MICACEOUS MINDSETS: CHEMICAL CHARACTERIZATION OF PUEBLO IV
UTILITY WARES AT MULTIPLE SITES ALONG THE RIO GRANDE

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I would like to thank my family for always being at my side, my Beloit College friends for their unwavering support, and my Günter Hans crew who experienced my ups and downs.
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ABSTRACT

Micaceous utility wares are commonly found at Ancestral Pueblo villages along the Rio Grande and adjacent areas, yet they have received comparatively little attention relative to the well-studied glaze wares with which they often share contemporaneity. Compositional studies show that glaze wares and their ingredients were often transported around the landscape, driven by a mix of ritualistic and economic factors, but utility wares were also a common component of daily Pueblo activities and are shown to have been involved in complex exchange schemes. Neutron activation analysis is used to chemically characterize micaceous utility sherds from six Pueblo IV (1300 – 1600 CE) sites between Santa Fe and Socorro, New Mexico. Five distribution patterns are recognized based on spatial patterns of compositional groups present within and shared between sites. These indicate procurement and/or manufacturing similarities between the Rio Puerco and the Albuquerque area, and differences to the north near the Jemez Mountains and to the south in the Rio Abajo. These trends are meant to help focus future compositional, geological, and petrographic research.
CHAPTER 1: INTRODUCTION

Discussions of community formation along the Rio Grande Valley in the Pueblo IV period (1250 CE –1600 CE) are underlain by the notion that similarities and dissimilarities existed between people on the landscape (Bayman 1999; Naranjo 1995; Nelson and Schachner 2002), and so integrative activities would be one characterization of successful settlements during times of immense social change. One factor that helped bring these communities together is the production, exchange, and use of Rio Grande Glaze Wares (Cordell and Habicht-Mauche 2012). Contemporaneous with this tradition was the production of micaceous utility ware, a technology that Eiselt and Ford (2007) describe as “truly transcultural”. It is ubiquitous throughout the Rio Grande’s Pueblo communities. Limited means with which to delineate such a common material on the landscape merits an investigation of chemistry and distribution at a broader scale. Bulk compositional analysis via neutron activation analysis (NAA) of micaceous sherds from six Pueblo IV sites indicate a mixture of communities that have relations with others in the study area, and those that have their actions set elsewhere.
CHAPTER 2: BACKGROUND
Part 1: Enter the Rio Grande

Beginning as early as the latter half of the 13th century, populations from the San Juan and Mesa Verde regions, Western Pueblo areas like Zuni, Acoma, and the Upper Little Colorado district, and local Rio Grande groups contributed to the social reorganization of the Central and Southern Rio Grande. Sociopolitical destabilization echoing from the wane of institutions like Chaco (Lekson 2008) and periods of drought (Berry and Benson 2010) are among many ideas identified as causes of migration. However, the scale at which these circumstances took effect is not clear, for what might be climate at one level may be food insecurity or violence at another. Or groups might have been drawn to new opportunities, rather than forcibly relocated. Since the effects on communities and familial groups were certainly not uniform, and that evidence indicates variable migration group sizes from individual households to hundreds of individuals (Nelson and Schachner 2002), one can assume a heterogeneous social landscape. That landscape consists of integration and fission, of some familial ties and some not, and of dissension and harmony. In the broadest sense, those regional similarities are still recognized and manifest across expansive archaeological delineations of the New Mexico Rio Grande (Figure 1).
Figure 1. The study area and studied sites partitioned by the regional geographic nomenclature for archaeological research along the Rio Grande.
Various ecological zones make up the Rio Grande (Griffith et al. 2006). Of note to this study is the Albuquerque Basin and Rio Grande Floodplain where all the sites of direct concern are located. Also relevant are the semiarid tablelands of western New Mexico and their associated uplands, and the conifer forests, woodlands, and savannas of the Manzano and Sandia Mountains to the east. To the north lies the Jemez and Sangre de Cristo Mountains with various forests, woodlands, and shrublands, while the Jemez has more widespread forests composed of volcanic rocks. To the south, Chihuahuan basins, playas, and grasslands extend up from the principle Chihuahuan Desert and stop about 30 kilometers north of Socorro (Griffith et al. 2006).

The Rio Grande Valley is the result of geologic rifting that caused extension in some areas and tectonic uplift in others. Lithospheric extension was primarily during Neogene to Quaternary times, with some evidence pointing to earlier episodes, and uplift and volcanism as recent as the Holocene (Cordell 1978). Northern portions of the Rio Grande more closely resemble the textbook definition of a single rift valley, while southern portions are mostly indistinguishable from the Basin and Range Province; however, these basins are vital for clay deposition because they consist of exposed formations that are susceptible to erosion (Keller and Baldridge 1999). The combination of volcanic activity, exposure of old rock formations, and generation of new formations from temperature and pressure subsequently yielded complex sedimentological sequences from their erosion. Both widespread and localized clay deposits formed. Many of these sources have been identified as archaeological clays (Habicht-Mauche 1993; Nelson and Habicht-Mauche 2006; Shepard 1936, 1942, 1965; Warren 1970, 1976, 1980).
Settlement Patterns and Social Organization

Throughout the 1300s and 1400s CE, the Rio Grande on average experienced population increases and nucleation into large villages. Two common frameworks for understanding this settlement pattern and the corresponding social circumstances across such a broad geographic space were popular in the early 2000s. One perspective looked at defining settlement clusters and then used analyses beyond the site to put it in a regional context (Adams and Duff 2004). Another perspective primarily analyzed the site, occasionally at the expense of regional models (Habicht-Mauche et al. 2006). Understanding the social circumstances of this period requires both regional and local consideration. This work utilizes districts as defined in Adams and Duff (2004) and considers the circumstances of individual sites within and between districts.

Within these districts, and varying from site to site, settlement and material histories are complex from the cohesion of immigrants and locals that carried out their lifeways in traditional, hybridized, and novel forms. Researchers have identified evidence of Mogollon and Western Pueblo migrants in the Rio Puerco, Rio Abajo and Central Rio Grande in various proposed magnitudes (Eckert 2008; Eckert and Cordell 2004; Eckert and Snow 2015; Marshall and Walt 1984). The arrival of migrants had potential to leave a resounding impact on the social landscape for centuries to follow, perhaps best emphasized at Tijeras Pueblo and the proposed migration of people from the Mariana Mesa and Upper Little Colorado districts to the west (Habicht-Mauche and Eckert 2021). But what else kept communities along the Rio Grande cohesive? Corresponding with the formation of large communities into densely packed pueblos, glaze ware technology made its mark on Southwest Indigenous history.
Part 2: Rio Grande Glaze Wares

Theory

The value of the glaze ware to both the Ancestral Pueblo potters and modern Southwest archaeologists is difficult to overstate. Even excluding the still relevant symbolic significance and animism of pottery production that a growing body of literature has been addressing (VanPool and Newsome 2012), the glaze ware is still a remarkable technological feat that became a hallmark of innovation, community formation, and exchange for the Rio Grande Pueblo IV period. Dually, archaeometric studies have provided a growing body of literature that elucidates landscapes of movement. Glaze wares were manufactured and moved because it made sense in some framework of exchange, and also because the material constituents and finished vessels made it meaningful to do so.

Bandelier (1892) was among the first to note aggregated Pueblos during Pueblo IV. Studies thereafter frequently looked at the context of those communities at the regional level and their political integration (e.g., Adams and Duff 2004; Snead et al. 2004). With empty space in between clustered communities (e.g., Cochiti, Albuquerque, Rio Puerco, Rio Abajo), a flavor of World Systems Theory began to emerge. In archaeology, this is the idea that contained worlds of interaction exist, and deviations in the volume and nature of those interactions vary between a core and outside that core (i.e., periphery, semi-periphery) (Peregrine 1996). As variability increased because of more site-by-site investigations, more theoretical frameworks were developed and applied.
Situated on a different facet than World Systems Theory is Practice Theory, which focuses on people as active participants and catalysts of cultural actions rather than any overarching institutions (Eckert and Huntley 2022; Ortner 1984; Stark 2006). Furthermore, objectivism (understanding people via the externalities acting on them) and subjectivism (understanding people via their perception of the world) are depolarized and bridged through *Habitus*, which is a way of connecting people and the structures of culture in a dynamic dance wherein one is not so deterministic for the other (Bordieu 1980). In the context of ceramic studies, the Anthropology of Technology often accompanies Practice Theory because the daily activities of individuals are important components of a sociotechnical system, which bridges techniques and the material culture (Pfaffenberger 1992). This merger very much dictated the interpretive formulation of Communities of Practice, Communities of Identity, Communities of Ideology, and Constellations of Practice (Cordell and Habicht-Mauche 2012). These communities are collectives of individuals who share a techno-social framework of manufacture to the extent that pottery is identifiable both within and between collectives (Lave and Wenger 1991; Stark 2006).

From a combination of theoretical foundations such as these, the researcher can begin to understand the emergence of the most cumulative theoretical framework for a study of this nature: craft production. Costin (2005:1033–1044) defines craft production as “...any transformational process involving skill, aesthetics, and cultural meaning, and consider the results of that crafting to be crafts”. From this definition, both the agency and technicality of production are acknowledged. Costin (2001) further emphasizes that craft production requires an investigation of the “production system”; this is holistic and calls for the integration of artisans, the means of production, organization and social
relations of production, objects, relations of distribution, and consumers. It should be clear that this is an optimum, for not all studies allow the consideration of all facets of the production system at once. This poses a problem because a production system is fundamentally integrated. To talk in parcel for an explanation of craft production is flawed. Indeed, Costin (2005:1039) emphasizes that “Studies of craft production have tended to be provincial and compartmentalized”. In other words, production has been subject to examination via the lens of a single type of material (e.g. ceramic, lithic). While this study does not rely on the examination of many kinds of materials, it does compare classes of materials within the same material type. Therefore, while this research is not a study of craft production, it is another piece of that “integrated whole” that sets out to examine the distribution of micaceous wares in the context of the well-studied glaze ware phenomena. In this sense, glaze ware research is an informative partner to this micaceous study, all while micaceous utility wares offer their own novelty for ceramic distribution in the Rio Grande. To understand micaceous wares, it is necessary to also understand glaze wares.

*Archaeology*

Anna O. Shepard was a pivotal figure in southwest ceramic research, which was well established after her work with Alfred V. Kidder at Pecos Pueblo. Kidder (1936) described her petrographic work as a “bombshell” that concluded much of the pottery at Pecos was not made at Pecos, and thus implicated trade. Shepard’s controversial view of market exchange in the southwest sat opposite to the notion of individual village autonomy and Kidder’s own view of migration (Cordell 2006). In a much-needed call for
improved interdisciplinary research by archaeologists and ceramicists, Shepard (1942) emphasized regional perspectives by defining districts of production based on temper groups. This study concluded that centers of glaze ware production dictated distribution on the landscape, where Albuquerque, Santa Domingo, and Zia areas were production centers until the Galisteo region dominated production during the Intermediate Glaze Ware period (1450 – 1515 CE). Shifting centers of production through time were supported in general by Helene A. Warren’s petrographic research (1969, 1970). Later, Shepard turned her attention to glaze paints, where she identified the paints as the commodity, rather than the pot, and postulated the nature of Rio Grande glaze paint technology and whether raw material constituents were rooted more locally or from Western Pueblos (Shepard 1965).

Glaze ware chronology has two general traditions that each define separate characteristics for their respective typologies. In Western Pueblo areas the focus is on a suite of characteristics that include slip color and designs, while in the Rio Grande rim form and temper are examined (Eckert 2006). The latter will be of focus here because the study area resides well within the Rio Grande Glaze Ware Series. The only exception is along the Lower Rio Puerco, where both Western and Rio Grande Pueblo Glazes are found, as well as local varieties called Pottery Mound Polychrome and Hidden Mountain Polychrome that are dated to 1375 CE – 1450+ CE and 1400 CE – 1450+ CE by examining rim form (Eckert 2003). Mera (1933) initially developed the Rio Grande Glaze Ware Series and, after refinement over more than 80 years by others, currently has three major phases called early, intermediate, and late. Early glazes consist of Glaze A and B types; intermediate glazes consist of Glaze C and D types; late glazes consist of Glaze E and F types. The early Glaze A vessels seem to be the most variable and are split
into Red, Yellow, and Polychrome, while later glaze classes are more internally consistent. Eckert (2006) describes the following types and their associated dates: Glaze A Red (1313 CE – 1500+ CE), Glaze A Yellow and Polychrome (1321 CE – 1450+ CE), Glaze B (1410 CE – 1500+ CE), Glaze C (1430 CE – 1600+ CE), Glaze D (1460 CE – 1550+ CE), Glaze E (1480 CE – 1630+ CE), and Glaze F (1525 CE – 1700 CE).

Glaze wares were manufactured in New Mexico as early as 1275 CE, however the Rio Grande did not truly develop and carry out its own ideas for glaze ware production until the beginning of the 14th century. Similar technologies were utilized as early as the 8th and 9th centuries in the Four-Corners region (Stark 2006), though it is still unclear whether later developments were independent of this or not. What is known is that technological changes were underway between the 12th and 14th centuries. Some involved a shift from mineral to carbon-based black paint, and a steady abandonment of copper and implementation of lead for paint recipes (Stark 2006). The latter is especially important for understanding the glaze ware relationship between Western Pueblos and the Rio Grande.

Herhahn (2006) examined glaze paint recipes from eastern Arizona, western New Mexico, and the Rio Grande and found pre-Rio Grande glaze series similarities with Western Pueblos. These similarities manifested in the utilization of copper colorants and a flux recipe with copper and lead, like Zuni. However, Glaze A paint recipes steadily replaced the copper-lead flux and implemented a manganese-lead flux (Herhahn 2006). Accompanied by evidence of local production techniques and a lack of chemical homogeneity between the west and east, subtle transmission from Zuni potters, rather than direct migration from the west, is the primary cause for a local Rio Grande glaze tradition that leaned on the west in the initial stages of its development (Herhahn 2006).
Crown (2014) corroborates this conclusion by noting general recipe transmission from west to east and population movement from north to south along the Rio Grande. Western Pueblos and Rio Grande communities may have also developed their technology and technique within different social environments. Zedeño (1994) in east-central Arizona observed drastic technological differences between settlements, but with shared decorative elements; this is hypothesized as different ethnic groups living in nearby proximity. Meanwhile, Crown (2014) notes frequent interaction amongst Rio Grande pueblos because of the fast adoption of colorants and their consistent application.

Other important patterns and trends in Rio Grande glazes are worth mentioning to frame glaze wares in Rio Grande lifeways. Early developments included a period of experimentation (Glaze A), followed by standardization in technology (Bower et al. 1986; Eckert 2006), which was due in part to technological aspects mentioned in the previous paragraph. Corresponding with nucleation and glaze wares, ritual architecture and ideology took diverse forms, including depictions of warfare and the rain/fertility iconography associated with Katsina (Eckert and Cordell 2004). The ultimate lesson from these generalizations is that Rio Grande glazes changed along with people and their behavior, and that caused archaeologists to think differently about community organization. Subsequently, those organizations were viewed as more nuanced compared to the centers or production proposed during Shepard’s era (Nelson and Habicht-Mauche 2006). Compositional studies have played a significant role in this realization.

Compositional Studies
While production models involving centers of glaze ware production have fallen out of favor, Shepard’s suspicions about lead paint as the commodity appear correct.

Lead isotopic studies have shown that many communities in north and central New Mexico utilized lead sources located in the Cerrillos Hills (Habicht-Mauche et al. 2002). Evidence of controlled and uncontrolled access to these sources is apparent. For example, at the site of San Marcos lead from glaze wares was homogenous during the Intermediate Period (1425 CE – 1515 CE) (Glaze C and D), while at Kuapa and Pueblo Blanco the lead isotopic signature was heterogeneous (Habicht-Mauche et al. 2000). This showed that both patterned and variable access and technological application were present, somewhat dictated by ease of procurement. Later work expanded this dataset with the addition of Tonque, Abó, and Quarai and found extraordinary durability in the glaze recipe through time, as well as similarity to the San Marcos recipe, yet with some potter-to-potter flexibility allowed (Schleher et al. 2012). The conclusion can be drawn that formal learning was present, but also that recipe standardization was not determined by a select few crafters. Moreover, Abó and Quarai utilized lead from the Socorro region increasingly through time (Huntley et al. 2007), while Tonque and San Marcos used Cerrillos. Yet, a single base glaze recipe is still chemically recognized (Schleher et al. 2012). Although other sources of lead would have been viable, consistent utilization of select sources helped maintain intercommunal relationships.

Flux recipes could be different from site-to-site depending on multiple factors such as proximity or potter agency, with flavors of regional consistency that reflect traditions. This also extended to other aspects of pottery manufacture. For potters at Tonque and San Marcos Pueblo, yellow clays near Tonque were selected for separate technological applications – a slip at San Marcos and the body at Tonque, while glaze
paint recipes were consistent between them (Eckert et al. 2018). Since other more accessible sources of yellow clay were available to San Marcos, producing pottery with different resources could have been a social strategy that surpassed simple constraints of access (Eckert et al. 2018). Differences in the distribution of glaze ware recipes relative to other ceramic resources is a common theme that overlays broad connectivity on top of site-specific practices. Temper type is also another traceable element of glaze ware manufacture because certain rocks predominate in certain areas, harking back to many of Shepard’s analyses. For example, glazes from the Galisteo Basin and Santa Ana Basin are often tempered with intermediate volcanic rocks and fine-grained basalt, respectively (Habicht-Mauche 1995).
Part 3: Micaceous Utility Wares

Compared to glaze wares, micaceous wares have not been given the same level of attention. Micaceous wares can be referred to as “mica-tempered,” but these wares can also come from residual micaceous clays wherein mica is already a constituent of the clay (Shepard 1985). Crushed mica may be purposefully added to a mica-deprived clay, or micaceous clay may be applied as a slip (Eiselt and Ford 2007). This demonstrates that micaceous utility wares can either be tempered or not, depending on the nature of 1) the clay and 2) the preferences of the potter. This effectively means that provenance studies of micaceous clays are constrained to a bulk compositional analysis of the paste, or petrographic analysis of the mica. Comparatively, Glaze Ware provenance research gets the added benefits of traceable lead-based paint recipes and the addition of temper that does not typically originate from the procured clay. These utility wares also do not have a refined chronology, though decorated styles tend to be earlier and plain styles later (Eiselt and Ford 2007; Franklin and Schleher 2012).

The lack of complex paste recipes for micaceous wares might help compositional studies because they are more related to their geological origins. Furthermore, they are common in the Rio Grande and appear to transcend ethnic, linguistic, and technological boundaries. They are even found as far as Protohistoric Apache sites in Nebraska and Kansas on the Central High Plains, wherein some are even derived from Rio Grande sources (Trabert et al. 2016). Being a sheet mineral, mica has a propensity to align in a certain direction when acted upon, and interlocks with elongated clay particles. This makes micaceous wares particularly resistant to forces applied perpendicular to this alignment, making them a strong and sensible vessel for daily activities. These wares are also especially resistant to thermal shock, making them effective and durable cooking
vessels (West 1992). Technological aspects may help explain their widespread use, but the glittering appearance vessels gain with the addition of mica could also play some role.

One of the most important studies for chemical analysis of micaceous sherds was by Eiselt and Ford (2007), where they matched sherds to micaceous clays from 10 mining districts in the northern Rio Grande using NAA. This study showed that micaceous artifacts (n=510) could be matched with a parent clay formation on a rather consistent basis. About 68% of archaeological specimens were assigned to actual source areas, while an additional 22% were assigned to districts (Eiselt and Ford 2006). If tying the artifact to the landscape is possible, how then might archaeologists reconstruct their movement? Ethnographic accounts in 19th century multi-ethnic Vecino communities have also shown that micaceous wares moved rather frequently: their raw materials were exchanged for foodstuffs, they would accompany small transactions, and may be used as payment for services (Eiselt and Darling 2012). The research may not be as developed as that for glaze wares, but work done thus far has indicated that 1) these artifacts are chemically distinct and 2) they were active in exchange processes.
CHAPTER 3: THE STUDY AREA

Researchers have multiple avenues in which to partition the Pueblo IV Rio Grande as discernable archaeological units. The method utilized here will be by district and, when applicable, cluster. A district constitutes a geographic area, while a cluster contains archaeologically related sites that are close together and separated from other clusters (Eckert and Cordell 2004). This study includes a total of six sites across four districts. The sites include Kuapa in the Cochiti District, Chamisal in the Albuquerque District, Hummingbird Pueblo and Pottery Mound in the Lower Rio Puerco District, and Abeytas and Pargas in the Rio Abajo District (Figure 2). All these sites were occupied contemporaneously to some degree.
Figure 2. Extent of the study area with relevant districts. The extent of districts roughly corresponds to the extent of clusters, wherein more sites also reside.
Part 1: Archaeological Clays

Though technically any clay could be used as a paste in non-residual micaceous ware recipes, they may also be used in their residual form where bountiful amounts of mica are present. The best work thus far has been done in the archaeological northern Rio Grande, where most areas with micaceous clays in the Sangre de Cristo and southern San Juan Mountains are eroded from the Precambrian Vadito group and other minor sources (Eiselt 2006).

Generally, for the study area, micaceous clays in the archaeological central and southern Rio Grande are derived from a mica-rich parent formation. Furthermore, those formations are usually located in upland zones that surround the basins because the exposure of those metamorphic rocks usually requires uplift or some other mechanism of tectonic activity. The Sandia, Manzanita, and Manzano Mountains to the east have been often discussed as an origin of micaceous clays (Habicht-Mauche and Eckert 2021). Sierra Lucero, Ladron Peak, Polvadera Peak, the San Mateo Mountains, and the Chupadera Mountains rise above western portions of Rio Grande Basin and have metamorphic formations (Horton et al. 2017).

The clays between the four districts are quite variable. Starting north in the Cochiti District, also the southern end of the Pajarito Plateau, archaeological clays mostly consist of varying percentages of sand and glassy pumice (Ruscavage-Barz 2002). On the other hand, Broxton and Vaniman (2005) paint a less ubiquitous geological picture, especially noting the variability in pumice per formation. At Kuapa, basalt was a common temper for Glaze Wares, which likely came from the south somewhere in the Santo Domingo Basin (Nelson and Habicht-Mauche 2006). Clay deposits of the well-
utilized Santa Fe Formation are much thinner west of the Pajarito Fault Zone (Broxton and Vaniman 2005).

The Albuquerque, Lower Rio Puerco, and the northernmost portion of the Rio Abajo District are included in the expansive Albuquerque Basin that stretches as far north as the Jemez River and well south of the confluence of the Rio Grande and Rio Puerco. The primary fill of the Albuquerque Basin is the Upper Santa Fe Group. This unit is composed primarily of Precambrian igneous, metamorphic, and sedimentary rocks from the Sandia, Manzanos, and Los Pinos uplifts to the east, basic and intermediate volcanics from the Jemez and Nacimiento uplifts to the north, and basic volcanics and mixed lithologies from fluvial transportation via the Rio Puerco and Rio San Jose systems from the west (Hawley et al. 1994). In more northern stretches of the Albuquerque Basin the geology is more variable wherein Kuapa is located, but in the vicinity of Chamisal sediments mostly derive from Rio Grande channel facies or clays enriched in metamorphic rocks from the east. The Belen subbasin to the south is characteristically different (Minor and Hudson 2006), where Hummingbird Pueblo, Pottery Mound, and Abeytas are located. Compositional differences in clays between these are not entirely elucidated, but differences are driven by varying lithological origins. Larson (2013) notes differentiation in clay sources for the central Rio Grande, where western sources contain a higher variety of volcanic rocks and eastern sources contain more metamorphic rock like schist.

In the central Rio Grande Valley, communities primarily utilized red and tan clays, while in the Rio Puerco red, yellow, tan, and olive clays were used for a variety of purposes (Franklin and Schleher 2012). Greater variety may not just be a behavioral one, but also geological. In the Lower Rio Puerco, various formations in addition to the Upper
Santa Fe group were accessible, including the Datil, Ceja, and Abo formations of igneous, metamorphic, and sedimentary form (Eckert 2008). Temper utilization may be more variable relative to clay selection. Eckert (2008) recognized various temper types in the Lower Rio Puerco, including multiple igneous categories, metamorphic types like quartz-mica schist from the Sandias near Tijeras Pueblo and gneiss from residual clay deposited in the Central Rio Grande, sand with varying lithologies that has been unsourced, and sherd of varying types and combinations.

Near the confluence of the Rio Grande and Rio Puerco is Abeytas Pueblo. This area includes the Ceja Formation, which spans both up the Rio Puerco and up to Albuquerque, Lomatas Negras Formation, Los Duranes Formation, Menaul Formation, and Los Padillas Formation. All these formations are fluvial deposits and have varying degrees of coarse and fine sediments with multiple lithologies (McCraw et al. 2006). Meandering on the Rio Grande further south to the Rio Abajo, the Santa Fe Group persists but is accompanied by more igneous flows than what is found in the typical Santa Fe deposit (Marshall and Walt 1984). Western and Eastern flanks of the valley consist of igneous and metasedimentary rocks, as well as more recent clay and igneous deposits (Marshall and Walt 1984).
Part 2: Pueblo Sites

Kuapa

As the northernmost site in this study, located just southeast of the Cerrillos Hills and Jemez Mountains along the Rio Grande, it consists of an estimated 400+ rooms, 9 Kivas, 3 or more plaza spaces, and was occupied from 1200 CE –1400 CE (Adams and Duff 2004, Appendix). Decorated Pottery includes Santa Fe and Galisteo Black-on-white and Glaze A (Adams and Duff 2004, Appendix).

Chamisal

This site is located near Albuquerque along the Rio Grande. It conservatively consists of 40-50 rooms and radiocarbon dates put occupations between 1335 CE and 1562 CE, but three pending samples may alter this range (Alexander Kurota, personal communication March 2022). The range of decorated pottery at the site is quite diverse, from early white wares to historic Native American wares. Those relevant to the time periods of this study include Santa Fe and Galisteo Black-on-white, Glaze Wares such as Arenal Polychrome, Agua Fria Glaze-on-red, and other types all the way up to Kotyiti Polychrome (Alexander Kurota, personal communication March 2022).

Tijeras Pueblo

Nestled in the mountains to the east of Albuquerque, Tijeras dates between about 1275 CE and 1400 CE (Wendorf and Reed 1955). Structures and spaces consist of between 10-12 smaller room blocks residing near a 125-room core, a rectangular and
circular kiva, and one plaza. Ceramics primarily consist of Glaze A Red, Black-on-white wares, and various Western-style Pueblo glazes and polychromes. (Habicht-Mauche and Eckert 2021).

**Hummingbird Pueblo**

Located on the Lower Rio Puerco, Hummingbird Pueblo consists of around 200 rooms, at least 1 rectangular kiva, 3 enclosed plazas, and was occupied between 1300 CE – 1450 CE (Adams and Duff 2004, Appendix). The terminal date may be earlier or as late as 1500, since abandonment of this area is still unclear (Eckert 2008). The ceramics here generally consist of Western Pueblo glaze wares and Early and Intermediate Rio Grande glaze wares (A, B, and C) (Adams and Duff 2004). Eckert (2008) provides a more detailed analysis of ceramics.

**Pottery Mound**

Downriver from Hummingbird Pueblo, Pottery Mound includes about 400 rooms, an astounding 16 kivas, at least 3 plazas, and dates between 1300 CE – 1450 CE. Like Hummingbird Pueblo, the latter date is debatable. Decorated ceramics include Western Pueblo glaze wares, Hopi yellow ware, and Rio Grande Glaze A through D. Eckert (2008) provides a more detailed analysis of ceramics.

**Abeytas**

Pargas Pueblo

Located furthest south, just south of modern-day Socorro, Pargas Pueblo is geographically firmly planted in the Piro tradition. Early investigations of the site revealed it was highly disturbed and disarticulated to the point of having no clear architectural character (Marshall and Walt 1984). These early surveys yielded decorated pottery consisting of Glaze A, B, and C, while later work added Glaze D and E (Adams and Duff 2004).
CHAPTER 4: METHODS
Part 1: Assemblage and Analysis

A total of 166 micaceous utility sherds were analyzed by neutron activation analysis (NAA) at the University of Missouri Research Reactor (MURR). Sherds from Pargas, Chamisal, and Kuapa were provided by the Maxwell Museum of Anthropology at the University of New Mexico. Sherds from Pottery Mound, Hummingbird, and Abeytas were provided by Dr. Suzanne Eckert at the University of Arizona - Tucson. A micaceous utility ware dataset from Tijeras Pueblo (Habicht-Mauche and Eckert 2021) was included at the data analysis stage, leaving a total assemblage of 201 specimens. The procedures for sample preparation and analysis are described in Glascock (1992). A total of 33 elements were measured, while standards include SRM-1633a Fly-ash, SRM-688 Basalt Rock from NIST, SRM-278 Obsidian Rock, and Ohio Red Clay. Copper (Cu) and magnesium (Mg) were removed from the Tijeras dataset to make it compatible with the data analyzed at MURR. Nickel (Ni) was also removed from the MURR dataset because of frequent concentrations below detection limits.

NAA is an appropriate method here for a couple of reasons. First, NAA is not susceptible to matrix effects present in heterogeneous materials like pottery (Glascock 1992). Second, micaceous utility wares are not excessively heterogeneous due to the frequent lack of added temper. It can then be deduced that NAA results closely represent the chemistry found in naturally occurring parent clays. Following the detection and subsequent conversion of gamma ray spectra into elemental concentrations, a combination of bivariate plots and Mahalanobis distance were used to discern compositional groups. A micaceous utility ware dataset from Tijeras Pueblo (Habicht-
Mauche and Eckert 2021) was included at the data analysis stage. Elemental variables and statistical tools merit further elaboration.
Part 2: Statistics

To understand the statistics, how chemical information is pulled and interpreted from measurements should be clarified. The nature of provenance research in archaeology usually follows one of two pathways. In one, artifacts are directly compared to geologic source groups. This is typical for obsidian research because source locations and chemistries on average are more discrete (e.g., Glascock 2002), even though variability has been identified at these discrete sources (e.g., Knight et al. 2017). In the other, groups are defined through chemical similarities between artifact specimens. When applicable, these groups are then compared with raw material samples to match sample groups with loci on the landscape. This approach is necessary when samples could be derived from geographically and geochemically variable parent formations. This is especially common with ceramic research because clays can occupy expansive geographic regions and be derived from multiple geologic processes. Additionally, mixing/altering of clays, added temper, and other behavioral aspects result in compositional changes.

The main statistical goal then is to identify groups of related artifacts. Compositional groups in this research were defined through a series of methods including elemental scatter plots and Mahalanobis distance (MD). Euclidean distance was also used to compare compositional groups to previous NAA elemental data. Visual assessment of elemental plots was the primary tool to distinguish sets of chemically related samples. Visual indicators were cross-checked with verification at a statistical level with MD, which measures the probability that any given point belongs to a distribution (or cluster) in the compositional hyperspace. Euclidean distance assessed any relationships between
compositional groups and other known groups from MURR’s Southwest NAA database. Some groups were found to match Rio Grande White Wares (Socorro and Santa Fe Black on White), but the nature of this connection exceeds the scope of this research.

Compositional groups can only be refined through MD if they meet certain criteria. This reasoning is defined by the statistical requirement that to perform Mahalanobis distance (MD), the group must have 2 more members (sherds) than the number of variables measured (elements). Aluminum, potassium, calcium, manganese, zinc, antimony, strontium, and barium were excluded from the MD calculations because they did not aid in discriminating larger compositional groups. These, along with the exclusion of nickel for low detection purposes, place the number for MD calculation at 25 (23 variables + 2 = minimum group size). However, this is a minimum because group separation is increasingly optimal as the difference between the member size and variables measured increases. The group size limitation has restricted the ability to use MD to further assess some of the smaller compositional groups.
Part 3: Interpretive Scope

This study consists of two levels of categorization: 1) *compositional groups* and 2) *distribution patterns*. The former is defined by bivariate analysis of group membership and Mahalanobis distance (MD) and is determined irrespective of archaeological distributions. The latter is defined by similarities and differences in the *compositional groups* within and between archaeological sites. These are dependent on archaeological phenomena, because it places the members of each compositional group into a cultural space and shows whether *compositional groups* contain members from multiple sites or are isolated to one site. For example, two sites may both have high frequencies of a single compositional group. From here, it may be inferred that these sites share in a *distribution pattern*.

It is important to note that not all artifacts at a single site contribute to the categorization and elucidation of a single distribution pattern, nor are distribution patterns always defined by just one compositional group. Instead, they are defined by considering the frequency of *shared* ceramic groups between sites or *isolated* ceramic groups at a site. Distribution patterns may also be determined in bulk, where the presence of several types of utility wares at any given site outweighs minimally shared types between two or more locations.

The distribution patterns are not meant to be geographic delineations that define from where clay is procured. They do, however, suggest shared technological strategies and, potentially, population/material interactions across loci. Thus, this research does not match ceramic artifacts with natural resources on the landscape. Instead, it identifies
chemical relationships across sites to understand shared procurement strategies and/or movement of micaceous vessels.
CHAPTER 5: RESULTS

Part 1: Compositional Groups

Ten new compositional groups, designated Group 1 through Group 10, were defined in this study. The inclusion of Tijeras was important because it is known for exporting micaceous wares and mica schist (Habicht-Mauche and Burgess 2016). However, the Tijeras group was slightly refined through MD and does not exactly reflect that group originally reported by Habicht-Mauche and Eckert (2021). Thus, a total of 11 groups are identified in this study (Figures 3 and 4). Eight outliers were identified and are not included here.

Figure 3. Identified compositional groups in the study area.
Figure 4. Scatter plot showing separation between Group 2 and the Tijeras Core.

Compositional groups either include micaceous sherds recovered from multiple sites or are local to a particular site, and these define what distribution patterns are recognized. The distribution patterns include Area A, Area B, Area C, Area D, Area E, and Area F. These areas are summarized by archaeological sites and count of members within certain compositional groups (Table 1).
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**Table 1.** Count of compositional groups across different sites.

It is important to note that not all artifacts from a single site contribute to the categorization and elucidation of a single distribution pattern, nor are distribution patterns always defined by just one compositional group. Instead, they are defined by considering the frequency of **shared** compositional groups between sites (e.g., Chamisal, Hummingbird Pueblo, and Pottery Mound) or **isolated** compositional groups at a site (e.g., Pargas). Distribution patterns may also be determined in bulk, where the presence of several compositional groups of utility wares at any given site outweighs shared groups between two or more locations (e.g., Kuapa, Abeytas).
Part 2: Distribution Patterns

Many distribution patterns are local to individual sites, but correlations are still observed between sites in varying degrees (Figure 5). Area A includes Compositional Group 1 and is only found at Pargas Pueblo, with 27 of the 30 sherds from this site comprising that group. Area B includes sherds from Compositional Groups 2, 7, and 8. Groups 2 and 8 are unique to Abeytas Pueblo and reinforce Abeytas as a separate distribution pattern. Group 7 shows limited evidence of Abeytas’ relationships with Chamisal Pueblo and Hummingbird Pueblo. Area C includes Tijeras and is unique to Tijeras, with 32 of the 34 sherds being confidently assigned to this group. Just one sherd from Hummingbird Pueblo and one from Pottery Mound are in the Tijeras compositional group. Area D is defined by the high frequency of Group 10 and is shared between Hummingbird Pueblo, Chamisal, and Pottery Mound. Area E includes Kuapa. Apart from three sherds belonging to Group 10 and one belonging to Group 6, all other sherds and their relevant compositional groups are unique to Kuapa.
**Figure 5.** Frequencies of compositional groups per site with proposed distribution patterns captured in the study area.
Part 3: Unassigned Specimens

All sites have sherds that have not been assigned to compositional groups. There are many potential behavioral or analytical reasons for this. Eight outliers are most likely resulted from analytical error, while the 40 unassigned specimens could be any mix of specimens distinct from compositional groups or marginal members of groups that were removed to statistically refine compositional groups. With the assumption that unassigned wares are a true archaeological signature, they could underly the fact that all sites have some degree of micaceous clay/ware procurement or trade that, unless additional data prove otherwise, are emblematic of instances embedded in the nuances of small-scale household ceramic production and exchange. These might also reflect inconsistencies in production that may or may not be a factor of temporal trends, learning, clay mixing, or undefined micaceous clay sources.
CHAPTER 6: DISCUSSION
Part 1: Assessing the Interplay of Archaeology and Chemistry

Interpreting production from bulk chemical data can be a challenging endeavor. Expansive clay formations have the potential of unpredictable chemical homogeneity and heterogeneity at depth and across space. For example, it is known that geological formations like the Santa Fe Group occupy expansive areas and contain archaeological clays (Denny 1940; Galusha and Blick 1971). Differentiating such clays of archaeological relevance typically relies on petrofacies, a combination of lithic and mineralogical characteristics that may or may not crosscut geological formations (Eckert et al. 2015; Miksa and Heidke 2001; Heidke et al. 2002).

This research takes the stance that artifact compositions within the same chemical group from two different sites do not reflect two independent signatures. Rather, they are real and behavioral. This is not without merit, because potters are found to be very particular about the clays they select (Eiselt and Ford 2007). Moreover, similar compositions can reflect procurement from extremely particular natural environments, tying together the significant blend of natural and cultural landscapes. So, a study of distribution is vital for 1) unveiling similarities and differences between sites and 2) using those patterns to infer potential exchange relationships and manufacturing strategies. The potential for micaceous wares to exhibit familial ties and other connections between households (Cowell and Jenks 2021; Duff 2002; Larson 2013) means their distribution is likely much more spatially complex than settlement-to-settlement relationships.
Part 2: Micaceous Ware Distribution Patterns

Although five separate micaceous ware distributions are defined based on compositional groups and their makeup of archaeological proveniences, the type of distribution encountered at the site-level falls into three broad categories. First, the micaceous wares people utilized are compositionally like those found at other sites in the study area. Chamisal, Pottery Mound, and Hummingbird Pueblo reflect this situation with noteworthy frequencies of sherds in Group 10. Second, the wares people utilized reveal traces of compositional affinities with wares from other sites in the study area, but they ultimately seem to be looking elsewhere. Kuapa, Abeytas, and Tijeras, though there are some compositional similarities with sites in the Rio Puerco and Albuquerque regions, have higher frequencies of nonrelated compositional groups. Third, the micaceous wares people utilized are not reflected elsewhere in the study area given no overlap in either compositional groups or distribution patterns. The Pargas ceramics represent this type of distribution.

Distribution Pattern D

Evidence of micaceous utility exchange between the Rio Puerco and the Albuquerque region is not novel. Eckert (2008) notes that the presence of micaceous utility wares in the Rio Puerco is evidence of exchange with Rio Grande populations. Franklin and Schleher (2012) further explored this connection by comparing Montaño Bridge Pueblo, located near the modern city of Albuquerque in the Tiguex Province, and Pottery Mound. However, they identified opposite imported utility ware signatures. Montaño Bridge Pueblo obtained utility wares from the Galisteo, Tonque, and Sandia-Manzanos regions, while Pottery Mound made most of their own utility wares. Many micaceous wares from
both sites are made with local clays but imported finished wares and/or mica is possible at both, and remarkably frequent at Montaño Bridge Pueblo (Franklin and Schleher 2012).

Fast-forwarding to more site-level studies in the Tiguex region, extraordinary variability in micaceous ware utilization is recognized. At Alameda Pueblo, Montaño Bridge Pueblo, and Chamisal, 55%, 20% and 42% of utility wares are micaceous, respectively, while just 3% of utility wares are micaceous at Piedras Marcadas (Franklin 2017). Located around just 8 kilometers apart at most, dramatic differences in frequency are recognized. This suggests that the exchange of utility micaceous wares between the Rio Puerco and Albuquerque area may change from site-to-site.

*Distribution Pattern C, B, and E*

Tijeras Pueblo, Kuapa, and Abeytas all have evidence of occasional interaction with settlements along the Rio Puerco and at Chamisal. Tijeras Pueblo shows a predominantly local micaceous signature with only two compositional matches along the Rio Puerco. This may be an issue of sample size since it is well known that Tijeras exported mica temper and finished vessels throughout the Rio Grande (Habicht-Mauche and Burgess 2016). As a coalesced community, familial ties were spatially extensive because ceramics indicate migrations from the Mariana Mesa district of west-central New Mexico, the Upper Little Colorado region of east-central Arizona, and the Albuquerque region (Habicht-Mauche and Eckert 2021). As seemingly a gateway between the Western Pueblo world and Rio Grande communities, the Rio Puerco may have served as an
important threshold for migrating peoples and may account for the exchange of finished micaceous wares, and certainly mica for tempering, from Tijeras.

Kuapa’s compositional groups reflect a heterogeneity that could reflect similar behaviors noted in previous research. Habicht-Mauche (2000) notes a heterogeneous lead isotopic signature as evidence of exchange, as well as direct procurement from the Cerrillos Hills. Glaze ware studies have also shown that their exchange at Kuapa was more ad hoc (Nelson and Habicht-Mauche 2006). The data presented here for Kuapa identifies a third of the assemblage as unassigned, five distinct compositional groups, and three of those groups as unique. It is by far the most compositionally variable site in the study. Evidence exists for minor connections between there and Chamisal and perhaps the Rio Puerco, but micaceous exchange/procurement schemes emphasized more locally or to the north could account for the variability observed.

At Abeytas, Group 7 is also found at Hummingbird Pueblo and Chamisal. This corresponds with the vectorial relationship proposed at Abeytas for imported glaze wares that mostly come from the Galisteo, Albuquerque, and Rio Puerco areas, while glazes from other sites in the Rio Abajo cluster are less frequent (Eckert and Snow 2015). This characterization of glaze trade and manufacture sets it apart from other sites in the Rio Abajo that conventionally belong to the Piro Pueblos and has been one variable in a still heavily debated Piro or non-Piro debate for Abeytas (Giomi 2014; Lekson et al. 2004). The micaceous wares may appear to follow the trend of affiliations with the north more than the south, but more comparisons with sites local to Abeytas and to the south would need to be made.
The unique micaceous utility ware signature at Pargas may be a factor of its geology since it is distant from the rest of the study area. Significantly, residents there are not doing the same things those at Abeytas are doing. Excavations of Pargas describe it as a “typical Piro assemblage” with mostly locally produced glazes, some technological and stylistic affinities with Western Pueblos, matching temper groups found at other Piro sites, and utility ware correlations with the Tigua province to the south (Marshall 1986:34). So, it may not be so surprising that the micaceous ware data are unique to those compared to the north; indicating that residual micaceous clays or mica temper may be procured more locally as well. Those areas of procurement may reside fairly close either to the east or west due to uplifted regions forming a narrower corridor-like topography. From those uplifts, temper sources may be located at higher elevations or micaceous clays may be formed at their base. To the west there are small outcrops of the Vadito Group consisting of Paleoproterozoic metasedimentary rock, rhyolitic lavas, and tuffs; to the east formations consist of granitic plutons, sedimentary units like sandstone and shale, and Lower middle Tertiary felsic volcanics from the Datil Group (Horton et al. 2017).
CHAPTER 7: CONCLUSION

The bulk analysis of micaceous sherds from six aggregated Pueblo settlements between Santa Fe and Socorro is the starting point of micaceous utility ware research that may begin to stitch together relationships in their manufacture and exchange across a broad area. Ceramic compositional groups define similarities and dissimilarities between sites. Distribution patterns integrate those compositional relationships to generate ties of a geological, technological, and/or population nature. Some primary conclusions are as follows.

1. Distribution Pattern D, as defined by the preponderance of Group 10 at Hummingbird Pueblo and Pottery Mound and its ubiquity at Chamisal, identifies shared micaceous utility pastes between the Rio Puerco and the Central Rio Grande. Eckert (2008) observed links between the Rio Puerco and central Rio Grande populations in terms of Rio Puerco utility wares, but this research potentially narrows that observation to Chamisal. Future work should examine micaceous relationships between the Rio Puerco and the Central Rio Grande, especially in the Tiguex region where Chamisal and many other sites with varying frequencies of micaceous wares are located.

2. Manufacturing/procurement strategies at Kuapa and Abeytas are primarily focused elsewhere. Future work should focus on ascertaining relationships between these sites and others not covered in this study, especially those more
local such as the Cochiti District for Kuapa. One exception is Group 7 at Abeytas that includes sherds from Chamisal and Hummingbird Pueblo, which may assist in affirming whether Abeytas is Piro or non-Piro, or whether that distinction is even necessary.

3. While Tijeras Pueblo and the adjacent Sandia and Manzanos Mountains have been emphasized as an import source of mica, and they surely were, this sample shows no matches with pastes from Tijeras except for two in the Rio Puerco. With the description of Distribution Pattern 4, their occurrence in Rio Puerco assemblages may be part of a down-the-line exchange process.

4. Residents at Pargas Pueblo clearly dealt with micaceous wares differently. This study affirms Pargas as a Piro site with little to no micaceous similarities with Pueblos to the north included in this study. Moreover, a single compositional group at the site appeals to a consistent procurement strategy that may be more locally oriented.

For well over a century, archaeologists and ceramicists alike have known of micaceous utility wares and studied them. But only relatively recently have the nuances of their manufacture begun to be elucidated. Researchers have thus far shown that the movement of the mica temper and finished wares was common, and that micaceous clays are chemically distinguishable. This research is an expansion of that endeavor, and from it many anthropologically relevant ideas manifest.
First, as more data are gathered researchers may be better able to distinguish between the movement of finished vessels with materials and/or the movement of ingredients (i.e., mica), giving archaeologists a better material meaning of what connected households means. This has direct implications for communities of practice, the ethnic, linguistic, and cultural boundaries we have drawn, and the technological/geopolitical process of manufacture.

Second, utility micaceous wares can help evaluate scales and frequencies of interaction. The reconciliation of stagnant data with movement on the landscape is a major obstacle for archaeological interpretations. As items meant for trade and daily utilization, we may find that they were less episodic and more continuous in their circulation than glaze wares.

Third, utility micaceous wares add another element for studying the nature of connections between communities. If we accept these utility wares as familial and indicating close relationships, what does it mean if glaze ware exchange is oriented towards other sites in the same way or somewhere else entirely? It need not be so dichotomous or deterministic, but we may find that strategies/reasons for these nuances exist outside the realm of material access and technological choice.
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This article describes the local exploration of sedimentology along the Rio Grande River, and its utility is mainly for historical recognition. Understanding the geology and natural formation processes in the Rio Grande has a long history. This article must be taken with a grain of salt, because naturally as a rift, uplift is variable and so sediment depths and characteristics may not be as reliable as a geologically timid region such as the Burlington Formation in the Midwest, which spans as a reliable depth with consistent texture over a vast area. However, this article does elaborate on a local depiction of sedimentology called the Webb Bluff section. This section is Eocene in date and consists of, from more to less deep, a micaceous sandstone, greensand marls with glauconite, fossils, and carbonate, and a greenish to blue clay. This Eocene-dated strata may be the products of clays that were utilized by Rio Grande populations.

Keller, G. R., and W. Scott Baldridge

This article emphasizes the geological and geophysical knowledge of the Rio Grande Rift Valley as of 1999. The article has two main aims: to elaborate on the structure and evolution of the rift, and to explore current questions about its evolution. The core utility of this article is to help provide a general geological background for the Rio Grande Rift Valley. In this sense, the article unveils the following. The Northern and Southern rift areas are geologically different. The north is a much more distinguishable
single rift valley that divides the Great Basin from the Plains, while the south is nearly indistinguishable from the adjacent Basin and Range province—yet can be delineated with the addition volcanic features. However, the most distinguishing feature of the Rio Grande Rift is its Basins, with highly exposed sediments and subsequent erosion as a product of uplift. Most importantly, this article asserts that the most recent erosion of Eocene dated sediments represent a topographic datum, so describing the geological parent formations of sediments (i.e., clays) in this region are feasible.
Part 2: General Background and Theory

Nelson, Margaret C., and Gregson Schachner

Understanding the Rio Grande during time periods corresponding to micaceous wares and glaze ware sites must integrate knowledge of migrations and ultimate population growth, because these population dynamics have implications on ceramic production. Generally, the resolution of our data best fits regional explanations for migrations, but this does not mean they did not happen for distinct reasons at different scales. What might be climate at the regional level, may in fact be conflict at the local, and food insecurity at the familial. Moreover, the size of the populations moving matters. In most cases, it tends to be families moving or parts of families fissioning, and rarely entire communities. For the Rio Grande, however, studies indicate migration sizes from families to many hundreds. Just as their reasons for movement may be reflective of their group sizes, their integration is also dependent upon preexisting local relationships, local population dynamics, local resources, etc. This latter point is where I find this particularly useful for the background of my research. I suspect that variable group sizes were not just a reflection of variable push/pull factors, but also of the multitude of reasons to settle in the Rio Grande. Niches might have been open for large groups, or large groups may have had the capacity to take in large numbers, or small groups had the space on a landscape, or many small populations could take in small numbers themselves. The possibilities are numerous, but this most importantly emphasizes a cultural landscape of possibilities that led to village aggregation, periods of ceramic heterogeneity, and even more widespread ceramic exchange than what had been identified prior to migrations.
This paper examines tree ring dates and uses counts by cultural region as a proxy for trends in construction activity for those regions overall. For my research, I am primarily concerned with trends in the San Juan, Hopi, Cibola-Acoma-Laguna, and Rio Grande regions. Time here is broken down into wet periods (W1 and W2) and dry periods (D1 and D2) between 600 and 1600 CE. The wet and dry periods, while different times are captured by region, they roughly date to the following: W1 dates to roughly 1040-1130 CE, W2 dates to to 1190-1270 CE, D1 to 1130-1190 CE, and D2 to 1270-1300 CE.

The relationship between the Northern San Juan and Central San Juan is intriguing. During the W1 and D1 periods, construction accelerated and then decreased sharply, respectively, for the Northern San Juan. This same pattern followed for W2 and D2. While timber harvesting never ceased during D1 for the Northern San Juan, it did for the Central San Juan. During the W1 period, construction is higher in the North and relatively lower in the south, but this pattern flips entirely during W2. The wane of Chaco during D1 could have implications for these regions. For the Cibola-Acoma-Laguna region there was some harvesting during wet periods, a little during the first drought, and essentially none during the second drought. Extensive timber harvesting resumed after D2 drought (1310-1370 CE). In the Hopi region, most harvesting was in W2 with little during W1, and a sharp increase at the end of W2 (~1250 CE). Construction declined sharply until reemerging around 1360 CE. Little timber exists in this area, so recycled
wood could be an issue. For the Rio Grande, there is little timber activity for W1 and D1. During W2, there was a large amount of construction, and little in D2. After 1380 and 1520 CE, timber harvesting increased dramatically as a result of either a flowering local population or migrants introducing themselves to the area.

For my research, I will largely use these trends to understand general population activities across multiple regions. This study is interesting because it represents ecological motives for the movement of populations. While this certainly is not the only means in which to account for migration, it is useful to describe and assess environmental dynamics coupled with proxied construction data across multiple areas. This study emphasizes the role of moving groups in Southwest prehistory.


This chapter provides a general background of the Pueblo IV period and sets the stage for settlement patterns as a unit of analysis in the Pueblo world. For my purposes, this chapter is primarily useful for describing widespread population and ceramic developments during Pueblo IV, and to see how those have changed over time. This book establishes an interesting perspective that is the antithesis to many chapters in the Social Life of Pots, in that analyses beyond the site at a regional level should be utilized to put a site in better context; many chapters on glaze wares emphasize site-level analyses that disprove regional models. I find this difference important and that components of both are certainly vital for interpreting exchange.

It is my interpretation that early evaluations of the Pueblo world are based in part on World Systems Theory, and for populations during Pueblo IV there is very much a
similar flavor. Researchers were comfortable with the findings of Pueblo II and the dominant political/religious centers of Chaco and Hohokam, and so evaluated other archaeology in a way that made it seem the people of Pueblo IV would seek similar organization. Bandelier (1892) was one of the first to note settlement clusters in the Pueblo IV world, then future work looked at regional contextualization and proposed political integration of those aggregated settlements. This historical development is important and a component of interpreting the history of archaeology in the Rio Grande.

Mills, Barbara J., and Patricia L. Crown (editors)

This chapter summarizes craft production and introduces many useful concepts to apply craft production to ceramics in the archaeological record. This chapter is to establish a general basis from which I may understand the site and between-site characteristics of ceramic production and exchange. Mills and Crown define craft production, summarize models, note how to identify craft production in the archaeological record, and how compositional analyses play a role in doing so. I found the following information of note. 1) Previously unknown to me, no ceramic workshops have been found in the Southwest. Instead, residential spaces were the primary zone to produce ceramics. But this does not mean designated areas did not exist. For example, production tools and clay were found on the floor of a room at Madera Quemada in southeast New Mexico, and many tools associated with ceramic production have been found at the site level just outside residential spaces. However, archaeologists’ interpretations are usually limited because those same areas were often cleaned. 2) Arguments for craft specialization are often made when the pottery is compositionally
homogenous and has widespread distribution. Minor exchange usually does not mean specialist production, but large-scale exchange can. 3) Inter/intra-site frequencies of local and nonlocal ceramics could unveil variables of production and/or exchange between two or more sites. 4) Though concentration of potters widely varies throughout the American Southwest (estimated population and the pottery uncovered), and Chuskan pottery in the Chacoan area have been shown to produce as much as 50% of the ceramics at all Chacoan sites, some Rio Grande villages may have had even higher concentrations of production.


The bulk of this review is focused on Ancestral Pueblo pottery production and how this process was taught to and learned by amateurs. Learning is not foundational to my research, but the summary of its implication in the Pueblo world is. Pottery was learned from an early age from skilled crafters and was an ever-growing socially integrated process as life went on. The means and modes of its manufacture were sometimes malleable, though innovations have been denied, but were otherwise often established because of a combination of geographic circumstances, social worlds, and symbology. It played a role in the formulation of identity, and people understandably did not want this to change abruptly. However, change could happen abruptly because of multiple factors, including migration.

Enter the Rio Grande, a hotbed for migrating populations. Cynthia Herhahn (2006) studied glaze paint recipes from east-central Arizona, west-central New Mexico, and the Rio Grande valley, concluding that transmission in these recipes occurred from
west to east. An idea that matches similarities between early Glaze Wares at Arroyo Hondo and Heshotauthla Glaze Wares. Rather than migration, these were the result of transmission through some interaction, but not direct learning from populations moving into the region. In the Rio Grande at this time, colorants were adopted with little resistance, suggesting direct transmission and fluid interaction of potters within the region, but not between. Additionally, in east-central Arizona, technological differences were abundant in settlements close to one another, while decorative styles were more homogenous. This may be evidence of different ethnic groups maintaining distance, but the copying of decorations with little to no contact (Zedeño 1994).

The Rio Grande social world seems to have encountered recipe transmission from the west and migrating populations from the north, although this is of course not so dichotomous and directional. But these describe the general relationships and opened the study of communities of practice and identity in the Rio Grande Valley. Pottery groups and pottery production were undergoing change. Rapid adaptation is emblematic of the flexible learning of pottery production at an early age. While glaze wares may have been somewhat standardized for ritual purposes, allowing little flexibility in production once a recipe has been established, others such as micaceous utility wares may have been more versatile in their production.


This is over a 400-page book, so fragments have been selected relevant to my research. The following selections include clays, origin and occurrence, and physical properties (pp. 6-12), types of tempering material (pp. 26), glazes (pp. 44-48), and the
interpretation of ceramic data (pp. 331-360). The history, lessons, facts, and overall information throughout these sections are seemingly innumerable. In general, these chapters are meant to provide me with the knowledge to discuss (especially in regard to micaceous wares when applicable): 1) clay formation processes, 2) impact of clay compositions on pottery, 3) glazes and their properties, and 4) the possible interpretations of ceramics in the archaeological record.

Clay is a geologically complex material determined compositionally by its parent rock. Clay used to be thought of as a substance in of itself, consisting of differing purities of kaolinite. But clay consists of small crystalline structures, consisting of various materials from other rocks. The clays utilized by Rio Grande populations were mostly residual clays, consisting of some minerals of the parent rock and weathered under normal temperatures, residing at the surface or shallow depths. Thus, these clays are accessible, but vary in quality.

The matching of clay and temper has structural implications for the final vessel. Sand tends to be weakest, especially with rounded grains, rock and ash give intermediate strength, and sherds are the strongest. Mica is a sheet mineral and, as a temper and a constituent in clay, causes alignment in one direction when fired at lower temperatures, but weakness when force is applied parallel to the alignment. Pastes that contain mica are often referred to as mica tempered. This term is misleading because it implies crafters added mica, but residual clays can contain high percentages of mica and quartz. Thus, those residual clays do not require a temper.

Glazes were appealing to crafters because different firing temperatures and atmospheres yielded different colors from the same glaze recipe. These aesthetics may play some part in the extensive experimentation that took place in the Rio Grande Valley.
A glaze is essentially a glass that forms when a liquid changes to a solid state, but when it forms fast enough for the atoms to not structure themselves regularly (i.e. glass). Crafters may calculate mixtures to make up the random atomic structure of the glaze. In the American Southwest, glaze paints with a lead-oxide flux were the predominant type, until populations in the Rio Puerco began to work with a vitreous paint high in copper content. Pottery with this vitreous paint appeared just prior to developments of glaze paints in the Rio Grande Valley. Moreover, pottery high in copper content is found to the west in Arizona, thus leading to the interpretation that glaze recipes could be emulated from western traditions. However, accidental vitrification can occur on black and white ware that was common in the Rio Grande region.

The last section on interpretation was effective at reminding the bounds and limits of my data, as well as not over-sell my interpretations that follow, because this is a common criticism with using one cultural medium to describe a dynamic system. Table 11 was helpful here in breaking down the identification of pottery from a foreign source at a site. Furthermore, this section clarified the economics of the movement of pottery and mentions the necessary focus on utilitarian wares to properly understand craft economies.


This article reviews craft economies in the Puebloan Southwest: characteristics, current research and theoretical perspectives, and future work. My research will, in part, adopt the theoretical framework for craft economies. To speak on the topic of theory, craft economic frameworks have in general witnessed an increasing emphasis on human
agency, rather than ecology, as a determinant of economy. Additionally, Southwestern sites were previously viewed as entirely autonomous, but shifts in recent decades view them as non-autonomous. Groups are interconnected on the landscape in more ways than they are not. Questions then arose about whether a single artifact across multiple sites can truly capture a craft economy. I say: of course not, but an economy is not always an integrated whole. The benefit of examining a single good across sites is this: it can “…identify the specific institutions that mediated and sometimes integrated the economies of diverse human populations” (pp. 262). These are the Rio Grande populations during migrations, and the ceramic productions of those realities.

This article is also useful because it summarizes craft economies across the Southwest during the Middle Formative (600 - 1150 CE) and Late Formative (1150 - 1450) that are relevant for a study of the Rio Grande. In other words, I am aiming to understand the craft economies of populations before migration and aggregation along the Rio Grande. The Middle Formative is the time of great cultural establishments, such as Chaco and Hohokam, that had extensive trade networks and means of procuring and producing crafts. In the Mesa Verde region, household specialization of ceramics began around 575-725 CE. It was reorganized in the 12th and 13th centuries with trench kilns that increased production. One of these products was San Juan Red Ware, but it did not appear to be traded extensively because they are geographically concentrated. At Chaco, craft specialization appears to be common, and the economic system is hierarchical. Kayenta appears to have little to no craft specialization.

In the Late Formative, the question remains if craft economies of intensive production were a function of population aggregation, and how differing ethnic groups and economies became integrated. This is relevant to the Rio Grande as a whole.
Increased production was seen earlier in the Mesa Verde region in the form of kilns and appears in other regions afterwards (post Pueblo III). Along with intensity perhaps came standardization. Glaze ware design elements in the Rio Grande were standardized, moving from household to village-level industries. But was this a function of experimentation with new technology or increased production? Maybe the latter can be substantiated, since utilitarian ceramics were produced at a large scale in association with the implementation of kilns in the Northern Rio Grande.


This book chapter links Practice Theory and the Anthropology of Technology and the study of Glaze Wares in the Prehispanic Southwest. Practice theory focuses on the actions and outcomes of participants, rather than cultural institutions that might be postulated as catalysts of studied outcomes. In other words, people make their culture out of a series of feedback loops, rather than culture making the people. In the Southwest, one way this framework is used is to investigate the link between technological characteristics and changes in organization. My purpose for reading this chapter is to understand technological developments of glaze wares, as well as how theory fits into deciphering those changes.

I am primarily interested in Practice Theory as a framework for communities of practice. Ceramics are an additive technology that reflects multiple technical choices. The system of manufacture and any component of it may be shared amongst a group of people, forming a community of practice. The scale of these defined communities can be
variable, from a few proximal households or a small village (local system), to widespread sharing of multiple local systems (macrosystem). Both have been found in the Rio Grande involving the manufacture and exchange of finished products and raw materials. However, Glaze Wares are not isolated in the Rio Grande. The history and interregional development of this technology are vital to the establishment of large towns and migrations within and to the Rio Grande Valley.

Glaze Ware technology was used as early as the 8th and 9th centuries in the Four-Corners region with Black-on-white wares, reached potters in west Mexico as early as the 10th century CE, and is seen across much of Southwest after 1250 CE. This technology eventually spread to regions of the Little Colorado River, Zuni, and Acoma, and eventually throughout the Rio Grande Valley and into the southern Rio Grande. Glaze Ware technology changed during the movement of peoples and ideas. In the middle and northern Rio Grande, black paint shifted from mineral to carbon-based during the 12th to 14th centuries. Additionally, a shift from low lead and high copper to the inverse for glazes during the same timeframe. Decorative elements and firing procedures also drastically changed during the PIV period, peaking in popularity based on diverse designs from 1424 to 1450 CE. Migrations were important, and technological innovations are key, but they in of themselves are not organizational changes. An accumulation of these factors is important to the study of Glaze Wares.

Costin, Cathy L.

My research on micaceous wares is not a study of craft production, because the scope of my research cannot justify the analysis of an entire production system. To
summarize Costin, production systems are complex and integrated, and cannot be defined through the analysis of a single component (i.e., pottery). However, I do see utility in an additive approach that utilizes components of the craft production framework to better understand the social implications of a single class of material. The integration into a larger production system can be accomplished later, and more effectively, if the study is already shaped by the kinds of questions and perspectives formulated in craft production theory.

The general goal of craft production theory is to explain technological choice, why production is organized the way it is, and the interrelationship of these two factors. This is a common theme among Glaze Ware studies that utilize Practice Theory and the Anthropology of Technology to merge technology and the social world. This chapter provides the nuances of how that relationship manifests, which is why it will be especially useful and dictate many of the interpretations I pose regarding the chemical characterization of the Micaceous Wares.


This chapter offers a refreshing overview of the information detailed in this volume, connects it with theory, and establishes future directions of researching regarding ceramic technologists, archaeologists, anthropologists, etc. I am primarily using this chapter as a historical reference to Glaze Ware research, its theoretical foundations, what kind of work has been carried out, and what work remains.
Although there are other convoluted problems to assess with glaze wares (e.g. glaze wares and relationships between the Rio Grande and Western Pueblos like Zuni), what got my attention in this chapter was questions about how Pueblos were organized beyond the village level. Coupled with this problem is understanding distribution and what both catalyzed and sustained it. What I hope my micaceous wares could elucidate at glaze ware sites is how utility wares compare to glazes in terms of their procurement and potential exchange patterns. Micaceous wares may also offer a glimpse into another component of household production. At the bare minimum, I would want to carry out what Leonard did in her interpretations—evaluate the distributions of pottery—but save the mechanisms of movement for future research because they could not be clarified at the time.


This chapter puts practice theory, situated learning theory, and notions of pottery production in perspective in order to explain communities of practice, communities of identity, communities of ideology, constellations of practice, etc. While many papers in this volume seem to be concerned with pottery production, I want to focus on distribution. To do so, I plan to utilize relevant theoretical orientations in craft production that describe distribution and combine these with more socially integrated considerations like practice theory. Comparing, contrasting, and integrating these different frameworks constructs a useful lens for examining patterns like chemical heterogeneity/homogeneity, artifact frequencies, and source locations, and how these connect to or manifest within
social circumstances. Moreover, if I want to improve the context of micaceous wares by describing them at Glaze Ware sites, my theoretical considerations that describe certain patterns should match across these artifact types. In other words, the distribution of micaceous wares may be best elucidated by comparing them with distribution of glaze wares (e.g., local production, exchange, etc).

Glascock, Michael D.

This article explains the procedures of Neutron Activation Analysis (NAA) and the multivariate statistics available for the analysis of ceramic chemical data. Since I am using NAA as the method for data collection, and GAUSS, bivariate statistics, and Mahalanobis distance for the data analysis, I will summarize and explain all these and exclude other nonrelevant information from this article. Mike Glascock and April Oga will be included in the acknowledgments for their part in transforming the data from gamma ray spectra to functioning data in GAUSS.

NAA works by bombarding the atoms in a sample with neutrons. This turns those atoms into unstable radioactive isotopes, ushering in the gradual decay to a stable state. Decay is measured by half lives, and those atoms emit gamma rays along the way that are detectable and unique for specific elements of which that atom belongs. Advantages of NAA are that it's highly precise and accurate, handles large sample sizes, avoids matrix effects, and measures between 30 and 35 elements.
The procedures for sample preparation and data-acquisition are discussed in-depth in this article. However, some details have changed and have been adjusted based on the 2021 lab procedure. First, an approximately 2cm² piece is clipped off the original sample. Second, a drill burr is used to remove contamination, such as external slips or surface leaching and then brushed clean and washed with deionized water. Third, and after drying, each individual sample is crushed to a talcum-like powder texture with an agate mortar and pestle. Fourth, the powder is dried in an oven and weighed in two different batches of 100 mg and 200 mg.

The following explains the nature of irradiating the sample. To obtain the short counts, the 100 mg samples are irradiated for 5 seconds, allowed a decay time of 25 minutes, and counted for 12 minutes to detect emitted gamma ray spectra for Al, Ba, Ca, Dy, K, Mn, Na, Ti, and V. The 200 mg samples are placed in a metal cylindrical bundle, along with standards. They are then irradiated for 24 hours, allowed to decay for 7 days, and then counted for 2,000 seconds. This yields the middle count and the elements of As, La, Lu, Nd, Sm, U, and Yb. The samples are let rest and after 3 to 4 weeks are measured again for 10,000 seconds, yielding the long count and the elements Ce, Co, Cr, Cs, Eu, Fe, Hf, Ni, Rb, Sb, Sc, Sr, Ta, Tb, Th, Zn, and Zr. The reliability of the data is dependent on ratioing the concentrations of unknown elements to the known values of standards. At MURR the standards used are SRM-1633a Flyash, SRM-688 Basalt Rock from NIST, SRM-278 Obsidian Rock, and Ohio Red Clay.

The goals for data analysis of ceramics are to 1) identify clearly differentiated groups, or 2) assign unknown specimens to known groups. Compositional variance, normality, and element correlations are important to mention as statistical variables that guide further data analysis. The compositional variance of any given element is the
spread of lowest and highest measured concentrations. Upon increase, it becomes exceedingly difficult to use that element to assign an associated sample to a particular compositional group. For normality, element variation is more normal under a lognormal distribution, and so the values are converted to logarithms. Transferring to logarithms also adjusts for the major magnitude difference between major elements and trace elements. Element correlations are well known in the literature. These correlations merit bivariate analyses.

The methods of data analysis are multiple, but the techniques I will use include bivariate analysis and Mahalanobis Distance. The point of the former is to search for correlations in the compositional hyperspace that partition groups because of differentiated concentrations of that combination of elements in certain sample subgroups. Mahalanobis Distance is the Euclidean distance squared, divided by the group variance in the direction of the specimen. This technique calculates the probability that a sample belongs to a group by incorporating both proximity to the group and a calculation of how the density of the group decreases away from the centroid and towards the sample in question.
Part 3: Rio Grande Archaeology

Habicht-Mauche, Judith A.

This chapter examines pottery at the site of Arroyo Hondo in the Santa Fe region of the Northern Rio Grande leading up to and during the Classic Period (1300-1450 CE). This paper is useful for two reasons: 1) it extrapolates on other cultural and population dynamics from ceramic data, and 2) it leads into and includes the development of glaze wares. The combination of these two points unveils the current interpretation of Arroyo Hondo and the Santa Fe region as follows.

The 13th century northern Rio Grande mostly consisted of dispersed communities with access to quite different resources. So, direct access trade and relationships predominated, leading to the widespread distribution of Santa Fe Black-on-white. At the turn of the 14th century, local variations of Santa Fe began to appear. The reasons for this are not entirely clear but could be due to deterioration of preexisting open-access relationships or the influx of immigrants from the San Juan region, or both. Also at this time, settlement patterns changed to aggregated communities because of regional population growth. While this may have encouraged interaction between communities, it also led to territory and resource conflict, compounding community aggregation as a measure of safety. Within these amplified aggregations, new communities and ethnic alliances formed, and thus new pottery traditions. One of these new pottery styles was Glaze A Red, a popular type in the northern Rio Grande that likely originated out of the Albuquerque district, which rose out of a brief period of experimentation and eventually
standardization by around 1350 CE. Glaze wares require access to lead and seem to indicate the transition from household production to household industry and production for trade (commodification). However, old Black-on-white types continued to be produced for local consumption.

Additional information I would like to include, aside from the microcosm of Arroyo Hondo consists of the following. Early glaze wares at Arroyo Hondo are early transitional and show affinities to western glazes like Heshotauthla Polychrome in the Acoma-Laguna area. Additionally, two major sources of glaze-painted ceramics have been identified as of this chapter. 1) The Galisteo Basin with intermediate volcanic rock temper (e.g. diorite, andesite, dacite). 2) Santa Ana Mesa with fine-grained basalt temper or tempered with basalt-tempered ceramics. Additionally, temper for half the Santa-Fe Black-on-white includes volcanic ash from Tesuque Formation of the Española Basin. Some of my samples seemed ashy with mica inclusions, though I cannot confirm at this point if it is volcanic ash. But this would be an interesting thing to examine later during this project. XRF and petrographic analysis of Glaze A Red identified Albuquerque, Santo Domingo, and Galisteo as major production areas for early types. Homogeneity in their signatures may indicate standardization. Procurement of types from more distant areas in later contexts, while closer ones in earlier contexts, may indicate a broadened ceramic trade through time.

This chapter offers a finer scale, migration-based, linguistic-delineated, perspective on settlement patterns in the northern Rio Grande leading up to and including the Pueblo IV period. Although they are primarily addressing regional patterns, a more detailed analysis other than “migrations occurred” is vital for understanding Rio Grande archaeology. Moreover, while the theme of this book is regions, Fowles does provide useful information as to why populations may aggregate and how intragroup and site-level analysis is helpful.

Tewa and Tiwa seemed to take shape during the Coalition period (1200 - 1325 CE), which is very much a time of immense change for the northern Rio Grande resulting from increases in population density. The Tiwa came to reside on the northern portions of the Taos Plateau, while Tewa came to occupy the Chama region, Espanola Basin, Pajarito Plateau, and much of the area around Santa Fe. The differences between Tewa and Tiwa are multiple and will not be mentioned here. In general, both aggregated but appear to have done so for distinct reasons. Tewa sites have more evidence of violence, and so aggregation may not be as ritually motivated as others have postulated, especially since little religious evidence has been uncovered. Inter-site organization amongst the Tewa seemed limited until evidence of local Rio Grande ceramic wares started appearing around 1300, followed by further construction and population increases. Biscuit wares and 3 distinct sociopolitical settlement clusters became important in the following century, with the former being a hypothesis for the earliest forms of ceramic associations with identity.

For the Tiwa, population was lower, and aggregation did not occur as quickly or compactly on the landscape. The means for aggregation seem much more identity driven than their Tewa counterparts. Little evidence of violence exists for the Tiwa, and they
produced mineral-based black on white vessels much later than the rest of the northern Rio Grande. Additionally, they did not participate in the Katsina religion, and there is a lack of ceremonial structures (e.g., kivas). These combined factors have made the argument that Tiwa very much sought a preservation of their own cultural identity, and modifications to that identity on their own terms.

The distinction between these two groups is their reason for aggregation. The reasons for aggregation are multiple but seem to be separated in this chapter by a combination of identity, space on the landscape, and levels of violence. I do agree with the point made by the author that spatial proximity cannot be equated to collaboration. In the case of the Tewa, this might be emblematic. Instead, the author posits: “Rather than viewing the clusters as the product of people banding together to defend themselves, we can envision cluster formation as a result of internal efforts toward fission and separation that were stymied by the reality that there was very little room left in which to separate.” This leads to an elaboration of intragroup tensions and how they may be dealt with amongst Pueblo sites. Pottery may have had a crucial role.

Part of being able to talk about the procurement and exchange of a particular resource or finished good involves understanding settlement patterns. While I do not agree with some of the regional settlement pattern postulations that are reflective of World Systems Theory, I do see the utility in understanding at least how some aggregated communities manifest from a combination of local demographic growth and the influx of migrants. This chapter delves into 1) rhetorical and theoretical issues and 2) how site patterns can be manifested.

There are two big takeaways for me in terms of theoretical issues. One is how to define a site on the grounds of its occupation and utility. Pueblo groups are highly mobile and have been known to move from one site to the next at different intervals and scales. Moreover, if they move then this merits some advantage/disadvantage or utility for certain sites, or alternatively some purpose for the social group. I would never postulate that the Glaze Ware sites I am including involved population movements between one or the other, but mobility, especially prior to the peak of settlement aggregation, is worth considering for the formation and maintenance of communities on a landscape in which people are moving just as frequently as materials. A second takeaway is issues with the settlement cluster as a unit of analysis, because different cluster resolutions will yield different relationships. Most settlement clusters have only been interpreted at the regional scale, and this is problematic.

This paper elaborates on three interesting settlement patterns that are being argued as resulting from 1) the distribution of natural resources, 2) settlement histories, and 3) sociopolitical phenomena. None of the settlement clusters in these examples pertain to my study, but the variability in how aggregation happens (or is interpreted) is useful to know, nonetheless. Additionally, organization at the group level may fundamentally
impact organization at the household level, the medium for which most glaze ware sites seem to be operating. There is much information to explore about these examples, but worth noting here is that glaze wares are present at many of the early components of the larger sites, and prevalent throughout the growth of these aggregated communities.


This chapter offers a plethora of information regarding districts relevant to the sites in my study on micaceous wares. I have two sites that reside in the Lower Rio Puerco district, one site in the Albuquerque district, and one site in the Cochiti district. At its core, the point of this chapter is to examine settlement trends, subsistence, migration, and regional interaction within each of these districts during Pueblo IV. I have recorded more precise information about each district in notes, but general ideas are as follows.

Settlement aggregation into clusters largely reached its zenith in the 1300s, resulting from aggregation of preexisting dispersed roomblock communities from the 1200s. During the 1400s, aggregation into fewer pueblos, but with larger populations on average, became a common theme. Population in general declined through the 1500s and 1600s. Migrations into the region appear to be absent or minimal, especially since there was a large base population established during Pueblo III. Subsistence revolved around dry agriculture and hunting/gathering. The landscape was used extensively and creatively to extract the necessary resources to support a growing population. Glazes were traded extensively and delineations in space can be made between certain glaze types. The extensive exchange of glazes and the number of glaze types generally increased from
early Pueblo IV and through the 1500s, which corresponds with settlement aggregation. Aggregation also correlates with diversifying ritual architecture and iconography, including evidence of warfare at least as an ideology, as well as rain and fertility iconography associated with Katsina.

Overall, the combination of evidence for little to no migration into the central Rio Grande, settlement aggregation, extensive utilization of resources on the landscape, and increasingly diverse and regionally defined glaze wares and ritual activity all contribute to a landscape defined by the interaction and cooperation of many previously separated groups native to the central Rio Grande. Site-by-site differentiation in ritual activity, superimposed on shared glaze ware traditions, and coupled with diverse resource acquisition strategies, establishes the notion that multiple distinct groups were living on the landscape. Moreover, it suggests that within clusters of settlements, different sociolinguistic groups were living that made the fusion of all these aspects necessary. The only formal cluster recognized throughout these districts is Pottery Mound and Hummingbird Pueblo. Strewn over this entire discussion, the authors make note of defining settlement clusters and how that unit of analysis may have implications on perceptions of data.


This book provides limited information on Pargas and Abeytas, but substantial information about Ancestral Piro and some local geology/ecology of significance. The environment is topographically quite varied and falls into the Mexican Highlands basin and range province. Environ of multiple types and many important landmarks border the
east and west of the Rio Grande. Pargas Pueblo is heavily disturbed, so the exact character of the site cannot be defined. Abeytas, the furthest northern settlement of the ill-defined Ancestral Piro landscape, is also heavily disturbed from modern activity, but the best evidence indicates an artifact spread of around 350 square meters. Both sites contain glazes A-C.

The time period that includes the tenure of these sites is known as Ancestral Piro, dating from approximately 1300-1540 CE, or Glaze A-D. Ancestral Piro appears to be a result of the fusion of both indigenous Elmendorf groups and intrusive populations that resulted in large population increases, though this has been debated elsewhere. Overall, this timeframe is characterized by increased regional population, coalescence into large villages, expansion along rivers, and the presence of puddled-course adobe. Some fortified places may indicate dissension in the area. Prior to Ancestral Piro, settlement placement and strategies were more flexible, but with the inception of the timeframe of relevance here, a more rigid plaza/roomblock layout was prevalent. However, settlement location did diversify. Gray wares and glaze wares predominate, most being produced locally.


Two of my sites reside in the Rio Abajo, ecologically located in the Chihuahuan Desert: Abeytas Pueblo and Pargas Pueblo. The former is located the furthest north between the Rio Grande and Rio Puerco before their confluence. Pargas is located about 60 kilometers downriver on the Rio Grande. This chapter gives limited specific
information about these sites, but it does put the Rio Abajo in context, which is the primary utility here.

The Rio Abajo was occupied by village-living farmers and was known to the Spaniards as Piros. The archaeological district spans about 100 km up and down the Rio Grande and associated tributaries. During the Ancestral Piro Phase (1300-1540), population increased suddenly evidenced by significantly larger average room block size, populations expanded into previously uninhabited areas, adobe became more frequent, and glaze wares were introduced. Glaze A was present early and steadily phased out by Glaze C and D. Glaze B is absent apart from Abeytas and Sevilleta Pueblo, which may mark the northernmost extent of what has come to be known as the Southern Pueblo tradition.

The Colonial Piro Phase is demarcated by the appearance of Glaze E and F. The most common type early in this period is Glaze D, and even Glaze A is still uncovered. However, by the 1600s Glaze E became the most common and Glaze F began to appear in the archaeological record. The settlement patterns as a result of the Spanish are mixed. Many sites are still occupied, but residential populations are certainly reduced. Many additional sites are also constructed because of the arrival of the Spanish. Prior to the Pueblo Revolt of the 1580s, the Rio Abajo was largely abandoned. Abeytas appears to have been abandoned either before or at the arrival of the Spanish. Pargas was excavated about four centuries after these revolts (Marshall 1986).

Cooper, Zachary J.
I am primarily using this article as a reference to the populations that existed prior to complex migrations and population growth in the Rio Grande. This paper primarily addresses the arrival of farming populations in the Rio Grande during the latter stages of Pueblo I and the entirety of PII via two different hypotheses: the Northern Origin and Southern Origin. These hypotheses inherently involve the introduction of Tinoan languages in the Rio Grande. The Northern hypothesis says Tinoan speakers mainly derive from San Juan populations to the north, while the Southern Origin hypothesis states that Tinoan languages (Tewa and Tiwa) originate in the Rio Grande and changed from the influx of peoples from the San Juan region.

As other readings have taught me, migration is important both at the source and the destination. Regions that are historically affiliated with one another may have increased propensities for migrations because of connected familial groups or foundational trade relationships. In terms of pottery, this seems to especially hold for the Rio Grande and relationships with the San Juan.

Giomi, Evan

I am mainly using this thesis for describing the separation between Piro and the rest of the Northern Rio Grande populations throughout the Glaze Ware periods, as well as background information when necessary. This thesis seemed to answer my speculation that Piro had different things going on. Glaze Wares in the Rio Abajo at Piro sites seem to mostly be local productions, along with evidence of a shared community of practice with Albuquerque and Rio Pureco potters based on clay and temper selection. Moreover, there is almost no Glaze B and limited glaze C sherds, which indicates no affinities with
the developments coming out of the Galisteo Basin. There is evidence of more trade with Tompiro and Western Pueblo groups, but in other items I have read even this seems relatively limited. Giomi further argues that Glaze Ware’s played an integral role in forming a pan-Pueblo identity and is not rooted to Spanish conquest and the imposition of a single Pueblo identity.
Many questions persist about the nature of Abeytas Pueblo. While the discussion surrounding the identification of Piros is not major to my research, this paper does suggest caution about how I might interpret ceramic relationships moving forward. I fall in line with the interpretation that Abeytas is a fluid settlement that transcends Piro and Southern Tiwa ‘boundaries. In other words, the presence of ceramics from a site like Pottery Mound is not as far-fetched as it seems, even though there is supposedly a linguistic barrier. In a similar vein, this article makes me question how Piros have been defined in space and time. While Abeytas has characteristics indicating it is Ancestral Piro, petrographic analysis of 40 sherds has revealed imported Glaze Wares from the Galisteo, Albuquerque, Rio Puerco, other Rio Abajo villages, and Western Pueblos. No Black-on-white component is identified at Abeytas, but it is present at other sites along the Rio Abajo. This indicates that there was an indigenous population living in the area prior to apparent population increase. However, the case could be made that increase in settlement numbers over the glaze ware period (+11) is simply a result of reorganization. Technological reorganization also happened. Prior to 1300, brown wares were the primary utility ware, but switched to grey wares after. While decorated wares were fired in a reducing atmosphere and undecorated in an oxidizing atmosphere prior to 1300, this relationship flipped afterwards. Migrations or local developments, or both? While evidence of a large-scale population influx is absent, it does not mean some never trickled into the area. Overall, the Rio Abajo is defined in the Glaze Period by primarily
local developments and a reorganizing population that only loosely, or not at all, consisted of migrants. Abeytas’ connections are multiple, and its affiliation as Piro or not is up for debate.


This article identifies patterns of procurement and production for lead in the Cerrillos Hills for three sites: San Marcos, Pueblo Blanco, and Kuapa. In summary, isotopic studies identified in a sample of 40 that most or all lead for Glaze Wares of the Intermediate Period (1425 - 1515 CE) at these sites originate from the Cerrillos Hills. San Marcos lead has a homogenous isotopic makeup, indicating that potters there may have controlled access and production for a particular area of lead in the nearby hills. Pueblo Blanco and Kuapa, on the other hand, have a more heterogeneous isotopic pattern, which indicates degrees of both exchange and potentially self-procurement in differentiated locations in the same hills. Proximity to resources did not play a factor in procurement for any of these sites. However, greater costs of acquisition at the latter two sites may have played a role in different lead ores being mixed - contributing to heterogeneity.

I can connect many ideas in this paper to interpretations of micaceous wares, though the nature of the data is different of course. From this paper, I now know that Kuapa contains evidence for uncontrolled lead-procurement and probably trade that contributes to different lead isotopes. Also, that heterogeneity/homogeneity in a group of like artifacts is important. Relative heterogeneity in an assemblage of micaceous wares from the same site could mean uncontrolled, differentiated access that may be organized at the household level, not the village level. Also, it could mean trade, depending on what
other chemical clusters can be defined. Homogeneity could indicate more controlled access, more controlled trade, or at the bare minimum a collection of households that essentially use the same pottery ingredients - perhaps evidence for village-level organization.

Marshall, Michael P.

A total of 713 sherds were excavated from Pargas Pueblo in the Rio Abajo. There are indications that it is a “typical Piro assemblage” with a combination of locally produced Rio Grande glaze wares, extremely low (but consistently present) frequency of western glazes, and an overall numerical domination of plain gray utility wares. Temper types consist of sand, basalt, microdiabase basalt, and white igneous rock. The plain wares are usually tempered with basalt or sand, Glaze wares have an even spread of all four temper types, and usually slipped with tan or red pigment. However, vacation in slip color does exist. Apparently, the four temper groups are often seen at other Piro sites, and sand temper is more common in earlier vessels, while crushed rock usually occurs later. Although Glaze A, C, D, and E are found at the site, Glaze A is temporarily fluid and patterns with the Rio Abajo observation that Glaze A was consistently the most produced glaze ware.

There is no discussion here on micaceous wares (unless I am misinterpreting the language of the chapter). It does provide some provenience information, which could be useful for matching the provenience of my micaceous wares. But the point is clearly made that the plain grey ware industry is the representative utility industry amongst the
Piro and in the Tigua province. This means that micaceous wares were uncommon and likely imported.

Kurota, Alexander, Principal Investigator, University of New Mexico Office of Contract Archaeology. Personal Communication March 2022.

Information on chamisal has come sparsely from other readings, but primarily via email correspondence with Alexander Kurota; he is currently in the process of writing a report on the site. Alex sent information on glaze wares, room counts, and general occupation timelines. The earliest reliable median C14 date is 1335 CE while the latest is 1562 CE. The site has an estimated 40-50 rooms and has ceramics from the Rio Grande Coalition Period all the way through the Glaze Ware period. Glaze wares include Arenal G-P Agua Fria all the way to Kotyiti G-P. Evidence of a historical component is present.


Though this volume is ripe with information regarding theoretical frameworks and how social boundaries may be defined, I am primarily concerned with more technical aspects of the sites and the ceramics. It is important of course to connect things to theory and thus interpretation, but that will not be explored thoroughly here. In summary, Eckert identified multiple migrant groups from the west settled in the study area. These groups were discernible based on technological and stylistic attributes, allowing for the differentiation of communities of practice and communities of identity.

Communities of practice and identity changed with the adoption of glaze wares as an influx of migrants and the act of aggregation shifted potter strategies and relationships.
between households. Ceramic evidence indicates local and immigrant groups living and interacting with one another at Pottery Mound and Hummingbird Pueblo. This evidence was primarily from petrographic evidence linking non-local pottery to homelands, and local petrographic signatures of local production. Micaceous wares themselves are glossed over and used to affirm ties between the Rio Puerco and Rio Grande. Glaze wares uncovered at these sites are elaborated on and will deserve reference in the future.

Especially important to my work may be considerations of temper. Igneous rocks (olivine diabase, hornblende latite, augite monzonite, mixed igneous rock, ash, pumice, tuff, rhyolite) were used as temper in various forms and percentages. Metamorphic rocks were also used (quartz-mica and gneiss) that are posited as coming from the east in the Sandia-Manzano ranges and the central Rio Grande. Though it is clear more work should be done. Sedimentary rocks like sand were utilized as well. Sherd tempers were common as well and combined with any of the other temper types.
Part 5: Micaceous and Glaze Ware Research

Habicht-Mauche, Judith A.

This chapter is an overview of Glaze Ware production and associated social contexts. I am primarily using this chapter for 1) map reference of multiple sites in the Rio Grande Valley and surrounding regions, and 2) the variability of social contexts in which Glaze Wares are found (which is largely the driving theme of this book). Understanding the socially imbued quality of Glaze Wares is a fundamental theoretical framework. These qualities include aspects like social history, technology as practice, and Habitus, which are all ways to bridge technology and social reproduction. In this theoretical structure, Glaze Wares are vital because they are proposed for connecting communities of practice. Moreover, they were not elite status goods. They are found in multiple domestic contexts but do appear important for ritual events. In my study of micaceous wares, superimposing the chemical data for utility wares onto observations about Glaze Ware sites could become paramount for understanding social relations between sites.

Eckert, Suzanne L.

This chapter is an overview of glaze ware ceramics in the East-Central Arizona, West New Mexico, and Rio Grande Glaze Wares. I have used this article to acquire a
stylistic and temporal understanding of Glaze Wares throughout the region. While other articles discuss variability in interpretation, this chapter provides evidence of physical variation. Additionally, it shows relationships between Glaze Wares that hint at permeation of different traits from certain areas and potential affinities. This article has dismantled my previous inclination that one Glaze Ware type was predominant across multiple areas, but regional variation is the most important. This will be important to consider if the implications of micaceous wares include either local acquisition, extensive trade, or a combination of both.

Nelson, Kit and Judith A. Habicht-Mauche

It is important to have a firm grasp of manufacture and exchange both within and between sites in the Rio Grande. This chapter elaborates on an aspect of that relationship via exchange patterns between finished Glaze Wares and lead, as well as summarizes the hypotheses behind how communities and provinces formed in the central Rio Grande valley. How exchange and community formation mold into one another has resounding implications on perceived dynamics of exchange during the Pueblo IV period (1300 - 1600 CE).

Previous research on community formation in the Rio Grande valley emphasized the formation of evenly distributed settlement clusters that were interpreted as various regional systems that were dictated by ethnolinguistics and set boundaries. Ceramic styles and types were used to reinforce these divisions, where affinities in material culture were interpreted as alliances. Glaze wares, the lens of analysis for this study, put these macro
relationships into question, while also offering a finer-grained resolution for the analysis of inter community relationships via households and individuals.

Early work on glaze wares defined centers of production in sites or provinces that controlled regional distribution. During the Early Glaze Ware period, those centers were thought to be Albuquerque, Zia, and the Santo Domingo areas. In the Intermediate period (1450-1515 CE), Galisteo was postulated by Anna Shepard. In the Late Glaze Ware period, more localized production centers emerged. Later studies found more nuances, with early, red-slipped glazes being produced in more areas than previously thought, and that Galisteo produced one yellow-slipped glaze pottery while Tongue Pueblo outside that region produced most glazes for the intermediate period. However, these general patterns tend to obscure site by site diversity. At four separate sites, including Kuapa which is related to my research, the authors found a frequency of temper-defined Glaze Ware types that does not detect any regional shift. Instead, frequencies seemed more random, and it is interpreted that exchange of Glaze Wares is more ad hoc and dependent on multivariate household relations, and more importantly not dictated by an overarching institution. However, lead from mines at Cerrillos was ubiquitous across the sites and is interpreted as being the result of a more interregional network of exchange.


This chapter looks at regional transactions through nonlocal pottery rather than local pottery production at two different sites. This is useful to my research for two reasons. First, one of the sites is Pottery Mound, a site where some of my micaceous
wares were excavated. Second, there is a long discussion of imported utility wares and source locations (based on temper), as well as glaze wares. These characteristics delineate the contemporaneous Pottery Mound and Montaño Bridge Pueblo dramatically.

At Pottery Mound, potters produced a vast number of their own glazes with local materials, while most imported pottery came from Western Pueblos like Acoma, Hopi, and Zuni. There also seems to be some level of imitation in the form of slips and design elements. At Montaño Bridge there are glaze ware connections with sites to the Northeast, located in the Galisteo Basin. About half of the glaze wares at the site were imported. Interestingly, this site has no pottery from Western Pueblos.

The most common sources of mica for utility ware temper are the Sandia and Manzanos mountains to the east of the Rio Grande Valley. At Pottery Mound, there are 29 utility sherds with this mica and 1 decorated sherd with mica. A total of 95 utility sherds came from outside sources, and 65 of these were from the west. Four percent of the utility assemblage is nonlocal, and three percent contain mica temper. The styles of utility wares tend to go from corrugated styles, to obliterated coil, to plain grey. At Montaño the pattern for utility wares is entirely different. First, 16 percent of the utility wares contain temper similar to glaze ware temper technology. Second, 1677 utility ware sherds were determined to be imported (46% of utility wares, 16% of all wares, and 53% of the imported wares contained micaceous temper), evidence of either the trade of the containers or their ingredients. Most wares were made from local materials, indicating temper may have been imported. The most likely origin for micaceous wares or their ingredients at both sites may be Tijeras Pueblo, which is known for exporting micaceous wares but fewer glaze wares.
Early Glaze A types between the sites were similar and suggest early regional cohesion. This deviated in later timeframes, where Pottery Mound began affiliating more with the west and Montaño Bridge with the northeast. Moreover, imports for the latter increased over time. Temper type transitioned to more hornblende latite ash blends, which corresponds with the wane of Tijeras. Non-decorated and decorated wares were clearly traded, and other goods may have been transported in these containers. Additionally, the frequency in artifact type does not correlate with distance. This may suggest that social obligations and networks trump ease of access.

Goff, Sheila

The two major goals of this article are to summarize influential glaze ware research that has been completed on the Pajarito Plateau and posit that their production began much earlier than Shepard had hypothesized some decades ago. This region contains one of my sites: Kuapa, and is referred to in other publications as being part of the Cochiti Cluster. This plateau was the most volcanically active in the Rio Grande region, thus yielding a diverse set of potential materials to use in crafting endeavors. Petrographic analyses of this diversity allowed Goff to set constraints on production and identify glaze ware production before the Late Period (1480-1700 CE) during the Early (1313-1500 CE) and Intermediate (1410-1600 CE) Periods.

Kuapa is one site with evidence of early glaze ware production. However, it never became a regional center for glaze production like Puye or sites in the Frijoles Canyon during the Late Period. Most assemblages at sites in the northern part of the Cochiti Cluster are not dominated by glaze wares like in the south. Kuapa and Frijoles are in the
south, but interestingly enough Puye lies furthest to the north. Instead, most sites in the north primarily produced Biscuit Wares.

While information on Kuapa here is important for my purposes, this article also puts the history of research in one region in excellent perspective. It affirms that distribution studies are a necessary first step for incorporating new materials into our interpretations - all aspects of a technology must be understood if it is to be socially imbued. Shepard (1942) was the first to note north/south delineations early on, as well as propose that glazes were coming from the Albuquerque region. Later work unveiled nuances in that north/south divide, and that glazes were not imported from Albuquerque, but produced locally. This information is largely elucidated by more work on the same kind of artifact in the form of further studies on temper type, recipes, etc. Are we at the stage of diversifying the suite of artifacts with provenance to understand how social patterns are embedded in material culture? I would say so, and I think this is the direction micaceous utility wares are headed.


Understanding the technological implications of diffusion and migration is vital for understanding Rio Grande Glaze Ware technology. There is much temptation in separating these into either/or statements, but the phenomena that brought about glaze technology in the Rio Grande were much more convoluted and complex. Early glaze
compositional analysis suggests affinities with Western Pueblo settlements like Zuni, and limited affinities with this further west. Later glazes indicate a divergence from these affinities into the Rio Grande’s own glaze production technology that rose out of an adoption of combined traits.

Rio Grande potters adopted a suite of western glaze techniques that fit into current production strategies already established in the basin, such as the continued use of mineral pigments and firing techniques. The lack of compositional homogeneity between western glaze wares and Rio Grande glaze wares, overall, is an indication that diffusion and inter-community transmission played a more pronounced role than direct migration. While early Rio Grande potters utilize the same copper colorant as far western potters, fluxes are more similar to Zuni. Moreover, a key difference is that Glaze A paints used a combination of manganese and lead, while Zuni potters used copper and lead. Around the late 1300s, the Mn-Pb paint was rapidly adopted by Rio Grande communities, becoming more and more distinct from Zuni through time. It appears the inception of glaze technology was not the result of pervasive migration from the west, but underlying interaction with Zuni communities.


This article evaluates glaze recipes over time at San Marcos as a means to assess standardization and documented changes in production intensity through time. Moreover, these findings are combined with other regional data on glaze production at Tonque, Abó and Quarai. These findings are important for my purposes because they evaluate other
previously mentioned patterns but substantiate them with a larger dataset. Moreover, they address production more directly and what it could mean for social networks and communities of practice, which is what I am interested in.

The authors found stability in some of the standard lead, silica, and alumina oxides. Later glazes had less alumina, producing a runnier glaze, which is documented elsewhere. Interestingly, there was more variability in colorants, and their minor amounts and lack of statistical patterning suggests it was not intentional. Over time, though, glaze recipes remained consistent. These factors suggest that 1) there was an effective teaching framework in place, and 2) flexibility was allowed because of colorant variability. Huntley (2008) reached a similar interpretation for Zuni potters.

The base glaze recipe endured through time, and personal variability seemed to be allowed. A formal framework of learning was in place, but it was not standardized by a select few. From here, the inference is made that social networks were strong and communities of practice consistent. Tonque, Quarai and Abó also followed a consistent glaze recipe that was not that variable from San Marcos. This is significant because, although leads used by Abó and Quarai appeared to be from the Socorro area and San Marcos and Tonque used Cerrillos, a pan-regional glaze ware recipe is still recognized. This differs from the Mogollon and Zuni regions, where both had variable glaze recipes and, consequently, varied communities of practice.

For my purposes, thorough knowledge of the technological procedure behind the production of glaze wares is probably not necessary. However, some fundamentals (especially those that we understand more fully) about their production are essential to other anthropological interpretations that I have been reading. For example, knowns include that coil and scrape method started the pot; that bichrome and polychrome background were formed from slip clays; a lead-based pigment produced darker lines and areas of dark glaze, and that firing finished oxidation and brought out colors. Unknowns include the type of lead mineral, pigment preparation, how colorants impact glaze, and specific firing sequences.

Some progress has been made concerning what lead mineral was used. Lead isotope studies throughout the Rio Grande and recent archaeological findings at San Lazaro indicate galena was the primary lead source. Moreover, excavations at San Lazaro may have revealed firing platforms that seem analogous to shallow firing basins for b/w ceramics and Mesa Verde trench kilns. Lead glaze was found on some stones that make this correlation potentially circumstantial, and unfired glaze pigment was discovered inside the pot and found to be galena. Chemical data elsewhere with traces of sulfur also substantiated that galena was the most common lead-bearing mineral for glaze paint.
Part 6: Compositional Studies

Bower, Nathan W., Steve Faciszewski, Stephen Renwick, and Stewart Peckham

Considering the application of XRF technology on a limited sample size of ceramics, I was surprised at the consistency of results posited here that I have read elsewhere. I see this article as an early example of differentiating sherds via elemental composition, but through methods observed less today because the nature of our analyses has changed.

The authors primarily used statistical measures of certain elements to assess factors such as what sherds group together (dendrogram) from sites in the Albuquerque area. The correlation coefficient of element concentrations analyzed via SEM-XRF accurately group, with a few exceptions, non-Rio Grande glaze wares and Rio Grande Glaze Wares. In the first major group, various subgroups included Western Pueblo sherds, Biscuit Wares, and a couple glaze wares. The authors suggest this could be evidence of some nature of recipe exchange going on between Western Pueblos and the Rio Grande, given their elemental similarities. In the second major group, later E-F Glazes are higher in lead and lower in Si, which results in a runny glaze. They also corroborate Anna Shepard’s observation that that Mn and Al concentrations also decreased in later glaze wares. Elemental variability in Glaze A is highest when compared to all other glaze types, except for D, which may suggest early experimentation in recipe occurring. Other observations and conclusions drawn from this paper include various color matching with composition, as well as mining in the Cerrillos Hills for glaze components and their eventual trade as both whole vessels and distinct ingredients.
Eckert, Suzanne L., Kari L. Schleher, and David H. Snow
2018 Following the Yellow Brick Road: Yellow Slip Clays and the Production of Rio Grande Glaze Ware in North Central New Mexico. *Journal of Archaeological Science: Reports* 21: 565–574.

This article covers an example of two villages potentially involved in a tight-knit material and technological relationship that was stable through time. These two villages are San Marcos and Tunque Pueblo in north central New Mexico, both contemporaneous and in a geologically variable region. Geology in this region is interesting and could pose implications for the findings in this research. LA-ICP-MS was used to analyze historic bricks, clay samples, and slips on ceramic sherds. Statistical analyses included PCA (Principal Component Analysis), K-means cluster, and bivariate plots. The chemical findings suggest a couple of things. First, the variability in the chemical data for clay samples is much broader than the variability within ceramics. This suggests a level of selectiveness and retained knowledge and meaningful teaching/learning relationships that are culturally bounded. Second, San Marcos and Tunque potters were using the same yellow clay for slips, which is located near Tunque. Though the two yellow clays they utilized may have been different subsets of the same clay, and technologically applied differently, it suggests a meaningful relationship between the two communities. Moreover, they were utilizing the same glaze ware lead and recipes. As concluded elsewhere, specialized resources travelled more broadly than non-specialized ones, suggesting varying levels of social interaction in the Rio Grande Pueblo world.

Habicht-Mauche, Judith A., Stephen T. Glenn, Mike P. Schmidt, Rob Franks, Homer Milford, and A. Russell Flegal
This study compares ICP-MS laser ablation and acid dissolution techniques for lead glazes on Rio Grande glaze wares along the upper middle Rio Grande Valley. While this paper does not offer any new anthropological conclusions that have been noted in other articles on lead ore acquisition and utilization around the Cerrillos hills, it does explain how ICP-MS isotopic data is measured and interpreted. Furthermore, a comparison of techniques is meaningful and characterizes much of the history of archaeometric studies in the region. Out of the two ICP-MS techniques compared, acid dissolution was found to be more accurate, while laser ablation tended to be less accurate and precise; placing samples lower along the evolution line for Cerrillos lead ore isotopes. I find this to be slightly concerning, especially since the distinction between Cerrillos mines in the north and south is differentiated along this evolution line. However, laser ablation is less costly, and less destructive, which makes it the more appropriate technique for large archaeological datasets.

Huntley, Deborah L., Katherine A. Spielmann, Judith A. Habicht-Mauche, Cynthia L. Herhahn, and A. Russell Flegal

This article is an exploration of the provenance of lead ore sources and glaze recipes for two sites in the Salinas area of New Mexico, between the Manzano Mountains and the Chupadera mesa: Quarai and Abó. The authors used MC-ICP-MS and an electron microprobe to obtain the isotopic and and chemical signature of lead (ore or glaze) and
glazes, respectively. The results should be approached with caution, but the authors find evidence of lead ore mixing due to their distant proximity to most of the major lead sources in the region. Although not all the lead sources are distinguishable from the Cerrillos district. However, there is some evidence to support a shift towards southern lead sources near Socorro as time progressed. For example, in the early 15th century, the Galisteo district, with the Cerrillos mine, produced the standard recipe of Rio Grande Glaze ware. In the 16th century, however, the Salinas district, including the two sites in this study, became major producers as Galisteo production fell out of favor. But since Salinas lead shows a mix of both Cerrillos and non-Cerrillos sources, the Galisteo Basin may have still played an important distributive role. Lead may have been imported from distant lands and peoples, but the recipe was local.

While not directly correlated to my work with micaceous wares, this is a study that reminds me that mixing of different micaceous clays could be possible if conditions of demand and high procurement cost are right. This is always something to consider as I interpret my data, but I have little choice but to move forward with the assumption that the micaceous clays are unmixed, and that one data point represents one “kind” of clay. Of course, interpretations can still be made from chemical heterogeneity or homogeneity within a given group.


While not contemporaneous to glaze or micaceous wares, this article contains important patterns that were underway at a local level in the Late Development to Coalition period (1050 CE - 1320 CE). These patterns were in the Taos region, along the
Rio Grande del Rancho drainage. Settlement patterns progressed from the typical dispersed pothouse hamlets and into aggregated communities. Mineralogical and chemical data from NAA were used to examine black-on-white ceramics and how these changed while settlement patterns shifted. Before delving into the data, aggregation appears to have been caused by migrating populations. This is shown with 1) demographic studies showing population growth, 2) sudden shifts in ceramic technology and style, and 3) abundant osteological evidence of violent death from conflict. Nearly the entire estimated population of the Rancho drainage aggregated into the site of T’aitöna. Oral history also supports violence in this region.

In the geologically variable (and clay-source variable) region of Taos, interesting chemical and mineralogical patterns emerge. Ceramic data prior to migrations into the region indicate a heterogeneous chemical makeup, meaning multiple different sources characterized the ceramic ideas of the local population. This might be expected with mobile populations in a geologically varied landscape. However, the most high-quality clays were being imported from the north. When migrations hit the region, clay use became less diverse and more homogenous. In other places in the Rio Grande, settlement aggregation and homogenization of clay recipes have been considered specialization. However, the wares in the latter period of this study are of poorer quality and less standardized than those before.

Certainly, these patterns should be acknowledged, and substantiates the need for combining mineralogical and chemical data, less certain characteristics and interpretations be overlooked. This had made me rethink some interpretations in previous readings. However, it is certainly a different socio-historical context. The northern Rio Grande much more consistently faces the brunt of population migrations and subsequent
dissension, whereas other regions of the Rio Grande witnessed population growth because of aggregating indigenous groups. This does not mean migrating groups never reached these other regions, but certainly less pronounced than in the far north where Taos is located. Either way, I must think more critically of re-established correlations moving forward.

Eiselt, B. Sunday, and Richard I. Ford

This study confirms that micaceous clays are matchable to micaceous wares uncovered in prehistoric and historic contexts. While this article has an underlying theme that necessitates the reacquisition of clay resources for Native American communities in contemporary contexts, I am primarily concerned with the archaeology and geology here. The geology of the northern Rio Grande is complex and has undergone extensive deformation that equates to multiple sources of metamorphosed rocks and, subsequently, micaceous clays. These clays are generally located in the Sangre de Cristo Mountains and the southern San Juan Mountains. Their parent rocks are typically Precambrian in age, have high concentrations of muscovite mica, while quartz and feldspars account anywhere from 40-60% of the rock. Geologists have defined 10 major mica-mining districts in the northern Rio Grande region around Santa Fe and Taos. A major geologic formation of these rocks is called the Vadito group. Weathering from these deposits rich residual clays consisting of up 80% mica.

Micaceous wares are transcultural and were produced as early as 1300 CE and into the present day. They had many roles in utilitarian and non-utilitarian spheres, which accounts for their widespread exchange. The pastes for micaceous wares are already self-
tempered with the mica in the residual clay, thus making finished vessels more durable and thermally efficient. Additionally, this equates to less production modification, and thus greater correlation between the chemistry of the artifact and the chemistry of its raw constituents. But in some cases, micaceous wares are also defined by processes like purposefully tempering based on different mica sizes, crushing schist and adding as temper, and applying micaceous clay as a slip.

Research indicates earliest use of micaceous clay was in the Tewa basin and spread to the middle Rio Grande and northeastern New Mexico by 1500 to 1550 CE. Micaceous ware research is still in its infancy, which is why there is major benefit in defining source-utilization patterns for different communities through time and space. Some progress has been made in terms of defining micaceous wares from a technological evolution point of view. That is, early plain paste styles tend to be corrugated, incised, or ribbed; later styles are smoother on the interior and exterior. However, problems persist with time, technological distinctions between groups and ethnicities in the historical period and defining who made such wares.

Sherds and clays from archaeological and historical samples, guided by native potters to identify reliable sources of clay during a multi-year survey in the northern Rio Grande, would mostly be sourced and were chemically distinct. When the sherds could not be sourced to a specific spot on the landscape, they could usually be determined to reside within a specific district. This article is particularly important for my research, because it proves that micaceous wares can be chemically characterized through NAA, and that differentiation between natural resources can be achieved.

Eiselt, B. Sunday, and Richard I. Ford.
2006 Analysis of Micaceous Clay Sources in the Northern Rio Grande. *Transactions-
American Nuclear Society* 95:475.

This short article is basically a condensed version of the article above, but with better summarization of the methods. I will present those here. NAA was performed at the University of Michigan, Phoenix Memorial Laboratory, and the University of Missouri Research Reactor to chemically characterize the same clay tiles and sherds. There were 150 clay samples from the field, 23 raw clay samples, and 5 vessel fragments from modern pottery workshops. A total of 510 archaeological samples attributed to Pueblo, Hispanic, and Jicarilla Apache potters were also submitted. Various statistical techniques were used to discern groups, each being consistent in their results. Some distinguishable sources include Petaca, Picurís, and Cordova Truchas. Various subgroups can be found within Picurís and Petaca districts. Cordova Truchas may be the earliest source used for micaceous wares by northern Rio Grande potters. NAA only misclassified 4 of the 28 known sherd and clay samples. About 68% of the archaeological specimens were assigned to a particular source area, while 22% were allocated to undefined areas, but within certain districts.

Eiselt, B. Sunday, and J. Andrew Darling

This study is temporally not relevant to my research because it falls after the latest occupations of my sites, the Pueblo Revolt, and well into the formation of Vecino communities in the northern Rio Grande. However, historical documentation of the nature of micaceous ware production and exchange may be useful as lead-ins to any of my interpretations as I try to envision micaceous ware exchange in the prehistoric Pueblo
world. However, it is important to remember that Vecino communities are multi-ethnic villages that especially consist of Hispanic peoples. The organization of these communities is likely different than the Pueblo communities before.

Women were vital for Vecino communities in the 19th century northern Rio Grande Valley. Through NAA and styles of micaceous ware sherds, this study examines multiple Hispanic sites to determine how emerging Vecino communities relied on interethnic trade. Of particular concern are gendered economies—the wares and priorities of women within these newly forming communities. In some ways, these emerging communities parallel to earlier interethnic community developments during Pueblo IV. The general conclusion was that multiethnic communities, shown via a diverse ceramic assemblage, traded frequently via the mobility of women and women’s crafts. Additionally, specialized production of certain goods by certain communities, and subsequent trade, was beneficial for energy/time allocation. For example, Jicarilla women had normative tasks each day, and so found little utility in producing small micaceous wares. However, there was utility in making and trading large vessels that maximized the return on their transactions because they also held things to trade and barter, which helped bolster their households economically.

This article also helped me think about the purpose of exchanging micaceous wares. Ethnographic accounts record Vecino women trading for Jicarilla micaceous wares for equal amounts of foodstuffs. Two groups competent at micaceous ware production would also frequently go to each other’s communities and make small transactions. Micaceous wares were also given to another community to pay for services or curing ceremonies. Raw materials were also exchanged.
This article presents ceramic and petrographic data as evidence that Tijeras Pueblo, located between the Sandia and Manzanos Mountains just east of Albuquerque, was a coalesced community. Coalescence is innovation that sprouts out of community diversity and agency, resulting in new forms of technology and practice that bind otherwise separate groups of people. Tijeras has a long occupation history from about 1275 CE to 1400 CE. The site contains both Western and Eastern Pueblo pottery types, so what is to be made of this relationship? Results indicate that 30% of the Zuni glaze wares and about 10% of the White Mountain Red Wares are local copies. Additionally, these are found in earlier occupation levels, indicating some evidence that an earlier migration of Western Pueblo peoples could have occurred. Moreover, some sherds matched with chemical profiles from the Mariana Mesa district. These combined traits indicate that people from this area may have migrated to Tijeras Pueblo, apparently because of dissension. Data in this study also corroborate findings elsewhere that much of the “Zuni” glazes present at Tijeras appear to have come from the Upper Little Colorado district.

Another aspect of this study, though not really discussed, is the sourcing of thirty utility micaceous wares. Any information on sourced micaceous wares could be useful. Tijeras has been regarded as a high potential source for micaceous wares in the Rio Abajo and even Rio Puerco districts because of durable history and strategic location between the Sandia and Manzanos Mountains, common sources of mica for the central Rio Grande. The sourced wares here seem to cluster quite tightly, though it's not the raw
chemical data being observed. This could indicate control or at least consistency in how Tijeras residents were procuring residual mica-rich clays, or at least trading for. It would be interesting to see if the chemical data here matches with chemical data of mica from the sites I will be discussing.