do not show a reduction in diversity for slip color.

Design layout, structure, and elements were measured on a sample of 140 whole and partial vessels from throughout the Northern and Central Rio Grande Valley. The most common layout type throughout the sequence was an interior band only type. The use of a panel is very common for Glazes A through D, but Glazes E and F rarely have a paneled design layout. For paneled bowl interiors, the most common type of panel division throughout the sequence was a square or rectangular division. More than half of the vessels had a top framing line, but these lines were most common on Glaze B vessels and least common on Glaze E vessels. The rotation and symmetry of the overall design is most commonly 2-fold translation. The number of lines dividing panels varies over the sequence, with a general increase in the number of lines used. Overall, the Shannon diversity index for these various aspects of layout and structure are variable – no one

Glaze Ware type sees any overall trends in reduced or heightened diversity. Design elements and motifs show a different pattern. The Shannon diversity index shows a high, yet stable amount of diversity throughout the sequence until the Glaze F period. Glaze F sees increased standardization, or reduction in diversity. In addition, the prevalence of certain elements and motifs changed throughout the sequence, with motifs containing triangles decreasing from Glaze A to F, while motifs consisting of lines and line combinations increased. Bird and human-related motifs were more prevalent during the intermediate Glaze Ware periods.

In summary, there are a number of temporal changes in attribute state or the average value for particular attributes, but there is no clear pattern of increased or decreased standardization of any attribute for the intermediate Glaze Ware period.

The Organization of Production at San Marcos Pueblo

The stability in the amount of variation apparent in the products made by potters at San Marcos Pueblo suggests that there was little change in the composition of the pottery production group over time. The stability in technological, morphological, and decorative characteristics of potter's products suggests little change in the communities of practice through time. There are a number of interesting details within the data for particular attributes that yield insight into the nature of production of ceramics at the site. A number of the attributes changed through time, for example, maximum rim thickness changed with Glaze Ware type, but the level of standardization did not change. This suggests that potters may have been innovative in development of new rim forms, but once a new type of rim was accepted by the community of potters, everyone began making them the same way. The data suggest that the intentional nature of a change in

the rim form did not modify how standardized the attribute was on the vessels. It may be that the change simply became internalized quickly and thus continued to reflect the mechanical nature of standardization we see in the stable attributes, such as wall thickness.

Concentration of production at San Marcos Pueblo is supported, not only by previous research on material exported from the site, but by the findings of the current research that suggest that the vast majority of ceramics found at the site were manufactured there. Scale of the production unit is suggested to have been similar throughout the sequence; it likely was small and on the level of the individual household, based on the lack of any differences in vessels made for local use and those exported from the site.

A number of interesting trends are suggested by patterns in the late Glaze Ware types data. Two attributes suggest greater degrees of processing for Glaze E vessels. Both aplastic processing, as seen in the angularity of the monzonite grains, and polishing were more common for Glaze E samples. This increase in polishing may relate to relatively high levels of polishing on Glaze E vessels in the wider Northern Rio Grande region. Many Glaze E vessels throughout the Northern Rio Grande were made at Pecos Pueblo (Dyer 2010; Shepard 1942) and Pecos vessels tend to have higher levels of polishing than vessels made at other sites (Dyer 2010). Perhaps San Marcos potters were cognizant of this greater luster on many Glaze E vessels and tried to emulate this feature on their own pots.

Another trend in a number of attributes is an increase or decrease in the number of attribute states during the late period, especially with Glaze F production. There is an

increase in the number of slip and glaze colors in the later Glaze Ware types, as well as a decrease in the number of motifs used to decorate Glaze F vessels. These data suggest some impact from Spanish contact and presence on pottery production, but it is significant that the changes are primarily on the intentional decorative attributes that would have been more visible.

Evaluation of Models: The Relationship Between Standardization and Intensity of Production

Because of the straightforward nature of the data, determining the model that is a better fit was clear. Model 1, in which standardization is a direct indicator of changes in intensity of production at San Marcos Pueblo, is not supported. There is no significant increase or decrease in the level of standardization for any attribute examined. Vessels made for local use and for export reflect the same levels of standardization (or lack of standardization). Because all attributes, both intentional and mechanical, show no change in standardization through time, no discussion of these differences is necessary. Although it is interesting to note that the mechanical, morphological attributes are the most standardized of any of the attributes overall, there was no temporal change in their standardization.

Model 2, in which standardization is not a direct indicator of changes in intensity of production at San Marcos, is supported by the data. The exported and local samples do not exhibit differences in level of standardization, suggesting that vessels made for export were not made by a smaller group of potters than the vessels used at San Marcos. Because Model 2 is supported, it is clear that there is less than a direct relationship between the documented changes in intensity of production at the site and the level of

standardization of the ceramic assemblage produced. These results suggest a number of possibilities, which are listed here and discussed below in greater detail. The first possible explanation is the simplest: that change in specialization intensity is not reflected in increased standardization of the assemblage produced at San Marcos. The second possible explanation of the results is that the confounding factors discussed in Chapter 4, including the impossibility of knowing the actual number of producers, conflation of a long time scale, and other factors, are still a concern in the interpretation of production at San Marcos. Although this project was developed with the idea that we held many of these factors constant, it may be that they were not held constant enough.

The first possible explanation, that standardization does not change with intensity of production, has been discussed by Eric Blinman (1988). Blinman (1988:77) suggests that potters in the Prehispanic Southwest never reached levels of craft specialization that would be reflected in increased standardization in the pottery assemblages produced. This is certainly a possibility. The relatively low levels of production, always at the household level, may not have required potters to produce pots at a high enough rate to modify the level of standardization. On the other hand, there does seem to be some evidence of increased standardization in certain assemblages documented by others, such as the large vessel sizes discussed in Chapter 4. So many potters may have contributed to assemblages that it may not be possible to recognize true standardization. It seems likely that if there were ever high enough levels of production going on in the Prehispanic American Southwest, they would be in the large, aggregated Classic period towns such as San Marcos with extensive evidence for export of goods to other villages. Valerie King

(2003) also found no evidence for increased standardization in the specialized production of vessels in the Chuska Valley during the earlier Chacoan period.

The second possible explanation of the result may be significant: confounding factors may blur the record, and I may not have been able to sort out these factors at San Marcos due to the local sherd sample having been entirely from surface collection. The relationship of standardization to increased intensity of production is a complex one. Most ethnographic research suggests that, as potters spend more time making pots, the standardization of their products increases. In archaeological cases, it is often hard to see this relationship between intensity and standardization. At San Marcos, the sum of products made by potters making more pots than their earlier predecessors does not show more standardization. Does this suggest that more intensive production does not lead to greater levels of standardization? Perhaps, but not necessarily. If we examine the issue from the other direction, when a change in standardization does occur, it is clear that standardization can result from either an increase *or* a decrease in production intensity. As addressed by Stark (1995), the ratio of producers to the number of products produced is significant. For example, at our hypothetical village during period A, ten potters provide pots for a population of 100. They spend about a quarter of their time making pots. During period B, five potters provide pots for a population of 50. They also spend about a quarter of their time making pots. Just based on the smaller number of producers, the total amount of variation in the products from period B may be reduced and, hence, *appear* more standardized. Inversely, if the number of potters increased in period B, production may appear *less* standardized.

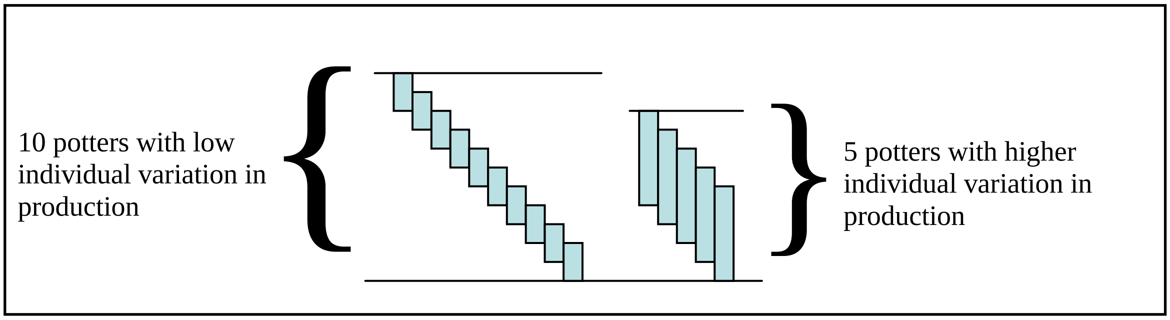


Figure 11.1: **Overall lower assemblage variation for less intensive production for five potters versus higher intensity of production for ten potters.**

What the data from San Marcos suggest is that while standardization may be dependent on changes in intensity of production on an individual level, as is suggested by many ethnographic examples, standardization of an assemblage produced by a group of potters is blurred by confounding factors. These factors, including the number of producers, production episodes, vessel size classes, and even time, are challenging, and sometimes impossible, to control for in the archaeological record.

The stability in ceramic production from the A.D. 1300s to the late 1600s at San Marcos is surprising, considering the number of obvious social and economic changes that occurred during this period. Spanish Contact and eventual Spanish presence at San Marcos surely had social and economic effects on the Pueblo's residents, yet these are not reflected in any great change in the measured amount of variation seen in the ceramics produced. Changes occurred with Spanish contact in agricultural processing, room size, household composition, the introduction of draft animals, and dwelling construction in the Western Pueblo region (James 1997), and some of these changes certainly also occurred at San Marcos, yet we do not see drastic changes in the ceramic production system.

Other areas of the Protohistoric world also show a lack of change in standardization from prehistoric to historic production. In her research at Zuni, Mills (1995) found that the level of standardization in size did not change from the mid-fifteenth to the late seventeenth century. Mills attributes this stability to consistency in the skill level of producers throughout this sequence. Compositional data suggest that Zuni Glaze Ware vessels were produced in fewer locations, but there was not a change in the ratio of producers to consumers, and hence no changes in skill that would lead to greater levels of standardization (Mills 1995:221). This inverse relationship between standardization and specialization, as seen through a reduction in production locales, may be like the pattern I see at San Marcos. The ratio of producers to consumers may not change through time at San Marcos, and changing amounts of goods exported may reflect change in the size of the site at different times rather than changes in the intensity of production.

The number of producers is a significant issue when considering the relationship between the standardization of an assemblage of ceramics and the level of specialized production occurring at the site. Based on the areas of use of the site discussed in Chapter 2 (Figure 2.7), I proposed that area of use of the site did not change drastically, based on spatial extent of the distribution of the different ceramic types, but other researchers' estimations of population for the site have yielded significant variation. Eden Welker (1997) used Nelson's notes (1915) and artifacts to assign buildings to temporal periods. She identified four periods of occupation, with time spans of approximately 85 to 110 years (Welker 1997:78). She found that the four periods coincided with (1) Glaze A and B, (2) Glaze C and D, (3) Glaze E, and (4) Glaze F. Population estimates were

determined using room counts. Welker (1997:86) estimates the first occupational period had a population of 738, the second 1,696, the third 729, and the fourth 536. If these estimates are accurate, we might see major changes in the level of standardization of the ceramic assemblage produced at San Marcos through time, especially for the Glaze C and D period. We do not. There are a couple of possible explanations. One explanation is that the number of producers does not change even though overall town population change. Those producers would need to increase their production intensity to provide more people with vessels and, according to the standardization hypothesis, their products should be more standardized. Another explanation is that the number of producers does increase with this increase in population at the site. If this is the case, then it is possible that we have more producers than we had in the earlier period, yet the assemblage they are now producing is about the same in the level of standardization. This may suggest that these producers became more standardized on an individual level, but, because there were more producers, cumulative blurring resulted in a level of standardization similar to the earlier and later periods.

Far from being purely a cautionary tale, the results of this research suggest that looking at standardization of production can be fruitful, if care is taken to view producers as closely as we view their products. This is not always an easy suggestion, especially in the Southwest. San Marcos would seem to be an ideal test case, yet because of our lack of control over the size of the site at different periods of time and lack of household assemblages that might allow for better control for time, developing conclusions on how many people might have been making pots during any one period of time is very difficult. Archaeological sites with room-level excavated materials, such as Tonque Pueblo just a

few kilometers to the west of San Marcos (Morales 1997), may allow for greater levels of control of production by particular households.

Directions for Future Research

Other villages in the Northern Rio Grande have also long been assumed to have been production centers for the manufacture of Northern Rio Grande Glaze Ware. Tonque Pueblo is one of these villages, and it may have eclipsed San Marcos in the production of Glaze D vessels (Warren 1969). Exploring the organization of production at Tonque Pueblo will continue to add to our knowledge of pottery production in the Classic period towns of the Northern Rio Grande, as well as help to continue to evaluate the relationship between standardization and production intensity in the region. Because the results of this dissertation suggest that control over producers as well as production amounts may be paramount, Tonque is the logical next step in evaluating the relationship between the degree of standardization and specialized production because of the detailed, room-level excavations conducted there by the Albuquerque Archaeological Society (Morales 1997). San Marcos, with primarily surface-collected materials, does not allow for a high degree of control over individual household production. In addition, the ceramic sherds from Tonque are much larger than the majority of sherds from San Marcos, thus allowing for a greater possibility of successfully identifying size classes of vessels than was possible with the small, surface-collected San Marcos materials. I have already begun to examine a small sample of sherds made at Tonque Pueblo, and the pattern of standardization is intriguing—there does seem to be a slight increase in standardization from Glaze C to Glaze D in rim diameter and framing line thickness (Table 11.1).

Table 11.1: ***Percent Coefficient of Variation for a sample of sherds from Tonque Pueblo for the attributes of rim diameter and framing line thickness.***

Glaze	N	Rim Diameter % CV	Framing Line Thickness % CV
C	25	23.53	35.48
D	25	16.4	23.77

Another question not fully addressed by this dissertation is the relationship between glaze paint color and chemical composition. The results suggest that color is dependent not only on composition, but may be affected by firing technology and the underlying clay and slip as well. Eric Blinman and Cythnia Herhahn have begun to address this issue, and I plan on working in conjunction with them through the use of additional microprobe compositional analysis, as well as experimental and replication studies, to unravel the complexities of glaze paint color and composition (Blinman et al. 2009).

Summary

The results of this dissertation suggest that pottery production at San Marcos Pueblo was stable from the 1300s until final abandonment during the Pueblo Revolt of 1680. The degree of standardization of the vessels produced does not change with the changes in amounts of pottery exported from the village, and vessels made for export are not more standardized than those that remain for local use. Even with the major political and social changes brought about by Spanish Contact and the Spanish presence at the site, the conservative pottery-making tradition used in the manufacture of Northern Rio Grande Glaze Wares remains relatively constant. The relationship between standardization and increased intensity of production is not apparent in the pottery from San Marcos. This finding has implications for the use of standardization as a measure of

intensity of production. Confounding factors, including changes in number of producers, numbers of production episodes, vessel size classes, and lack of control of time of production of particular types, may blur the relationship and should be controlled for as much as is possible in using standardization to view aspects of the organization of production.

Appendices

Appendix A

Reference Tables

Table 1: Pottery Types and Glaze Type Codes of the Rio Grande Glaze Ware Series

Glaze Type Code	Glaze Type	Glaze Rim Type
CGP	Cienegilla Glaze Polychrome	A
CGY	Cienegilla Glaze-on-Yellow	A
AFR	Agua Fria Glaze-on-Red	A
LPP	Los Padillas Glaze Polychrome	A
SCP	San Clemente Glaze Polychrome	A
LGY	Largo Glaze-on-Yellow	B
LGR	Largo Glaze-on-Red	B
LGP	Largo Glaze Polychrome	B
EGY	Espinoso Glaze-on-Yellow	C
EGR	Espinoso Glaze-on-Red	C
EGP	Espinoso Glaze Polychrome	C
SLP	San Lazaro Glaze Polychrome	D
SLR	San Lazaro Glaze-on-Red	D
SLY	San Lazaro Glaze-on-Yellow	D
PGR	Pecos Glaze-on-Red	E
PGP	Pecos Glaze Polychrome	E
PUR	Puaray Glaze-on-Red	E
PUY	Puaray Glaze-on-Yellow	E
PUP	Puaray Glaze Polychrome	E
KGY	Kotyiti Glaze-on-Yellow	F
KGR	Kotyiti Glaze-on-Red	F
KGP	Kotyiti Glaze Polychrome	F

Table 2: Slip Color Grouped Categories

Munsell Color	Color Name	Grouped Color Category	Further Grouped Color Category
10R2.5/1	reddish black	black	black
10R3/3	dusky red	red	red & orange
10R3/4	dusky red	red	red & orange
10R3/6	dark red	red	red & orange
10R4/1	dark reddish gray	gray	gray
10R4/2	weak red	reddish brown	brown & reddish brown
10R4/3	weak red	red	red & orange
10R4/4	weak red	red	red & orange
10R4/6	red	red	red & orange
10R4/8	red	red	red & orange
10R5/2	weak red	gray	gray
10R5/4	weak red	red	red & orange
10R5/6	red	red	red & orange
10R5/8	red	red	red & orange
10R6/3	pale red	pinkish	off white & pinkish
10R6/4	pale red	pinkish	off white & pinkish
10R6/6	light red	pinkish	off white & pinkish
10R7/6	light red	pinkish	off white & pinkish
10R8/3	pink	pinkish	off white & pinkish
10Y8/1	white	off white	off white & pinkish
10YR2/1	black	black	black
10YR2/2	very dark brown	brown	brown & reddish brown
10YR3/1	very dark gray	gray	gray
10YR3/2	very dark grayish brown	brown	brown & reddish brown
10YR3/3	dark brown	brown	brown & reddish brown
10YR4/1	dark grey	gray	gray
10YR4/2	dark grayish brown	brown	brown & reddish brown
10YR4/4	dark yellowish brown	brown	brown & reddish brown
10YR5/1	gray	gray	gray
10YR5/2	grayish brown	brown	brown & reddish brown
10YR5/3	brown	brown	brown & reddish brown
10YR5/4	yellowish brown	brown	brown & reddish brown
10YR6/1	gray	gray	gray
10YR6/2	light brownish gray	tan	tan
10YR6/3	pale brown	tan	tan
10YR6/4	light yellowish brown	tan	tan
10YR7/1	light gray	gray	gray
10YR7/2	light gray	tan	tan
10YR7/3	very pale brown	tan	tan

Munsell Color	Color Name	Grouped Color Category	Further Grouped Color Category
10YR7/4	very pale brown	tan	tan
10YR8/1	white	off white	off white & pinkish
10YR8/2	very pale brown	tan	tan
10YR8/3	very pale brown	tan	tan
10YR8/4	very pale brown	tan	tan
2.5Y2.5/1	black	black	black
2.5Y4/1	dark grey	gray	gray
2.5Y5/1	gray	gray	gray
2.5Y6/1	gray	gray	gray
2.5Y6/2	light brownish gray	tan	tan
2.5Y7/1	light gray	gray	gray
2.5Y7/2	light gray	tan	tan
2.5Y8/1	white	off white	off white & pinkish
2.5Y8/2	pale yellow	tan	tan
2.5YR2.5/1	black	black	black
2.5YR2.5/2	very dusky red	reddish brown	brown & reddish brown
2.5YR3/1	very dark gray	reddish brown	brown & reddish brown
2.5YR3/2	very dark grayish brown	reddish brown	brown & reddish brown
2.5YR3/3	dark reddish brown	reddish brown	brown & reddish brown
2.5YR4/1	dark reddish gray	gray	gray
2.5YR4/2	weak red	reddish brown	brown & reddish brown
2.5YR4/3	reddish brown	reddish brown	brown & reddish brown
2.5YR4/4	reddish brown	reddish brown	brown & reddish brown
2.5YR4/6	red	red	red & orange
2.5YR4/8	red	red	red & orange
2.5YR5/1	reddish gray	gray	gray
2.5YR5/2	weak red	pinkish	off white & pinkish
2.5YR5/3	reddish brown	pinkish	off white & pinkish
2.5YR5/4	reddish brown	reddish brown	brown & reddish brown
2.5YR5/6	red	red	red & orange
2.5YR5/8	red	red	red & orange
2.5YR6/1	reddish gray	gray	gray
2.5YR6/2	pale red	pinkish	off white & pinkish
2.5YR6/3	light reddish brown	pinkish	off white & pinkish
2.5YR6/4	light reddish brown	pinkish	off white & pinkish
2.5YR6/6	light red	orange	red & orange
2.5YR6/8	light red	orange	red & orange
2.5YR7/1	light reddish gray	gray	gray
2.5YR7/2	pale red	pinkish	off white & pinkish
2.5YR7/3	light reddish brown	pinkish	off white & pinkish

Munsell Color	Color Name	Grouped Color Category	Further Grouped Color Category
2.5YR7/6	light red	orange	red & orange
2.5YR8/1	white	off white	off white & pinkish
5Y2.5/1	black	black	black
5Y4/1	dark gray	gray	gray
5Y5/1	gray	gray	gray
5Y8/1	white	off white	off white & pinkish
5YR2.5/2	dark reddish brown	brown	brown & reddish brown
5YR3/3	dark reddish brown	reddish brown	brown & reddish brown
5YR3/4	dark reddish brown	reddish brown	brown & reddish brown
5YR4/1	dark gray	gray	gray
5YR4/3	reddish brown	reddish brown	brown & reddish brown
5YR4/4	reddish brown	reddish brown	brown & reddish brown
5YR5/1	gray	gray	gray
5YR5/3	reddish brown	reddish brown	brown & reddish brown
5YR5/4	reddish brown	reddish brown	brown & reddish brown
5YR5/6	yellowish red	orange	red & orange
5YR6/2	pinkish grey	buff	buff
5YR6/3	light reddish brown	buff	buff
5YR6/4	light reddish brown	buff	buff
5YR6/6	reddish yellow	orange	red & orange
5YR7/2	pinkish grey	buff	buff
5YR7/3	pink	buff	buff
5YR7/4	pink	orange	red & orange
5YR7/6	reddish yellow	orange	red & orange
7.5YR2.5/1	black	black	black
7.5YR2.5/2	very dark brown	brown	brown & reddish brown
7.5YR2.5/3	very dark brown	brown	brown & reddish brown
7.5YR3/1	very dark grey	black	black
7.5YR3/3	dark brown	brown	brown & reddish brown
7.5YR4/2	brown	brown	brown & reddish brown
7.5YR4/3	brown	brown	brown & reddish brown
7.5YR4/4	brown	brown	brown & reddish brown
7.5YR5/2	brown	brown	brown & reddish brown
7.5YR5/3	brown	brown	brown & reddish brown
7.5YR5/4	brown	brown	brown & reddish brown
7.5YR6/2	pinkish grey	buff	buff
7.5YR6/3	light brown	buff	buff
7.5YR6/4	light brown	buff	buff
7.5YR6/6	reddish yellow	orange	red & orange
7.5YR7/1	light gray	gray	gray

Munsell Color	Color Name	Grouped Color Category	Further Grouped Color Category
7.5YR7/2	pinkish grey	buff	buff
7.5YR7/3	pink	buff	buff
7.5YR7/4	pink	buff	buff
7.5YR8/1	white	off white	off white & pinkish
7.5YR8/2	pinkish white	buff	buff
7.5YR8/3	pink	buff	buff
7.5YR8/4	pink	buff	buff
GLEY1 2.5/	black	black	black
GLEY1 3/1	very dark gray	gray	gray
GLEY14/	dark gray	gray	gray
GLEY14/n	dark gray	gray	gray
GLEY15/	gray	gray	gray
GLEY16/	gray	gray	gray
GLEY17/	light gray	gray	gray

Appendix B

Petrographic Data

Table 1: Percent clay, minerals, and voids from the point-counting petrographic data.

Sherd Number	Glaze	Percent Clay	Percent Minerals	Percent Voids
A01	A	69.82	27.81	2.37
A02	A	59.31	38.62	2.07
A04	A	68.49	29.45	2.05
A05	A	62.33	32.88	4.79
A06	A	60.00	35.17	4.83
A07	A	60.54	35.37	4.08
A08	A	46.90	46.21	6.90
A09	A	60.00	38.62	1.38
A10	A	54.79	41.10	4.11
A11	A	60.69	36.55	2.76
A12	A	58.78	38.51	2.70
A13	A	61.07	37.58	1.34
A14	A	60.40	38.93	0.67
A16	A	67.79	28.19	4.03
A17	A	57.72	36.91	5.37
A18	A	64.67	30.00	5.33
A19	A	74.83	21.85	3.31
A20	A	60.00	32.67	7.33
A22	A	60.00	36.00	4.00
A23	A	58.67	35.33	6.00
LA A01	A	56.86	41.18	1.96
LA A02	A	68.21	29.14	2.65
LA A03	A	57.79	36.36	5.84
LA A04	A	58.94	34.44	6.62
LA A05	A	62.00	34.67	3.33
B01	B	66.00	32.67	1.33
B02	B	55.10	34.01	10.88
B03	B	56.85	39.04	4.11
B04	B	60.39	38.31	1.30
B05	B	68.49	27.40	4.11
B06	B	59.86	34.69	5.44
B07	B	65.52	29.66	4.83
B08	B	60.81	33.11	6.08
B09	B	64.86	31.08	4.05
B10	B	56.62	36.03	7.35
B11	B	60.93	35.10	3.97
B12	B	61.22	33.33	5.44
B13	B	70.67	23.33	6.00
B14	B	64.90	32.45	2.65

Sherd Number	Glaze	Percent Clay	Percent Minerals	Percent Voids
B15	B	72.55	22.88	4.58
B16	B	61.59	35.10	3.31
B17	B	69.28	26.80	3.92
B19	B	62.67	33.33	4.00
B20	B	54.67	37.33	8.00
B21	B	62.00	36.00	2.00
C01	C	60.00	35.33	4.67
C05	C	68.35	27.85	3.80
C06	C	51.15	38.17	10.69
C07	C	55.22	37.31	7.46
C08	C	65.33	33.33	1.33
C09	C	66.22	31.08	2.70
C10	C	62.16	32.43	5.41
C11	C	66.20	30.99	2.82
C12	C	59.31	40.00	0.69
C14	C	62.33	33.56	4.11
C15	C	58.11	36.49	5.41
C17	C	66.89	29.73	3.38
C18	C	69.13	27.52	3.36
C20	C	57.79	35.71	6.49
C21	C	53.29	41.45	5.26
C22	C	66.01	30.72	3.27
C24	C	63.69	35.03	1.27
C25	C	45.10	48.37	6.54
C27	C	54.19	38.71	7.10
LA C01	C	59.60	37.75	2.65
LA C02	C	46.36	39.74	13.91
LA C03	C	56.29	37.09	6.62
LA C04	C	57.89	39.47	2.63
LA C05	C	63.09	30.20	6.71
D03	D	55.86	40.69	3.45
D05	D	60.27	38.36	1.37
D06	D	57.46	39.55	2.99
D07	D	45.58	48.30	6.12
D09	D	66.22	33.11	0.68
D10	D	57.53	39.04	3.42
D14	D	59.59	37.67	2.74
D16	D	55.78	34.01	10.20
D18	D	64.00	34.00	2.00
D19	D	60.81	36.49	2.70
D20	D	60.26	39.74	
D21	D	62.58	32.26	5.16
D22	D	51.68	42.28	6.04
D30	D	53.69	42.28	4.03

Sherd Number	Glaze	Percent Clay	Percent Minerals	Percent Voids
D31	D	57.05	34.23	8.72
D32	D	60.93	38.41	0.66
D33	D	54.00	37.33	8.67
D36	D	57.33	40.00	2.67
D37	D	68.87	30.46	0.66
D39	D	57.33	36.67	6.00
LA D01	D	62.00	34.00	4.00
E03	E	54.68	43.88	1.44
E05	E	63.09	33.56	3.36
E06	E	52.67	46.00	1.33
E07	E	64.00	33.33	2.67
E08	E	61.38	33.79	4.83
E11	E	60.00	37.93	2.07
E12	E	65.77	34.23	
E15	E	57.72	39.60	2.68
E19	E	43.15	54.79	2.05
E20	E	49.32	43.15	7.53
E22	E	56.49	33.77	9.74
E28	E	56.69	38.22	5.10
E29	E	58.44	35.06	6.49
E31	E	61.04	33.77	5.19
E32	E	67.30	31.45	1.26
E33	E	48.37	46.41	5.23
E35	E	64.10	32.69	3.21
E39	E	65.16	31.61	3.23
E41	E	52.83	44.65	2.52
E44	E	56.13	35.48	8.39
F01	F	62.91	31.13	5.96
F02	F	52.41	43.45	4.14
F03	F	76.47	20.26	3.27
F04	F	60.00	36.55	3.45
F05	F	67.79	30.20	2.01
F06	F	61.90	34.01	4.08
F07	F	59.18	40.14	0.68
F08	F	64.63	31.29	4.08
F11	F	62.16	37.16	0.68
F12	F	72.29	26.51	1.20
F13	F	60.40	36.91	2.68
F14	F	61.33	32.67	6.00
F15	F	60.67	31.33	8.00
F16	F	64.00	32.00	4.00
F17	F	60.93	32.45	6.62
F18	F	61.59	34.44	3.97
F24	F	60.67	34.67	4.67

Sherd Number	Glaze	Percent Clay	Percent Minerals	Percent Voids
F25	F	57.33	34.00	8.67
F26	F	71.33	23.33	5.33
F27	F	63.33	30.67	6.00
F29	F	64.67	32.67	2.67
LA F01	F	65.79	33.55	0.66
LA F02	F	59.49	31.65	8.86
LA F03	F	60.26	33.77	5.96

Appendix C

In-depth Descriptions of the Methods

In-depth descriptions of the methods and rational for the measurement of morphological and technological attributes examined in this dissertation were developed jointly for the larger San Marcos Ceramic Project with Jennifer Boyd Dyer (2010).

For all attributes that are dependent on light, we use a standard light with UV filter. These attributes are slip color, glaze paint color, and degree of luster.

1) Framing line thickness

Up to five measurements of the framing line thickness. Sometimes sherd was not large enough to get five measurements. Minimally, do three, one at each end of the line at the sherd breaks and one in the center of the line/ sherd. Take measurements for each framing line.

2) Framing lines' distance below rim

For each framing line, take up to five measurement from the very tip of the sherd to the top of the framing line (put the edge of the calipers on the top of the rim).

3) Slip Color

Take one Munsell color for interior & exterior slip if present. Take the color for the most dominate color area for each side. Also take an exterior & interior slip paint color, if present.

4) Glaze Paint Color

Take one Munsell color for interior & exterior glaze if present. Take the color for the most dominate color area for each side.

5) Core Pattern

Record using core pattern sheet from Pierce 1999 (Figure 10.1). Upper side is exterior, lower side is interior.

6) Degree of luster

Record degree of luster on the exterior and interior of the sherd. Also note any markings or lines on the surface. Categories are high (relatively uniform shiny/ glossy finish), medium (slightly shiny, but ranges from matte to shiny only in some areas), low (matte, not shiny at all). Note should include if there are striation, crazing, wipe marks, lines, etc.

7) Sherd Thickness

Because we want body thickness, take up to three measurements along the bottom (opposite of rim) edge of the sherd (one on each edge & one in the center).

8) Rim Diameter

Using the template, measure the diameter at the fattest part of the rim (as opposed to the tip of the rim because at the tip you are not able to line the template & that is not actually the orifice diameter - it could be larger than the orifice diameter there). Be sure that you are holding the card board template flat (not curved at all) and have the light shining up from below the sherd. Place the sherd against the template curve. If you are able to rock the sherd back and forth against the template, that template is too small. If you see a crack of light in the middle of the sherd, that template is too large. When you are getting close to the right measurement, but sure to run the sherd along the whole edge of the template to be sure of a perfect fit.

9) Maximum Rim Thickness

Take three measurements along the rim at the thickest point (one on each edge & one in the middle).

Appendix D

Data from the Local and Exported Sherd Samples

Data from the Local and Exported Sherd Samples

Table 1: Categorical Data from the Local and Exported Sherd Samples

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
A01	A	CGY	LA 98	O	Brown		7.5YR5/3	10YR7/3	med	low
A02	A	CGY	LA 98	F	Dark black		10YR7/2	10YR8/3	med	low
A04	A	CGY	LA 98	E	Dark black		10YR7/3	10YR7/3	med	low
A05	A	CGP	LA 98	H	Dark black	Dark black	10YR7/2	10YR8/3	low	low
A06	A	CGY	LA 98	G	Grey		10YR7/3	10YR8/3	low	low
A07	A	CGY	LA 98	G	Grey		10YR6/3	10YR7/2	med	low
A08	A	CGY	LA 98	B	Dark black		10YR6/3	7.5YR6/4	high	med
A09	A	CGY	LA 98	E	Dark black		10YR7/4	10YR7/3	med	med
A10	A	CGY	LA 98	B	Dark black	Dark black	10YR7/4	10YR7/4	med	med
A11	A	CGY	LA 98	C	Dark black		10R5/4	10YR7/3	med	med
A12	A	CGP	LA 98	D	Grey		7.5YR7/4	7.5YR8/3	high	med
A13	A	CGY	LA 98	A	Dark black		7.5YR6/3	10YR8/2	med	med
A14	A	CGY	LA 98	B	Grey		10YR7/2	10YR6/2	med	med
A15	A	CGY	LA 98	F	Dark black		10YR7/3	10YR7/3	low	med
A16	A	CGY	LA 98	B	Dark black		10YR7/3	10YR7/3	med	med
A17	A	CGY	LA 98	F	Brownish black		7.5YR7/3	10YR7/4	low	low
A18	A	CGY	LA 98	F	Brownish black		10YR7/2	10YR7/2	med	med
A19	A	CGY	LA 98	A	Grey		2.5YR7/1	2.5YR7/1	med	high
A20	A	CGY	LA 98	E	Brown		10YR7/3	10YR7/3	med	high
A21	A	AFR	LA 98	B	Reddish Brown		2.5YR5/6	2.5YR6/6	low	low
A22	A	CGY	LA 98	B	Grey		10YR7/3	10YR7/3	med	med
A23	A	CGY	LA 98	A	Dark black		10YR8/1	2.5Y8/1	med	high
A24	A	CGY	LA 98	A	Dark black		2.5YR6/1	2.5YR7/1	high	med
A25	A	CGY	LA 98	G	Brownish black		10YR8/2	2.5Y8/1	high	high
A26	A	CGY	LA 98	A	Brownish black		10YR8/2	10YR8/2	high	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
A27	A	LPP	LA 98	F	Dark black	Dark black	10R4/6	10R4/6	med	med
A28	A	CGY	LA 98	C	Dark black		10YR7/3	10YR7/4	med	low
A29	A	AFR	LA 98	C	Reddish Brown		2.5YR4/4	2.5YR4/1	high	high
A30	A	CGY	LA 98	A	Dark black		10YR7/2	10YR7/2	med	med
A32	A	CGY	LA 98	G	Brownish black		10YR7/2	10YR8/2	med	low
A33	A	CGY	LA 98	E	Dark black		10YR7/3	10YR8/2	med	med/high
A34	A	CGY	LA 98	G	Dark black		10YR7/2	10YR8/1	high	high
A35	A	CGY	LA 98	A	Grey		10YR8/1	10YR7/1	high	med
A36	A	CGP	LA 98	F	Dark black		5YR6/4	10YR7/2	high	med
A38	A	CGY	LA 98	B	Dark black		10YR7/3	10YR7/3	high	high
A39	A	CGY	LA 98	A	Dark black		10YR7/1	10YR8/2	med	med
A40	A	CGY	LA 98	A	Brownish black		10YR7/3	10YR7/2	med	med
A41	A	CGY	LA 98	K	Grey		10YR8/2	10YR8/3	med	med
A42	A	CGP	LA 98	B	Brown		2.5YR4/6	10YR6/2	high	high
A43	A	CGY	LA 98	D	Brownish black		10YR5/3	10YR7/3	high	high
A44	A	CGY	LA 98	H	Brown		10YR7/3	10YR8/3	high	med
A45	A	CGY	LA 98	C	Dark black		10YR8/3	10YR7/4	med	high
A46	A	CGY	LA 98	G	Brownish black		10YR7/3	10YR7/2	med	high
A47	A	CGY	LA 98	B	Brownish black		10YR7/4	10YR8/1	med	med
A48	A	CGY	LA 98	H	Dark black		10YR6/2	10YR7/2	med	high
A49	A	CGY	LA 98	C	Brownish black		10YR6/3	10YR6/2	high	high
A50	A	CGY	LA 98	B	Dark black		10YR8/3	10YR8/3	med	high
A51	A	CGY	LA 98	A	Oxidized, unclear	Dark black	10YR6/1	gley14/N	high	high
A53	A	CGY	LA 98	A	Brownish black		10YR7/3	2.5YR6/2	low	high
A54	A	CGY	LA 98	A	Brownish black		2.5YR7/2	2.5YR6/1	med	med
A55	A	CGY	LA 98	A	Brown	Brown	10YR4/1	10YR7/2	med	med
A56	A	CGY	LA 98	F	Dark black		10YR7/4	10YR8/3	low	low
A57	A	CGY	LA 98	C	Dark black		10YR7/3	10YR7/4	med	med
A58	A	CGP	LA 98	G	Dark black		2.5YR4/4	10YR7/3	med	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
A59	A	CGY	LA 98	C	Dark black		10YR7/3	10YR8/1	high	high
A60	A	CGY	LA 98	F	Dark black		10YR7/3	10YR7/3	med	med
A61	A	CGY	LA 98	A	Dark black		10YR7/3	2.5YR6/2	low	low
A62	A	CGY	LA 98	F	Brownish black	Brownish black	10YR7/3	10YR5/1	med	med
A63	A	CGY	LA 98	B	Dark black		10YR7/2	10YR7/3	high	high
A64	A	CGY	LA 98	C	Dark black	Dark black	10YR6/4	10YR7/3	med	low
A65	A	CGY	LA 98	C	Brownish black		10YR7/3	10YR8/3	med	med
A66	A	CGY	LA 98	E	Dark black		10YR7/3	2.5YR8/1	med	med
A67	A	CGY	LA 98	E	Dark black		10YR7/3	10YR8/2	med	med
A68	A	CGY	LA 98	G	Brown		10YR6/3	2.5Y8/2	med	low
A69	A	CGP	LA 98	G	Brownish black		2.5YR4/3	10YR6/3	med	med
A70	A	CGY	LA 98	C	Dark black		10YR7/4	10YR7/3	low	med
A71	A	CGY	LA 98	B	Dark black		10YR7/2	10YR8/2	med	med
A72	A	CGP	LA 98	B	Brownish black		5YR5/4	10YR8/1	high	high
A73	A	CGY	LA 98	H	Dark black		10YR8/2	10YR8/3	med	med
A74	A	CGY	LA 98	C	Dark black		10YR8/1	10YR8/3	high	med
A75	A	CGY	LA 98	A	Oxidized, unclear		10YR8/2	10YR6/2	low	med
A76	A	CGY	LA 98	G	Brownish black		7.5YR7/4	10YR8/1	low	med
A77	A	CGP	LA 98	E	Dark black		10YR8/2	10YR8/2	med	med
A78	A	CGY	LA 98	B	Dark black		10YR8/2	10YR8/2	med	high
A79	A	CGY	LA 98	G	Brown		10YR7/2	10YR7/3	med	med
A80	A	CGY	LA 98	A	Grey		10YR6/2	10YR5/1	high	high
ASU A01	A	CGY	LA 120	H	Brownish black		10YR7/2	10YR8/2	Med	med
ASU A02	A	CGY	LA 120	A	Dark black		10YR8/2	10YR8/3	med	med
ASU A03	A	CGY	LA 120	C	Brown		10YR8/2	10YR8/3	med	high
ASU A04	A	CGY	LA 120	A	Brownish black		10YR8/1	10YR8/1	low	med
ASU A05	A	CGY	LA 120	C	Dark black		10YR7/2	10YR7/2	low	med
ASU A06	A	CGY	LA 120	G	Dark black		10YR8/2	10YR8/2	med	med
ASU A07	A	CGY	LA 120	J	Dark black		10YR8/1	10YR8/2	med	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
ASU A08	A	CGY	LA 120	A	Brownish black		10YR8/1	10YR7/1	med	high
ASU A09	A	CGY	LA 120	A	Dark black		2.5Y5/1	10YR7/4	med	low
ASU A10	A	CGY	LA 476	F	Brownish black		10YR8/2	10YR8/2	high	high
ASU A11	A	CGY	LA 120	G	Dark black				med	med
ASU A12	A	CGY	LA 120	G	Black with green		10YR8/3	10YR8/3	med	med
ASU A13	A	CGY	LA 120	F	Brown		2.5Y7/2	2.5Y7/2	med	med
ASU A14	A	CGY	LA 120	A	Brownish black		2.5Y8/1	2.5Y7/2	med	med
ASU A15	A	CGY	LA 120	C	Dark black		10YR8/2	10YR7/2	med	med
ASU A16	A	CGY	LA 120	C	Dark black		10YR8/2	10YR8/3	med	med
ASU A17	A	CGY	LA 120	B	Dark black		10YR7/3	10YR8/3	med	high
ASU A18	A	CGY	LA 120	B	Dark black		10YR7/4	10YR7/4	med	high
LA A01	A	CGY	LA 70	A			10YR8/2	10YR7/3	med	med
LA A02	A	CGY	LA 278	F			10YR7/2	10YR7/2	med	high
LA A03	A	CGP	LA 70	C			10YR8/1	10YR7/2	med	high
LA A04	A	CGP	LA 70	C			10YR7/4	10YR7/2	med	med
LA A05	A	CGY	LA 374	E			10YR7/4	10YR7/3	med	med
LA A06	A	CGY	LA 374	G			10YR8/2	10YR7/2	med	med
LA A07	A	CGY	LA 70	B			10YR7/2	10YR8/2	med	high
LA A08	A	CGY	LA 7	F			10YR7/3	10YR7/3	med	low
LA A09	A	CGY	LA 7	F			10YR7/3	10YR7/3	med	med
LA A10	A	CGP	LA 278	D			10YR7/4	10YR7/4	med	med
LA A11	A	CGY	LA 7	C			10YR8/2	10YR8/3	low	low
LA A12	A	CGY	LA 7	E			10YR7/2	10YR7/4	low	low
LA A13	A	CGY	LA 7	C			10YR6/3	10YR8/3	low	low
UC A01	A	CGY	LA 80	B	Brown		10YR7/3	10YR8/2	high	high
UC A02	A	AFR	LA 51	F	Dark black		7.5YR5/4	2.5YR5/6	high	med
UC A03	A	AFR	LA 51	B	Dark black		2.5YR5/6	2.5YR5/6	high	high
UC A04	A	CGY	LA 80	E	Brownish black		10YR8/3	10YR8/4	med	med
UC A05	A	CGY	LA 80	H	Dark black		10YR7/1	10YR8/2	med	low

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
UC A06	A	CGY	LA 421	F	Dark black		10YR8/3	10YR7/3	med	med
UC A07	A	CGY	LA 28	B	Dark black		10YR8/2	7.5YR7/3	med	high
UC A08	A	CGY	LA 38	C	Dark black		10YR7/4	10YR7/3	high	med
UC A09	A	CGY	LA 51	A	Brown		10YR7/2	10YR8/1	med	med
UC A10	A	CGY	LA 183	F	Dark black		10YR8/3	10YR7/4	high	med
UC A11	A	CGY	LA 80	C	Dark black		7.5YR7/3	10YR7/3	med	med
UC A12	A	AFR	LA 26	B	Dark black		2.5YR5/6	2.5YR5/6	high	high
UC A13	A	CGY	LA 26	B	Dark black		10YR8/3	10YR8/3	med	med
UC A14	A	CGY	LA 7	H	Dark black		10YR7/4	10YR7/4	med	high
UC A15	A	CGY	LA 7	F	Brownish black		10YR8/2	10YR8/3	med	med
UC A16	A	CGY	LA 7	B	Dark black		10YR8/3	10YR8/3	med	med
UC A17	A	CGY	LA 123	A	Brownish black		10YR8/2	10YR8/2	med	med
UC A18	A	CGY	LA 183	G	Dark black		7.5YR8/3	10YR8/2	med	high
UC A19	A	CGY	LA 183	B	Dark black		10YR8/3	10YR8/3	high	high
ASU B01	B	LGP	LA 120	C	Dark black	Dark black	10Y8/1	10Y8/1	high	high
ASU B02	B	LGP	LA 120	B	Dark black	Dark black	10YR7/3	10YR7/4	high	high
ASU B03	B	LGP	LA 120	G	Brownish black	Dark black	2.5Y8/1	2.5Y8/1	med	high
ASU B04	B	LGY	LA 120	E	Brownish black		10YR8/2	10YR7/3	med	med
ASU B05	B	LGY	LA 120	B	Dark black		10YR7/4	10YR6/3	high	high
ASU B06	B	LGY	LA 120	G	Brownish black		10YR7/3	10YR7/3	med	high
ASU B07	B	LGY	LA 120	C	Brownish black		10YR8/2	10YR7/3	med	high
ASU B08	B	LGY	LA 120	E	Brownish black	Brownish black	10YR7/3	10YR8/2	med	high
ASU B09	B	LGY	LA 120	E	Brownish black	Dark black	10YR7/2	10YR7/3	high	med
ASU B10	B	LGY	LA 120	B	Dark black		10YR/3	10YR/3	med	med
ASU B11	B	LGP	LA 120	D	Brownish black	Brown	10YR7/2	10YR8/3	med	med
ASU B12	B	LGP	LA 95	F	Brownish black	Dark black	10YR8/3	10YR8/2	med	med
ASU B13	B	LGY	LA 120	E	Brown	Brown	10YR7/2	2.5Y7/2	med	high
ASU B14	B	LGP	LA 120	B	Dark black	Dark black	10YR8/3	10YR7/2	med	med
ASU B15	B	LGY	LA 120	G	Grey	Dark black	10YR7/3	10YR8/3	low	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
ASU B16	B	LGY	LA 120	C	Brown		10YR7/2	10YR7/2	med	med
B01	B	LGY	LA 98	O	Dark black		10YR7/3	10YR8/2	med	med
B02	B	LGY	LA 98	B	Brown		10YR7/3	10YR7/3	med	med
B03	B	LGY	LA 98	G	Dark black		10YR7/3	10YR8/2	high	high
B04	B	LGY	LA 98	A	Dark black		10YR7/2	10YR8/2	med	med
B05	B	LGP	LA 98	J	Dark black	Dark black	7.5YR6/3	10YR7/2	med	med
B06	B	LGY	LA 98	B	Dark black		10YR7/3	10YR7/3	low	med
B07	B	LGY	LA 98	F	Dark black		10YR7/3	10YR7/2	med	med
B08	B	LGY	LA 98	F	Brownish black	Dark black	10YR7/3	10YR7/3	high	med
B09	B	LGY	LA 98	G	Dark black	Dark black	10YR8/2	10YR7/2	med	med
B10	B	LGY	LA 98	A	Grey		10YR7/3	Firecloud	high	med
B11	B	LGY	LA 98	A	Dark black		10YR7/2	10YR7/1	med	med
B12	B	LGY	LA 98	B	Dark black		7.5YR6/4	7.5YR6/3	low	low
B13	B	LGY	LA 98	H	Dark black	Black with green	7.5YR6/3	7.5YR7/4	low	low
B14	B	LGY	LA 98	A	Dark black	Dark black	Discard	Discard	high	high
B15	B	LGY	LA 98	B	Dark black	Dark black	7.5YR7/3	7.5YR8/3	high	high
B16	B	LGY	LA 98	C	Brownish black		10YR7/4	10YR7/4	med	med
B17	B	LGY	LA 98	D	Brownish black		10YR7/2	10YR8/3	med	med
B18	B	LGY	LA 98	B	Brownish black		10YR7/3	10YR6/2	high	high
B19	B	LGY	LA 98	E	Brownish black		10YR7/2	10YR5/1	med	high
B20	B	LGY	LA 98	A	Brownish black		10YR6/2	10YR7/2	low	med
B21	B	LGY	LA 98	G	Dark black	Grey	10YR7/2	10YR8/3	med	low
B22	B	LGY	LA 98	B	Dark black		10YR8/3	10YR8/2	high	high
B23	B	LGY	LA 98	B	Brown		10YR8/1	10YR7/2	high	high
B24	B	LGY	LA 98	C	Brownish black		10YR7/2	10YR8/2	high	high
B25	B	LGY	LA 98	E	Dark black		7.5YR7/3	10YR7/2	high	med
B26	B	LGY	LA 98	G	Dark black		10YR7/4	10YR7/3	high	med
B27	B	LGY	LA 98	A	Dark black		10YR7/2	10YR3/1	med	high
B28	B	LGY	LA 98	D	Dark black		10YR6/2	10YR7/2	med	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
B29	B	LGY	LA 98	E	Brownish black		10YR8/1	10YR8/3	high	high
B30	B	LGY	LA 98	A	Dark black		10YR7/2	10YR8/2	high	high
B31	B	LGY	LA 98	E	Grey		10YR7/3	10YR7/3	high	high
B32	B	LGY	LA 98	A	Dark black		10YR7/2	10YR7/1	med	med
B33	B	LGY	LA 98	A	Dark black		10YR7/3	10YR8/3	med	med
B34	B	LGP	LA 98	H	Dark black	Dark black	10YR7/2	10YR8/4	med	high
B35	B	LGY	LA 98	A	Brownish black	Brownish black	10YR7/2	10YR7/2	med	med
B36	B	LGY	LA 98	F	Grey		10YR7/4	10YR7/4	low	med
B37	B	LGY	LA 98	H	Dark black		10YR7/2	10YR7/3	med	high
B38	B	LGY	LA 98	H	Brownish black		10YR8/1	10YR8/1	high	high
B39	B	LGY	LA 98	H	Brownish black		10YR7/2	10YR8/2	med	med
B40	B	LGY	LA 98	A	Brown		10YR7/1	10YR7/1	high	high
B42	B	LGY	LA 98	E	Dark black		10YR8/3	10YR8/3	high	high
B43	B	LGY	LA 98	G	Grey		2.5Y8/2	2.5Y5/1	high	high
B44	B	LGY	LA 98	A	Brownish black		10YR7/2	10YR7/3	high	high
B45	B	LGY	LA 98	E	Dark black		10YR8/2	10YR8/2	med	high
B46	B	LGY	LA 98	F	Dark black		10YR7/3	10YR7/3	med	med
B47	B	LGY	LA 98	B	Dark black	Dark black	10YR7/4	10YR7/4	med	med
B48	B	LGY	LA 98	A	Dark black		10YR7/2	10YR8/3	med	med
B49	B	LGY	LA 98	H	Dark black		10YR7/3	10YR8/2	med	high
B50	B	LGY	LA 98	A	Dark black		10YR7/3	10YR7/3	high	med
B52	B	LGY	LA 98	F	Dark black		10YR7/3	10YR8/1	med	high
B53	B	LGY	LA 98	D	Dark black		10YR7/2	10YR7/3	med	med
B54	B	LGP	LA 98	A	Dark black	Brownish black	10YR7/1	10YR7/1	med	med
B55	B	LGY	LA 98	A	Brownish black		10YR7/1	10YR7/2	low	low
B56	B	LGY	LA 98	H	Dark black		10YR7/3	10YR7/4	med	med
B57	B	LGP	LA 98	A	Dark black	Brownish black	10YR8/3	10YR7/2	high	med
B58	B	LGY	LA 98	A	Dark black		10YR7/2	10YR8/3	med	high
B59	B	LGY	LA 98	G	Brownish black	Brownish black	10YR8/3	10YR8/2	high	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
B60	B	LGY	LA 98	F	Dark black		10YR8/3	10YR7/4	high	med
B61	B	LGP	LA 98	B	Grey	Brownish black	10YR7/3	10YR8/3	high	high
B62	B	LGY	LA 98	E	Brownish black		10YR7/4	10YR6/1	med	med
B63	B	LGY	LA 98	B	Grey		10YR7/4	10YR7/4	high	high
B64	B	LGY	LA 98	H	Dark black		10YR8/3	10YR8/3	med	med
B65	B	LGY	LA 98	G	Dark black		10YR7/3	10YR7/1	high	med
B66	B	LGY	LA 98	A	Dark black		10YR7/3	10YR7/3	high	high
B67	B	LGP	LA 98	C	Brown	Brown with green	10YR7/2	10YR7/2	high	high
B68	B	LGP	LA 98	C	Dark black	Brownish black	10YR7/3	10YR8/2	med	med
B69	B	LGY	LA 98	A	Brown	Green	10YR7/3	10YR7/3	med	low
B70	B	LGP	LA 98	E	Dark black	Dark black	10YR7/4	10YR7/3	high	high
B71	B	LGP	LA 98	G	Dark black	Dark black	10YR6/4	10YR7/4	high	high
B72	B	LGR	LA 98	B		Dark black	2.5YR5/4	2.5YR5/4	high	high
B73	B	LGY	LA 98	A	Dark black	Dark black	10YR4/1	10YR4/1	high	high
B74	B	LGY	LA 98	A	Dark black		10YR8/1	10YR7/1	high	high
B75	B	LGY	LA 98	A	Brownish black		10YR8/3	10YR8/3	med	med
B76	B	LGP	LA 98	G	Brown	Dark black	10YR8/3	10YR7/2	low	med
B77	B	LGP	LA 98	A	Oxidized, unclear	Dark black	10YR6/2		high	low
B78	B	LGP	LA 98	B	Dark black	Brownish black	10YR7/4	5YR7/3	med	med
B79	B	LGY	LA 98	B	Dark black		10YR8/2	10YR8/2	med	med
B80	B	LGY	LA 98	G	Dark black	Dark black	10YR7/4	10YR7/1	med	med
LA B01	B	LGY	LA 278	A			10YR7/2	10YR7/2	high	med
LA B02	B	LGY	LA 240	F			10YR7/2	10YR8/3	med	med
LA B03	B	LGY	LA 240	G			10YR8/2	10YR8/2	med	med
LA B04	B	LGY	LA 7	F			10YR7/4	10YR7/3	med	med
LA B05	B	LGY	LA 3443	G			10YR7/4	10YR7/2	med	med
LA B06	B	LGY	LA 64	C			10YR7/4	10YR7/4	med	high
LA B07	B	LGY	LA 240	F			10YR8/1	10YR8/2	high	low
LA B08	B	LGP	LA 70	E			10YR7/1	10YR6/1	high	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
LA B09	B	LGY	LA 374	F			10YR7/3	10YR7/2	high	med
LA B10	B	LGP	LA 70	G			10YR7/3	10YR8/3	high	med
UC B01	B	LGY	LA 80	G	Dark black		10YR7/3	10YR7/3	med	med
UC B02	B	LGP	LA 80	A	Grey	Brownish black	10YR7/1		med	high
UC B03	B	LGY	LA 80	B	Dark black			10YR8/3	high	eroded
UC B04	B	LGY	LA 7	F	Brownish black		10YR7/3	10YR7/3	med	high
UC B05	B	LGP	LA 7	A	Dark black		10YR7/2	10YR7/4	med	high
UC B06	B	LGY	LA 7	G	Dark black		10YR7/2	10YR7/2	med	high
UC B07	B	LGY	LA 7	E	Dark black		10YR8/3	10YR8/3	med	med
UC B08	B	LGY	LA 7	H	Dark black		10YR7/3	10YR7/3	med	med
UC B09	B	LGY	LA 123	A	Brown		10YR7/1		high	high
UC B10	B	LGY	LA 80	A	Dark black	Dark black	10YR7/1	10YR7/2	high	high
UC B11	B	LGY	LA 7	F	Dark black		7.5YR7/3	10YR7/4	med	med
ASU C01	C	ESY	LA 120	C	Dark black	Dark black	10YR7/2	10YR7/3	med	med
ASU C02	C	EGY	LA 476	E	Dark black					
ASU C03	C	EGY	LA 120	A	Brownish black				low	high
ASU C04	C	SLY	LA 95	E	Dark black		10YR8/3	10YR8/3	med	med
ASU C05	C	EGP	LA 476	C	Dark black	Dark black	7.5YR7/4	10YR6/3	med	med
C01	C	EGY	LA 98	G	Dark black		10YR7/3	7.5YR6/3	high	med
C05	C	EGY	LA 98	G	Dark black	Dark black	7.5YR7/4	2.5YR6/1	med	low
C06	C	EGP	LA 98	A	Brownish black	Dark black	10YR7/3	10YR7/2	med	med
C07	C	EGY	LA 98	F	Dark black		10YR7/3	10YR8/2	high	med
C08	C	EGP	LA 98	H	Brown	Brown	10YR6/2	10YR7/3	med	med
C09	C	EGY	LA 98	B	Brownish black	Brownish black	10YR7/3	10YR7/3	med	med
C10	C	EGP	LA 98	A	Brownish black	Brownish black	7.5YR6/4	10YR6/2	high	med
C11	C	EGP	LA 98	F	Dark black	Dark black	7.5YR7/3	7.5YR8/3	high	high
C12	C	EGY	LA 98	A	Grey		10YR6/2	10YR7/1	med	med
C13	C	EGY	LA 98	A	Dark black	Brownish black	10YR6/1	2.5YR8/1	med	med
C14	C	EGP	LA 98	G	Dark black	Dark black	10YR8/2	10YR8/2	high	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
C15	C	EGP	LA 98	F	Dark black		2.5YR6/4	7.5YR7/3	med	med
C16	C	EGP	LA 98	B	Dark black	Dark black	10YR8/2	10YR7/4	med	med
C17	C	EGY	LA 98	H	Dark black		10YR8/4	10YR8/4	med	med
C18	C	EGP	LA 98	B	Dark black	Dark black	7.5YR8/2	7.5YR8/3	med	med
C20	C	EGP	LA 98	B	Brownish black	Brownish black	10YR8/2	10YR7/4	med	high
C21	C	EGY	LA 98	C	Dark black		10YR8/2	2.5Y8/1	med	med
C22	C	EGY	LA 98	H	Dark black		2.5Y8/1	10YR8/4	high	high
C24	C	EGP	LA 98	A	Brownish Grey	Brownish black	10YR8/2	GLEY14/	high	med
C25	C	EGP	LA 98	C	Dark black	Brown	10R4/3	GLEY16/	high	high
C27	C	EGP	LA 98	A	Brown		10YR8/2	10YR8/1	high	high
C28	C	EGP	LA 98	D	Reddish Brown	Dark black	10YR7/4	10YR8/3	high	high
C29	C	EGY	LA 98	A	Oxidized, unclear				med	
C30	C	EGP	LA 98	F	Dark black	Dark black	10YR7/3	10YR8/2	high	med
C31	C	EGP	LA 98	D	Brownish black	Brownish black	10YR7/2	10YR8/3	high	high
C32	C	EGP	LA 98	F	Brown with green	Brownish black	10YR8/3	10YR8/3	med	med
C34	C	EGY	LA 98	C	Dark black		10YR7/4	10YR8/4	med	high
C36	C	EGY	LA 98	G	Grey		10YR7/1	10YR4/1	high	high
C37	C	EGP	LA 98	H	Oxidized, unclear	Oxidized, unclear	2.5YR8/1	2.5YR8/1	low	low
C38	C	EGP	LA 98	F	Brown	Brown	10YR8/1	10YR8/1	med	high
C40	C	EGP	LA 98	A	Grey	Dark black	10YR7/2	10YR6/2	high	high
C41	C	EGY	LA 98	F	Brownish black		10YR7/4	10YR8/1	high	high
C42	C	EGY	LA 98	G	Brown		10YR7/3	10YR7/2	low	med
C43	C	EGY	LA 98	H	Brownish black		10YR7/3	10YR7/3	high	med
C45	C	EGP	LA 98	G	Brownish black	Brownish black	10YR7/4	10YR8/2	med	high
C46	C	EGY	LA 98	G	Grey		10YR7/3	10YR7/3	med	high
C47	C	EGP	LA 98	E	Oxidized, unclear	Brown	10YR7/4			med
C48	C	EGP	LA 98	G	Dark black	Dark black	5YR7/4	10YR8/2	high	high
C49	C	EGP	LA 98	H	Dark black	Dark black	10YR7/4	10YR7/4	low	low
C50	C	EGP	LA 98	C	Dark black	Dark black	5YR6/3	5YR6/3	high	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
C51	C	EGR	LA 98	H	Dark black	Brown		10R5/6	med	
C52	C	EGP	LA 98	E	Brownish black	Dark black	10R5/4	10YR7/4	high	low
C53	C	EGP	LA 98	C	Dark black	Dark black	10YR/4	10YR7/3	high	med
C54	C	EGP	LA 98	A	Dark black	Brown	10YR4/1	10YR4/1	high	high
C55	C	EGY	LA 98	M	Dark black			2.5YR7/1	high	
C56	C	EGP	LA 98	H	Brownish black	Brown	10YR7/2	2.5YR5/4	med	high
C57	C	EGY	LA 98	G	Dark black		10YR7/3	10YR8/3	high	high
C58	C	EGP	LA 98	C	Grey	Grey	10YR7/4	10YR7/4	med	med
C59	C	EGY	LA 98	B	Brownish black		10YR7/4	10YR7/4	high	high
C60	C	EGP	LA 98	F	Brown	Brown	10YR6/3	10YR7/2	med	med
C61	C	EGP	LA 98	H	Dark black	Brown	10YR8/1	10YR8/1	high	high
C62	C	EGY	LA 98	E	Grey	Dark black	10YR8/1	10YR7/3	low	med
C63	C	EGP	LA 98	A		Reddish Brown	10YR6/2	10YR4/1	high	med
C65	C	EGP	LA 98	E	Dark black	Dark black	10YR7/4	10YR8/3	high	high
C67	C	EGP	LA 98	A	Brown	Brownish black	10YR7/2	10YR8/2	high	high
C68	C	EGY	LA 98	E	Brownish black		10YR7/3	10YR8/1	high	high
C69	C	EGY	LA 98	D	Dark black		10YR7/2	10YR8/3	med	high
C70	C	EGP	LA 98	C	Dark black		10YR7/4	2.5YR4/6	med	low
C71	C	EGY	LA 98	F	Brownish black		10YR8/3	10YR8/3	high	high
C72	C	EGY	LA 98	H	Dark black	Dark black	10YR8/1	10YR8/1	med	med
C73	C	EGP	LA 98	A	Dark black	Oxidized, unclear	10YR7/3	10YR7/3	high	low
C74	C	EGP	LA 98	E	Reddish Brown	Reddish Brown	10YR8/3	10YR8/2	med	high
C76	C	EGP	LA 98	H	Dark black		10YR7/4	7.5YR7/4	med	med
C77	C	EGP	LA 98	O	Brown	Grey	10YR8/1	10YR4/1	high	high
C78	C	EGP	LA 98	C	Brownish black	Brownish black	10YR8/1	10YR5/1	med	high
C79	C	EGY	LA 98	K	Reddish Brown		10YR7/3	10YR7/3	med	med
C80	C	EGY	LA 98	B	Reddish Brown	Reddish Brown	7.5YR8/3	7.5YR8/4	med	high
D12	C	EGP	LA 98	A	Brown	Brown	10YR7/2	10YR7/2	med	med
LA C01	C	EGY	LA 62	E			7.5YR8/1	7.5YR7/4	low	low

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
LA C02	C	EGY	LA 70	D			10YR7/2	10YR7/4	med	high
LA C03	C	EGY	LA 7	G			10YR7/2	10YR7/3	med	med
LA C04	C	EGY	LA 278	A			10YR7/1	10YR8/2	med	med
LA C05	C	EGP	LA 64	F			10YR8/2	10YR8/2	high	med
UC C01	C	EGP	LA 62	F	Dark black	Dark black	10YR8/1	10YR8/2	high	high
UC C02	C	EGP	LA 80	F	Brown	Dark black	10YR7/2	10YR7/2	high	eroded
UC C03	C	EGY	LA 80	A	Dark black		10YR8/1	10YR7/2	low	low
UC C04	C	EGY	LA 183	C	Dark black		7.5YR7/3	7.5YR7/4	med	low
UC C05	C	EGP	LA 7	B	Brownish black	Brown	10YR8/3	10YR8/3	med	med
UC C06	C	EGY	LA 7	G	Brown		10YR7/2	10YR7/2	med	med
UC C07	C	EGY	LA 7	B	Dark black		10YR7/4	10YR7/4	med	high
ASU D01	D	SLP	LA 476	F	Brown	Dark black	10YR8/2	10YR8/2	med	low
ASU D02	D	SLP	LA 476	F	Dark black	Black with green	10YR7/3	10YR7/2	med	med
ASU D03	D	SLP	LA 476	C	Grey	Grey	5YR7/3	7.5YR7/3	med	med
D03	D	SLP	LA 98	C	Dark black	Dark black	7.5YR6/4	2.5YR6/4	med	med
D05	D	SLP	LA 98	G	Dark black	Dark black	2.5YR5/1	10YR6/2	med	med
D06	D	SLY	LA 98	A	Dark black	Dark black	10YR5/2	10YR7/2	med	med
D07	D	SLY	LA 98	A	Dark black	Brown	Eroded	7.5YR5/3	med	eroded
D09	D	SLR	LA 98	B	Dark black	Dark black	7.5YR7/3	7.5YR8/2	med	med
D10	D	SLP	LA 98	F	Brownish black	Green	10YR7/2	10YR7/3	med	med
D13	D	SLR	LA 98	F	Dark black	Dark black	5YR6/4	10R5/6	med	med
D14	D	SLY	LA 98	B	Oxidized, unclear	Grey	Eroded	Eroded	med/lo w	eroded
D16	D	SLR	LA 98	A	Dark black		7.5YR6/3	10YR8/2	med	med
D18	D	SLP	LA 98	E	Dark black	Dark black	10R4/4	10YR8/2	high	med
D19	D	SLP	LA 98	C	Dark black	Dark black	10YR8/2	2.5Y8/1	high	high
D20	D	SLP	LA 98	C	Brownish black	Dark black	2.5YR5/4	10YR8/1	med	med
D21	D	SLP	LA 98	C	Dark black	Dark black	10R4/6	7.5YR6/4	med	high
D22	D	SLR	LA 98	C	Reddish Brown	Reddish Brown	10R4/6	2.5YR5/6	med	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
D23	D	SLY	LA 98	A	Dark black	Dark black	10YR8/2	10YR8/1	high	high
D24	D	SLP	LA 98	A	Dark black	Dark black	10YR7/2	10YR8/2	med	med
D30	D	SLP	LA 98	C	Dark black	Dark black	2.5YR6/4	2.5YR6/4	med	med
D31	D	SLY	LA 98	A	Dark black		10YR7/2	10YR7/2	med	high
D32	D	SLR	LA 98	G	Dark black		2.5YR4/2	2.5YR5/4	high	high
D33	D	SLP	LA 98	C	Brownish black	Dark black	10YR8/3	10YR7/3	med	med
D36	D	SLY	LA 98	A	Brownish black		10YR7/2	10YR7/2	high	high
D37	D	SLP	LA 98	D	Oxidized, unclear	Brown	7.5YR7/3	5YR6/4	high	high
D38	D	SLY	LA 98	A	Brownish black		10YR7/2	10YR5/1	high	med
D39	D	SLP	LA 98	H	Dark black	Dark black	10YR7/3	7.5YR5/3	med	low
D40	D	SLY	LA 98	A	Oxidized, unclear				high	high
D42	D	SLP	LA 98	B	Brownish black	Dark black	7.5YR7/4	7.5YR7/4	med	high
D43	D	SLP	LA 98	A	Brown	Dark black	10YR7/3	10YR7/2	med	high
D45	D	SLP	LA 98	G	Dark black	Grey	5YR6/4	10YR7/2	med	low
D46	D	SLY	LA 98	C	Dark black		10YR6/3	7.5YR6/4	high	high
D47	D	SLP	LA 98	B	Brownish black	Brown	10YR7/2	5YR7/4	med	med
D48	D	SLP	LA 98	C	Oxidized, unclear	Dark black		10YR7/3	high	high
D49	D	SLP	LA 98	A	Oxidized, unclear	Brownish black	10YR7/2	10YR7/4	med	med
D53	D	SLY	LA 98	C	Green	Black with green	7.5YR7/2	7.5YR7/2	high	high
D56	D	SLP	LA 98	A	Brown	Brown with green	10YR7/3	10YR7/3	med	high
D57	D	SLP	LA 98	C	Dark black	Dark black	7.5YR7/4	7.5YR8/3	high	high
D58	D	SLP	LA 98	A	Brownish black	Brownish black	10YR5/1	10YR5/1	low	high
D61	D	SLP	LA 98	B	Dark black	Dark black	7.5YR7/3	7.5YR8/2	high	high
D62	D	SLY	LA 98	F	Brownish black		10YR6/3	10YR7/2	med	low
D66	D	SLR	LA 98	B	Dark black	Dark black	2.5YR7/6	5YR7/6	high	high
D70	D	SLP	LA 98	A	Brown with green	Oxidized, unclear		2.5Y6/2	high	low
D71	D	SLY	LA 98	A	Brownish black		10YR8/1		high	high
D72	D	SLY	LA 98	C	Dark black		10YR7/2	10YR7/4	high	high
D73	D	SLP	LA 98	F	Brownish black	Dark black	10YR6/2	10YR7/1	high	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
D75	D	SLY	LA 98	A	Brownish black		10YR7/2	10YR8/2	high	med
D76	D	SLR	LA 98	C	Oxidized, unclear	Brownish black	5YR6/4	5YR6/4	low	low
D77	D	SLP	LA 98	H	Oxidized, unclear	Black with green	10YR7/2	10YR6/2	high	high
D80	D	SLR	LA 98	C	Brownish black				low	low
LA D01	D	SLP	LA 70	E			7.5YR6/4	7.5YR6/4	high	high
UC D01	D	SLP	LA 51	G	Brownish black	Brownish black	10YR6/2	10YR6/3	high	high
UC D02	D	SLP	LA 62	B	Dark black	Dark black	2.5YR7/3	2.5YR6/3	high	med
UC D03	D	SLP	LA 62	C	Dark black	Dark black	2.5YR5/4	10R5/6	med	low
UC D04	D	SLP	LA 62	C	Brownish black		10YR8/2	10YR8/2	high	med
UC D05	D	SLY	LA 62	F	Brownish black	Oxidized, unclear	5YR7/2	10YR8/2	high	low
UC D06	D	SLP	LA 80	B	Brown	Reddish Brown	10YR7/3	7.5YR7/4	low	med
ASU E01	E	PUP	LA 120	C	Brownish black		10YR7/3	10YR7/3	med	med
ASU E02	E	PUP	LA 95	J	Reddish Brown	Brown	2.5YR6/4	2.5YR5/4	med	med
E03	E	PUR	LA 98	G	Dark black	Brownish black	2.5YR6/6	2.5YR4/6	med	med
E05	E	PUY	LA 98	H	Dark black	Dark black	10YR7/3	10YR7/4	high	high
E06	E	PUR	LA 98	C	Dark black	Dark black	2.5YR5/6	7.5YR6/3	med	high
E07	E	PUR	LA 98	H	Brownish black	Brownish black	2.5YR5/4	7.5YR6/3	med	med
E08	E	PUY	LA 98	I	Dark black	Dark black	10YR7/3	10YR7/3	med	med
E09	E	EGY	LA 98	H		Brownish black	5YR6/2	10YR8/2	med	med
E11	E	PUP	LA 98	B	Dark black	Dark black	10R5/6	7.5YR7/2	med	med
E12	E	PUP	LA 98	F	Brown	Brown	7.5YR7/2	7.5YR7/1	low	low
E15	E	PUR	LA 98	B	Brownish black	Brownish black	2.5YR4/6	5YR4/4	high	high
E19	E	PUP	LA 98	F	Brownish black	Brownish black		10YR7/2	low	eroded
E20	E	PUP	LA 98	F	Brown	Brown	10YR6/2	10YR6/2	high	low
E22	E	PUP	LA 98	B	Dark black	Oxidized, unclear	2.5YR6/4	GLEY15/	low	low
E28	E	PUP	LA 98	C	Brown with green	Brown with green	7.5YR7/3	10YR6/2	med	high
E29	E	PUP	LA 98	A	Dark black	Brownish black	10YR7/1	10YR7/3	high	high
E31	E	PUY	LA 98	C	Dark black	Dark black	10YR5/2	10YR7/2	low	high
E32	E	PUY	LA 98	A	Dark black	Dark black	10YR6/2	10YR6/2	med	eroded

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
E33	E	PUP	LA 98	E	Brown	Brown	10YR6/2	10YR7/2	high	med
E35	E	PUP	LA 98	B	Dark black	Brownish black	10YR8/1	10YR7/2	low	med
E38	E	PUP	LA 98	G	Black with green	Black with green	10YR8/1	10YR8/1	med	high
E39	E	PUP	LA 98	A	Brown	Dark black	10YR7/1	10YR5/1	high	high
E41	E	PUY	LA 98	G	Dark black		7.5YR6/4	7.5YR7/3	med	med
E42	E	PUR	LA 98	D	Reddish Brown	Reddish Brown	10R8/3	7.5YR7/3	low	high
E44	E	PUY	LA 98	H	Grey		10YR7/2	10YR8/3	med	high
E46	E	PUY	LA 98	A	Dark black	Dark black	10YR6/1	10YR6/1	med	high
E47	E	PUP	LA 98	H	Dark black	Dark black	7.5YR7/3	10YR8/1	high	eroded
E48	E	PUP	LA 98	A	Dark black	Brownish black	10YR5/2	10YR6/1	high	high
E50	E	PUR	LA 98	B	Brownish black	Brownish black	5YR7/4	5YR7/3	high	high
E52	E	PUP	LA 98	B	Brown	Brown	10YR6/2	10YR7/1	high	high
E54	E	PUP	LA 98	A	Brownish black	Brownish black			high	high
E55	E	PUY	LA 98	A	Grey	Dark black	10YR8/1	10YR7/2	eroded	eroded
E56	E	PUY	LA 98	A	Brownish black	Brownish black			high	high
E57	E	PUP	LA 98	F	Brown	Brown	10YR7/3	10YR7/2	high	high
E59	E	PUP	LA 98	A	Oxidized, unclear	Dark black	10YR7/1	10YR6/3	high	high
E60	E	PUY	LA 98	C	Brownish black		10YR7/2	10YR8/3	high	high
E61	E	PUR	LA 98	C	Reddish Brown	Reddish Brown	2.5YR5/4	5YR5/4	high	high
E62	E	PUP	LA 98	G	Grey	Grey	10YR7/3	2.5YR5/4	high	med
E63	E	PUY	LA 98	A	Dark black	Dark black	10YR6/2	10YR7/1	high	high
E64	E	PUP	LA 98	N	Reddish Brown	Reddish Brown	10YR7/4	10YR5/2	high	high
E65	E	PUP	LA 98	H	Dark black	Oxidized, unclear		7.5YR6/2	low	med
E66	E	PUY	LA 98	B	Brownish black		10YR7/3	10YR6/2	high	med
E67	E	PUR	LA 98	H	Dark black	Dark black		10R4/4	high	med
E68	E	PUP	LA 98	B	Dark black	Dark black	10YR6/2	10YR7/2	high	med
GOVE02	E	PUP	LA 111322/4451	H	Dark black	Dark black		7.5YR7/2	med	high
F01	F	KGP	LA 98	C	Brownish black	Brownish black	10YR8/2	10YR7/2	med	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
F02	F	KGP	LA 98	A	Oxidized, unclear	Oxidized, unclear	5Y5/1	2.5Y7/1	med	med
F03	F	KGY	LA 98	A	Brown with green	Brown with green	10YR5/3	10YR5/2	low	low
F04	F	KGP	LA 98	B	Dark black	Dark black	2.5YR7/3	10YR8/2	high	high
F05	F	KGR	LA 98	F	Dark black	Dark black	10R5/6	2.5YR5/6	high	high
F06	F	KGP	LA 98	F	Dark black	Dark black	10YR7/4	10YR6/4	med	med
F07	F	KGY	LA 98	A	Brown	Green	2.5Y8/1	2.5Y7/1	med	med
F08	F	KGP	LA 98	A	Green	Brown	10YR8/2	10YR8/2	med	med
F09	F	KGR	LA 98	H		Brown	10YR6/2	10R5/6	high	high
F11	F	KGP	LA 98	E	Oxidized, unclear	Oxidized, unclear	10YR6/2	2.5Y6/1	low	low
F12	F	KGY	LA 98	G	Brown with green		10YR7/2	2.5Y8/2	med	high
F13	F	KGY	LA 98	A	Brown with green	Oxidized, unclear	10YR5/3	7.5YR5/2	med	med
F14	F	KGP	LA 98	B	Dark black	Dark black	10YR7/3	5YR6/4	low	low
F15	F	KGR	LA 98	F		Dark black	2.5YR5/6	5YR5/4	med	med
F16	F	KGP	LA 98	M	Brownish black	Brownish black		10YR8/2	med	med
F17	F	KGY	LA 98	A	Oxidized, unclear	Dark black	10YR5/1	10YR5/2	high	high
F18	F	KGP	LA 98	F	Brownish Grey	Brownish Grey	10YR8/2	10YR7/2	med	med
F21	F	KGY	LA 98	H	Oxidized, unclear	Oxidized, unclear	NA	10YR5/1	eroded	eroded
F22	F	KGP	LA 98	F	Brown	Brown	GLEY14/	2.5Y6/1	med	med
F24	F	KGY	LA 98	G	Brown with green		10YR8/4	10YR8/3	high	high
F25	F	KGP	LA 98	F	Oxidized, unclear	Oxidized, unclear	10R5/6	2.5YR5/8	low	low
F26	F	KGP	LA 98	A		Black with green	10YR6/3		high	high
F27	F	KGP	LA 98	A	Brown with green	Dark black	10YR6/2	10YR7/2	med	high
F29	F	KGP	LA 98	E	Dark black	Brownish black	2.5YR4/3	10YR8/2	med	med
F33	F	KGR	LA 98	C	Dark black	Dark black	10R6/6	10R4/6	high	high
F34	F	KGP	LA 98	E	Black with green	Reddish Brown	2.5YR5/2	10YR8/1	med	med
F36	F	KGR	LA 98	D	Dark black	Brownish black	2.5YR5/3	2.5YR5/4	med	med
F38	F	KGP	LA 98	A	Brownish black	Brownish black	10YR5/1	7.5YR7/4	med	high
F39	F	KGY	LA 98	A	Green	Green	10YR7/2	10YR7/3	med	high
F41	F	KGR	LA 98	C	Dark black	Dark black	2.5YR6/6	2.5YR5/4	low	high

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
F42	F	KGY	LA 98	A	Black with green	Brown with green	10YR7/3	10YR4/1	high	high
F43	F	KGP	LA 98	G	Brown	Brown	2.5YR5/3	10YR7/4	med	med
F44	F	KGY	LA 98	A	Brown with green	Brown with green	7.5YR8/4	7.5YR7/4	low	low
F45	F	KGP	LA 98	D	Reddish Brown	Reddish Brown		10R4/4	high	high
F46	F	KGR	LA 98	E	Brown	Brown	2.5YR4/2	7.5YR5/2	low	high
F47	F	KGY	LA 98	C		Green	10YR8/2	10YR8/2	med	med
F49	F	KGY	LA 98	A	Green	Green	10YR5/2	10YR5/1	high	high
F52	F	KGY	LA 98	E		Brown with green	10YR6/3	10YR8/2	high	med
F53	F	KGP	LA 98	C	Brownish black	Brown	7.5YR7/3	10YR7/3	high	med
F55	F	KGP	LA 98	E	Black with green	Reddish Brown	5YR5/4	10YR7/3	high	high
F56	F	KGR	LA 98	F	Brownish black	Brownish black	10YR5/2	5YR6/3	high	high
F57	F	KGR	LA 98	C	Brownish black	Brown	2.5YR4/6	10YR6/1	med	med
F59	F	KGY	LA 98	C	Brownish black		10YR7/3	10YR7/3	low	high
F60	F	KGY	LA 98	A	Brown with green	Brownish black	10YR4/1	10YR5/2	high	high
F61	F	KGY	LA 98	A	Brownish black	Brown	10YR6/1		high	high
F63	F	KGP	LA 98	C		Dark black	5YR5/3	2.5YR5/4	high	high
F64	F	KGY	LA 98	B	Brownish black	Grey	7.5YR7/4	10YR7/3	low	low
F65	F	KGR	LA 98	A	Black with green		5YR6/4	10YR4/1	high	med
F66	F	KGP	LA 98	E	Brown with green	Brownish black	2.5YR5/6	10YR7/3	med	med
F68	F	KGY	LA 98	E	Brownish black	Brownish black	10YR5/2		med	high
F69	F	KGY	LA 98	C	Black with green	Brownish black	10YR5/2	2.5YR5/2	high	med
F70	F	KGY	LA 98	B	Dark black	Dark black	10YR7/3	10YR7/4	med	med
F71	F	KGR	LA 98	G		Brownish black	2.5YR4/4	10YR4/1	high	high
F73	F	KGY	LA 98	A	Brown with green		10YR8/1	10YR8/1	low	low
F74	F	KGY	LA 98	H	Brown with green	Brown with green	10YR5/2	10YR7/4	high	high
F75	F	KGP	LA 98	C	Reddish Brown	Reddish Brown	10YR5/2	7.5YR6/3	med	med
F76	F	KGR	LA 98	B	Oxidized, unclear	Oxidized, unclear	5YR5/4	2.5YR5/4	high	high
F77	F	KGY	LA 98	G	Brown with green	Oxidized, unclear	10YR6/2	10YR7/2	med	low
F78	F	KGR	LA 98	A	Brown with green	Brown with green		7.5YR6/3	high	med

Sherd #	Glaze Rim Type	Glaze Type Code	Recovery Site	Core Pattern	Int. Glaze Color	Ext. Glaze Color	Ext. Slip Color	Int. Slip Color	Int. Luster	Ext. Luster
F79	F	KGR	LA 98	C	Oxidized, unclear	Brown	2.5YR5/6	2.5YR5/4	low	med
F80	F	KGY	LA 98	H		Brown	10YR7/2	10YR7/3	med	med
GOVF15	F	KGP	LA 111322/4451	H	Dark black	Black with green		10R5/6	high	high
GOVF21	F	KGP	LA 111322/4451	G	Green	Brown	7.5YR8/2		low	med
GOVF30	F	KGP	LA 111322/4451	A	Brown with green	Brown with green	10YR7/3	10YR7/3	med	med
GOVF31	F	KGP	LA 111322/4451	G	Oxidized, unclear	Brownish black	10YR7/3	10YR7/3	low	med
LA F01	F	KGR	LA 591	D			2.5YR5/4	2.5YR5/6	high	high
LA F02	F	KGP	LA 295	G			10YR8/3	2.5YR5/4	med	med
LA F03	F	KGY	LA 591	A			10YR6/3	10YR6/3	high	high
PECF03	F	PGP	LA 625	C	Brown	Brown			low	low
UC F01	F	KGP	LA 80	A	Black with green	Brown		7.5YR6/2	med	med

Table 2: Metric Data from the Local and Exported Sherd Samples

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
A01	A	8.63	23	13.00	5.93	4.89	7.69	6.21
A02	A	13.14		18.69	5.81	5.28	9.81	6.60
A04	A	10.62	28	15.29	5.21	4.22	10.97	5.21
A05	A	6.25	25	3.96	6.88	4.07	7.80	7.40
A06	A	6.37	57	3.82	7.06	5.40	15.22	5.94
A07	A	7.89	38	14.17	6.64	6.45	11.69	3.84
A08	A	5.19	21	13.22	6.26	5.63	11.59	7.64
A09	A	5.22	15	12.90	4.56	3.92	8.55	7.25
A10	A	6.28	34	2.40	6.55	5.27	9.74	5.62
A11	A	6.11	38	6.18	4.81	4.31	2.88	5.21
A12	A	13.23	24	3.89	5.58	4.44	6.11	7.09
A13	A	9.41	41	8.64	5.47	4.89	7.37	7.63
A14	A	7.08	43	13.65	5.01	4.63	7.96	3.82
A15	A	6.39	20	3.23	5.95	4.98	12.63	4.28
A16	A	7.9	56			6.14	1.03	8.34
A17	A	10.6	38			7.58	10.71	7.32
A18	A	6.7	18			5.47	4.99	4.33
A19	A	11.6	31			5.65	4.70	5.43
A20	A	9.3	35			6.48	7.71	6.02
A21	A	13.2	31			4.93	7.38	8.37
A22	A	11.8	18			5.58	6.88	4.79
A23	A	6	26			5.03	9.04	6.96
A24	A	13.6	23			4.77	4.56	7.54
A25	A	8.5	15			4.25	3.26	7.71
A26	A	8.8	20			4.58	18.35	2.10
A27	A	11.6	20			4.38	3.99	6.82
A28	A	9.9	26			5.91	10.90	5.64
A29	A	10.7	28			4.76	11.65	8.38
A30	A	13.1	46			5.93	7.96	6.06
A32	A	9	31			5.33	5.63	4.10
A33	A	9.4	18			5.21	1.67	5.87
A34	A	16.1	37			4.57	15.22	4.21
A35	A	12.2	37			6.59	10.76	6.75
A36	A	8.2	35			5.12	4.96	4.18
A38	A	6	30			4.95	9.10	7.58
A39	A	11.3	31			5.50	8.56	7.23
A40	A	6.9	34			4.88	2.33	7.96
A41	A	5.2	38			5.47	5.84	6.00
A42	A	13.9	23			5.13	4.63	4.79
A43	A	6.5	25			4.94	3.95	5.71
A44	A	9.2	25			5.54	18.91	4.56

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
A45	A	5.6	29			6.15	12.53	8.09
A46	A	11.1	28			5.83	17.62	6.51
A47	A	6	29			5.29	12.38	5.60
A48	A	6.8	27			5.51	17.67	3.16
A49	A	8.9	35			7.09	10.45	7.27
A50	A	11.7				4.66	13.14	4.98
A51	A	7.5	22			5.45	3.36	4.99
A53	A	6.1	26			4.64	5.75	6.92
A54	A	11.9	34			6.17	9.70	7.77
A55	A	27.6	32			7.25	13.09	10.08
A56	A	8.8	22			5.55	11.05	5.68
A57	A	13.2	25			5.09	7.28	2.82
A58	A	11.2	29			5.47	9.47	6.73
A59	A	5.6	33			5.27	4.99	6.91
A60	A	5.9	42			5.24	9.06	4.68
A61	A	6.5	36			5.71	4.95	6.30
A62	A	6.6	31			5.41	7.71	5.88
A63	A	6.3	29			4.71	19.17	7.39
A64	A	10.9	18			4.87	5.99	7.96
A65	A	10.3	23			6.12	9.47	8.05
A66	A	11.4	23			6.40	3.73	3.22
A67	A	11.4	21			5.42	4.03	6.87
A68	A	7.8	39			5.58	5.57	5.92
A69	A	13.9	24			5.88	4.59	3.42
A70	A	7.5	32			4.72	9.95	6.33
A71	A	7	27			6.56	10.61	4.04
A72	A	6.9	37			5.49	11.78	8.52
A73	A	6.3	33			4.75	5.19	11.76
A74	A	5.1	33			4.66	6.74	5.99
A75	A	10.5	38			5.79	13.25	6.53
A76	A	6.8	17			5.10	11.04	5.48
A77	A	7	18			5.00	3.62	8.12
A78	A	20.5	34			4.95	11.18	4.78
A79	A	10.9	25			4.91	6.61	5.95
A80	A	11.4	23			5.33	9.72	7.12
ASU A01	A	1.3				4.37	4.01	6.68
ASU A02	A	17.9	30			5.88	16.22	6.76
ASU A03	A	9.7	32			5.05	3.94	7.61
ASU A04	A	12.2	32			5.42	6.10	6.63
ASU A05	A	14.6	34			6.21	14.41	8.08
ASU A06	A	8.9	26			5.41	6.12	7.41
ASU A07	A	9.6				4.67	0.00	
ASU A08	A	11.2	32			5.12	5.86	5.19

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
ASU A09	A	5.7	29			5.82		4.23
ASU A10	A	51.6	20			5.70	6.38	7.34
ASU A11	A	5.3	27			5.04	7.61	6.32
ASU A12	A	6.9	37			5.31	11.74	6.07
ASU A13	A	16.2	37			5.70	5.26	7.38
ASU A14	A	7.5	27			5.06	6.08	4.49
ASU A15	A	10.7	25			4.81	8.37	10.43
ASU A16	A	6.8	34			5.11	8.04	2.87
ASU A17	A	22	26			5.40		
ASU A18	A	11.3	20			3.76	10.72	3.96
LA A01	A	27.4	23			6.12	11.31	5.30
LA A02	A	32.3	30			5.26	12.72	4.78
LA A03	A	28.8	27			4.72	5.29	7.44
LA A04	A	33.2	35			5.88	11.22	3.19
LA A05	A	12.6	29			6.10	7.10	5.91
LA A06	A	11.4	28			5.04	9.08	8.81
LA A07	A	13.8	26			5.21	5.81	8.23
LA A08	A	7.4	29			4.89	9.59	4.40
LA A09	A	9.4	24			5.82	15.44	4.60
LA A10	A	11.9	28			5.03	6.45	5.66
LA A11	A	7.9	28			5.08	6.35	3.53
LA A12	A	6.8	42			4.70	5.26	9.72
LA A13	A	10.6	26			5.92	10.73	4.25
UC A01	A	6	26	1.91	6.50	5.30	2.98	9.68
UC A02	A	14	24			6.32	10.31	2.99
UC A03	A	11	31			4.75	6.72	11.39
UC A04	A	5	20			6.06		
UC A05	A	6	17			5.54	1.27	8.89
UC A06	A	4	36			6.47	5.09	5.20
UC A07	A	5	25			4.88	3.62	7.28
UC A08	A	4	21			6.34	8.93	6.49
UC A09	A	27	34			5.12	11.08	6.49
UC A10	A	16	28			5.23	4.69	6.62
UC A11	A	9	27			5.76	13.90	5.47
UC A12	A	11	28			4.86	7.65	12.04
UC A13	A	7	25			4.66	10.55	8.56
UC A14	A	24				5.48	3.87	6.40
UC A15	A	18	34			6.40	13.00	6.23
UC A16	A	8	29			5.47	12.10	7.07
UC A17	A	10	24			5.64	5.21	5.89
UC A18	A	7	30			4.60	8.25	7.64
UC A19	A	12	27			5.64	4.14	7.00
ASU B01	B	1.5		2.03	6.05	3.99	6.35	5.24

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
ASU B02	B	15	28	7.43	9.99	7.08	5.14	8.21
ASU B03	B	18.9	27	1.30	7.47	4.40	4.54	4.29
ASU B04	B	8	25	2.41	8.21	6.52	7.34	9.71
ASU B05	B	3.9	27	4.10	8.44	6.41	16.75	
ASU B06	B	4.3	31	8.23	7.10	5.23	9.95	4.99
ASU B07	B	3.4	27	3.03	6.95	6.15	12.40	3.46
ASU B08	B	6.5	29	5.43	9.17	7.40	4.68	9.84
ASU B09	B	7.4	24	3.73	7.99	5.82	5.89	8.00
ASU B10	B	6.1	25	5.03	7.30	4.47	12.47	7.07
ASU B11	B	7.7	18	1.66	8.37	4.94	4.26	8.79
ASU B12	B	25.6	27	1.78	8.78	5.56		
ASU B13	B	15.4	19	6.05	9.51	5.09	7.03	11.73
ASU B14	B	7.7	22	1.93	7.58	5.46	8.39	8.75
ASU B15	B	8.6	24	1.69	7.15	5.22	6.29	5.49
ASU B16	B	22.4	26	2.09	8.15	4.49	2.08	14.54
B01	B	9.05	43	6.93	6.94	5.53	5.60	8.53
B02	B	5.97	38	5.53	8.36	4.59		
B03	B	19.81	33	3.17	7.48	5.41	7.06	6.08
B04	B	23.9	24	1.55	10.26	6.47	6.85	6.12
B05	B	16.02	29	2.19	8.25	4.98	0.00	7.82
B06	B	14.82	23	2.07	7.62	4.58	6.19	5.83
B07	B	4.9	24	2.07	6.82	4.71	5.32	9.35
B08	B	10.38	29	1.57	7.62	5.90	3.09	6.89
B09	B	12.64	35	4.03	7.92	6.79	6.05	8.02
B10	B	5.83	37	2.33	6.74	5.02	15.25	5.27
B11	B	15.35	37	2.48	9.61	4.36	5.53	5.86
B12	B	14.99	39	3.14	9.61	6.61		
B13	B	5.88	43	3.54	8.26	6.78	5.92	6.86
B14	B	5.68	30	3.28	7.48	6.66	19.75	7.04
B15	B	10.68	22	4.00	8.48	4.29	5.93	6.90
B16	B	9.6	31	2.01	7.10	5.51	10.39	7.14
B17	B	7.3	35	1.60	7.21	5.13	15.93	5.05
B18	B	5.4	42	4.54	11.76	6.89	12.53	7.49
B19	B	5.5	42	1.58	7.19	3.88	6.58	4.95
B20	B	9.6	38	5.21	7.48	5.50	14.97	6.06
B21	B	8.4	36	2.29	6.75	5.03	7.39	5.94
B22	B	10.3	42	3.23	7.85	5.47	17.03	
B23	B	7	37	6.53	9.34	5.06	3.62	8.19
B24	B	15.8	39	3.11	9.20	4.71	11.91	3.79
B25	B	20.6	22	1.61	7.59	4.11	4.02	4.38
B26	B	5.8	18	2.94	6.73	4.86	6.27	7.33
B27	B	8.9	42	2.59	6.88	5.39	8.69	5.48
B28	B	13.4	36	2.03	7.12	4.28	7.10	8.13

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
B29	B	10	34	3.29	9.96	5.31	4.88	7.78
B30	B	7.3	29	1.25	7.50	3.37	5.90	6.11
B31	B	18.1	31	3.86	9.13	4.98	9.60	7.19
B32	B	9.3	36	2.06	8.33	4.94	8.42	
B33	B	7.7	38	2.32	8.92	3.92	6.69	7.82
B34	B	15.3	28	4.14	8.30	6.07	5.17	8.92
B35	B	13.4	21	2.50	6.65	4.81		
B36	B	14.4	27	3.83	8.19	5.90	13.24	7.78
B37	B	10.2	20	3.23	9.23	4.25	16.12	
B38	B	12.8	19	10.13	7.91	4.87		
B39	B	10.5	29	2.76	10.48	5.57	6.82	6.04
B40	B	8.3	31	2.87	7.21	4.18	8.71	7.17
B42	B	7.6	34	1.83	7.46	4.91	10.64	3.37
B43	B	12.9	33	6.84	8.64	3.84	4.94	4.25
B44	B	7.4	35	5.08	8.08	5.46	15.77	
B45	B	14.4	33	9.00	7.76	3.58	18.33	5.57
B46	B	8.6	32	3.42	8.52	6.26	4.69	9.40
B47	B	15.1	31	3.26	9.97	4.85	5.56	9.73
B48	B	8.3	26	3.88	9.22	4.14	4.54	7.04
B49	B	7.2	31	10.06	6.93	5.18	2.56	5.36
B50	B	6.6	33	2.70	9.13	4.07	18.26	
B52	B	14.6	33	4.01	8.98	5.49	9.02	4.32
B53	B	15.1	38	2.26	7.61	4.66	8.41	7.69
B54	B	23.1	27	4.46	8.60	3.86	3.69	7.19
B55	B	13.7		11.00	7.84	5.45	6.06	5.17
B56	B	10	49	1.25	6.91	3.84	4.61	10.96
B57	B	5.5	31	3.77	7.57	6.98	3.10	7.55
B58	B	15	29	3.51	8.25	5.87	8.35	5.63
B59	B	8	21	3.74	8.42	5.72	13.53	5.00
B60	B	6.1	22	2.46	7.46	5.74	5.00	7.21
B61	B	5.9	43	2.92	7.15	4.46	10.22	6.13
B62	B	10.3	31	3.55	7.96	4.16	7.58	5.60
B63	B	8.4	31	0.00	8.29	5.97	17.18	7.91
B64	B	16.2	27	3.20	8.43	4.71	7.18	8.21
B65	B	5.8	28	2.94	8.10	6.16	4.05	
B66	B	5.8	27	2.77	6.98	6.07	12.43	
B67	B	11.6	28	2.16	6.61	4.25	8.08	6.07
B68	B	5.9	31	2.79	7.46	4.10	8.44	6.77
B69	B	9.7	33	4.58	7.46	4.44	12.05	9.47
B70	B	14.5	19	2.87	8.54	4.37	6.37	10.10
B71	B	15	22	5.06	8.22	7.21	9.72	8.04
B72	B	7.2	17	1.64	5.19	3.12		
B73	B	12.9	20	2.22	6.66	4.24		

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
B74	B	8.1	29	3.35	7.94	5.70	12.78	5.63
B75	B	12.6	19	3.90	8.75	5.97	8.25	9.55
B76	B	14.8	25	3.62	7.39	5.16	9.74	6.07
B77	B	9.8		2.84	8.21	3.88	4.80	4.22
B78	B	5.2	22	3.07	8.50	4.50	9.73	6.79
B79	B	11.3	32	3.09	7.15	4.92	8.30	5.23
B80	B	6.3	29	3.28	9.11	3.50	9.37	8.35
LA B01	B	14.3	33	5.33	10.36	6.77	9.31	5.74
LA B02	B	7.6	27	2.03	8.48	3.82	4.71	4.55
LA B03	B	8.7	34	2.12	7.33	4.49	10.13	9.06
LA B04	B	7.6	36	2.76	8.32	4.39	7.80	6.41
LA B05	B	13.1	22	2.82	6.42	4.88	6.20	7.53
LA B06	B	23.7	33	0.00	7.32	5.33	13.79	7.12
LA B07	B	22.6	28	2.01	7.79	6.36	10.19	7.81
LA B08	B	30.7	22	2.90	7.53	5.20	15.96	9.94
LA B09	B	9.4	33	3.64	7.94	4.74	8.15	6.66
LA B10	B	9.5	19	1.79	9.17	5.60	5.37	12.15
UC B01	B	8	37	1.43	6.94	4.97	17.35	5.96
UC B02	B	20	36	2.17	6.78	5.14	7.76	7.00
UC B03	B	14	25	5.04	7.10	5.11	21.71	
UC B04	B	17	19	4.57	6.22	5.43	9.24	11.21
UC B05	B	13	29	1.47	8.44	5.68	11.05	4.86
UC B06	B	10	38	3.12	8.36	6.54	6.40	6.62
UC B07	B	7	37	2.02	7.13	4.70	6.27	6.30
UC B08	B	24	25	3.06	7.78	6.53	7.48	9.33
UC B09	B	8	25	1.22	5.36	3.37	3.59	6.86
UC B10	B	12	37	3.50	8.81	5.97	13.10	4.54
UC B11	B	14	30	3.56	8.30	7.07	8.15	11.17
ASU C01	C	5.9	28	4.82	7.71	5.65	11.32	9.71
ASU C02	C	8.2	28	9.37	7.18	5.62	15.27	4.22
ASU C03	C	13.1	20	7.27	8.92	5.21	17.37	2.60
ASU C04	C	0		6.48	7.84	5.31	8.42	5.26
ASU C05	C	0		5.74	5.81	5.21		
C01	C	8.08	18	4.22	6.91	4.42		
C05	C	5.47	22	7.30	7.17	4.52	0.00	7.80
C06	C	5.48	43	8.90	6.13	4.33		
C07	C	8.3	24	11.00	7.49	5.10	10.73	7.69
C08	C	13.01	33	13.91	7.40	5.41	15.21	5.86
C09	C	7.11	43	13.24	8.47	5.36	15.51	7.40
C10	C	6.77	21	6.38	7.36	5.14	9.97	6.15
C11	C	20.38	57	10.03	11.53	4.84	19.74	5.52
C12	C	5.71	23	5.50	7.10	5.09	14.68	4.34
C13	C	7.69	21		6.84	3.97	15.65	10.10

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
C14	C	15.61	38	8.90	7.76	4.96	11.20	4.88
C15	C	5.31	33	9.20	7.93	5.35	17.41	6.21
C16	C	18.1	33	16.44	6.90	6.17	12.64	7.32
C17	C	6.8	18	9.41	6.22	4.85	13.04	5.42
C18	C	9.08	32	9.12	6.83	3.43		
C20	C	6.13	29	12.02	8.43	6.46	18.34	6.56
C21	C	9.24	27	7.98	5.69	5.38	8.86	4.93
C22	C	9.51	27	9.74	6.41	6.09	9.11	4.11
C24	C	8.39	33	13.13	6.85	5.66	10.88	4.72
C25	C	12.67	32	14.88	9.18	7.00	7.31	2.88
C27	C	25	53			7.47	24.07	6.77
C28	C	16.6	43	7.90	7.11	4.37	13.53	10.31
C29	C	13.3	34	6.80	7.46	6.01	11.37	7.23
C30	C	12	17	7.28	6.79	4.18		
C31	C	18.1	36	8.48	7.85	5.67	10.14	5.50
C32	C	5	39	11.96	7.75	6.07	17.44	5.09
C34	C	17	39	8.10	9.81	5.03	15.00	6.69
C36	C	8.5		8.48	8.40	4.72	12.19	6.23
C37	C	5	23	10.15	7.57	5.76	15.30	4.93
C38	C	11.1	28	9.88	6.88	4.78	10.56	5.92
C40	C	10.2	29	9.29	9.16	5.17	19.05	6.29
C41	C	6.6	29	12.01	7.04	3.73	12.51	9.08
C42	C	7.2	24	9.48	8.95	6.15	14.44	9.60
C43	C	5.4	23	7.87	8.79	5.51		
C45	C	6.4	27	6.82	6.46	4.91	8.79	8.59
C46	C	7.8	33	5.50	5.77	5.41	5.77	9.31
C47	C	15.7	23	10.64	6.57	6.22		
C48	C	19.6	35	9.85	8.74	4.87	18.64	3.97
C49	C	5.4	41	7.73	7.84	5.42	11.87	10.48
C50	C	6.1	34	8.74	7.65	5.09	15.41	6.93
C51	C	6.1	15	6.65	4.92	5.74		
C52	C	5.7	27	6.55	7.89	6.58	13.38	4.46
C53	C	6.2	34	4.21	7.40	5.54	16.52	
C54	C	7.2	24	9.74	7.81	4.16	18.32	4.01
C55	C	16.8	20	10.69	6.33	4.49	19.91	4.96
C56	C	16.1	33	10.00	7.01	5.81		
C57	C	13	32	4.56	6.63	5.27	11.30	8.71
C58	C	5.9	22	6.22	8.16	6.23	17.10	
C59	C	6.5	26	7.74	8.63	6.70	18.92	
C60	C	10.9	38	20.54	6.42	5.11	25.65	5.70
C61	C	12.7	25	7.34	7.30	5.34		
C62	C	15.6		5.91	7.72	5.74	11.71	6.94
C63	C	7.9	21	6.61	8.15	5.84		

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
C65	C	10	24	6.74	8.15	5.89	8.12	6.94
C67	C	9.3	28	11.90	7.36	4.54	8.88	4.89
C68	C	23.2	43	9.55	8.85	4.84	17.64	8.27
C69	C	5.9	41	11.67	6.03	5.76	15.31	5.79
C70	C	7.1	27	4.33	6.74	4.69	9.79	6.08
C71	C	6.8	25	7.37	8.57	3.91	16.50	7.91
C72	C	5	27	8.68	6.37	4.51	14.06	5.19
C73	C	8	26			6.13		
C74	C	5.9	28	8.08	8.05	5.65	17.27	6.79
C76	C	10.4	27	9.91	6.31	4.33	10.83	4.13
C77	C	6.2		4.90	7.16	6.47	11.50	5.42
C78	C	12.5	29	5.84	7.96	5.56	11.68	5.87
C79	C	7	26	4.49	5.73	4.59	4.79	6.72
C80	C	7.8		5.31	5.63	3.82		
D12	C	13.95	38	9.61	7.81	5.71		9.17
LA C01	C	34.7	32	7.54	8.30	4.69	11.35	2.72
LA C02	C	26.2	33	5.22	8.84	5.07		
LA C03	C	9.4	17	3.22	5.18	5.43	5.51	8.27
LA C04	C	11.8	31	4.58	8.82	4.73	0.00	
LA C05	C	58.9	27	8.01	6.93	4.39	13.82	5.66
UC C01	C	17	31	8.96	7.21	4.93	12.62	6.10
UC C02	C	8	19	5.45	7.62	5.35	12.34	7.12
UC C03	C	8		7.50	8.63		9.31	11.95
UC C04	C	10	23	10.24	7.33	4.66	9.07	6.79
UC C05	C	22	23	5.72	6.72	4.39	11.29	6.21
UC C06	C	18	25	9.50	7.37	6.75	11.49	8.22
UC C07	C	8	28	6.78	7.89	6.28	10.30	5.30
ASU D01	D	6.4	31	10.73	7.19	5.03	18.02	
ASU D02	D	5.6		9.75	9.89	7.98	13.10	7.81
ASU D03	D	0						
D03	D	6.39	38	12.18	6.70	6.11	14.90	4.51
D05	D	12.99	38	13.09	7.98	4.82	14.36	5.54
D06	D	5.97	23	11.12	7.19	5.38	14.21	5.09
D07	D	8.58	57	22.01	9.33	8.71		
D09	D	7.72	19	9.18	6.94	4.27	0.00	7.99
D10	D	12.84	26	9.89	8.73	5.03	19.72	4.34
D13	D	9.11	38	16.51	8.63	3.74	20.63	5.03
D14	D	6.72	32	18.06	6.57	4.87	23.09	4.74
D16	D	9.19	35	13.36	8.45	5.15	17.08	5.56
D18	D	11.25	25	12.95	7.29	4.66	12.06	4.11
D19	D	21.48	34	11.97	8.71	5.78	44.02	5.27
D20	D	15.27	21	15.18	6.25	5.12	22.21	3.64
D21	D	15	29	16.03	8.81	4.94	29.35	4.23

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
D22	D	20.99	21	22.47	6.40	4.09	22.56	7.99
D23	D	11.2	38	14.09	7.43	3.85	19.63	7.08
D24	D	7.1	39	15.21	8.81	6.46	17.39	4.54
D30	D	16.1	43	17.02	8.47	4.71	24.68	4.70
D31	D	7.5	37	9.79	7.10	5.40	15.65	
D32	D	12.6	37	17.51	7.03	4.27	26.20	5.98
D33	D	11	34	9.75	8.11	5.22	15.87	
D36	D	17.7	30	12.61	8.70	6.51	16.43	4.94
D37	D	11.2	35	13.17	6.45	5.19	19.67	5.94
D38	D	8.4	36	11.58	7.88	5.98	16.15	6.38
D39	D	14.7	28	12.19	8.42	4.84		
D40	D	5.6	26	8.77	8.93	5.90	11.67	10.40
D42	D	16.1	26	7.18	7.53	5.00	9.23	5.82
D43	D	11.3	25	11.24	9.29	5.74	13.28	8.01
D45	D	5.6	31	17.25	7.70		20.91	
D46	D	7.4	35	18.32	6.83	4.64	23.21	5.47
D47	D	17.3	26	16.20	7.67	4.53		
D48	D	11.7	42	15.03	8.77	6.04	21.57	5.82
D49	D	6.9	27	14.57	6.42	4.36	25.66	
D53	D	9.4	28	11.02	6.93	4.93	13.58	6.20
D56	D	10.5	20	8.45	7.30	3.32	15.22	5.10
D57	D	5.2	36	11.74	8.19	5.41	21.71	
D58	D	5.2	37	9.07	5.42	3.80	8.77	6.52
D61	D	5.5	22	11.64	6.91	4.89	13.87	6.00
D62	D	22.3	25	10.50	6.62	4.93	16.54	5.90
D66	D	8.7	27	12.36	6.32	4.68	14.94	6.19
D70	D	10.7	27	11.89	7.07	5.68	15.14	3.31
D71	D	8.3	32	9.87	8.28	4.63	14.59	8.91
D72	D	7.3	31	10.84	9.22	5.23	14.23	5.26
D73	D	16.4	32	9.14	9.84	3.81	12.70	5.50
D75	D	8.3	33	12.96	7.39	4.58	33.87	
D76	D	10.1	20	24.16	6.63	4.39	23.48	
D77	D	23.6	29	20.28	9.40	5.59	31.22	6.13
D80	D	11.8	24	12.78	8.58	4.44	3.43	6.79
LA D01	D	12.7	29	15.28	8.78	5.08	18.17	5.40
UC D01	D	33	39	12.16	9.80	5.99	11.22	4.70
UC D02	D	10	29	8.28	7.78	5.39	16.46	5.21
UC D03	D	16	31	12.06	8.96	6.43	17.10	5.78
UC D04	D	35	20	11.21	8.54	5.92	17.31	6.86
UC D05	D	63	22	13.63	7.54	4.81	19.62	5.61
UC D06	D	15	41	18.35	8.70	4.84	22.00	7.91
ASU E01	E	10		10.54	12.98	4.83	3.33	6.77
ASU E02	E	13.3	25	12.94	5.99	3.28	13.11	7.84

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
E03	E	18.4	34	27.38	8.14	5.39	26.63	7.06
E05	E	13.78	46	8.27	12.44	5.14	26.13	7.56
E06	E	11.14	33	20.59	8.73	6.10	25.27	7.72
E07	E	10.75	31	20.08	8.54	5.04	30.62	
E08	E	11.98	57	21.21	8.31	5.27		
E09	E	20.61	42	19.21	9.98	6.66		
E11	E	12.95	31	10.91	7.81	5.19	23.77	
E12	E	15.83	49	20.93	8.78	6.04	29.16	
E15	E	10.09	46	21.33	6.78	5.22	17.06	5.23
E19	E	19.63	46	17.56	8.59	5.25	27.28	5.87
E20	E	7.55	25	21.72	6.80	3.70	23.27	5.47
E22	E	21.96	30	12.03	9.74	5.36	22.80	4.11
E28	E	19	29	19.14	8.14	4.02	37.23	
E29	E	19.9	41	23.08	9.08	4.86	34.42	
E31	E	7.5	28	20.88	9.41	4.58	25.19	5.46
E32	E	11.1	35	13.73	8.18	4.26	22.30	
E33	E	10	32	16.57	9.29	4.64	29.10	4.01
E35	E	14.6	16	13.18	8.49	4.19	24.11	5.86
E38	E	25.9	28	10.87	9.31	5.46	14.12	6.06
E39	E	21.8	28	12.46	8.28	4.66	15.38	7.27
E41	E	12.8	32	10.92	10.63	5.29	17.34	5.81
E42	E	15.1	33	15.71	8.11	5.59	13.28	5.60
E44	E	12.8	38	11.05	9.57	4.96	15.58	7.18
E46	E	15.3	39	11.43	8.70	5.25		
E47	E	8.8		10.41	9.37	5.80	11.67	6.50
E48	E	6.3	37	12.13	6.84	3.73	14.24	3.93
E50	E	11.3	38	17.51	8.50	5.10		
E52	E	23.1	36	24.23	8.40	4.83		
E54	E	7.2	35	9.76	8.03	4.10	14.05	5.43
E55	E	11		13.53	8.10	5.51		
E56	E	9.8	35	23.76	7.75	5.75	30.10	6.46
E57	E	18.5	36	19.49	8.99	4.56		
E59	E	12.8	39	10.45	9.15	4.57		
E60	E	8.6	35	7.47	8.66	5.01	15.47	7.36
E61	E	18.5	41	15.88	8.51	4.96		
E62	E	6.5	21	15.31	7.72	5.31	9.36	4.39
E63	E	15.8	17	17.90	9.26	4.62	19.84	5.22
E64	E	21.1	30	26.98	7.99	5.67	27.28	
E65	E	24.87	20	11.23	7.78	4.21	11.34	9.21
E66	E	29.38	32	7.21	10.50	6.10	6.08	6.24
E67	E	35.13	31	15.77	12.41	5.35		
E68	E	21.01	22	18.58	7.90	4.96	23.44	4.71
GOVE02	E	24.02	21	34.00	10.40	4.80	34.30	4.13

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
F01	F	6.06	41	18.38	6.80	6.33		
F02	F	21.1	40	24.51	5.22	4.21	25.90	10.61
F03	F	13.02	14	19.11	5.11	3.62		
F04	F	5.57	37			6.24		
F05	F	14.62	35			6.26		
F06	F	7.08	32	23.94	7.26	5.00	26.62	6.13
F07	F	7.3	57	8.61	8.07	5.78	8.98	7.94
F08	F	13.38	33	20.24	7.76	4.74	28.07	4.35
F09	F	6.99		20.20	7.21	5.95		
F11	F	6.25	41	22.67	5.79	4.65		
F12	F	9.94	26	6.52	6.81	6.28	11.57	7.03
F13	F	5.74	57	15.38	6.19	3.41		
F14	F	8.07	42	23.65	6.67	5.85	25.78	
F15	F	10.87	34	29.98	6.23	4.55		
F16	F	21.38	20	12.24	6.67	4.87		
F17	F	7.21		27.75	6.51	5.63	26.32	
F18	F	10.44	56	14.53	6.67	5.48		
F21	F	11.1	34			5.40		
F22	F	16.8	24	38.16	9.38	6.25	37.26	6.68
F24	F	5.21	33	12.29	6.53	5.58		
F25	F	18.88	33	22.71	5.71	4.25		
F26	F	5.8	26			3.42		
F27	F	17	32			3.42	31.09	8.73
F29	F	0	37				26.09	
F33	F	6	22			3.03		
F34	F	8.9					32.56	
F36	F	7.1	42			6.08		
F38	F	7.9	17				23.99	
F39	F	6.1	30					
F41	F	17.6	53			4.59		
F42	F	19.7	43			5.50		
F43	F	21.6				4.01	30.39	5.55
F44	F	25.5	35			4.73	40.50	
F45	F	12.3	43			4.93	36.42	
F46	F	5.3						
F47	F	5.2	20			4.82		
F49	F	5.1	42					
F52	F	11.1	21			3.82		
F53	F	6.3	20					
F55	F	28.8	33			4.92	32.43	7.68
F56	F	15.1	25			4.82	27.10	
F57	F	16.4	37			4.58	36.94	
F59	F	11.5	32			4.47	22.54	

Sherd #	Glaze Rim Type	Weight (g)	Rim Diameter (cm)	Distance Rim Thickness (cm)	Rim Thickness (cm)	Sherd Thickness (cm)	Framing Line Distance (cm)	Framing Line Thickness (cm)
F60	F	10.5	29			6.04	16.34	
F61	F	8.4				4.23		
F63	F	20.1	21			5.22		
F64	F	8	43					
F65	F	8.4					18.67	
F66	F	9.8	38					
F68	F	7.7	25			3.65	19.86	
F69	F	5.8	29					
F70	F	13.3	24			4.07	29.33	6.71
F71	F	8.3	38			4.75		
F73	F	6.1	34					
F74	F	15.4	35			4.13	35.88	
F75	F	8.2	33				21.36	
F76	F	7.2	18					
F77	F	29.89	36	25.80	8.80			
F78	F	30.07	33	22.60	8.03	5.09	40.36	
F79	F	29.57	28	26.55	7.82	5.31		
F80	F	26.47		28.37	6.97	5.92		
GOVF15	F	6.91		19.60	6.55	5.85		
GOVF21	F	14.99	33	33.40	6.90	5.83		
GOVF30	F	61.22	38	42.70	8.10	5.65	36.37	5.53
GOVF31	F	56.08	38	41.30	8.05	4.77	38.95	
LA F01	F	31.1	41			5.18		
LA F02	F	16.9	20			8.09		
LA F03	F	31	22			5.17	25.62	7.19
PECF03	F	63.99	44	35.20	6.55	5.30	29.55	8.70
UC F01	F	32	26	12.06	6.44	4.75	22.63	4.71

Appendix E

Glaze Paint Compositional Data

Glaze Paint Composition

Table 1: Microprobe weight percent normalized compositional data, including averages for each sherd with color of the glaze indicated

Sherd Number*	Glaze Color	Al_2O_3	SO_3	Na_2O	MnO	K_2O	SiO_2	PbO	MgO	FeO	CaO	CuO	TiO_2	ZnO	Total
A05	Dark black	5.48	0.22	0.15	7.31	0.59	24.30	58.14	0.42	1.17	1.28	0.12	0.23	0.61	100.00
A09	Dark black	5.92	0.04	0.30	4.89	0.65	31.28	50.74	0.62	1.25	2.14	0.25	0.29	1.65	100.00
A11	Dark black	6.61	0.49	0.23	6.85	0.62	29.86	51.11	0.85	1.00	1.28	0.12	0.26	0.73	100.00
A13	Dark black	6.89	0.10	0.29	8.41	0.92	33.48	45.12	0.62	1.17	1.71	0.13	0.27	0.91	100.00
A22	Grey	7.84	0.14	0.27	4.81	0.20	30.43	50.92	1.21	1.69	0.84	0.11	0.18	1.37	100.00
A40	Brownish black	6.50	0.14	0.20	5.97	0.13	27.79	55.99	0.75	1.07	0.51	0.08	0.12	0.76	100.00
A43	Brownish black	3.63	0.59	0.28	8.42	0.70	26.80	56.05	0.54	0.63	1.46	0.03	0.12	0.78	100.00
A54	Brownish black	9.96	0.08	0.23	13.17	0.26	38.30	33.16	0.95	1.96	0.66	0.11	0.20	0.97	100.00
A55	Brown	7.92	0.11	0.20	3.57	0.85	27.46	56.08	0.92	1.06	1.46	0.02	0.35	0.02	100.00
A77	Dark black	5.23	0.08	0.18	8.93	0.12	28.32	52.67	0.62	1.82	0.21	0.19	0.09	1.56	100.00
A78	Dark black	5.65	0.08	0.16	7.02	0.17	25.56	58.64	0.66	0.71	0.35	0.05	0.13	0.83	100.00
B01	Dark black	5.45	0.30	0.22	5.80	0.80	22.24	61.67	0.55	0.82	1.58	0.14	0.16	0.29	100.00
B02	Brown	7.47	0.07	0.49	5.49	0.82	34.39	40.63	0.64	2.55	3.26	1.39	0.19	2.61	100.00
B03	Dark black	6.10	0.05	0.15	7.51	0.57	26.37	55.36	0.53	0.98	0.66	0.21	0.26	1.27	100.00
B06	Dark black	6.38	0.05	0.20	6.75	0.85	30.17	51.62	0.69	1.18	1.35	0.09	0.33	0.33	100.00
B07	Dark black	7.20	0.08	0.21	27.23	0.82	28.64	30.61	0.82	1.87	1.36	0.08	0.33	0.77	100.00
B10	Grey	5.14	0.02	0.24	5.94	0.46	25.57	54.66	0.68	1.58	2.32	0.10	0.43	2.85	100.00
B30	Dark black	5.51	0.90	0.12	4.95	0.18	24.66	61.76	0.53	0.77	0.23	0.11	0.13	0.17	100.00
B35	Brownish black	4.98	0.14	0.23	5.29	0.95	21.76	62.77	0.47	0.80	1.90	0.19	0.21	0.32	100.00
B52	Dark black	5.15	0.11	0.17	6.88	0.52	26.26	56.79	0.46	0.80	0.62	0.07	0.25	1.91	100.00
B69	Brown	4.31	0.10	0.28	4.47	0.12	25.79	59.06	0.47	0.85	0.42	0.19	0.09	3.87	100.00
B70	Dark black	5.31	0.32	0.20	4.34	0.12	25.33	59.99	0.51	1.64	0.25	0.07	0.11	1.82	100.00
C06	Dark black	4.64	0.75	0.55	1.21	1.07	22.09	62.99	0.95	1.70	1.66	0.17	0.30	1.94	100.00

Sherd Number*	Glaze Color	Al_2O_3	SO_3	Na_2O	MnO	K_2O	SiO_2	PbO	MgO	FeO	CaO	CuO	TiO_2	ZnO	Total
C07	Dark black	4.01	1.40	0.14	4.87	0.39	21.41	65.95	0.39	0.76	0.26	0.22	0.18	0.02	100.00
C08	Brown	6.46	0.12	0.24	2.11	0.71	28.26	55.73	0.83	2.44	2.28	0.13	0.28	0.43	100.00
C10	Brownish black	4.91	0.84	0.19	1.06	0.33	17.09	71.40	0.47	1.14	0.99	0.08	0.17	1.32	100.00
C14	Dark black	6.17	0.04	0.36	4.10	0.93	24.02	60.60	0.62	1.17	1.65	0.05	0.20	0.10	100.00
C51	Brown	4.70	0.10	0.21	1.18	0.64	21.25	68.24	0.54	1.29	1.17	0.06	0.22	0.39	100.00
C52	Brownish black	3.83	0.72	0.22	4.69	0.14	25.35	61.29	0.56	1.55	0.22	0.09	0.12	1.23	100.00
C52	Dark black	4.03	0.86	0.16	2.43	0.13	23.96	64.41	0.44	2.58	0.13	0.10	0.09	0.68	100.00
C53	Dark black	5.47	0.12	0.12	6.73	0.53	29.02	55.03	0.48	0.67	0.88	0.06	0.31	0.59	100.00
C72	Dark black	4.12	0.17	0.18	4.86	0.13	23.05	63.86	0.55	2.22	0.25	0.17	0.05	0.41	100.00
C73	Dark black	3.94	0.09	0.42	4.14	0.13	21.46	62.61	0.44	1.34	0.25	0.45	0.06	4.68	100.00
C74	Reddish Brown	5.47	0.88	0.14	3.47	0.54	22.99	63.94	0.53	0.93	0.76	0.09	0.22	0.04	100.00
C79	Reddish Brown	6.47	0.28	0.16	5.67	0.18	28.51	56.26	0.61	0.94	0.35	0.11	0.15	0.31	100.00
D03	Dark black	3.08	0.82	0.51	7.11	0.56	27.73	51.82	0.49	1.27	1.19	0.31	0.05	5.08	100.00
D05	Dark black	5.51	0.42	0.35	2.24	0.67	24.41	59.68	0.77	1.50	2.21	0.15	0.22	1.88	100.00
D09	Dark black	4.33	1.28	0.33	1.60	0.38	22.23	64.33	0.54	0.84	0.58	0.18	0.17	3.22	100.00
D10	Brownish black	5.58	0.11	0.46	4.47	0.56	30.71	50.04	0.59	1.63	1.72	0.20	0.20	3.73	100.00
D10	Green	5.22	0.10	0.34	4.84	0.53	29.10	52.46	0.36	1.30	0.97	0.36	0.17	4.25	100.00
D12	Brown	4.25	0.05	0.43	4.08	0.51	27.47	54.47	0.45	1.59	1.36	0.14	0.19	5.01	100.00
D22	Reddish Brown	4.32	0.78	0.31	2.60	0.68	23.56	62.62	0.65	1.91	1.49	0.04	0.17	0.88	100.00
D23	Dark black	2.19	0.63	0.27	3.39	0.69	28.48	59.57	0.26	2.13	0.52	0.44	0.05	1.39	100.00
D53	Black with green	4.17	0.43	0.37	1.10	0.60	15.67	69.67	0.91	1.54	2.21	0.08	0.15	3.09	100.00
D53	Green	5.88	0.30	0.42	0.91	0.57	23.27	60.58	0.73	1.37	2.46	0.02	0.10	3.39	100.00
D58	Brownish black	4.80	0.10	0.20	3.72	0.51	26.97	57.05	0.43	1.26	1.75	0.13	0.26	2.83	100.00

Sherd Number*	Glaze Color	Al_2O_3	SO_3	Na_2O	MnO	K_2O	SiO_2	PbO	MgO	FeO	CaO	CuO	TiO_2	ZnO	Total
E03	Brownish black	5.40	0.76	0.17	1.71	0.59	22.28	64.41	0.47	1.71	0.77	0.17	0.27	1.30	100.00
E03	Dark black	3.86	0.34	0.33	2.16	0.69	18.21	68.42	0.48	1.64	1.42	0.27	0.19	2.00	100.00
E08	Dark black	4.35	0.06	0.32	2.78	0.41	22.08	61.78	0.47	1.23	2.26	0.17	0.17	3.92	100.00
E11	Dark black	3.33	0.46	0.25	1.29	0.60	20.47	67.41	0.53	2.22	1.61	0.09	0.14	1.61	100.00
E15	Brownish black	4.89	0.56	0.50	1.51	0.83	26.33	58.76	0.86	2.09	0.98	0.17	0.20	2.33	100.00
E20	Brown	6.38	0.12	0.39	2.80	0.94	30.67	48.48	0.88	3.31	3.91	0.28	0.24	1.59	100.00
E28	Brown with green	5.23	0.11	0.31	0.99	0.66	20.97	65.49	0.47	1.64	1.84	0.17	0.18	1.93	100.00
E32	Dark black	2.98	0.43	0.25	4.85	0.46	19.35	66.31	0.43	1.64	1.53	0.24	0.09	1.44	100.00
E33	Brown	5.92	0.04	0.41	1.73	0.82	28.16	54.12	0.86	2.45	3.12	0.18	0.21	1.98	100.00
E35	Dark black	5.83	0.03	0.39	2.47	0.57	28.24	53.72	0.52	3.02	1.01	0.18	0.23	3.79	100.00
E38	Black with green	6.69	0.09	0.26	4.32	0.43	23.72	58.04	0.57	1.66	1.49	0.08	0.25	2.40	100.00
F01	Brownish black	3.77	1.67	0.28	1.85	0.36	18.81	68.23	0.60	1.38	0.90	0.28	0.09	1.79	100.00
F03	Brown with green	5.98	0.04	0.58	0.49	1.29	27.68	54.27	0.73	3.08	3.75	0.14	0.29	1.69	100.00
F04	Dark black	4.47	0.25	0.35	1.86	0.79	22.09	63.27	0.74	2.23	1.85	0.12	0.12	1.89	100.00
F05	Dark black	4.29	0.88	0.32	0.80	0.52	21.92	64.72	0.65	2.17	0.93	0.15	0.16	2.47	100.00
F07	Brown	6.70	0.02	0.11	5.69	0.44	27.31	55.72	0.56	1.10	0.54	0.03	0.29	1.49	100.00
F07	Green	5.97	0.11	0.17	4.71	0.70	28.92	52.26	0.70	2.54	2.09	0.07	0.32	1.44	100.00
F12	Brown with green	7.40	0.25	0.49	1.26	1.00	25.97	57.31	1.04	2.41	2.37	0.10	0.26	0.16	100.00
F22	Brown	4.59	0.05	0.18	4.84	0.63	27.24	57.76	0.47	2.68	0.92	0.15	0.23	0.26	100.00
F38	Brownish black	5.84	0.04	0.35	0.89	0.91	26.86	57.31	0.95	2.41	3.46	0.14	0.26	0.56	100.00
F53	Brown	7.64	0.40	0.34	0.92	0.64	26.00	57.22	1.41	1.87	1.98	0.17	0.17	1.24	100.00
F53	Brownish black	6.53	0.31	0.37	1.32	0.64	23.81	58.54	0.98	2.81	2.39	0.12	0.28	1.89	100.00

Sherd Number*	Glaze Color	Al_2O_3	SO_3	Na_2O	MnO	K_2O	SiO_2	PbO	MgO	FeO	CaO	CuO	TiO_2	ZnO	Total
F57	Brownish black	3.12	0.40	0.17	1.18	0.61	20.47	67.44	0.56	3.38	1.87	0.09	0.15	0.57	100.00
F66	Brown with green	5.22	0.08	0.21	3.24	0.64	26.40	58.95	0.63	1.04	1.09	0.10	0.28	2.13	100.00

*** Duplicate Sherd Numbers included if glaze color on the interior and exterior were different, average for these sherds included only the approximately 5 points on one side of the sherd**

Appendix F

Design Analysis

Table 1: Whole Vessel Sample List including Repository and Location of Recovery

Vessel Number	Glaze Type Code	Glaze Type	Museum*	Archaeological Site of Recovery	Museum Specimen/Catalog Number
A01	CGP	A	MM	Pecos	36.9.23
A02	CGY	A	MM	Pecos	36.9.26
A03	CGY	A	AMNH	San Marcos	29.0-4667
A04	CGP	A	AMNH	San Marcos	29.0-4691
A05	CGY	A	AMNH	San Marcos	29.0-4687
A06	CGY	A	AMNH	San Marcos	29.0-4621
A07	AFR	A	AMNH	San Marcos	29.0-4664
A08	CGP	A	AMNH	San Marcos	29.0-4688
A09	AFR	A	AMNH	San Marcos	29.0-4663
A10	AFR	A	AMNH	San Cristobal	29.0/ 2084
A11	CGY	A	AMNH	San Cristobal	29.0/ 2082
A12	AFR	A	AMNH	San Lazaro	29.0/ 2850
A13	CGY	A	AMNH	San Lazaro	29.0/ 2849
A14	CGY	A	AMNH	Pueblo Cieneguilla	29.0/ 4348
A15	LPP	A	AMNH	Pueblo Cieneguilla	29.0/ 4276
A16	CGP	A	AMNH	Pueblo Cieneguilla	29.0/ 4375
A17	AFR	A	AMNH	Paako	29.0/ 3519
A18	AFR	A	AMNH	Paako	29.0/ 3484
A19	AFR	A	MM	Paako	60.24.17
A20	AFR	A	MM	Paako	60.24.7
A21	AFR	A	MM	Tijeras	78.67.946
A22	AFR	A	MM	Paako	60.24.5
A23	AFR	A	MM	Zia	69.5.30
A24	AFR	A	MM	Pecos	36.9.45
A25	AFR	A	MM	Pecos	36.9.37
A26	AFR	A	MM	Tijeras	78.67.518
A27	SCP	A	MM	Pecos	36.9.28
A28	CGY	A	MM	Pottery Mound	66.102.20
A29	AFR	A	MM	Pottery Mound	80.52.2
A30	SCP	A	MM	Pottery Mound	87.50.8
A31	Untyped	A	AM	Tonque	PC1974.33.16
A32	Untyped	A	AM	Tonque	PC1976.83.113
A33	Untyped	A	AM	Tonque	PC1976.83.126
A34	SCP	A	MNM	Kuaua	21764/11
A35	SCP	A	MNM	Paako	21263/11

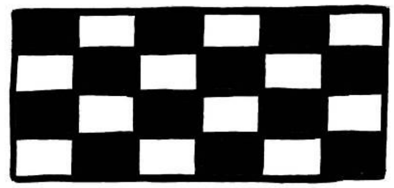
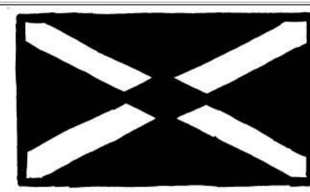
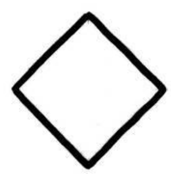
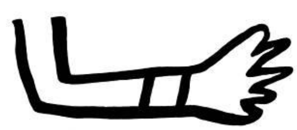
Vessel Number	Glaze Type Code	Glaze Type	Museum*	Archaeological Site of Recovery	Museum Specimen/Catalog Number
A36	SCP	A	MNM	Kuaua	21259/11
A37	AFR	A	MNM	Paako	21514/11
B01	LGY	B	MM	Pecos	36.9.22
B02	LGY	B	AMNH	San Marcos	29.0/ 4714
B03	LGP	B	AMNH	Pueblo de Los Aguajes	29.0/ 4198
B04	LGP	B	AMNH	Pueblo Cieneguilla	29.0/ 4254
B05	LGP	B	AMNH	Pueblo Cieneguilla	29.0/ 4373
B06	LGP	B	AMNH	Los Aguajes	29.0/ 4173
B07	LGP	B	AMNH	Los Aguajes	29.0/ 4158
B08	LGP	B	MM	Pecos	36.9.46
B09	LGP	B	AM	Tonque	PC1977.130.7
B10	LGP	B	MNM	Kuaua	21161/11
B11	LGP	B	MNM	Pecos	51621/11
B12	LGP	B	MNM	Pecos	42943/11
C01	EGP	C	MM	Puaray	36.12.55
C02	EGP	C	MM	Pecos	36.9.18
C03	EGP	C	AMNH	San Marcos	29.0-4610
C04	EGP	C	AMNH	San Marcos	29.0-4601
C05	EGY	C	AMNH	San Marcos	29.0-4554
C06	EGP	C	AMNH	San Marcos	29.0-4468
C07	EGP	C	AMNH	San Marcos	29.0-4714
C08	EGY	C	AMNH	San Cristobal	29.1-3562
C09	EGP	C	AMNH	Pueblo de Los Aguajes	29.0/ 4189
C10	EGP	C	AMNH	San Lazaro	29.0/ 2964
C11	EGP	C	AMNH	Pueblo Cieneguilla	29.0/ 4248
C12	EGP	C	AMNH	Los Aguajes	29.0/ 4161
C13	EGP	C	AMNH	Pueblo Cieneguilla	29.0/ 4263
C14	EGP	C	AMNH	Los Aguajes	29.0/ 4183
C15	EGP	C	AMNH	Los Aguajes	29.0/ 4175
C16	EGP	C	AMNH	Pueblo Cieneguilla	29.0/ 4327
C17	EGY	C	AMNH	San Cristobal	29.0/ 1675
C18	Untyped	C	AM	Tonque	PC1976.58.9
C19	EGP	C	MNM	Kuaua	21830/11
C20	EGP	C	MNM	Kuaua	21261/11
C21	EGP	C	MNM	Puaray	21844/11
C22	EGP	C	MNM	Kuaua	11280/11
C23	EGP	C	MNM	Kuaua	21401/11
C24	EGP	C	MNM	Kuaua	21388/11
C25	EGP	C	MNM	Puaray	21377/11
C26	EGP	C	MNM	Puaray	18017/11
C27	EGP	C	MNM	Puaray	18019/11

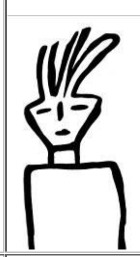
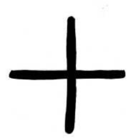
Vessel Number	Glaze Type Code	Glaze Type	Museum*	Archaeological Site of Recovery	Museum Specimen/Catalog Number
C28	EGP	C	MNM	Puaray	18018/11
C29	EGP	C	MNM	Kuaua	21630/11
D01	SLP	D	MM	Pecos	36.9.19
D02	SLP	D	AMNH	San Marcos	29.0-4588
D03	SLR	D	AMNH	San Marcos	29.0-4576
D04	SLP	D	AMNH	San Marcos	29.0-4595
D05	SLP	D	AMNH	San Marcos	29.0-4622
D06	SLP	D	AMNH	San Marcos	29.0-4561
D07	SLP	D	AMNH	San Marcos	29.0-4577
D08	SLP	D	AMNH	San Marcos	29.0-4569
D09	SLP	D	AMNH	San Lazaro	29.0/ 2896
D10	SLP	D	AMNH	San Marcos	29.0-4714
D11	SLP	D	AMNH	Pueblo Colorado	29.0/ 2571
D12	SLP	D	MM	Location Unknown	53.9.4
D13	SLR	D	MM	Sapawe	66.105.85
D14	SLP	D	MM	Location Unknown	39.21.23
D15	SLP	D	MM	Pecos	36.9.34
D16	SLY	D	MM	Paako	60.24.10
D17	SLP	D	MM	Puaray	36.12.21
D18	SLP	D	MM	Pecos	36.9.32
D19	SLP	D	MM	Pecos	36.9.33
D20	SLP	D	MM	Puaray	36.12.25
D21	Untyped	D	AM	Tonque	PC1977.130.8
D22	Untyped	D	AM	Tonque	PC1976.58.8
D23	Untyped	D	AM	Tonque	PC1976.83.22
D24	SLP	D	MNM	Kuaua	21764/11
D25	SLP	D	MNM	Puaray	21265/11
D26	SLP	D	MNM	Puaray	35743/11
D27	SLP	D	MNM	Kuaua	21847/11
E01	PGP	E	AMNH	San Cristobal	29.1-3566 B
E02	PUP	E	AMNH	San Marcos	29.0/ 4714
E03	PGP	E	MNM	Paako	21673/11
E04	PGP	E	MNM	Puaray	21892/11
E05	PGP	E	MNM	Puaray	21872/11
E06	PGP	E	MNM	Puaray	21494/11
E07	PUP	E	MNM	Kuaua	21412/11
E08	PUP	E	MNM	Kuaua	21326/11
E09	PGP	E	MNM	Puaray	11515/11
E10	PGP	E	MNM	Puaray	21753/11
E11	PGP	E	MNM	Puaray	11613/11
E12	PGP	E	MNM	Kuaua	11459/11

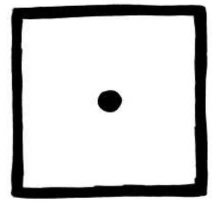
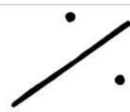
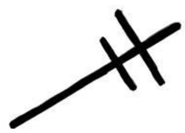
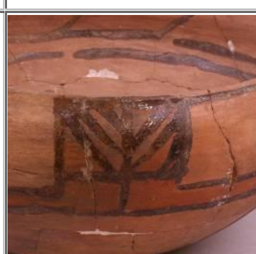
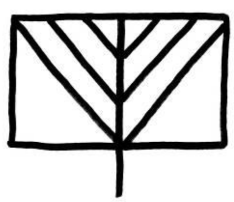
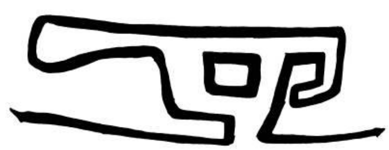
Vessel Number	Glaze Type Code	Glaze Type	Museum*	Archaeological Site of Recovery	Museum Specimen/Catalog Number
E13	PGP	E	MNM	Puaray	11274/11
E14	PGP	E	MNM	Puaray	18016/11
E15	PGP	E	MNM	Puaray	22021/11
E16	PGP	E	MNM	Kuaua	11285/11
E17	PGP	E	MNM	Puaray	21426/11
E18	PGP	E	MNM	Kuaua	11276/11
F01	KGR	F	AMNH	San Marcos	29.0-4507
F02	KGR	F	AMNH	San Marcos	29.0-4533
F03	KGR	F	AMNH	San Marcos	29.0-4544
F04	KGR	F	AMNH	San Marcos	29.0-4537
F05	KGP	F	AMNH	San Marcos	29.0-4509
F06	KGY	F	AMNH	San Cristobal	29.0/ 2059
F07	KGY	F	AMNH	San Cristobal	29.0/1930
F08	KGY	F	AMNH	San Cristobal	29.1/ 3530
F09	KGY	F	AMNH	San Cristobal	29.0/ 2058
F10	KGY	F	AMNH	San Cristobal	29.0/ 1921
F11	KGP	F	AMNH	San Cristobal	29.0/ 1920
F12	KGP	F	MM	Paako	60.24.9
F13	Untyped	F	AM	Tonque	PC1974.33.11
F14	Untyped	F	AM	Tonque	PC1974.33.13
F15	KGP	F	MNM	Puaray	21747/11
F16	KGR	F	MNM	Puaray	21501/11
F17	KGR	F	MNM	Kuaua	11281/11

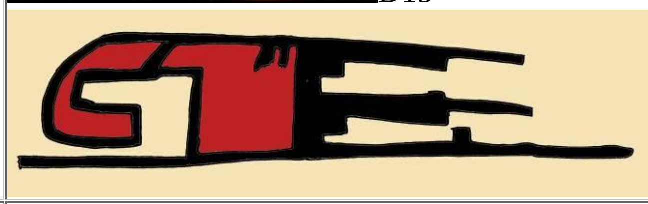
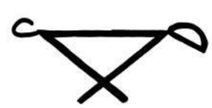
* Museum Abbreviations: MM = Maxwell Museum of Anthropology, AMNH = American Museum of Natural History, AM = Albuquerque Museum, MNM = Museum of New Mexico

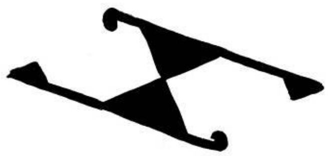
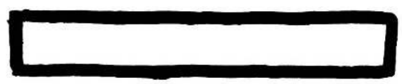
Table 2: List of all icons/motifs present on the whole vessel sample

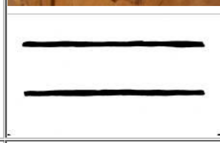
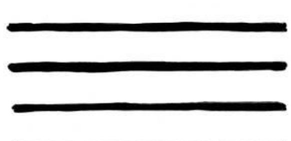
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
checkerboard, rectangle	 A17 
checkerboard, triangles	 A11 
circle, half	 C03
circle, half, with lines	 C13
diamond	 C08 
icon, animal (badger?)	No Photo
icon, arm with hand	 C01 

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
icon, capitan head/ body	 D03  D04  C09  D06   
icon, comma (tadpole?)	No photo
icon, cross	 C07  C16  F08  

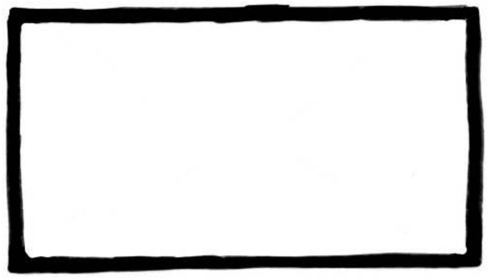
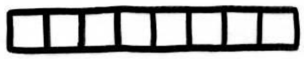
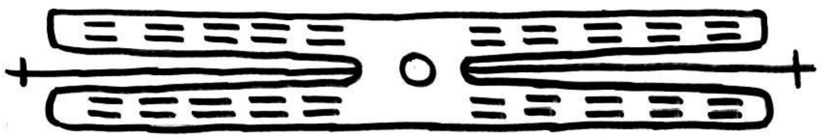
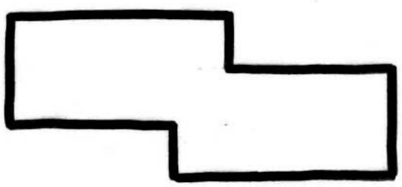
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
icon, dot in circle/ square (eye?)	 C15  D05 
icon, dragonfly	 C01  B08   
icon, face	No Photo
icon, hand	No Photo
icon, moth/ butterfly	 C01 
icon, rectangle with feather like detail (bird tail or feather?)	 D15 
icon, square bird	 C16 

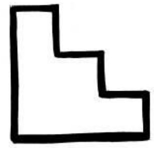
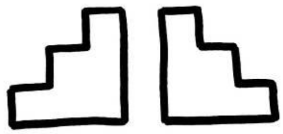
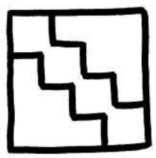
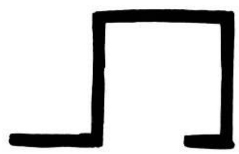
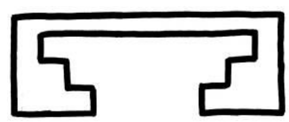
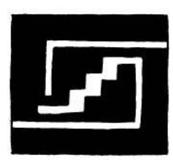
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
icon, square bird with step(s)	 D08  D15 
icon, step, hooked, legs (bird)	No Photo
icon, triangle, hooked, tail (bird)	 C10  C15  D14  D15
icon, triangle, hooked, tail, legs (bird)	 D13  C04 
icon, triangle, hooked, tail, legs with step (bird)	No Photo

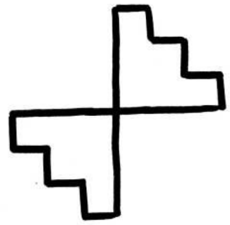
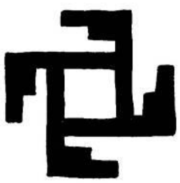
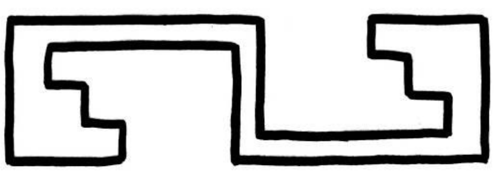
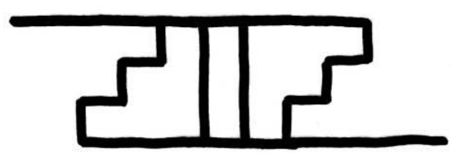
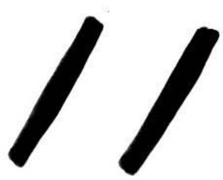
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
icon, triangles, back-facing, with bird motif	 C13  C11 
line	 C14 
line with dot elaboration	 D04  B08 
line with elaboration	 C05  C02

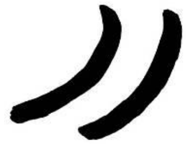
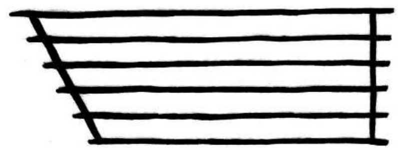
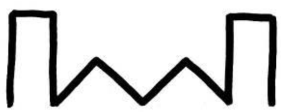
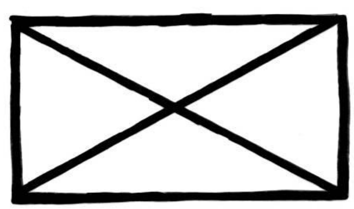
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
line with line elaboration	 D05 
line, filled	 C06
lines, 2	 A08  F03 
lines, 2, with elaboration	 F10
lines, 3	 D12
lines, 4	No photo 

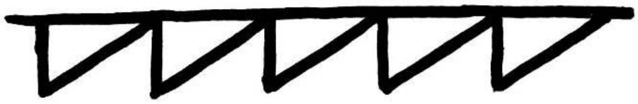
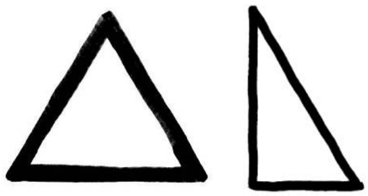
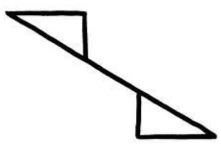
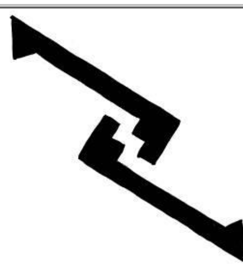
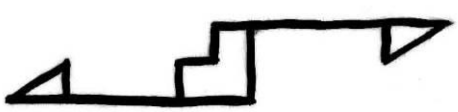
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
lines, 4, with elaboration	 A20 
lines, 5, with elaboration	 A10
lines, intersecting	 C05  B05 
pound symbol	No photo 

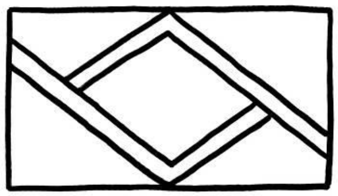
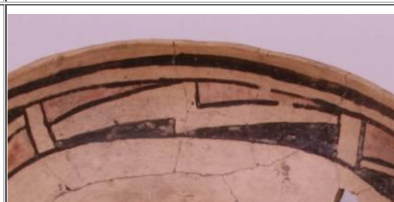
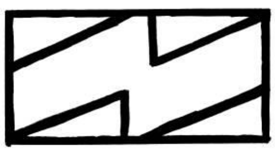
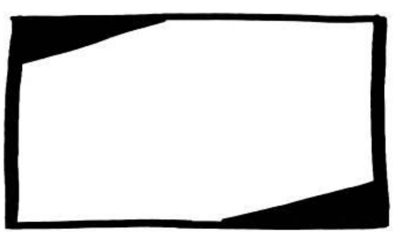
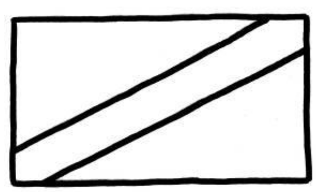
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
rectangle	 D13 
rectangle series	 B03 
rectangle, elaborate detail	 D08 
rectangle, joined (5)	 E01 
rectangle, off-set	 D03 

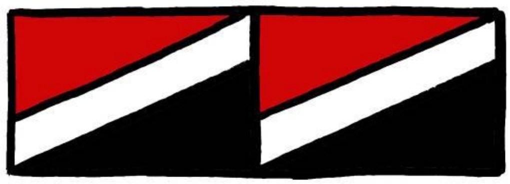
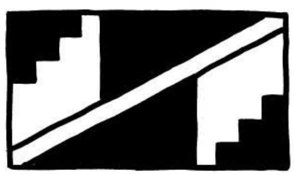
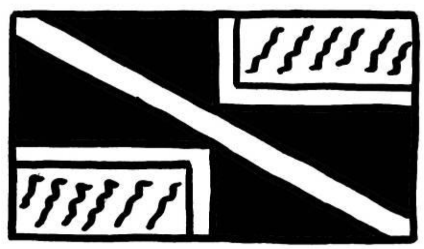
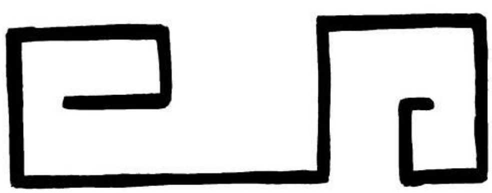
Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
steps	 B10 
steps, back-facing	 A20 
steps, back-facing, rotated	 A22 
steps, brief	 F06 
steps, forward-facing	 A16 
steps, interlocking	 A02  A09 

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
steps, opposed	 A20 
steps, opposed (4 - swastika)	 C10  D19 
steps, opposed, separated	 C12  D12  
tick mark	 A14 

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
tick mark, curved	 A02 
trapezoid	 D13 
triangle and line series	 F09  C11 
triangle, detailed (bird tail?)	 D08 
triangle, double motif	 B05  F10 
triangle, series, right	 F08  A12

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
	
triangles	 A13  D01 
triangles, back-facing	 C06  A16 
triangles, back-facing, with double step	 C16 
triangles, back-facing, with step	 C15  C11 

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
triangles, opposed, off-set	 A19  A21 
triangles, opposed, right, off-set with breaks	 A01  D05 
triangles, right, opposed	 A02  C03  

Element/ Motif Name	Photo and Drawing Examples of Element/Motif*
triangles, right, opposed, double	 A01 
triangles, right, opposed, filled	 A07  C14  
volute, square, double	 B07 

* All photos taken by Kari Schleher. Vessels included here are from the collections at the AMNH and the Maxwell Museum. See Appendix F, Table 1 for a list of whole-vessel item numbers and corresponding museum information.

Table 3: Element/ Motif/ Icon Grouped Categories

Element/ Motif	Grouped Category	Icon
icon, triangle, hooked, tail, legs with step (bird)	Bird	bird
icon, triangle, hooked, tail (bird)	Bird	bird
icon, triangle, hooked, tail, legs (bird)	Bird	bird
icon, step, hooked, legs (bird)	Bird	bird
icon, square bird with step(s)	Bird	bird
icon, square bird	Bird	bird
icon, triangles, back-facing, with bird motif	Bird	bird
checkerboard, triangles	Other Geometric	
pound symbol	Other Geometric	
checkerboard, rectangle	Other Geometric	
circle, half	Other Geometric	
circle, half, with lines	Other Geometric	
icon, cross	Other Icon	cross
diamond	Other Geometric	
icon, moth/ butterfly	Human/ animal/ bug Icon	dragonfly/moth/butterfly
icon, dragonfly	Human/ animal/ bug Icon	dragonfly/moth/butterfly
icon, dot in circle/ square (eye?)	Human/ animal/ bug Icon	eye
triangle with fringe (line elaboration)	Bird	feather/ bird tail
triangle, detailed (bird tail?)	Bird	feather/ bird tail
icon, rectangle with feather like detail (bird tail or feather?)	Bird	feather/ bird tail
icon, hand	Human/ animal/ bug Icon	human arm/ hand
icon, arm with hand	Human/ animal/ bug Icon	human arm/ hand
icon, capitan body	Human/ animal/ bug Icon	human face/ mask
icon, face	Human/ animal/ bug Icon	human face/ mask
icon, capitan head and body	Human/ animal/ bug Icon	human face/ mask
icon, capitan head	Human/ animal/ bug Icon	human face/ mask
lines, 3	Line(s)	
lines, 5, with elaboration	Line(s)	
lines, intersecting	Line(s)	
line with elaboration	Line(s)	
lines, 2, with elaboration	Line(s)	
lines, 2	Line(s)	
line	Line(s)	
lines, 4	Line(s)	
lines, 4, with elaboration	Line(s)	
line with line elaboration	Line(s)	
line with dot elaboration	Line(s)	

Element/ Motif	Grouped Category	Icon
line, filled	Line(s)	
icon, comma (tadpole?)	Human/ animal/ bug Icon	naturalized animal
icon, animal (badger?)	Human/ animal/ bug Icon	naturalized animal
rectangle, joined (5)	Other Geometric	
rectangle, off-set	Other Geometric	
rectangle	Other Geometric	
rectangle series	Other Geometric	
rectangle, elaborate detail	Other Geometric	
steps, back-facing	Step(s)	
steps, opposed, separated	Step(s)	
steps, brief	Step(s)	
steps, back-facing, rotated	Step(s)	
steps, interlocking	Step(s)	
steps, opposed	Step(s)	
steps, forward-facing	Step(s)	
steps, opposed (4 - swastika)	Step(s)	
steps	Step(s)	
tick mark, curved	Other Geometric	
tick mark	Other Geometric	
trapezoid	Other Geometric	
triangles, back-facing, with double step	Triangle(s)	
triangles, right, opposed, filled with black and step	Triangle(s)	
triangle, double motif	Triangle(s)	
triangles, right, opposed, filled	Triangle(s)	
triangles, right, opposed, double	Triangle(s)	
volute, triangle	Triangle(s)	
triangles, back-facing, with step	Triangle(s)	
triangles	Triangle(s)	
triangle and line series	Triangle(s)	
triangles, opposed, off-set	Triangle(s)	
triangles, back-facing	Triangle(s)	
triangle, series, right	Triangle(s)	
triangles, right, opposed	Triangle(s)	
triangles, opposed, right, off-set with breaks	Triangle(s)	
volute, square, double	Other Geometric	

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