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MISSION STATEMENT

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SEVENTEENTH-CENTURY COLONO FORM CERAMICS FROM THE ISLETA PUEBLO MISSION, NEW MEXICO

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Introduction

The purpose of this discussion is to describe and provide a context for the Colono form ceramic materials recovered from the Isleta Pueblo Mission test excavations conducted intermittently from 2012 to 2016 (see Figure 1). These investigations revealed a great deal of information about the mission, though some of the field investigations were brief, limited to a weekend between construction periods, or monitoring during the construction of a new office and classroom building complex subsequently built east of the Isleta church. Test excavations in 2012 in the East Compound area (Marshall 2012, 2015) revealed extensive midden and construction rubble deposits extending to a depth of 3.8 meters. The substantial depth of these stratigraphic deposits is related in part to the dumping of midden and building rubble of what appears to be an early mission structure over the edge of a bench slope and to the subsequent construction of retainer walls and other structures in the area. Monitoring and testing associated with the removal of the North Placita Rectory Roomblock in 2015 identified the northern section of the seventeenth-century Convento, while later grading for the building pad in 2016 exposed the basal foundations of a previously razed convento roomblock.

Figure 1. Map showing locations of the Isleta church and excavation provenience areas in the Placita and East Compound areas. The plan of the Mission and Placita is that prior to the 2016 demolition. Today the entire area of the former Placita and adjacent roomblocks is superimposed by a new church office building.

As noted, the focus here concerns the description of the Colono form materials recovered from the Isleta Mission. However, some comparative information concerning seventeenth-century Colono form ceramics in other New Mexico missions and estancia sites is also included, allowing for certain observations and conclusions. The information presented in many of the earlier New Mexico mission and estancia excavation reports ranges from quite good to very schematic. In recent years, scholars have completed dissertation studies specific to New Mexico Colono ceramics, mostly in the Rio Grande and adjacent subareas (Penman 2002; Dyer 2010; Gabe 2019). Important information on Zuni area Colono ceramics from the Hawikuh Mission is presented in Klinton Burgio-Ericson's 2018 dissertation.

The term *Colono form* in this paper refers to ceramics of indigenous Puebloan seventeenth-century manufacture which replicate Spanish ceramics and occasionally metal material items. The more common term "Colonoware" often used in Spanish Colonial studies of the circum-Caribbean area is avoided here because the materials found in New Mexico were produced by Puebloan populations from various subareas, each of which had a traditional ware of considerable antiquity. It is more appropriate to describe the Spanish forms in the context of each of these native ware-series. In the Southwest, the term "ware-series" is normally restricted to specific ceramic traditions associated with various Puebloan groups; reference to a set of Colono ceramics across the entire Southwest as a "ware" thus seems contradictory. However, the term Colonoware is the normally accepted term for these materials. In rare cases, Spanish decorative motifs may appear on traditional vessel forms such as the large Hawikuh Polychrome jar from Purisima Concepción with cross motifs (Burgio-Ericson 2018:738). There were no cross motifs found on traditional glazeware forms in the Isleta Mission collection.

An overview of the archaeological use of the term Colonoware since its first use in the 1950s is provided in a 2003 manuscript by James E. Ivey, "Locally-Made Trade Ware and the Colonoware Problem." Colonoware ceramics in North and South America exhibit a wide variety of attributes and were made by various indigenous populations, and, in some areas, by African slaves. They are, for the most part, a subset of local indigenous ceramic wares. They were often produced by indigenous populations as an entrepreneurial trade undertaking, but in some cases may have been produced in workshops overseen by European colonists. None of the Colono ceramics in New Mexico were made using a potter's wheel. They are generally believed to have been produced to supply European colonial populations, but some forms may have also been adopted by local indigenous groups. A more advanced type of Colono ceramic manufacture is evident in the Indigena Ware produced by Indians in the Valley of Mexico which are hand built vessels with designs reminiscent of late Aztec motifs, but with a majolica-like glaze (Lister and Lister 1982:34, 96-99).

Colono form ceramics were manufactured throughout the seventeenth-century Puebloan World and can be identified in various subareas as differing wares or ware variants. Those produced along and adjacent to the Rio Grande corridor south of Santa Fe and at Pecos are regional expressions of the Rio Grande Glazeware Tradition associated for the most part with different linguistic Puebloan Provinces (Piro, Abo Tompiro, Eastern Tiwa, Southern Tiwa, Eastern Keres, Western Keres [Acoma], and Tano). Whiteware Colono ceramics appear in the Salinas Province (Tabirá Whiteware) and in the Jemez Province (Jemez Whiteware). Colono materials in the northern Tewa Province include Sakona and Tewa Polychromes, and burnished Tewa Red and Kapo Black. In the western pueblos, Colono materials at Zuni are mostly Matsaki Buffware, while those at Hopi are primarily San Bernardo Polychrome. In some cases, specific villages have recognizable Colono ceramics based on paste and temper variations. There are some probable eighteenth-century micaceous Colono forms which could be Jicarilla, Picuris, or possibly non-Colono materials of Hispanic manufacture. Micaceous candleholders have been found at the Palace of the Governors (Cordelia Thomas Snow, personal communication 2020).

Description of the Colono Form Ceramics from the Isleta Pueblo Mission

The materials described in this report are all Southern Tiwan Glazeware obtained primarily from two separate provenience areas at the Isleta Pueblo Mission. There is no evidence to indicate that Colono form materials were imported to Isleta from other subareas. However, exchange of Colono forms between various subareas was common, especially exports from pueblos long known as centers of ceramic manufacture and trade.

The sample of Colono materials from the Isleta Mission is small, but sufficient to allow for a basic definition of materials. In an effort to provide some context for the Isleta materials, they are briefly compared with Colono form ceramics from other subareas.

Candelarios

A total of 14 candleholder fragments were recovered from seventeenth-century deposits in the Isleta mission tests. Most were found in early seventeenth-century stratigraphic levels, although two bases were recovered from late seventeenth-century strata in the East Compound tests. All of the candleholders are of Isleta Pueblo Glazeware manufacture tempered with either scoria or basalt. All consist of a solid coiled stem welded to a disk base. The sample includes two stems and 12 basal disk fragments (Figures 2, 3, and 4). The Isleta candleholders are rather short (10 to perhaps 15 cm high).

The two Isleta candleholder stems are plain undecorated ceramics with local basalt and scoria temper. One specimen was found in the East Compound in the lower charcoal midden at a depth of 3.4 meters. This is the oldest deposit in the East Compound area and dates to the early seventeenth century. Only the barrel or stem section of the specimen remains, but the holder is estimated to have had a height of 15 cm with a maximum stem diameter of 3.5 cm. This specimen has an unusually high quantity of basalt temper, making the item quite heavy and probably rather stable when in use. No other ceramic artifact recovered from the Isleta tests has such a high density of temper as this specimen. It was made from a single solid coil and has a restricted waist 2.5 cm in diameter (with horizontal scrape lines) and an expanded lower stem 3.5 cm in diameter (with vertical scrape lines). The single wax guard near the top is broken, while the stem top shows the concave depression for the candle receptacle. The base was an apparent disk support.

The other solid candleholder stem, with three wax guards, was found in the lower level of the North Midden Convento area, also from an early seventeenth-century deposit. The estimated height of the holder was about 10 cm. The diameter is 2.0 cm at the stem and 3.0 cm at the wax guards. This specimen is an undecorated tan glazeware with red scoria temper.

Most of the basal disks were found in the North Midden deposits, although four were found in the East Compound midden, one in a subfloor test of the South Roomblock, and another in the Convento North Room. It is interesting that both the Convento North Room and South Roomblock specimens rest directly upon the gravel deposits of a seventeenth-century flood, suggesting that they may have been broken during a late night inspection of the flood damage in the rooms. The candleholder basal disks range from 8.0 to 10.3 cm in diameter. One of the disks is decorated with a painted cross, and a glaze line on another basal fragment suggests a painted cross extending out from the stem. All of the basal specimens thicken toward the center at the stem attachment. One has a slight depression on the central underside base.

Candleholders are reported from most seventeenth-century mission and estancia sites in New Mexico and exhibit a good deal of regional variation. The solid pole-type candelarios found at the Isleta Mission are not reported elsewhere, save a single example set on a square-footed base from Hawikuh (Burgio-Ericson 2018:911). All of the other described examples have a hollow core and are coil made. The hollow core holders at Pecos tend to be a bit tall (one nearly complete specimen illustrated by Kidder is 23 cm high) with multiple wax guards and with an expanded trumpet-like footing (Kidder 1936:276). Those described from the Zuni Hawikuh mission have an expanded cone-like base with a single upper disk wax guard (Burgio-Ericson 2018:780, 91l). This upper disk guard is similar to Mexico City Blue-on-cream majolica candleholder

Figure 2. Candleholder stem and bases recovered from the early seventeenth-century deposits at the Isleta Pueblo Mission. Upper disk base is 10 cm in diameter. Painted line on middle-right base is likely one pole of a cross extending from the stem base. The cross on the basal disk, lower left, was likely one of four crosses painted on the foot.

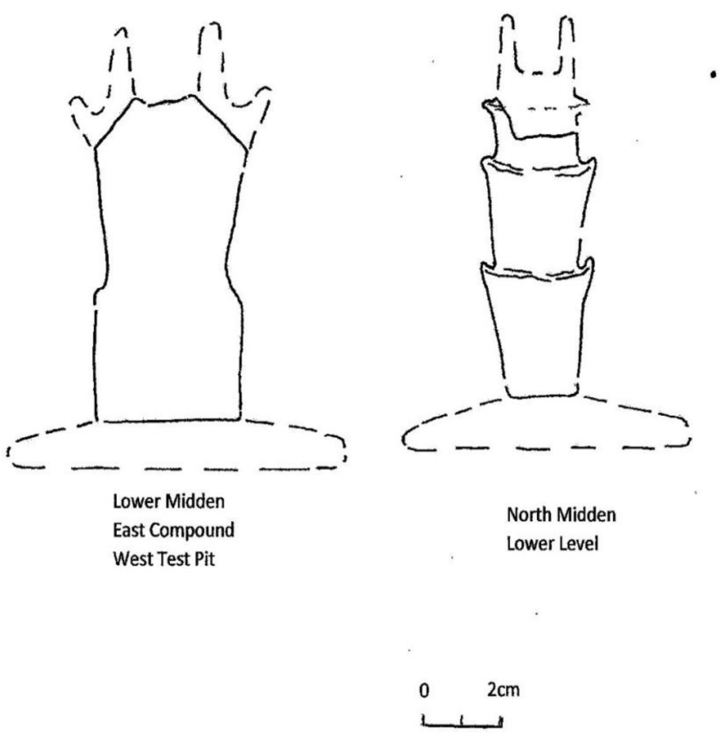

Figure 3. Candleholder stems from the Isleta Mission tests.

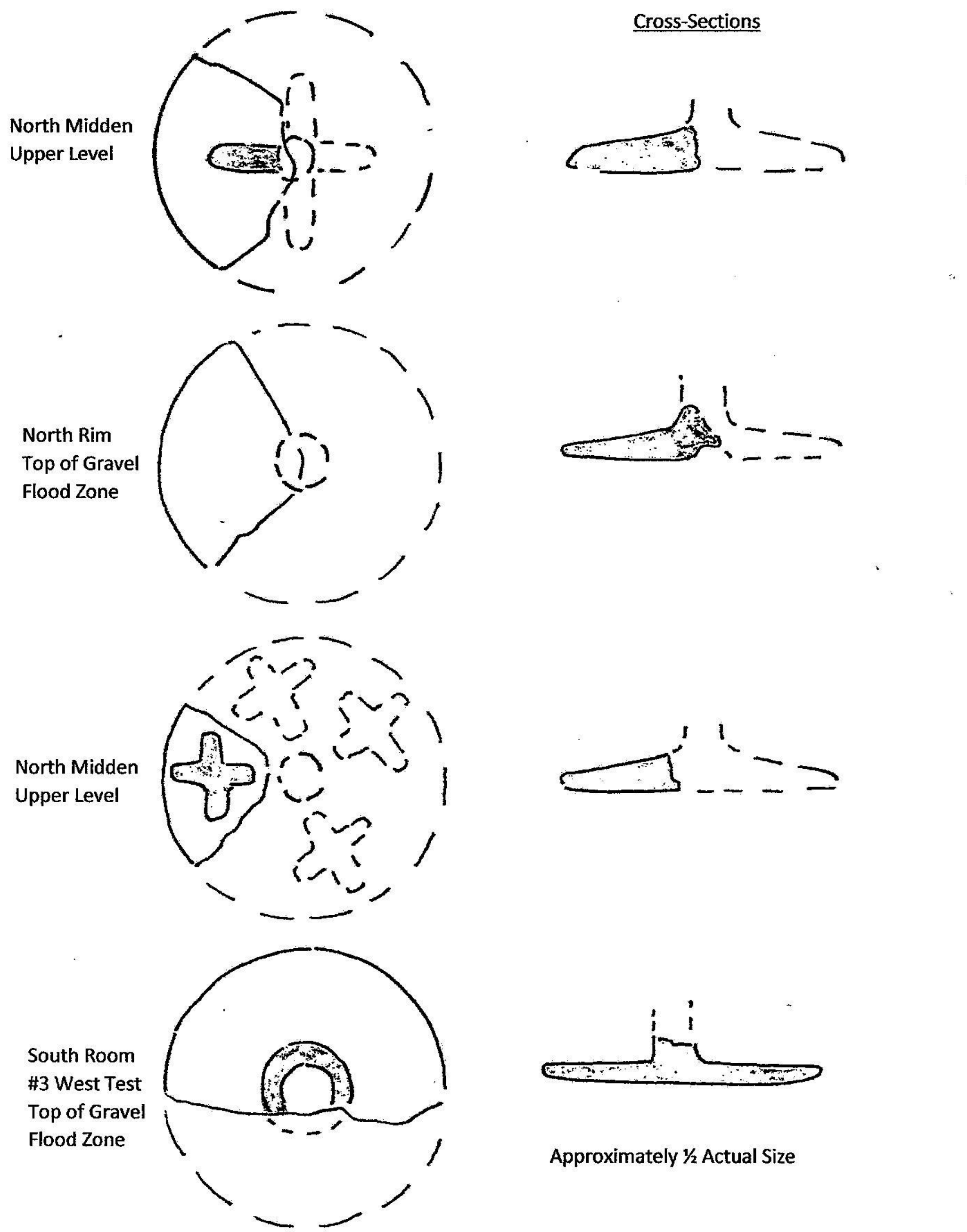

Figure 4. Examples of the candleholder basal disks from the Isleta Pueblo Mission.

specimens (Figure 5). One candleholder reported from Las Humanas (Van Valkenburgh 1979) has a capstan base (inverted cup with an expanded basal rim) similar to the Spanish-made metal candleholders which have been found at San Gabriel del Yunque (Ellis 1989:46), in the Caribbean (https://www.floridamuseum.ufl.edu/histarch/ceramic-types/, accessed December 2020), and at the Pine Ridge, Alabama site (Little and Harrelson 2005). However, the Las Humanas specimen appears to have a somewhat taller stem.

All of the New Mexico Colono form specimens are single candleholders, except one specimen from Giusewa is a candelabra with three candle receptacles. There is also one example of the flat-table holder from Hawikuh, a low tablet with four corner feet and a single pole stem (Burgio-Ericson 2018:911). Since most of the candleholders from seventeenth-century sites are reported as fragments, but not described, other forms may be present. Cross design decorations on candleholder basal disks occur at the Isleta Pueblo Mission, but apparently other holders in New Mexico are devoid of cross decorations, and most are plain and undecorated.

Some of the candleholders in seventeenth-century New Mexico missions were imported bronze, brass, and copper. Examples of these have been found at San Gabriel del Yunque (Ellis 1989:46) and San Lazaro (Fenn 2004:161), and they are mentioned in the Mission caravan supply inventories (Ivey 1993:54) and other seventeenth-century records. Velasco (1672) describes four *candelarios de asófar (brass)* at the Socorro Mission. Imported large pole-type *ciriales* candleholders, usually made of painted and gilded wood, are also mentioned and were used in the church and in processions (Ivey 1993:48). Certainly other candleholders were locally made of wood, some of which were likely of the cross-bar hanging chandelier type commonly used in the eighteenth century (Dominguez 1956:103) and later. A seventeenth-century carved wood table top holder was found at Hawikuh (Burgio-Ericson 2018:782).

Candle lantern boxes reported in the eighteenth century (Dominguez 1956:74) were likely also used in the seventeenth century. These boxes had selenite and perhaps mica panes and would have been useful for windy conditions outside, as well as being decoratively attractive. The use of selenite and cut mica pieces in the decoration of altar areas, retablos, and picture frames would have provided a striking effect in the dark interior of the sanctuary when illuminated by candle. Selenite-decorated altar areas have been identified by archaeological or historic evidence for San Marcos, Hawikuh, Awatovi, and Tajique, and were no doubt present at other missions.

Candle wax was both imported and of local tallow-type manufacture. Indeed, buffalo and sheep tallow candle manufacture was apparently a major industry in seventeenth- and eighteenth-century New Mexico (Simmons 1991:100). Tallow candles were exported to Northern Mexico as early as 1638 (Bloom 1935:242-248; Snow 1993:145). However, import of wax candles into New Mexico continued throughout the seventeenth century (Ivey 1993:55).

Wide-Flanged Soup Bowls

Most of the 42 glazeware soup bowls occur in the early seventeenth-century deposits in the Isleta Mission tests. Glazeware soup bowls occur in traces in the early East Compound deposits (4 specimens in a sample of 1,890 glazeware sherds), but with a higher frequency in the North Midden.

All of the glazeware soup bowls have wide-flanged edges, 3 to 4 cm in width. The few measured rim diameters range from 18 to 20 cm. Most of the soup bowl basins are shallow, but a few are rather deep (Figures 6 and 7) with an abrupt angle change from the flange to the bowl basin. Most are glaze-on-red, but two plain polished off-white specimens were recovered. Some of the soup bowls are decorated with rather crude crosses on the flange, while others have parallel line stripes or zigzag flange designs. Soup bowls are the only Colono form identified in the limited sample of the early eighteenth-century reoccupation deposits at Isleta. These specimens are rather shallow with a wide red-banded flange (Figure 8).

Figure 5. Mexico City Blue-on-cream candleholder fragment No. 2845, Florida Museum Type Collection, Lister Collection, Mexico City Metro Project (https://www.floridamuseum.ufl.edu/histarch/ceramic-types/, accessed December 2020). This specimen is an upper candlestick cup and decorated wide disk wax guard. Similar upper disk wax guards are found on the seventeenth-century candleholders from Hawikuh.

Figure 6. Soup bowls with cross motifs on the upper flange, striped lines, and plain undecorated.

Figure 7. Rim sherd of an early seventeenth-century soup bowl with a 3.5 cm flange and rather abrupt and deep bowl basin edge. This specimen was found in scraping the wall foundations of Convento Rooms 2 and 3.

Figure 8. Comparative example of Isleta Pueblo Red-Banded soup bowl, early eighteenth-century affinity. Red band on flange is 4 cm wide; estimated rim diameter is 20.0 cm.

Soup bowls are the most common Colono form type recorded in seventeenth-century New Mexico estancia and mission sites. However, small, plain, undecorated, hemispherical glazeware cups and bowls predominate in some locations and were obviously manufactured for Spanish use. The most common soup bowl forms are similar to those at Isleta, with a wide-flange, a relatively shallow basin, and a rounded base. Near vertical walls below the flange appear on three specimens from Isleta. Extra-wide flanges with smaller deep central basins and flat bases (like an inverted hat) are common in Tabirá Whiteware at Las Humanas, but also occur in minor glazeware quantities at San Marcos, in Salinas Red, and Plain Redware at Hawikuh. Some of the soup bowl specimens at Las Humanas have a ringed base which is unusual in soup bowl forms. Study of 108 soup bowl rims from the LA 20000 La Cienega Estancia (12 miles southwest of Santa Fe) identified a rim diameter range from 12 cm to 40 cm, with the majority in the 17 to 24 cm range (Connick 2018:65). Regional variation in soup bowl forms among the various seventeenth-century Puebloan subareas has been demonstrated (Dyer 2010:220-241).

Some smaller bowls with narrow flanges and flat bases, such as those common at San Marcos, are sometimes identified as soup bowls, but are more likely a different Colono form type somewhat similar to Isleta examples described below.

Deep Medium-Sized Bowls with Direct or Narrow Flanged Rims

Deep small- to medium-sized bowls with direct or narrow-flanged rim edges found at the Isleta Pueblo Mission are likely individual eating bowls manufactured for Spanish use. Forty-five specimens were recovered in the Isleta Mission tests, all of which were found in the early seventeenth-century deposits. Many of these vessels are decorated with crosses (Figure 9). Bowl rim diameters range from 9.0 to 16.0 cm (12.0 to 14.0 cm size most common). The bowls are rather deep with nearly vertical walls; some exhibit flattened bases. Flanges, when present, are 1.0 to 1.5 cm wide. A few flanges are decorated with ticks or vertical striped lines. These vessels, because of their frequent cross motif decoration and common association with the North Convento Midden (31 of the 45 specimens), were likely manufactured by Isleta potters for Spanish clergy use.

Small and deep bowls with or without narrow rim flanges, similar to those found at Isleta Pueblo, may not have been identified as Colono forms by other investigations. The small, narrow-flanged and shallow bowls at San Marcos, also with occasional cross decoration usually in the center interior of a flat base, are somewhat similar to the Isleta narrow-flanged bowls. Small bowls with narrow everted rims occur in some majolica ceramics and may have been the Spanish model for this New Mexico Colono form.

Cups and Small Hemispherical Bowls

A variety of handled cups has been identified in New Mexico Colono form collections. However, no handled cups were found at the Isleta Pueblo Mission. Instead, it is likely that a number of small undecorated hemispherical vessels were made for use as cups. A few of these may have been ringed based. In some seventeenth-century Spanish sites, such as Estancia Santiago near Bernalillo, there is a high incidence of small, plain, hemispherical cups and bowls (Marshall 2020b). Plain polished glazeware materials are also present in the Isleta Mission collections, especially in the late seventeenth-century deposits. Still it seems rather odd that no handled cups were found at Isleta. Handled pitchers are also rare at Isleta. This suggests that Isleta potters did not prefer to manufacture vessels with welded handles.

Figure 9. Examples of three individual eating bowls with and without a narrow rim edge flange, all with cross motifs on the upper interior wall. These specimens are from the early seventeenth-century deposits in the North Midden area.

In contrast, there is a wide variety of handled cup forms present at other seventeenth-century sites in New Mexico. In the northern Rio Grande—at the San Gabriel del Yunque Spanish capital, Unshagi in the Jemez (Zia Glaze imports), San Lazaro, Paa-ko, Estancia Santiago, and San Marcos—cups with flat bases and coil or strap handles have been found. Rare examples of small, low, unhandled cylindrical cups were found at Pecos (Kidder 1936:274), San Lazaro (Fenn 2004:298), and at Unshagi (Reiter 1938). One hemispherical glazeware handled cup with a ringed base was found at Unshagi (also of Zia Glazeware). Small, but rather tall, unhandled cups with or without ringed bases are common at Las Humanas. Both Pecos and Quarai appear to have manufactured handled cups with a round base and rather tall profile. One Salinas Red specimen from Comanche Springs, 10 miles east of Tome, has a somewhat expanded lower body resembling a small pitcher. Cups found at Hawikuh have coil handles with either a cylindrical body and flat base or are similar to small pitchers with a rounded body (Burgio-Ericson 2018:910, 947).

Ringed-based Glazeware Vessels

Ringed bases are common on Spanish tableware and majolica, as they are on modern dishware. While not a specific Colono form, they are a Colono attribute often found on Puebloan ceramics manufactured for Spanish use. Ringed bases may or may not occur on cups, bowls, pitchers, tinajas, and a few soup bowls.

A few ringed-based glazeware vessels from both early and late seventeenth-century deposits were found at the Isleta Mission (5 from the North Midden and 4 from the East Compound). The specimens from the North Midden (Figure 10) include an apparent plate or bowl with painted cross on the interior base and a 14.0 cm diameter ring on the exterior base. One smaller ringed base (5 cm in diameter) from the North Midden was a probable cup or small cylindrical vessel. The other North Midden specimens have ringed-base diameters of 8.0 to 10.cm and may have been small bowls or other forms.

Figure 10. Upper middle: Ringed-based vessels. Lower middle: Ringed-based bowl or plate with painted cross on the opposite, interior surface. Right: Large, flat sherd of probable rectangular box vessel. Left: Large, thick jar sherd with abrupt angle change, probably from neck area.

Glazewares with Painted Crosses

Glazeware vessels with painted crosses are rather common in the North Midden sample (21 specimens) and occur in traces in the East Compound collection. All of these specimens are associated with early seventeenth-century deposits. The higher number of cross-painted specimens in the North Midden is clearly linked to its location directly adjacent to the Convento Block and the use of these vessels by the clergy. Crosses appear on various Isleta Colono form vessels including soup bowls (4), candleholder bases (2), and deep bowls with or without flanged rims (8). A few are on the interior bases of small bowls or soup bowls (7), one of which has a ringed base. One deep bowl has painted crosses on both the interior and exterior surfaces. The crosses on soup bowls are located on the interior rim flange and perhaps also on the interior base. The crosses are sometimes crucifix (Roman cross) in form, but in other cases have the equal poles of a "+" form (Figure 11). None of the traditional larger Glaze F bowls exhibits cross-painted decorations, indicating that local Isleta potters only applied cross decoration for vessels produced for the Franciscans, not for their own domestic use.

The single specimen from the East Compound was found in the oldest early seventeenth-century deposits of the lower charcoal midden in Test Pit No. 3 at a depth of 3.8 m below the surface. It is a painted cross on the interior flat base of a larger bowl.

Figure 11. Basal sherds of three bowls with cross decorations, all from the North Midden.

Cross decorations also occur on some Colono forms in other subareas. Cross motifs in + or X and double-crossed dragonfly motifs are also common in some late prehistoric ceramics, but in most Colono form specimens the cross motifs were likely considered Christian motifs desired by the Spanish. Plus-like cross motifs are sometimes found on San Marcos and Tewa soup bowl rims and on occasional interior bases. They also occur on soup bowls from Pecos, Tonque, and Chamisal pueblos (Alexander Kurota, personal communication 2021). A cross motif appears in the cup and on the base of the Giusewa chalice, cross motifs are exhibited on a large Hawikuh Polychrome jar from the Purisima Concepción Mission sacristy, and a cross fleury motif decoration with a trefoil on each of the poles was found on a San Bernardo Polychrome soup bowl at Hawikuh (Burgio-Ericson 2018:738, 909).

Boxes (Rectangular Bowls) and Small Box

Four rectangular bowls with flat bases and vertical walls and one small ceramic box or canister with a solid glaze interior were found in seventeenth-century deposits. Two rather thick (11 and 13 mm) flat sherds found in the North Midden (Figure 12) are probable box fragments. These sherds are red slipped with no decoration and are of local manufacture. One is about 9 cm across with a very slight lip at the ends suggesting that it is the base of a box-like vessel. While rectangular flat-based bowls are sometimes found in prehistoric Pueblo deposits, it is likely that these thick-walled vessels were manufactured for Spanish use. Flat-based rectangular bowls, some with a slanted upper rim body are found elsewhere in seventeenth-century New Mexico collections and have been reported from Pecos Pueblo (Kidder 1936:289-290; McKenna 1986:9-11). Vessels of apparent similar form have also been found at Tonque and Paa-ko pueblos and at the Chamisal Site (Alexander Kurota, personal communication 2021). The only majolica boxes noted in a recent review are small ink wells with quill holder holes on the upper rim (https://www.floridamuseum.ufl.edu/histarch/ceramic-types/, accessed December 2020).

Figure 12. Small box-like vessel from East Compound area with thick solid glaze interior. The thick solid glaze application on the interior surface of this specimen suggests that this rather small vessel was used to contain medicinal or other precious fluids. The use of solid glazed interior surfaces is a rare Colono form attribute.

Eccentric Forms

Thick-Walled Jars. Rare, thick-walled, undecorated glazeware specimens were found in the early seventeenth-century deposits at the Isleta Pueblo Mission. They have a high density of temper material and represent unusual forms. It is likely that they were manufactured at Isleta Pueblo for specific Mission purposes. Eight sherds from one rather thick jar (8.0 to 12.0 mm) with a maroon slip and basalt temper were found in the lower charcoal midden zone in the East Compound. This was a large jar with an abrupt angle change in the wall. Another thick (11 mm) polished tan sherd (Figure 10, left), also with an abrupt angle change apparently near the rim, was found in the Lower North Midden deposits. These jars may have been large tinaja-like water containers.

Jar with rim cup. A glazeware jar rim from the Lower North Midden has a small cup attached to the outside rim (Figure 13). The semi-circular cup has a triangular cross-section. There is a drain hole (1.3 cm in diameter) between the cup and the jar made at the time of the vessel's manufacture, and which is located 2.5 cm below the rim. There are small crosses painted on the exterior rim of the cup. This vessel form is not identified at other seventeenth-century mission or estancia sites. The function of this vessel is undetermined.

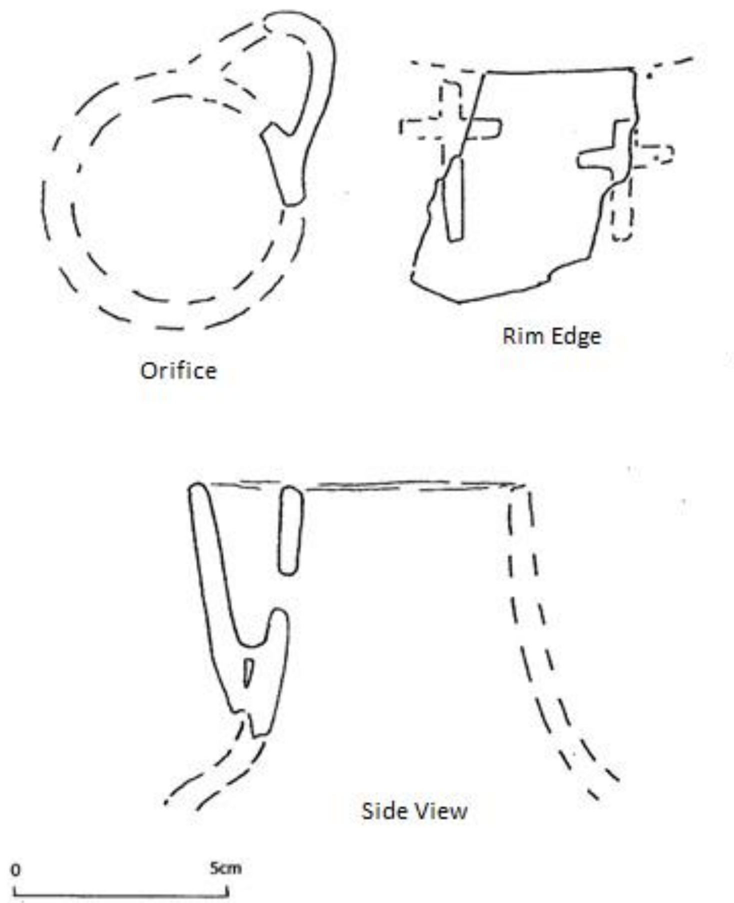

Figure 13. Glazeware jar with rim cup from Lower North Midden.

Discussion

Colono Form Types

The inventory of Colono forms in the samples from the Isleta Mission tests resembles those found elsewhere in seventeenth-century mission and estancia sites. However, there are several New Mexico Colono forms not present in the Isleta collections. Most obvious is the absence of handled cups and pitchers and hollow-stem candlesticks. The absence of handles might be related to a reluctance of Isleta potters to use the coil-welded method, although the solid pole candleholders, unique to Isleta Pueblo, do require a welded joint to the flat disk. Coil handles seem to be common elsewhere in New Mexico and are especially frequent in Colonial Acoma Glazeware and Tabirá Whiteware.

Certain Colono form types identified in New Mexico seventeenth-century collections tend to be rare or specific to certain subareas. However, their absence in the Isleta samples could be due to the limited size of the collection or to the specific proveniences within the Mission complex. Rare specimens reported elsewhere include: a saltcellar (salero), atypically large bowls (fonts) from Hawikuh and Awatovi, a sink (lavabo) and a pharmaceutical jar (albarello) from Hawikuh (Burgio-Ericson 2018), a chalice from Giusewa (Lambert 1981), a bleeding or shaving bowl (a bacia, a wide-rimmed flat bowl with side rim indentations) from Pecos (Penman 2020:210, 220), and three porringers (shallow bowls with wide-lobed rim lug handles), also from Pecos (Penman 2002:212, 218). Porringers are a common form in early Mexican majolica wares (Lister and Lister 1982:15, 32), but very rarely occur in New Mexico majolica or Colono form collections.

Also unique is a candleholder with a capstan base at Las Humanas which was modeled after Spanish bronze candlesticks (Van Valkenburgh 1979). Basin chamber pots (cylindrical, with a flat base, and a sharp flare at the rim edge) have been identified at a number of locations including San Gabriel, Quarai (McKenna 1991), and Pecos, but they are not frequent and apparently are not of the double handled type (Deagan 1987:27). An open cup-like vessel with a two-part footed base sometimes referred to as a ciborium was found at Abó, and is similar to a Mexico City majolica footed bowl (Lister and Lister 1982:15).

There are also a number of Spanish forms which seem to be missing from the New Mexico seventeenth-century Colono form inventory. These include pitchers with open rim spouts, typical chocolateras (usually, handled cylindrical upper body and lower bowl-like body), high ringed-footed bowls, censors, and alembics (two-part distilling vessels). Many of these vessels used in New Mexico were likely imported majolica or metal such as copper pot chocolateras. It is also likely that chocolate drinking cups were small majolica vessels (Snow 2012:46, 59). However, there is a possibility that some small Colono form cups were also used for chocolate consumption, and unwashed samples of these could be tested for traces of theobromine, caffeine, and theophylline, the chemical signature of chocolate (Crown 2012:39).

Lids are rather rare in majolica materials. One reported in New Mexico Colono materials is a domed lid of a San Bernardo Polychrome albarello (pharmaceutical jar) (Burgio-Ericson 2018:910). Similar domed lids were used on saleros (salt cellars), one of which, also a San Bernardo Polychrome, was from Hawikuh.

There are probably a number of eccentric forms such as the jar with a rim cup identified at Isleta which may represent unusual Colono forms yet to be identified. Other ceramic Colono form types include small ceramic plumbing pipes (probably for a convento sink) and roof drainage canales which have been found, to date, only at Awatovi (Brew 1949:Figure 30). Another form possibly unique to Awatovi consists of plainware ladles with perforations in the ladle bowl, much like a large slotted spoon, and having an apparent colander-like function. These have been identified by Hopi consultants as "rain ladles," which could be a post-facto explanation (Kelley Hays-Gilpin, personal communication 2021). These ladles could very well have been used to prepare foods introduced to Hopi by Spaniards or indigenous Mexicans such as boiled tamales (somiviki), or posole for stew (noqkwivi), which today employ the use of metal strainers. This was suggested by a Hopi student at Northern Arizona University in a current Pueblo Ethnology Seminar under the direction of Kelley Hays-Gilpin (Hays-Gilpin, personal communication 2021).

Oil lamps and lamp oil are mentioned in the seventeenth-century Colonial import records (Ivey 1993:55), but none have been found in New Mexico and majolica oil lamps do not appear to have been manufactured. Some ceramic oil lamps in Medieval Europe are of the ancient pinched cup-wicked type and hanging metal types are also known (Egan 2010:127). Those in use in seventeenth-century New Spain were probably of the hanging metal type. However, none apparently have been found in New Mexico.

Majolica tiles of both European import and local Mexican manufacture were in use in sixteenth- and seventeenth-century Mexico and thereafter, as well as in the circum-Caribbean area (Lister and Lister 1982:18, 22, 94; Goggin 1968:Plates 8, 10, 14, 15), but none seem to have been imported to New Mexico. Small and thin bizcocho-like tile fragments decorated with brown matte paint have been found at the Isleta Mission and Estancia Santiago (Marshall 2020a), but it is unknown whether these were used for wall decoration. Fresco secco paintings on church walls and conventos, similar in technique to kiva murals, are present in many of the seventeenth-century missions. Some are solid dado panels, others are done in a quasi-Puebloan geometric and naturalist style. However, a few were painted to mimic Spanish tile or other wall-painted decorations such as those identified at Giusewa (Bloom and Donnelly 1933:94), Awatovi (Montgomery et al. 1949), and Hawikuh (Burgio-Ericson 2018:710-711). There is no evidence to date of Colono tile manufacture in seventeenth-century New Mexico, nor are any tiles, local or imported, described by Dominguez in the late eighteenth-century missions.

Occasional indigenous Mexican ceramic imports and Colono forms are found in seventeenth-century New Mexico villas, missions, and estancia sites (Barbour 2011). They are most often red but occasionally gray-black burnished (bruñido) wares. Many have likely been identified as Tewa Red and Kapo Black types. Indigenous Mexican ceramics most often appear in the Santa Fe area, but are also found elsewhere. They sometimes exhibit fluted depressions in the vessel walls (Snow 1971; Penman 2002:188). A red Mexican bruñido fluted Colono form jar with a ringed base was recently recovered by Michael Bletzer at the Piro pueblo of Sevilleta (LA 774) (Figure 14). An earlier Aztec Polychrome specimen with a ringed base found at Hawikuh is likely a sixteenth-century specimen associated with the Coronado Expedition (Mathers 2019:320). No imported indigenous Mexican ceramic materials were found in the Isleta Pueblo Mission tests.

Figure 14. Imported seventeenth-century indigenous Mexican Red Polished Colono form jar found at Sevilleta Pueblo. Ringed base is 6.5 cm in diameter. (Photograph courtesy of Michael Bletzer.)

The ringed-base jar sherd depicted in Figure 14 was recovered in recent test excavations by Michael Bletzer at Sevilleta Pueblo. This medium-sized jar exhibits a highly polished red slipped exterior and scraped-smoothed buff unslipped interior. The vessel has defined furrows which extend up the lower vessel walls. The visible furrow and part of another near the ringed base suggests that there were 5 or 6 furrows extending up the wall. This type of furrowing is also present on two ringed-base Mexican Red Burnished jars recovered from the seventeenth-century component at the Cochiti Springs Estancia (Penman 2002:188).

New Mexico Colono Form Types and Regional Variability

Colono form ceramics in seventeenth-century New Mexico are those wares manufactured by indigenous Puebloan populations which copied forms or exhibit attributes of Spanish ceramics or Spanish objects of metal and wooden manufacture. Colono ceramics may be copies or near copies of Spanish forms or exhibit European attributes such as Spanish decorative iconography, ringed bases, and rare solid interior glaze on otherwise traditional vessel forms. It is likely that Puebloan Colono form ceramics were manufactured to a large extent for Spanish use and were produced within various Pueblo villages as an entrepreneurial activity for trade to Spanish populations, as tribute products, and for use in resident mission establishments. There is a possibility that some were produced in informal workshops or by servants and slaves under Spanish conscription. All of the New Mexico Colono form ceramics were hand built in traditional Puebloan methods without the use of a potter’s wheel. All of the wheel-made majolica, olive jars, and lead glaze wares found in lesser quantities in association with Colono ceramics are Spanish and occasionally Chinese imports. There is no evidence of local seventeenth-century Spanish ceramic manufacture in New Mexico. Minor quantities of indigenous Mexican Indian ceramics, mostly Red Burnished, were imported, probably via Spanish caravans; some of these ceramics exhibit Colono forms. These materials are most frequently found in the Santa Fe Villa and surrounding estancias (Barbour 2011), but do occur in traces elsewhere (Pecos Pueblo, Sevilleta Pueblo, and no doubt at other sites).

Colono form ceramics in each of the Puebloan subareas not only exhibit different ware characteristics, but there seems to be a good deal of regional stylistic expression in forms and iconography. Much of the regional and local Colono variability within the pueblos is, as yet, poorly known and further study of Colono form materials is needed.

The more remote locations from the main Spanish population centers in the Rio Grande corridor appear to exhibit a higher incidence of the infrequent Spanish form types. These include a high incidence of ringed-based vessels, large jars with handles, a capstan candleholder, and the wide-flanged, deep center basin soup bowls (inverted hat form) in the Salinas Red and Tabirá Whiteware materials, all of which are curiously devoid of Spanish iconography. In contrast, the Zuni Matsaki Polychrome Colono forms have a good deal of Spanish design elements and include the rare sink and font vessels. The San Bernardo Polychrome materials from the Hopi subarea and those exported to Zuni include such rare forms as a saltcellar (salero) and pharmaceutical jars (albarellos), while a font and apparent plainware clay plumbing pieces were found at Awatovi. Some of this variability might be due to direct association with the missions and conventos which would have more materials and forms associated with church activities. Colono inventories from various estancia sites lack these ecclesiastic Colono forms and have more functional assemblages that include soup bowls, cups, and candleholders, as well as occasional other forms.

While not reported in detail, candleholders seem to vary a good deal within the subareas, with coil-made hollow tube holders in the Northern Rio Grande, solid pole types on flat disks at Isleta Pueblo, and cone-based holders with wide upper disk wax guards at Zuni. The only capstan holder identified as yet in New Mexico was found at Las Humanas. Candleholders do, however, appear frequently in both mission-convento and estancia sites and in some areas may have been adopted by seventeenth-century Pueblo populations. Candleholders at Pecos Pueblo were most common in the deposits of the North Pueblo Midden rather than near the Mission (McKenna 1986:14).

Spanish design work on Colono form ceramics appears in certain areas with some frequency, such as the numerous cross motifs on the Isleta Glazeware materials, the occasional crosses on the rim flanges of Tewa soup bowls, and on interior bases of shallow, narrow-flanged, flat-based bowls in the Tano area. Other examples include the trefoil cross and a cross with bars on the outside arms which appear on a Hawikuh Glaze jar from Hawikuh. Also recorded from Hawikuh is a San Bernardo Polychrome soup bowl with lace designs similar to those on Puebla Polychrome (Burgio-Ericson 2018:919). In general, Spanish iconography primarily occurs on Colono forms and is rare or absent on traditional Puebloan vessel forms. Crosses may appear on smaller hemispherical bowls with direct rims, but these are apparently individual serving vessels typical of Spanish rather than Puebloan use.

Certain ceramic attributes, such as ringed bases, small footed specimens, and rare solid glaze interiors, are associated only with Colono materials even if appearing on traditional forms. Also evident is the more frequent use of flat bases, often on cups and small hemispherical bowls, candleholders, and other forms, along with a much higher frequency of plain, undecorated vessels.

It is clear that there is a higher concentration of Colono forms in Spanish-occupied sites such as estancias and the ecclesiastic precincts of the mission establishments than in Puebloan apartments. However, they do occur in Puebloan settlement areas, probably manufactured for distribution to Spaniards or for use by local populations. Locations with frequent Colono ceramics also have the highest incidence of Spanish majolica and other imports. Assemblage samples from these locations usually exhibit a high incidence of undecorated Colono forms, presumably because of the extra work involved in production for trade or tribute, or because Spanish populations found Puebloan iconography offensive, especially if masks or other "pagan" motifs were depicted.

In many of the Spanish seventeenth-century sites and site proveniences there seems to be a low to extremely low incidence of plain utility culinary ware. In the North Midden of the Isleta Convento this was 13.4 percent of the ceramic sample, whereas in some locations, such as the Ojo de la Cabra Estancias 19 miles east-southeast of Isleta Pueblo, the incidence of utility ware was extremely low to nearly absent (Marshall, Bletzer, and Walt 2017). This contrasts to frequencies of 40 to 60 percent in many Pueblo settlements. This low incidence of utility ware may be a manifestation of significantly differing food preparation habits or could be due to the use of copper pots by Spanish populations in the preparation of stews and other products which required boiling. In some cases there appears to be a higher number of outside Puebloan imports in Spanish estancia sites, some from more distant locations, than found in contemporary Colonial pueblos. For example, in the Ojo de la Cabra Estancias collections there is a relatively high incidence of Tewa materials and even a few Pecos Glazewares, none of which were found at the Isleta Mission. It is apparent, based on the incidence of imported materials in the Isleta Mission East Compound stratigraphic section, that there was a higher incidence of Puebloan trade in the early seventeenth century, with a significant decline in the later seventeenth-century deposits. This was perhaps due to the disruption by the Spanish of the earlier trade networks, but also to the abandonment of many pueblos under the Spanish policy of Reducción and the gathering of populations into the mission pueblos where they were subject to control and Christian doctrine.

There is much to learn about the nature of Colono form ceramic production in seventeenth-century New Mexico. In particular, careful study of Colono materials in museum collections is needed as many of these materials have not been adequately described or illustrated. Also, more attention should be given to the provenience location of Colono samples within sites as there appears to be uneven distribution of Colono specimens and specimen types. This is evident at Isleta Pueblo where Colono materials occur with more frequency in the Convento North Room and North Midden than in the midden and construction rubble deposits of the same period in the East Compound. It is also evident that additional care is needed to establish that Colono assemblages are not mixed, as eighteenth-century components sometimes overlie and intrude into seventeenth-century structures and deposits.

The study of eighteenth-century Colono form materials in New Mexico was not attempted in this study, but is a subject of interest. The Post-Revolt occupation of New Mexico, including later generations of New Spain, Mestizo Hispanic, and Genizaro communities was a distinct cultural landscape as compared to the seventeenth century. Many of the Colono forms of the seventeenth century continued to be made, especially soup bowls, and were in use in the general population, including the Puebloans. New forms may have been introduced and some older forms lost. Eighteenth-century Colono form materials in Micaceous Wares appear to have been made, perhaps by Picuris Pueblo, Jicarilla Apache, resident Hispanos, and Genizaros. Many of the seventeenth-century centers such as the Salinas Tabirá area, the Eastern Tiwa, the Piro, Abó, and certain areas of Tano and Eastern Keres were abandoned, ending Colono production there. Still later in the early nineteenth-century with entrance of the Anglo Americans, other forms were introduced and incorporated into Puebloan and other local ceramic industries. The process of adopting new forms and designs of foreign origin, and the indigenous development of new local ceramic art forms, continues today.

Context for Colono Form Ceramics Recovered from the Isleta Pueblo Mission

In the following section, information concerning the context of most of the Colono form materials from the Isleta Mission complex is presented. This includes some information concerning the discovery and limited exposure of the seventeenth-century Convento, and ceramic notes and tables concerning the two sample areas of the North Convento Room and adjacent North Midden.

In 2015, the existing North Placita Rectory Roomblock at Isleta Pueblo was razed in preparation for the construction of a new church office complex. Monitoring of this demolition and documentation of the block was completed by M. Marshall, resulting in a set of unpublished drawings, notes, and photographs. Much of the North Placita Block was relatively modern with adobe blocks (modern standard size 25 by 35 cm, tan sandy soil), milled lumber, and metal-framed window construction. However, sections of west area Rectory Block and the West Room above the Wine Cellar were of terron block construction and had some older hewn timber door and window lintels. Terron block construction appears to have been introduced to New Mexico, perhaps as early as the 1820s, by Anglo American populations, many of whom had formerly occupied cut-sod block houses on the Great Plains. In 1845, the Isleta Convento was reported to be in ruins, but was subsequently rebuilt about the time of the American occupation (Kessell 1980:222, based on Chavez Archives).

The subterranean Wine Cellar at the west end of the block was in use in recent times. However, structural evidence of a refilled lateral entry in the south cellar wall indicates that it was part of the older eighteenth-century Convento structure mostly razed in the early Territorial period. To our great fortune, the faced excavation of the wine cellar walls exposed sections of the seventeenth-century Isleta Mission Convento into which the eighteenth-century wine cellar intruded. Sections of two rooms, constructed with large white adobe blocks (colonial size, 58 by 27 cm and 10 cm thick) and set on the cobble substrate were exposed, as was a midden deposit adjacent to the North Room. We had but three days to clean, document, and obtain samples of these features before the cellar was refilled and construction resumed. We were able to map the stratigraphic profiles and excavate a small area of the North Room and the adjacent North Midden. The artifacts recovered from these relatively small excavation areas are identified in the following tables, and it is from the North Midden immediately outside of the Convento from which most of the Colono form ceramics were obtained.

In 2016 when grading in anticipation of actual construction of the office complex was initiated, we traced the Convento foundations across the Placita (Figures 15 and 16) and under the South Placita Roomblock. A separate report concerning this Convento block and its extension under the existing South Placita roomblock is in preparation. The east wall of this Convento Block was also exposed in the south face of the wine cellar (Figure 17). However, in the Placita area only the lower foundations of the seventeenth-century Convento remained intact. It is apparent that at least this section of the seventeenth-century Convento was razed, probably soon after the reoccupation of the Pueblo in 1709. Some of these adobe blocks were likely reused in the construction of the Post-Revolt Mission Church which was roofed in 1718 (Windes and McKenna 2011).

Figure 15. View of Convento foundations crossing the Placita 20 meters east of the present Mission Church. Refilled area of the Wine Cellar is in lower right frame. View to the southwest. Note three-adobe-wide east wall of the Convento Block and two-adobe-wide wall on the west. Smaller enclosures in the central room are adobe storage bins.

Figure 16. Adobe foundations of exposed Convento Block crossing the Placita. View to the North. Refilled area of the Wine Cellar and the North Room and North Midden is in the upper frame beyond the low bank. These lower foundations are at the level just below the original floor surfaces and were built in 30 cm deep trenches into the lower cobble substrate. This building had been razed to the lower foundation, probably during the early Post-Revolt period for reuse of the adobes in the early eighteenth-century mission buildings.

The Wine Cellar Excavations

The Wine Cellar was exposed following the 2015 demolition of the North Rectory Roomblock and the West Rectory Room above it. Prior to the refilling of the cellar, the archeological exposure and cleaning of the north, south, and west cellar walls was completed (Figure 17). This exposure of the stratigraphic sections resulted in the discovery of the foundations of the seventeenth-century Convento Roomblock (Figure 18), and a midden deposit adjacent and north of the block. Test excavations were then completed within limited areas of the North Room of the Convento Block and the adjacent North Midden. Some information concerning the wine cellar discoveries is presented in the following notes in order to provide a context for the Colono form material recovered from the Wine Cellar tests.

The North Room

The west wall of the North Room and a 4.6 meter east-west profile of the room were exposed in the wine cellar wall. The west adobe wall of the North Room is 60 cm thick and rests directly on

Figure 17. 2015 Wine Cellar excavations involved facing the cellar walls and cleaning the exposed stratigraphic sections which exposed remnants of the seventeenth-century Convento foundations and a North Midden stratigraphic section.

Figure 18. Detail of south face of Wine Cellar profile. Large, three-adobe-wide wall resting on cobble substrate is the east wall of the seventeenth-century Convento Block shown in Figures 15 and 16. The narrow wall to the right (west) is the side of the re-filled lateral entry into the eighteenth-century Wine Cellar. Terron blocks visible in upper section are the south wall of the Early Territorial Period extension of the eighteenth-century North Placita Rectory.

the cobble substrate at a depth of 1.8 m below the surface. The lower floor of the room and the base of the adjacent North Midden both rest on the topsoil covering the substrate. Thus, a shallow 20 cm foundation trench was excavated for the placement of the North Room wall onto the firm base of the cobble foundation. The North Room had two floor surfaces separated by a 20 cm thick zone of clean and coarse sand and pebbles which probably originated from an unusually high river flood event. An informal hearth found on the surface of this flood deposit was likely from temporary use of the room following the flood. A new upper floor, consisting of a 5 cm thick clay preparation, was placed over the flood deposit indicating reoccupation of the room (Figures 19 and 20). The North Room subsequently burned, as indicated by the oxidized upper floor surface and the wall and roof fall above. This debris consists of burned and unburned adobe fragments, melted adobe, and burned beam fragments. Since all of the ceramic materials found within the North Room are of seventeenth-century affinity, it is probable that the North Room was burned during the Pueblo Revolt along with other structures in the Pueblo.

The upper 60 cm of deposits above the North Room and the adjacent midden are Post-Revolt and partly disturbed by construction of the nineteenth-century Rectory.

Figure 19. North Room profile. West wall of North Room rests on cobble substrate. Lower floor was on original topsoil at time of construction. Upper floor at tip of arrow. Gravel flood zone between the floors. Upper burned floor and burned adobe and beam fragments in fill above the floor indicate probable destruction of the Convento building during the Pueblo Revolt.

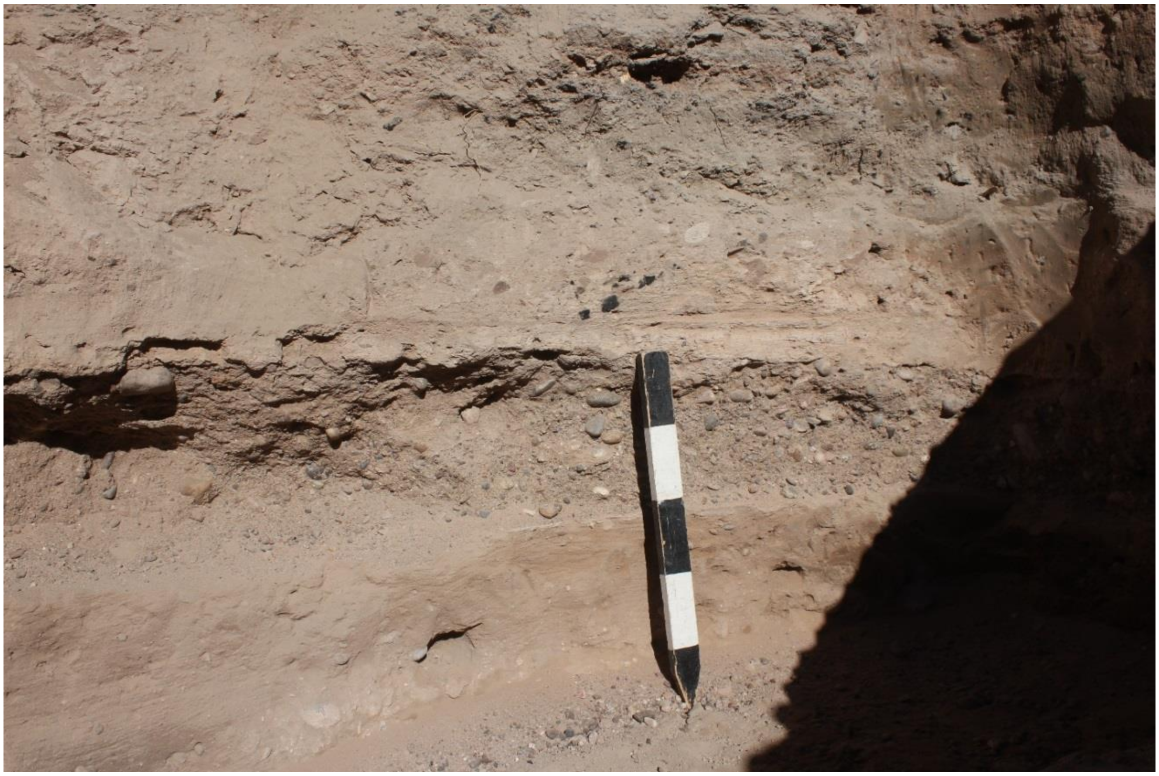

Figure 20. Detail of gravel flood zone between upper and lower floors the North Room. A similar flood zone was found in a test under the South "School" Roomblock. In both locations, late glazeware ceramics were found above and below the flood zone. Also in both locations, a candleholder fragment was found directly on the upper surface of the gravel, suggesting a nighttime visitation of both rooms to assess the flood damage. This flood surged over the level of the pueblo bench in the Mission area about 22 feet above the adjacent present flood plain. A major Rio Grande flood recorded in the historic records in 1665 that lasted three months may have been this unusual event (Scurlock 1999:44).

North Room Ceramic Notes. Very few artifacts were recovered from the North Room provenience area, in part due to the small excavation area (Table 1). In fact only 27 earthenware ceramic fragments were obtained in the 1.1 cubic meter excavation area. Only 3 glazeware sherds were found on the lower floor, all of which are Glaze F rim forms. A total of 7 sherds was found in the inter-floor flood deposit, 5 basalt-tempered utility sherds and 2 glazeware sherds, one of which is a candleholder base. A total of 11 sherds was found on the burned upper floor and included 7 glazeware sherds (including 1 soup bowl and 1 bowl with a flat base), 2 basalt-tempered utility sherds, and 1 early Acoma Matte Paint sherd. This is a jar body sherd with a red motif outlined in black matte paint (Figure 21).

The burned wall/roof fall deposits also had few ceramics, including 4 glazeware sherds (one Glaze F rim) and 3 sherds of a single probable Western matte paint bowl. This bowl was of hemispherical form with a direct rim and red maroon slip on both the interior and exterior. The traces of Western Matte paint ceramics on the upper floor and wall/roof fall suggest that at least some Acoma matte paint production began just before Pueblo Revolt.

Table 1. Ceramic and Other Artifacts from the Isleta Convento North Room.

Pueblo Ware/Type	**Lower Floor**	**Gravel Lens**	**Upper Floor**	**Room Fill**	**Total**
Utility Ware-Basalt Temper		5	2		7
Glazeware					
Scoria Temper		1	5	2	8
Basalt Temper	2	1	2	1	6
Sand Temper				1	1
Rhyolitic Tuff Temper	1				1
Western Red Slipped				3	3
Acoma Matte Paint			1		1
Total Ceramics	**3**	**7**	**10**	**7**	**27**
Other Materials					
Green Glass	3				
Mexican Yellow-Green Glaze			1		
Chipped Stone		2			
Red Sandstone Spall		1			

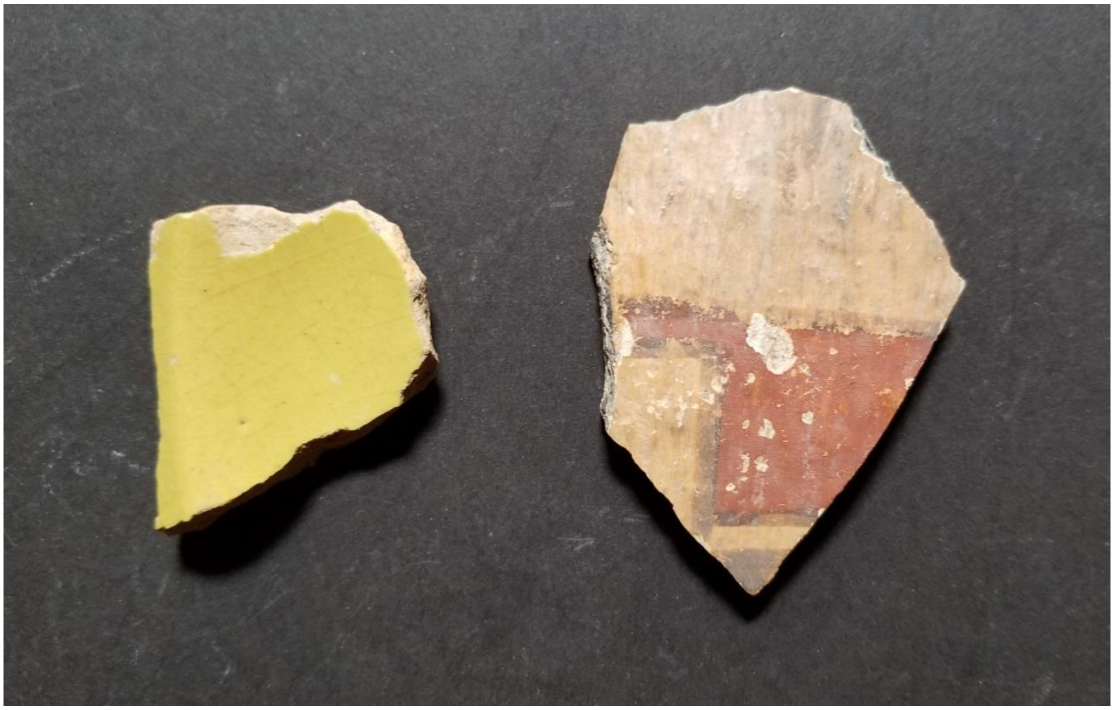

Figure 21. Mexican yellow-green glaze bowl sherd and early Acoma Matte Paint jar fragment from upper floor of North Room.

The only Spanish materials found in the North Room are a fragment of a yellow-green Mexican glaze vessel on the upper floor (Figure 21) and three fragments of a thin, dark blue-green glass vial on the lower floor (Figure 22).

Figure 22. Three glass fragments of a thin, dark blue-green vial from lower North Room floor (early seventeenth century). Largest fragment is 1.0 cm. in size.

The North Midden

The North Midden deposit was identified in the north cellar profile face west of the North Room directly outside and adjacent to the Convento building. This deposit consists of a 70 cm zone of midden fill located from about 80 cm to 1.5 m below the surface and resting directly upon the top soil of the "original" early seventeenth-century ground surface. The midden area subject to excavations was only 2.1 cubic meters. The midden consists of a series of horizontal ash and charcoal bands, with the densest deposits and highest artifact frequencies in the lower 50 cm. Part of the midden had been removed by the excavation of the north lateral entry into the Wine Cellar.

The ceramics found in the North Midden resemble those from the lower stratigraphic zone in the East Compound excavation area (Marshall 2012, 2015a) which are believed to date to the first half of the seventeenth century. The North Midden, as discussed in detail in the ceramic notes (below), contains a high incidence of glazeware ceramics of European form, as well as numerous glazeware vessels decorated with crosses. It is clear that this assemblage is directly associated with the Franciscan occupation of the adjacent convent buildings.

Two radiocarbon dates from the lower section of the North Midden, both of which were obtained from annual cultigen seeds, were analyzed. These samples processed by Direct AMS Radiocarbon Dating Services tend to confirm an early-to-middle seventeenth-century affinity for the lower midden deposits. The oldest date (Sample No. 2) was a carbonized bean seed found in the lower section of the North Midden. This sample dated to 1606 plus or minus 23 years. This suggests that the North Midden deposit is associated with the early period of the San Antonio de la Isleta Mission which is historically dated to about 1612-1613. Another sample (No. 1, a corn kernel) taken from the same level dates to 1642 plus or minus 23 years and thus could overlap with the bean sample during the period between 1619 and 1629.

North Midden Ceramic Notes. There seems to be no significant difference in the ceramic samples recovered from upper and lower levels of the North Midden (Table 2). In both levels there is a low incidence of Utility Ware (13.4% in the total North Midden sample) compared to the seventeenth-century samples from the East Compound (45%). Most of the glazeware materials (80%) are tempered with either scoria or basalt and are likely of local Isleta Pueblo manufacture.

Table 2. Ceramic Wares/Types and Other Materials Frequencies from the North Midden.

Pueblo Ware/Type	**Upper Section**		**Lower Section**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Utility Ware					145	13.4
Sand Temper	7	3.2	10	1.3	17	1.7
Basalt Temper	31	14.1	83	10.9	114	11.6
Granitic Temper	2	1.0	12	1.6	14	1.4
Glazeware					834	84.9
Sand Temper	7	3.2	19	2.5	26	2.6
Crushed White Rock Temper	6	2.7	17	2.2	23	2.3
Rhyolitic Tuff Temper	34	15.5	90	11.8	124	12.6
Basalt Temper	41	18.6	199	26.1	240	24.4
Scoria Temper	85	38.6	329	43.2	414	42.2
Western (sherd)			1	0.1	1	0.1
Tonque	6	2.7			6	0.6
Acoma Matte Paint	1	0.5			1	0.1
Unidentified			2	0.3	2	0.2
Total Ceramics	**220**		**762**		**982**	
Other Materials						
Chipped Stone	1		20			
Red Sandstone Spalls	3		7			
Onyx Spall			1			
Selenite			1			

A total of 34 large bowl rims was recovered from the North Midden and all are Glaze F forms. Identified Colono form specimens occur in relatively high numbers and it is likely that many of the glazeware body sherds are from Colono forms. The identified Colono form sherds from the North Midden include: 7 candleholder fragments, 38 soup bowls, 31 medium-sized deep bowls with or without narrow rim flanges, 6 ringed-based vessels, 2 thick flat sherds, 1 thick jar sherd with an abrupt angle change, and 1 jar with an attached rim cup. There is a total of 86 identified Colono form sherds in the collection, of which 21 have painted crosses. Also present is one glazeware spindle whorl fragment. The number of Colono form specimens in the North Midden greatly exceeds the much larger East Compound collection (Marshall 2015), probably because the North Midden is directly outside the Convento and was likely a Franciscan direct discard area.

Glazeware rim forms from the North Midden deposits consist of a predominance of large bowls with typical Glaze F rims, direct or narrow rim edge flares on small-to-medium Colono bowls, and wide-flanged soup bowls. Those identified in the scoria-tempered group from the North Midden (Figure 23) and in other glazeware temper groups show no significant difference between the upper and lower North Midden deposits.

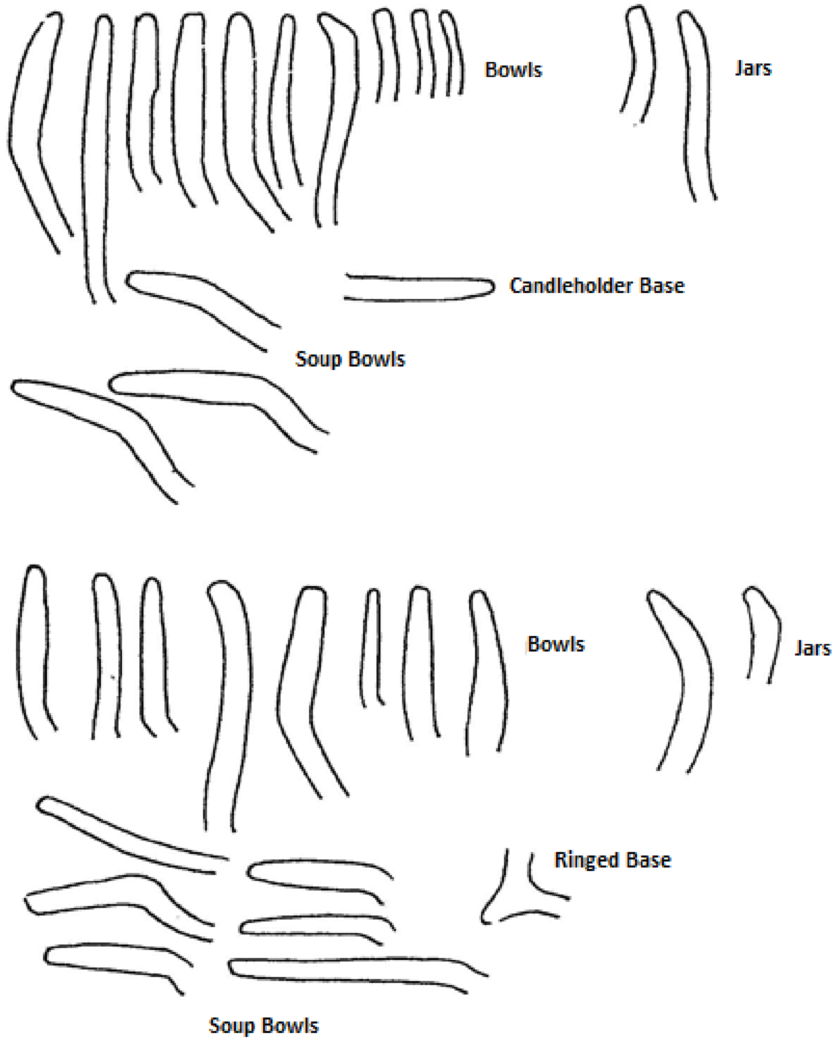

Figure 23. Scoria-tempered glazeware rim forms: Upper group is from upper North Midden; lower group is from lower North Midden.

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The Isleta tests were conducted as a preservation effort and recommendations for avoidance of intact cultural remains were followed in the subsequent building project. For the most part this involved the design of a shallow building pad and the monitoring of various utility trenches.

Research concerning Colono forms in seventeenth-century New Mexico was greatly assisted by Cordelia Thomas Snow. Her help is much appreciated. Information on European metal candleholders and oil lamps and reference to the Aztec Polychrome specimen from Hawikuh was provided by Clay Mathers. Comments and observations by Colonial scholars David Snow and Michael Bletzer were also provided. Illustrations were formatted by Elizabeth Marshall. I am grateful for the edits of this report completed by Peter McKenna and Gretchen Obenauf and the constructive comments provided by the Pottery Southwest Editorial Board—Alexander Kurota, Hayward Franklin, Kari Schleher, and Kelley Hays-Gilpin.

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SOURCING SURFACE TREATMENTS ON WHITEWARE CERAMICS FROM SOUTHEAST UTAH GREAT HOUSE COMMUNITIES

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Introduction

Previous elemental research on ceramics from Chacoan Great Houses in southeast Utah produced unexpected results. Whereas painted whiteware serving bowls are traditionally thought more likely to be traded or procured from further away than grayware cooking pots, neutron activation analysis (NAA) of the ceramic pastes of white- and grayware sherds from these communities found the opposite (Glowacki et al. 2015). The current project used laser ablation inductively-coupled plasma-mass spectrometry (LA-ICP-MS) to examine the surface treatments (slips and paints) of a subset of the same whiteware sherds to determine whether the source areas and procurement groups suggested by chemical signatures of the surface treatments (slips and paints) correspond with those previously determined for the paste/bulk chemistry of the sherds. Better understanding of the composition and sourcing of surface treatments can offer important insights about the nature of pottery production and trade in the ancient Southwest, such as revealing differences in procurement networks and in sources for different components of pottery making.

Glowacki and colleagues' (2015) NAA study of ceramics from Great House communities identified statistical differences in the pastes and bulk composition of the whitewares, noting three distinct compositional groups. The current project, using LA-ICP-MS, assesses whether the surface treatments correspond to those same groups or not. Specifically, we investigate the following: 1) whether the slips on the sample sherds separate out into the same or different groups than the previously identified paste groupings (or whether there is no significant grouping among slips), 2) whether the paints on the sample sherds separate into the same or different groups than the previously identified paste groupings (or whether there is no significant grouping among paints), and 3) whether the slips and paints have similar grouping patterns to each other.

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Background

The use of LA-ICP-MS has been successful in previous archaeological studies for separating and analyzing particular components of pottery and thus being able to trace the sources of the clay, paint materials, or inclusions of these ceramics (e.g., Sharratt et al. 2009; Halperin and Bishop 2016; Gehres and Querré 2018). In the Chacoan Regional System (ninth to twelfth centuries), multiple studies have used a combination of NAA and LA-ICP-MS to determine pottery material procurement strategies as well as ceramic exchange networks. Using the micro-sampling capabilities of the laser in LA-ICP-MS it is possible to separately analyze ceramic sherd components (i.e., clay and temper) and compare the identified groups to those identified by NAA bulk chemistry and petrography. This has been accomplished in Mexico, for example (Stoner and Glascock 2012). In the American Southwest, LA-ICP-MS has been used to infer different paint composition groups for ceramic sherds (Van Keuren et al. 2013). Energy dispersive X-ray fluorescence (ED-XRF) has been used to expand on the findings by determining paint composition on whole vessels (Ferguson et al. 2015). The methods from these studies have helped inform this project. Compositional groups for the bulk composition of ceramic sherd paste at Chacoan Great Houses in southeast Utah have already been established (Glowacki et al. 2015), so this study used those data as a reference point for designing the sampling strategy used in this project. By identifying similarities and differences in composition (and therefore potential similarities and differences in source locations), these cited studies have proved valuable in improving understanding of the procurement networks involved in ceramic production systems.

This study assesses whether the surface treatment compositions reflect similar groupings to the paste compositions. The idea that certain components of ceramic production are exchanged or procured at different distances, or have more or less specific recipes than other components, has been observed in previous research. For example, Arnold (1985:56) observed that potters traveled greater distances to procure surface treatments (slips and paints) than pastes and tempers. Potters today have commented that slip recipes have to be more precise (have a narrower set of particular requirements) than paste recipes. This could correspond to Arnold's observations of people traveling farther to procure slip clays and it could indicate that slip clay composition may be more similar across different groups than paste clay. Van Keuren and colleagues (2013:680) noted in their LA-ICP-MS study of Southwestern redware glaze paints that very specific recipes and ingredients were required to make each glaze paint type.

The Chacoan Regional System ushered in a change in economics, community philosophy, political structure, and inter-community interaction that transformed the Ancestral Pueblo world (Cameron and Duff 2008; Glowacki et al. 2015; Lekson 2006). It was a period of significant long-distance interaction and trade in the Southwest. The system flourished from circa A.D. 850 to 1150 in southeast Utah, southwest Colorado, northeast Arizona, and northwest New Mexico, and was centered on Chaco Canyon near present day Farmington, NM (Lekson 2006). This regional system has been identified in large part by architectural similarities at community centers called Great Houses, a series of Chaco roads throughout the region, and patterns of material good exchanges. A series of Great Houses in Chaco Canyon is thought to have influenced Chaco outlier (outside of Chaco Canyon) Great Houses (Lekson 2006).

Two such outlier Great Houses are Bluff and Comb Wash, both in southeast Utah on the northern edge of the Chacoan Regional System (Figure 1). Bluff Great House was constructed and occupied from the late 1000s to the middle 1200s, and thus had both Chaco and post-Chaco era occupations. It consisted of a multi-story Great House structure with more than 50 rooms, 4 community ceremonial structures called kivas, 2 roads leading to it, and a berm surrounding part of it (Cameron 2009). This complex, at the confluence of Cottonwood Wash and the San Juan River on the east side of Comb Ridge, was surrounded by a community of smaller sites (Cameron 2009). In contrast to Bluff, the Comb Wash Great House is located on the west side of Comb Ridge near the confluence of Mule Canyon and Comb Wash (Glowacki et al. 2015). It consisted of approximately 50 rooms, 5 kivas, 2 roads leading to it, towers, and a shrine. The Comb Wash community primarily differs from the Bluff community in that the Great House was constructed and occupied in the thirteenth century following the decline of the Chacoan Regional System, although there was settlement in smaller sites in the vicinity during the Chaco era (Hurst and Cameron 2015).

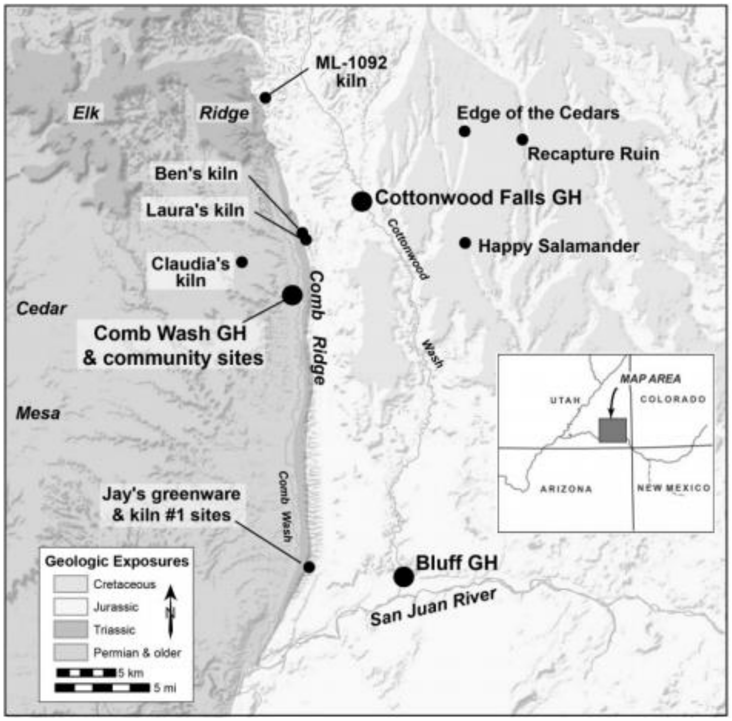

Figure 1. Map of the Study Area (from Glowacki et al. 2015).

Archaeologists have been surveying and excavating in the area of Bluff and Comb Wash since 1875. The ceramic collections analyzed in this project came from two field projects: the Bluff Great House Project and the Comb Wash Testing Project. The Bluff Great House Project, directed by Dr. Catherine Cameron of the University of Colorado, Boulder, lasted from 1995 to 2004, and included both mapping and excavation work. The excavations concentrated on the Great House, great kiva, and berm (Cameron 2009). The Comb Wash Testing Project was a five-year cooperative effort between the Bureau of Land Management and the University of Colorado, Boulder. The project had three field seasons (2002-2004). Sites in the Comb Wash Campground, as well as the Comb Wash Great House, were mapped and had sub-surface testing, also under the direction of Dr. Cameron.

A recent analysis project that utilized the collections from these two field projects was the Glowacki and colleagues project previously discussed. That project sought to identify the source locations of Chacoan and post-Chacoan ceramics west and east of Comb Ridge. NAA of the ceramic paste of graywares (corrugated cooking jars) and whitewares (serving bowls) identified five compositional groups relevant to this project. Groups 2 and 3 were both associated with corrugated jar production using resources from east of Comb Ridge. Group 4 was whiteware bowls made with materials from west of Comb Ridge, and Group 5 was whiteware bowls made with materials from east of Comb Ridge. The surprising find was that the grayware sherds from corrugated jars at Comb Wash (west of Comb Ridge), thought to be made locally with local materials, were actually procured from east of Comb Ridge in both the Chacoan and post-Chacoan periods. The whitewares, however, thought more likely to be traded and procured from a distance, were procured locally at each Great House. Comb Wash's whiteware sherds (mostly the post-Chaco Mesa Verde Black-on-white type, with a few Chaco-type Mancos Black-on-white) were of materials from the west side of Comb Ridge (Group 4). Bluff's whiteware sherds (both the Mancos and Mesa Verde types, Figures 2 and 3, respectively) were of materials from the east side of Comb Ridge (Group 5). Group 7 was a less significant grouping of whiteware sherds. Sherds in Group 7 did not have a consistent historical connection (i.e., a particular Great House-to-procurement-location pattern). For the LA-ICP-MS project, the results of which are discussed below, the researchers selected the whiteware sherds that were most representative of Groups 4, 5, and 7, respectively, to analyze the surface treatments and assess whether they had the same sourcing patterns as the pastes and whether they too seemed to come from the local procurement networks near each Great House.

Figure 2. Mancos Black-on-white (Wilson 2020).

Figure 3. Mesa Verde Black-on-white (Wilson 2020).

Sampling Strategy

While in residence at the Elemental Analysis Facility at the Chicago Field Museum, the first author examined a sub-sample of the Mancos (Chaco era) and Mesa Verde (post-Chaco era) black-on white sherds from various contexts in both Great House areas to assess whether these same groupings would hold true for the surface treatments (paints and slips) of these ceramics and assess whether further investigation of these potentially new patterns in Southwest procurement and trade networks is warranted. Unusual or unexpected patterns of serving ware procurement and exchange could have important implications for understanding the nature of relationships between communities during and after the Chacoan Regional System, as well as transforming archaeological thinking on the value and effort invested in utility versus special goods.

Glowacki and colleagues (2015) identified three groups of whiteware sherds: Groups 4, 5, and 7 (the other groups were graywares or other wares). The sample chosen for surface treatment analysis included 26 black-on-white sherds from the Comb Wash Great House (42SA24756), split among groups 4, 5, and 7, and 26 black-on-white sherds from the Bluff Great House (42SA22674), also split among groups 4, 5, and 7, for a total of 52 sherds. We also tried to have the Mancos and Mesa Verde black-on-white types represented for both sites because of the chronological style implications.

Given this information, Ferguson reviewed the original data (Glowacki et al. 2015) to see which samples were most representative (based on the highest probability of group membership calculated using Mahalanobis distance) of Groups 4, 5, and 7. These samples were selected for the Field Museum LA-ICP-MS analysis when possible. Sometimes the researchers had to select less representative samples from further down the list because the most representative ones were missing surface treatment. Each sample sherd selected was smaller than 5 centimeters in order to fit in the standard chamber for LA-ICP-MS. A list of the final samples selected can be obtained by contacting the lead author. The artifacts were recently transferred from the Department of Anthropology at the University of Colorado, Boulder, to the Edge of the Cedars Museum in Utah for permanent curation.

Analysis Methodology

The analyses were carried out at the Field Museum of Natural History in Chicago, with a Thermo ICAP Q Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) connected to a New Wave UP213 laser for direct introduction of solid samples. To sample the paint or slip, scan line mode was selected. Scan line mode (where the laser moves across the sample in a line) was selected instead of scan spot mode (where the laser analyzes one spot on the sample) because line scanning provides at least equal, if not better, information about the distribution of elements and isotopes than spot scanning while requiring less time (Prohaska et al. 2015). A first pass was set up to clean the surface of the sample to avoid contamination, with the following ablation parameters: laser beam diameter of 110 μm, operating at 50% of the laser energy (0.1 mJ), a pulse frequency of 10 Hz, and scan speed of 70 $\mu m.s^{-1}$. The analyzed material was sampled using a laser beam diameter of 100 mm, 80% of the laser energy, a pulse frequency of 10 Hz, and a scan speed of 40 $\mu m.s^{-1}$. For each sample, the average of two to five measurements corrected from the blank is considered for the calculation of concentrations, to try to minimize errors and account for inconsistencies that would produce outlying readings, such as cracks in the slip or paint. The isotope Si29 was used for internal standardization. Concentrations for major elements, including silica, are calculated assuming that the sum of their concentrations in weight percent in glass is equal to 100% (Gratuze 1999). Fully quantitative analyses are possible by using external standards: SRM 610 and SRM 679 manufactured by the National Institute for Standards and Technology. Certified values are available for a very limited number of elements. For SRM 610, concentrations from Pearce and others (1997) will be used for trace elements. These standards were used for this project.

Results

Slip-Clay Compositional-Analysis Results Compared to Paste-Clay Groups and Site-Based Provenience

The LA-ICP-MS analysis did not reveal distinct slip groups that corresponded with either NAA paste groups (Figure 4) or sites (Figure 5). As shown in Figure 4, the selected elemental plot (Th and Be) was the plot that showed the most separation, but even this separation does not reflect a significant patterned difference in slip among the groups. As shown in Figure 5, the confidence ellipses (group ranges) for the slips from the Comb Wash and Bluff sherds overlapped. So, whereas the whiteware pastes sorted into three distinct source or recipe groups in the NAA study, the slips lacked significant clustered patterns across all those groups.

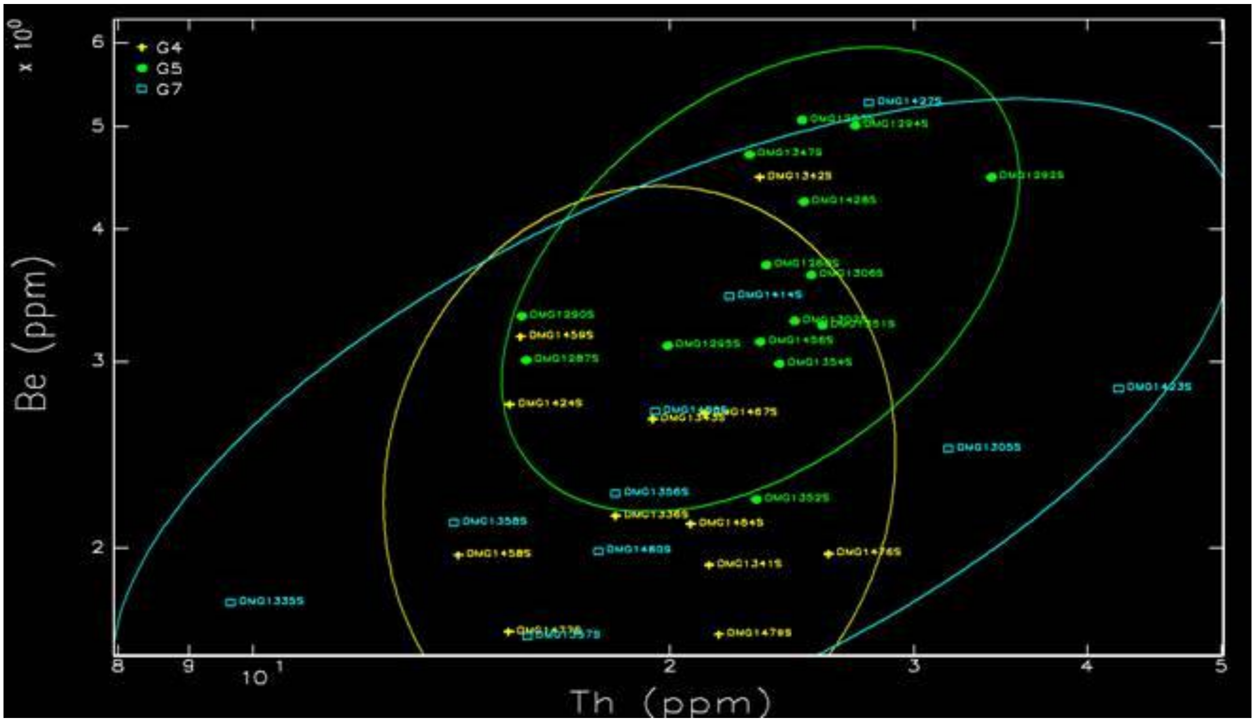

Figure 4. Slip chemistry by NAA paste group. Sherds from NAA group 4 are shown in yellow, NAA group 5 in green, and NAA group 7 in blue. There is not a significant patterned difference in slip among the groups.

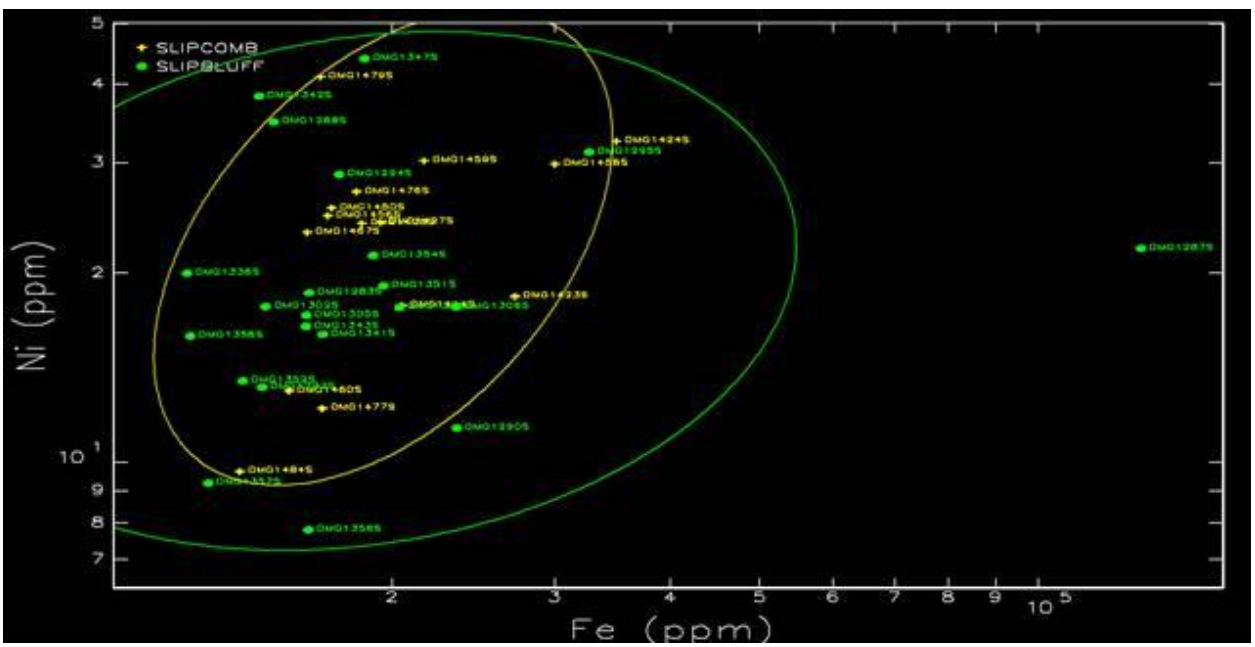

Figure 5. Slip chemistry by site. Sherds from Comb Wash Great House are shown in yellow, and sherds from Bluff Great House are shown in green. There was not a significant distinction in slip chemistry between the two sites.

Paint Compositional Analysis Results Compared to Paste-Clay and Site Groupings

Of the 52 sherds analyzed, only 26 had paint still visible on the 5-cm analysis specimens. The LA-ICP-MS analysis revealed two types of paints used on those 26 sherds for which paint composition was tested. The first type is called "iron black" (FeO). They are all about 10-28 percent iron concentration (about 12.8-36 percent iron oxide). The iron black is perhaps comprised of wustite, a mineral form of iron, or may be non-stochiometric iron oxide (Jeffrey Ferguson, personal communication 2019). There is no indication of manganese-based black. In Figure 6, the iron black samples are the ones with the higher iron (Fe) concentration.

The majority of the iron blacks correlate to NAA paste Group 5 (Figure 6), which is the only group that shows some consistency when slips are examined as well. NAA paste Group 4 only had one iron black paint sherd (Figure 6). The iron blacks might have some sub-groups; for example, three of the sherds were tightly grouped in every analysis conducted, but it is difficult to assess because of the small sample size that had iron black paint (n=14). It is also difficult to assess because the iron predominated the elemental signature for all the iron blacks, and the researchers did not detect significant amounts of, or patterns in, other elements that might have been expected to be correlated with the iron and that would have been more informative for grouping and distinction.

The second paint group is the carbon paint group. Since carbon content is not determined with LA-ICP-MS, the paint in this group was assumed to contain carbon because the sherds were Mesa Verde black-on-white that were determined by LA-ICP-MS **not** to have iron black paint on them. Previous archaeological and ethnographic studies have shown that the black paint on Mesa Verde black-on-white pottery and certain other Southwestern ceramic types tends to be made from organic matter, particularly plants such as Rocky Mountain beeweed, and thus the black pigment in these types is derived from carbon (Wilson 2020). There were twelve samples with carbon paint. There were no distinct carbon paint sub-types/sub-recipes, nor did the carbon paints correlate to one particular NAA group. For the sherds with carbon paint on them, their paint signatures and slip signatures grouped in a closely similar pattern. Neither the iron blacks nor the carbon paints grouped by site (Figure 7).

Correspondence of LA-ICP-MS Analysis with Southwest Ceramic Paint Types

This study showed that organic (carbon black) and mineral (iron black) paints can be distinguished from each other using LA-ICP-MS. The samples identified using LA-ICP-MS as iron black were identified previously by Southwest ceramicists as Mancos black-on-white sherds. The black paint on Mancos ceramics is usually mineral paint, whereas the black paint on Mesa Verde ceramics is usually organic paint (Wilson 2020). LA-ICP-MS technology detects the iron in the mineral paints, and since charred organic material is not detectable using LA-ICP-MS (the LA-ICP-MS laser will read through the charred organic material to what is underneath), the carbon paint samples will have a signature similar to the underlying slips.

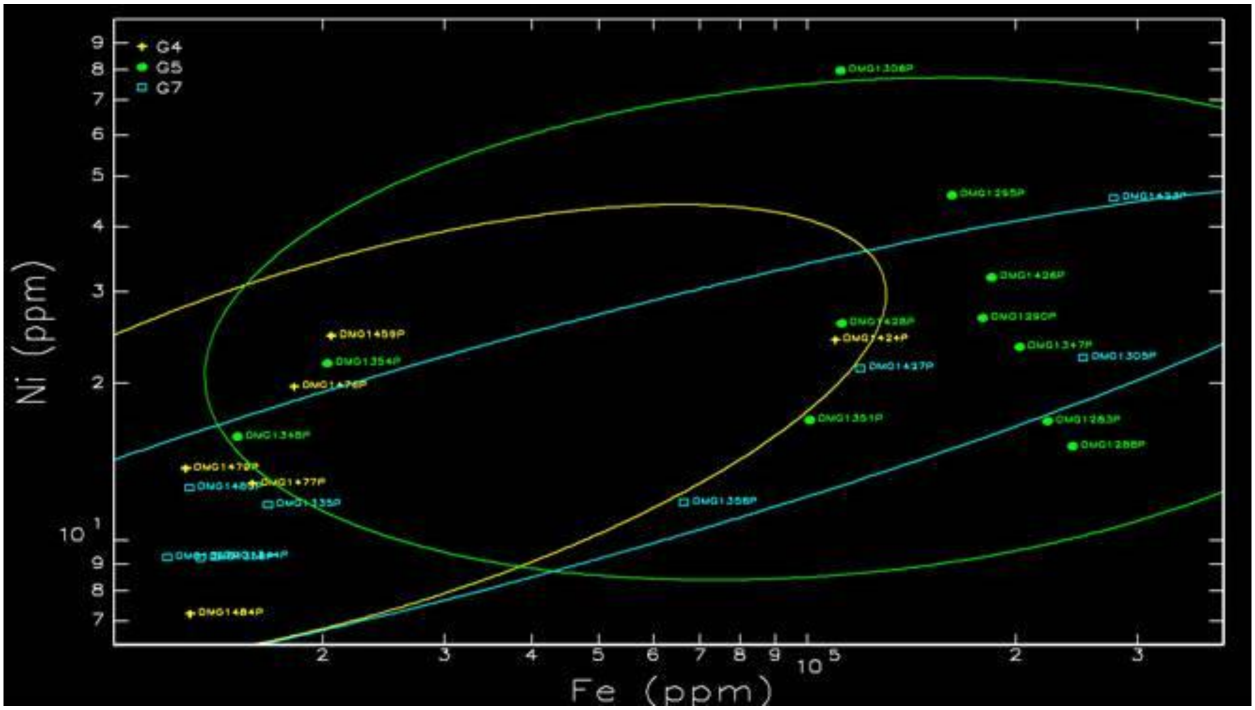

Figure 6. Paint chemistry by NAA paste group. Sherds from NAA group 4 are shown in yellow, NAA group 5 in green, and NAA group 7 in blue. The paints seem to split into two groups based on Fe (iron) concentration, but the groups do not necessarily align with the NAA groups.

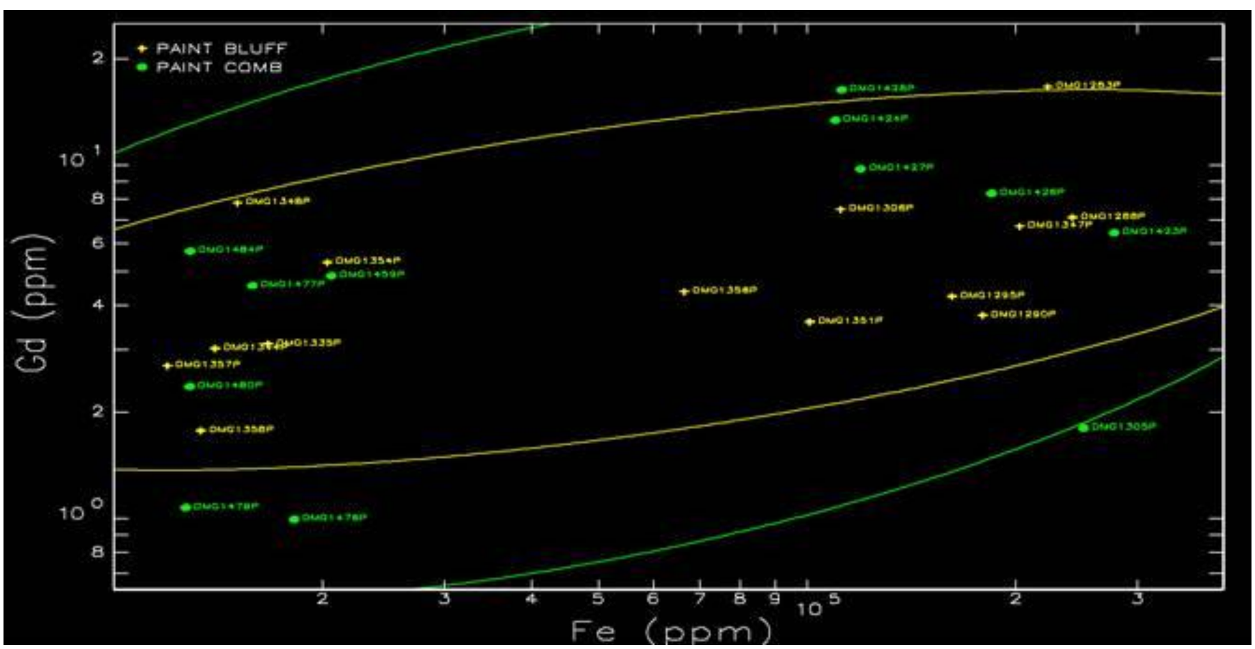

Figure 7. Paint chemistry by site. Sherds from Comb Wash Great House are shown in green, and sherds from Bluff Great House are shown in yellow. The paint groups do not correspond to the sites.

Temporal Sourcing Changes? Comparing Mancos and Mesa Verde Samples

As discussed in the previous paragraph, Mancos (Chaco era) and Mesa Verde (post-Chaco era) black-on-white samples had different paint composition signatures. There was not a paint composition distinction between the two study sites within the Mancos samples, nor between the two sites within the Mesa Verde samples. In Figure 4, there is a slight grouping (or distinction) of slip composition between the two types, with Mesa Verde samples being clustered toward the bottom of the graph. However, this grouping is not separated enough to be considered significant at this time. In summary, surface treatment analyses showed that Mancos and Mesa Verde ceramics are compositionally distinct from each other, but Bluff Great House Mancos samples were not distinct from Comb Wash Great House Mancos samples (same for Mesa Verde) with regards to surface treatments. However, with regard to paste, the Glowacki and colleagues (2015) study did show a distinction between the paste composition of Bluff and Comb Wash Mesa Verde samples. The subsequent sourcing of these compositionally distinct pastes revealed that the two communities were focusing more on local (and thus distinct) whiteware pastes in the post-Chaco period (Glowacki 2015).

Results Summary

In summary, the results of the LA-ICP-MS analysis of surface treatments suggest that there were two kinds of paints used: carbon black (organic) and iron black (mineral). The majority of the iron blacks correlate with NAA paste group 5, which is the group from which the majority of Mancos (mineral paint) sherds were sampled. The carbon black paints seem to closely resemble the slips in terms of grouping, which would make sense if the same or similar raw material is just pigmented with a bit of charred organics or mineral graphite (carbon) to make black and the laser is primarily ablating the underlying slips. All of the slips seem to overlap with each other with regard to the NAA groups, but NAA paste group 5 seems to be the most internally consistent in surface treatments (meaning that the elemental compositions of the surface treatments of the sherds in NAA paste group 5 were more tightly clustered/similar to each other than those of groups 4 or 7 were to each other). Group 5 slips have a higher concentration in a few elements compared to Groups 4 and 7. Groups 4 and 7 slips do not have key elemental distinctions from each other. However, even group 5's surface treatments were not clustered or grouped distinctly enough to be statistically significant, and the sample size of each of the surface treatment types in this study was relatively small.

Possible Implications

If methodological differences are not the source of the patterns observed in the data, then the results imply that this sample of sherds from southeast Utah Chacoan Great Houses, for which the paste clay compositions are distinct and presumably reflect different, particular source areas, have slip clays and paint material that are less distinguishable in a patterned way than the paste clays were. Furthermore, this suggests that the slips and paints do not come from the same distinct groups, or were not sourced from the same three distinct areas that the paste clays were sourced from. The fact that there was not grouping of slip clays into distinct source-area groups (whether similar or different to the paste clay groupings), and that the paints could not be grouped beyond the carbon/mineral distinction, suggests less distinction and less grouped variation in slip clay recipes and paint recipes than in paste clay recipes.

For the paints, the predominance of iron in the mineral (iron black) paints makes it difficult to distinguish other elemental signatures that would be useful for further group distinctions, and the carbon paint signatures are not distinct enough from the slip signatures to make group assessments for the carbon paints. This would help explain why the variation in paint did not group according to site or NAA paste groups. However, being able to differentiate mineral and organic paint using LA-ICP-MS is an interesting point of note for Southwest archaeologists. Previous studies have demonstrated the improved accuracy of scanning electron microscope assessment of paint types over visual assessments (Stewart and Adams 1999). The results in this current study provide further support for the argument of the utility of LA-ICP-MS, specifically, for mineral versus organic paint distinctions, which was made in another study (Speakman and Neff 2002). Repeating this analysis with a larger sample of iron black paint sherds would help assess whether or not distinct groups/sources of iron black (mineral) paints can be detected.

The results for the slips are more interesting because they suggest the scale of use of slip clays was broader than the scale of use of body clays. This could be because clays with good properties for slip were harder to come by. They either come from a single source, or the constraints on the needed properties resulted in potters choosing material of the same composition wherever it occurred. The fact that the samples do not have patterned grouping based on surface treatment composition makes the second possibility (similar recipes/properties, different sources) more likely. This means that the slips are likely more compositionally homogeneous due to potter selection and/or being from various, yet geologically homogeneous, locations. This pattern in the material record and archaeological record aligns with contemporary potters' reports in which they attest that slips require a more precise recipe, and thus there is less variation and more homogeneity among slips, whereas pastes and paints can have more variation (Gregory Wilson and Scott Ortman, personal communication 2019). These data also echo findings from earlier compositional analyses of Mesa Verde black-on-white ceramics. For example, a micro-XRF analysis of Mesa Verde ceramics from Goodman Point Pueblo demonstrated that paint recipes had more variation than slip recipes (Glowacki and Stech 2017). As seen with the outlier in Figure 5, LA-ICP-MS can identify ceramics made in the local, or common, style, but with different materials. Thus, there is potential to identify ceramics of a locally common style that were brought in from a different location, therefore adding nuance to the understanding of trade and interaction networks.

A potentially interesting take-away for archaeologists is that compositional groups may vary depending on which constituent of the object one looks at, and there may be situations where the granularity of resources and groups is different depending on which attribute of an object is being focused on. Whether these results add anything to the narrative of ancestral Pueblo society depends on whether the slips are consistent because of trade from the same source or because of stringent selection of compositionally similar materials. A slip clay survey would be required to connect the slips on the artifact sherds to their source(s) to assess this. A larger sample size would also help illuminate any further historically informative groupings.

Finally, data that demonstrate differences in variation among the different components of a vessel—paste/temper (wall construction), slip (surface preparation), and paint (decorative materials)—are relevant to understanding the material realities of the procurement and production process. For example, the raw material required for iron black mineral paints might be not be as readily available near a village as the beeweed required for organic paints, so the chronological shift from mineral to organic paints might impact how much paint that village can procure locally. Also, in addition to slips requiring a more precise (and thus more homogeneous) recipe than paste clays, as previously discussed, part of the reason that the Glowacki and colleagues (2015) paste study showed more distinct groupings than this surface treatment study could be because a larger—and more costly to transport—quantity of paste clay is required for vessel formation. These larger quantities are likely to be sourced from local, more varied sources. The smaller quantities of materials necessary for finishing (slip clays and paints) could be more easily and widely traded, while adhering to more precise compositional criteria. In other words, differences in procurement distance and diversity among the various components of pottery manufacture could be, in part, a product of the differences in quantity of material needed for each stage of vessel construction and the differences in the time investment in and visibility of each stage of vessel construction. Comparing the composition of materials produced in two different economic systems (the Chacoan Regional System and the post-Chaco era) also demonstrates how changes in regional networking and cohesion are reflected in raw material choices. Materials may have been circulating more frequently and from greater distances during the Chaco era. With all these interpretations of and inferences from compositional data, it is important to keep in mind that, firstly, materials having similar composition does not always mean the materials share the same source location; it may mean the source locations had similar properties. Secondly, multiple factors can impact the extent of the procurement networks of different materials, from amount of material needed to the status of regional trade systems.

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MULTISPECTRAL IMAGING OF SOUTHWEST CERAMIC PIGMENT: A PILOT STUDY OF PIGMENT USED ON FIVE BLACK-ON-WHITE CERAMIC TYPES

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Abstract

Multispectral imaging cameras are frequently used in art conservation for identifying pigments, as well as for monitoring change in pigments over time. Multispectral cameras take multiple images at 370nm, 448nm, 476nm, 499nm, 519nm, 598nm, 636nm, 700nm, 735nm, 780nm, 870nm, and 940nm wavelengths with UV bandpass, visible bandpass, and long pass filters to increase the range of captured information to include UV reflectance and fluorescence emission images. This pilot study explores the ability to utilize this non-destructive technique to analyze variability of pigment recipes within ceramic types and between types. Mineral and organic black pigments from five black-on-white ceramic types (Jemez, Cortez, Chuska, Red Mesa, and Abiquiu) from the American Southwest were used for comparative purposes. Pigment and reflectance values acquired from images via Image J software (open source freeware) were compared both within types and between types with one-way ANOVA analysis. Results show varying levels of significant statistical difference between types and minimal difference within most types sampled.

Introduction

Background

Southwest Pigments. Ceramicists in the American Southwest have used variation in black paint to distinguish cultural groups (Shepard 1939), to explore relationships between social groups (Wilson 1996), as well as to place ceramics within a chronological order (Hawley 1929). This is partly possible due to the basic variations that exist between organic (carbon based) and mineral paints (typically iron or manganese mixed with an organic component). The basic distinction between organic and mineral paints can be easily differentiated with the use of heat or hydrofluoric acid treatment (Colton 1953:20). Due to the difficulties of determining some of the organic components of pigment, much of the focus on Southwest pigment recipe identification has focused on glazewares, which are easier to distinguish from each other due to their mineral composition (Van Keuren et al. 2013; Duwe and Neff 2007; Habicht-Mauche et al. 2006; Huntley 2008; Huntley et al. 2012; Speakman and Neff 2005).

Clarification of black pigment recipes would enable us to answer many questions in the American Southwest. One major question that could be answered with a large-scale pigment database is the influence of migration and social interaction in terms of its impact on ceramic production. Within the Rio Grande region, three periods of migration or outside influence are suggested by three different occurrences: (1) the change from mineral to carbon pigment around A.D. 1200, (2) the commencement of Galisteo Black-on-white around 1220, and (3) the initial production of Rio Grande glazewares between 1310 and 1350 (Cordell 1995:204). These key changes are also associated with changes in pastes, pigments, rim styles and sizes, slips, temper, ceramic styles, and motifs within different areas of Southwest, all of which have been used to bolster differing arguments of the impact or influence migrations have had on ceramic production (Mera 1935; Shepard 1939; Shepard 1942; Wendorf 1954; Reed 1949; Ford et al. 1972; Wilson and Blinman 1993; Wilson 1996; Graves and Eckert 1998; Kohler et al. 2004; Ruscavage-Barz 2002; Washburn 2013). Washburn's critiques of the current state of migration studies (2013:35-36) include our inability to accurately look at migration patterns due to design elements that are ubiquitous across types and the common assertion that widespread presence of types represents interaction. It is hard to argue against this as many studies have focused on small regional areas (e.g., Douglass 1985; Habicht-Mauche 1995) and are thus unable to detect the universal aspects of ceramic production.

What could aid with these migration versus influence studies would be a large-scale geographical study that incorporates numerous ceramic types as well as a more inclusive approach to the elements being studied. Most aspects of ceramic production (i.e., clay, style, and temper) have been well researched in the American Southwest. However, most discussion of black pigment is limited to whether or not it is mineral or carbon based. Thus, studies on migration and interaction are failing to look at large scale patterns of pigment recipes. The reasons why a large-scale black pigment study has never been conducted within the Southwest are multifaceted. First, the visual error for identification of pigment as mineral or carbon varies. One study noted an average error of 15.8 percent and up to 57.9 percent for black-on-white varieties from the Mesa Verde area (Stewart and Adams 1999). Such error rates indicate that chemical analysis should be performed; however, this then becomes a cost limiting factor for most studies, and thus the reason large geographical areas have not been compared with each other.

The second reason why a large-scale black pigment recipe study has not been conducted may be due to the inherent principles of ceramic theory of how pigments are acquired and how data are interpreted. Pigments are not considered significant ceramic resources when compared to clays, fuels, and water (Arnold 1985:20). However, they are still affected by resource feedback mechanism. Resource feedback mechanism either limits or stimulates ceramic producers based upon (1) the quality or appropriateness of resources and (2) the distance to the resource. The factor of distance is further differentiated based upon (1) the straight line distance between two points (geodesic distance), (2) the time to cover the topography (pheric distance; see Arnold 1985), (3) energy expended to bring back supplies (transportation costs), and (4) the social and psychological cost incurred during the separation from one's social community (Arnold 1985:33). What makes studying these aspects difficult with pigment is that cross-culturally there are individuals who are willing to travel greater distances for pigment, and there is more variability in distances traveled for pigments and glazes than for clay and temper (Arnold 1985:32, 36). This means that there may be considerable overlap of resource areas being exploited by different cultural groups, or a differing interpretation could also be made of interregional contact and exchange (Arnold 1985:37, 60).

To get beyond these problems, ceramicists who have studied glazewares have attempted to apply different chemical analysis techniques to further tease apart the differences between sources. However, the disadvantage of using techniques such as pXRF (portable X-ray fluorescence) and LA-ICP-MS (laser ablation-inductively coupled-plasma mass spectrometry), and any of the other compositional analysis techniques, is that they are not capable of truly deconstructing a pigment recipe, which is what is needed to fully understand black pigment. Pigment recipes are more than just the specific ingredients that go into them; they are also the knowledge of processes and procedures for making them (Huntley 2006:108). Therefore, pigment recipes were probably relatively uniform; however, a recipe could easily produce differing results due to variations in firing attributed to lack of control (Blinman et al. 2012; Huntley 2008; Rands and Bargielski Weimer 1992; Rhodes 1957:150-151). However, if we can determine the amount of variability in black pigment recipes within types, we may be able determine the number of possible nodes of production and how they relate geospatially. Multispectral imaging may be a method that can be used to analyze variability within and between types.

Multispectral Imaging. Multispectral imaging (sometimes referred to as hyperspectral imaging, depending on the discipline) is a process that takes multiple images at specific wavelengths along the electromagnetic spectrum, including those beyond the visible range (Figure 1). This typically involves high-end camera equipment and numerous lens filters. Software utilized to capture and process the images makes it possible to analyze the spectral reflectance of specific aspects of the object photographed. This reflectance is dependent upon the scattering properties and characteristics of the material under investigation (Clark and Roush 1984; Hapke 1993).

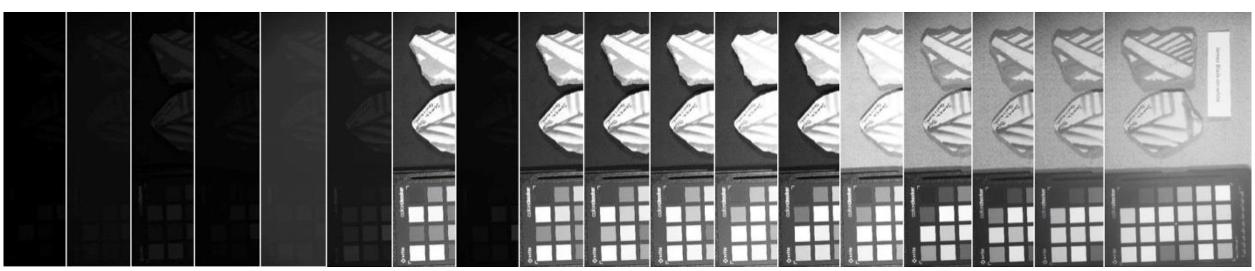


Figure 1. The images that are produced through the multispectral imaging process. The image on the far left is the 370nm wavelength, while the far right is the 940nm wavelength.

This technology has been utilized by conservation departments around the world since the early 1990s and shows promise in the realm of non-destructive archaeological artifact analysis through multi-spectral imaging of artifacts (Liang 2012). Multispectral imaging was first used in the 1980s for the purpose of remote sensing (Goetz et al. 1985). It has since spread to other fields of study, including medicine (Levenson and Mansfield 2006), agriculture (Lamb 2000), and food safety and processing industries (Gowen et al. 2007).

It is not possible to rely upon this technique for determining the elemental composition of pigments; however, scientific techniques such as elemental compositional analysis (i.e., pXRF, Raman spectrometry, and LA-ICP-MS) can be used in tandem with multispectral imaging to create a baseline of spectral curves of known pigment recipes based upon other forms of analysis. Similar comparisons have been successful in the field of art conservation where multispectral images of known pigments were used to identify pigments in other works of art (Cucci et al. 2016; Toque et al. 2009; Zhao et al. 2008; Havermans et al. 2003; Melessanaki et al. 2001; Baronti et al. 1998; Hoeniger 1991). Multispectral imaging also allows conservators to visualize underdrawings (Ricciardi et al. 2009) and analyze the degradation of objects (Marengo et al. 2004; Marengo et al. 2011). It is these capabilities provided by multispectral imaging which will allow archaeologists to compare the range of multispectral variability between recipes.

Methods

All images were taken with a Phase One IQ260 Achromatic camera equipped with integrated software and hardware along with two integrated light emitting diode (LED) illumination panels. The camera is equipped with an apochromatic macro AF 120mm lens and has a 60 megapixel 16-bit monochrome digital back and an 8964 x 6716 pixel CCD array at a 6.0 micron pixel size. The LED illumination panels are able to emit wavelengths of: 370nm, 448nm, 476nm, 499nm, 519nm, 598nm, 636nm, 700nm, 735nm, 780nm, 870nm, and 940nm. These lights work in tandem with the six-position motorized filter wheel that contain a UV bandpass, visible bandpass, and long pass filter to increase the range of captured information to include UV reflectance and fluorescence emission images.

Two sherds each of the Jemez Black-on-white (Figure 2), Cortez Black-on-white (Figure 3), Red Mesa Black-on-white (Figure 4), Chuska Black-on-white (Figure 5), and Abiquiu Black-on-white (Figure 6) ceramic types were selected from the Museum of Indian Arts & Culture's (MIAC's) H. P. Mera Reference Collection located at the Center for New Mexico Archaeology in Santa Fe. All images of sherds (Figures 2 through 6) included in this article were taken from the multispectral image at the 476nm wavelength. Colored dots on the images correspond to the area where reflectance data was measured.

Sherds of the same type were photographed together with a scale and color checker that allowed for calibration of pigment and reflectance data (Table 1) which was then exported from the Image J software and plotted as a spectral curve. These spectral curves were visually and statistically compared to each other. Statistical analysis to compare different ceramic types included one-way ANOVA (Table 2) and paired t-tests (Table 3) of the reflectance values.

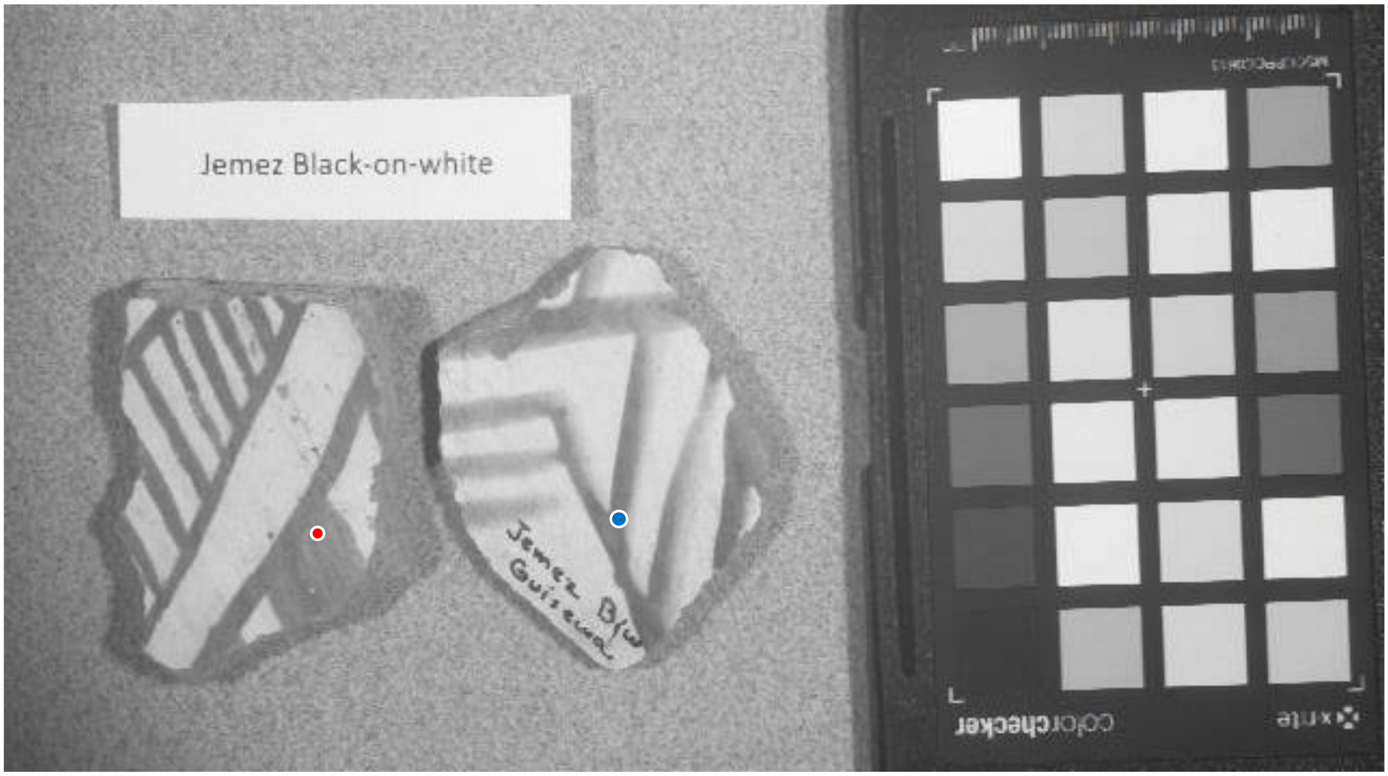
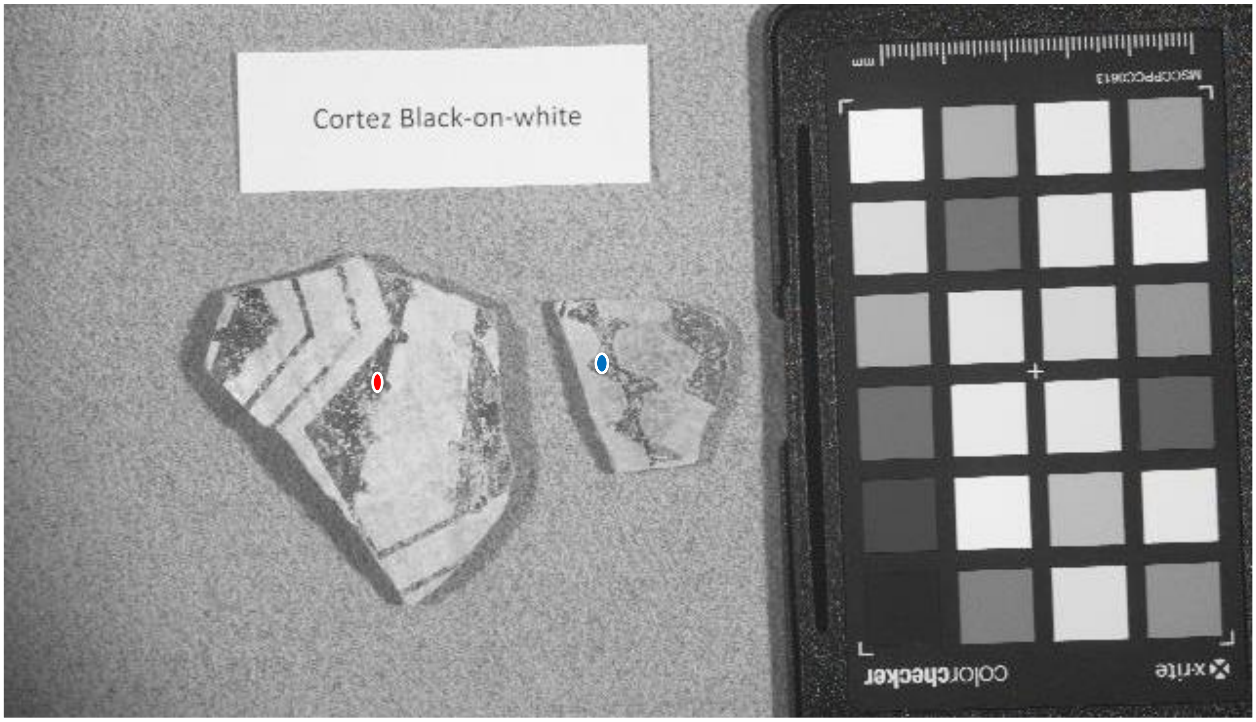


Figure 2. The Jemez Black-on-white sherds multispectral-imaged for the study. The red and blue dots correspond to the area that reflectance values were taken from and plotted in the adjacent graph. Collections of the Museum of Indian Arts & Culture/Laboratory of Anthropology, Museum of New Mexico, Santa Fe, NM.



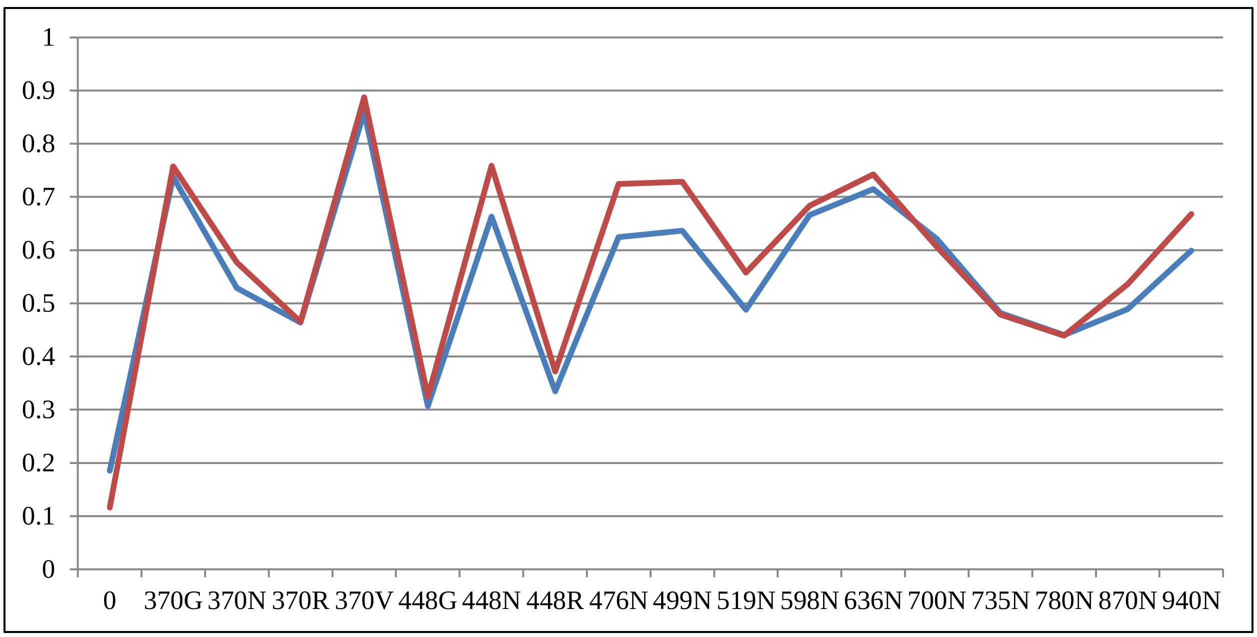
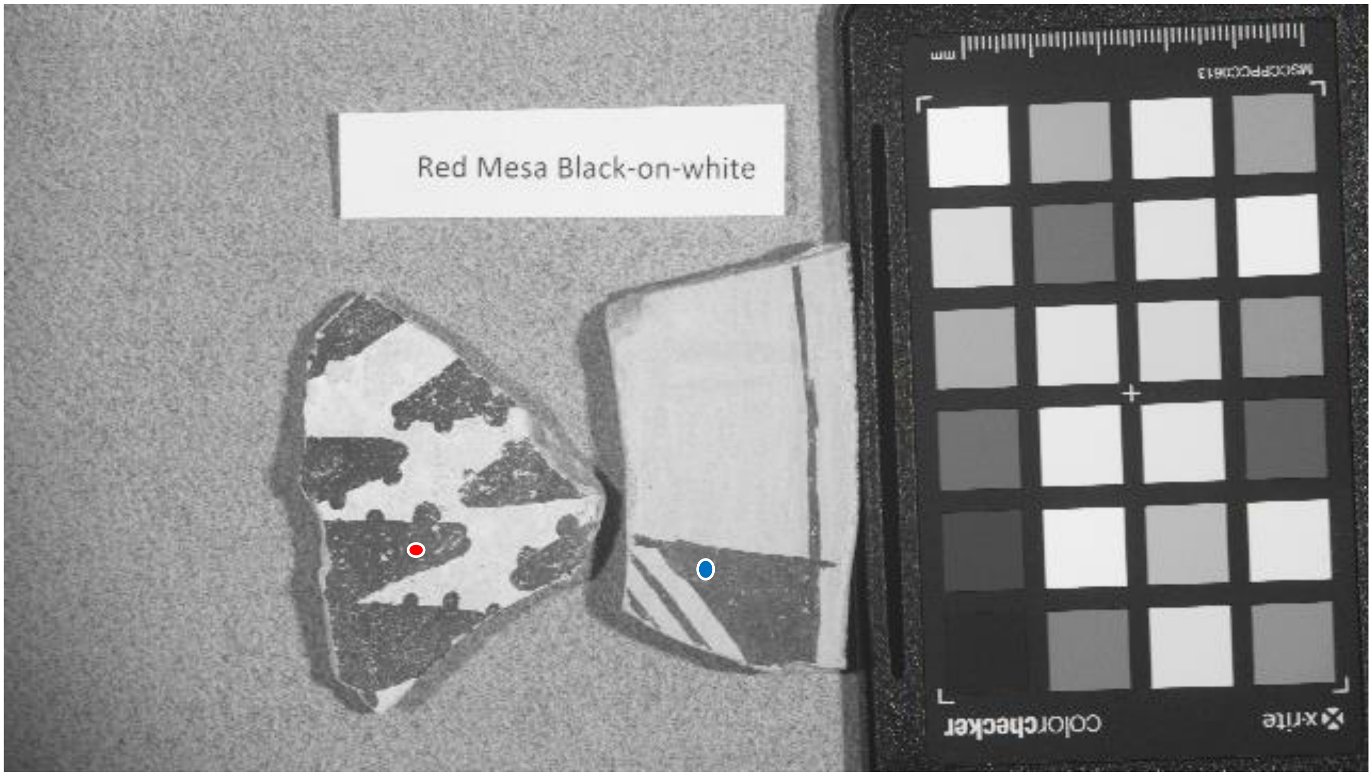


Figure 3. Cortez Black-on-white sherds multispectral-imaged for the study. The red and blue dots correspond to the area that reflectance values were taken from and plotted in the adjacent graph. Collections of the Museum of Indian Arts & Culture/Laboratory of Anthropology, Museum of New Mexico, Santa Fe, NM.



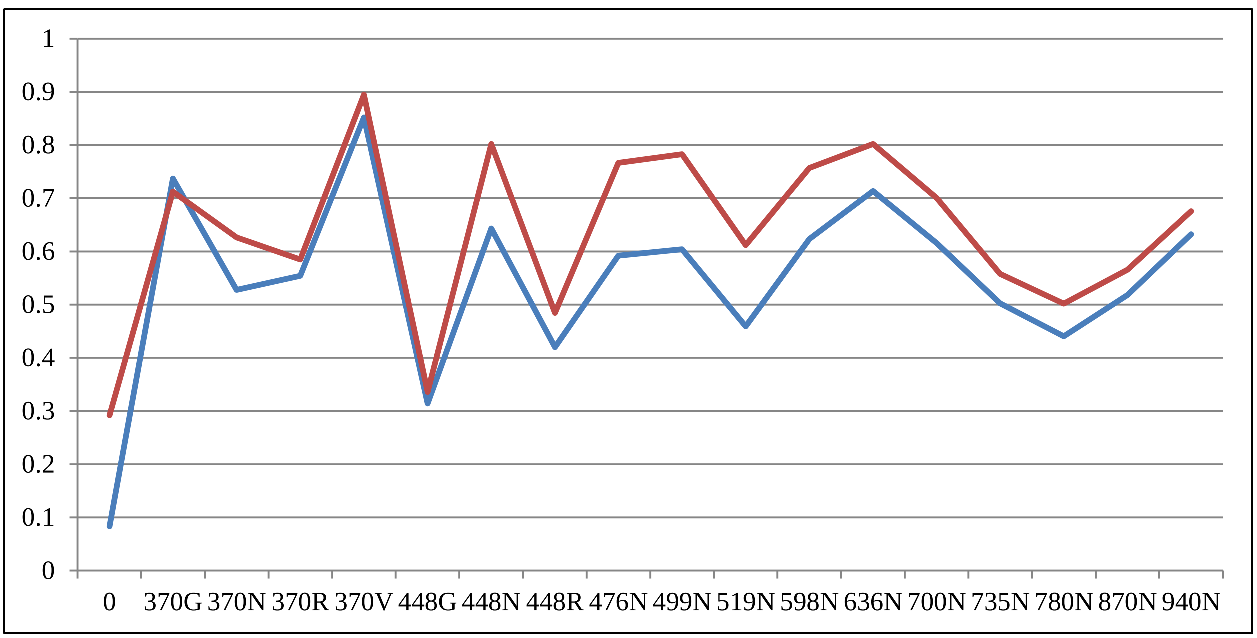


Figure 4. Red Mesa Black-on-white sherds multispectral-imaged for the study. The red and blue dots correspond to the area that reflectance values were taken from and plotted in the adjacent graph. Collections of the Museum of Indian Arts & Culture/Laboratory of Anthropology, Museum of New Mexico, Santa Fe, NM.

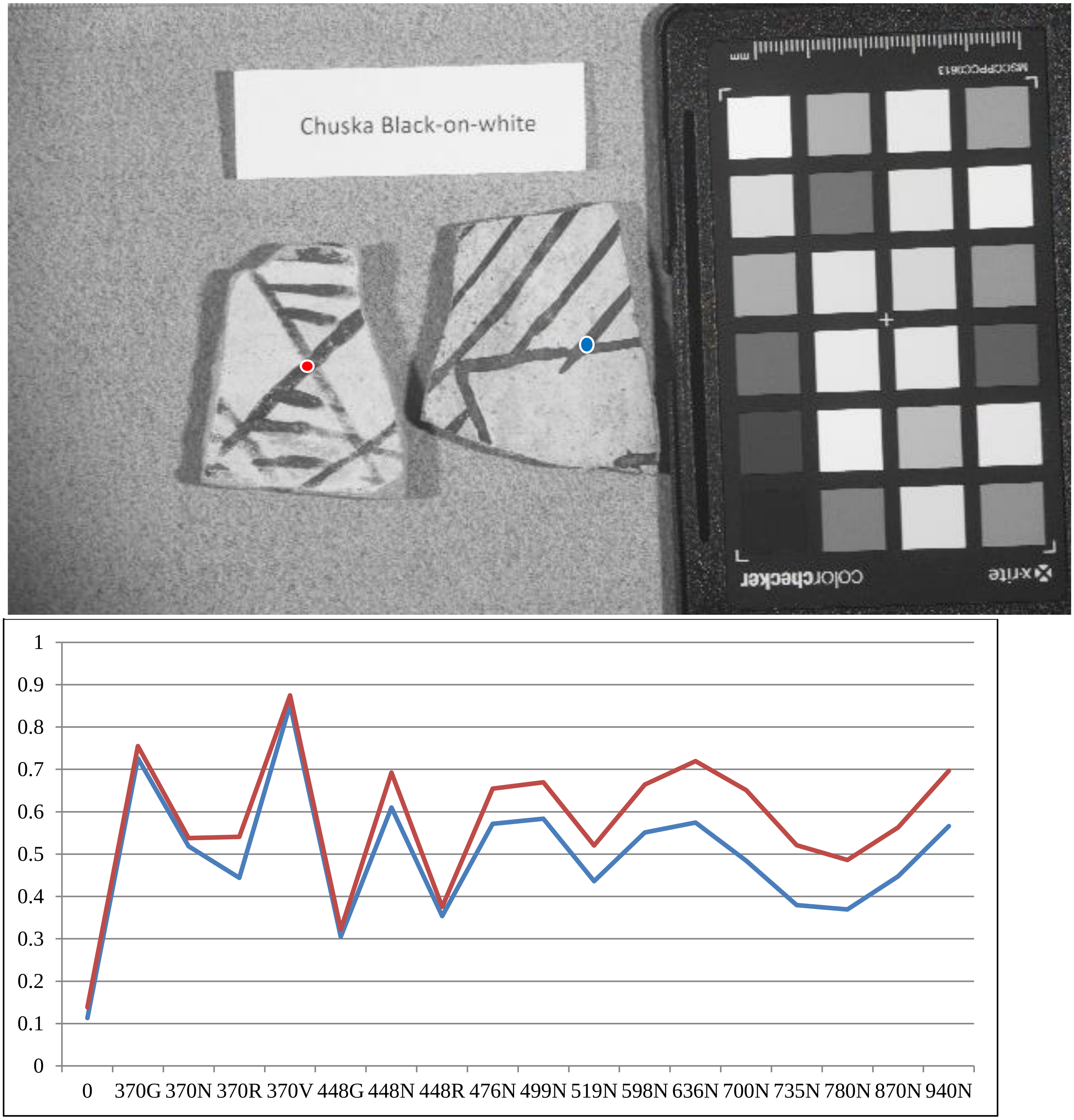
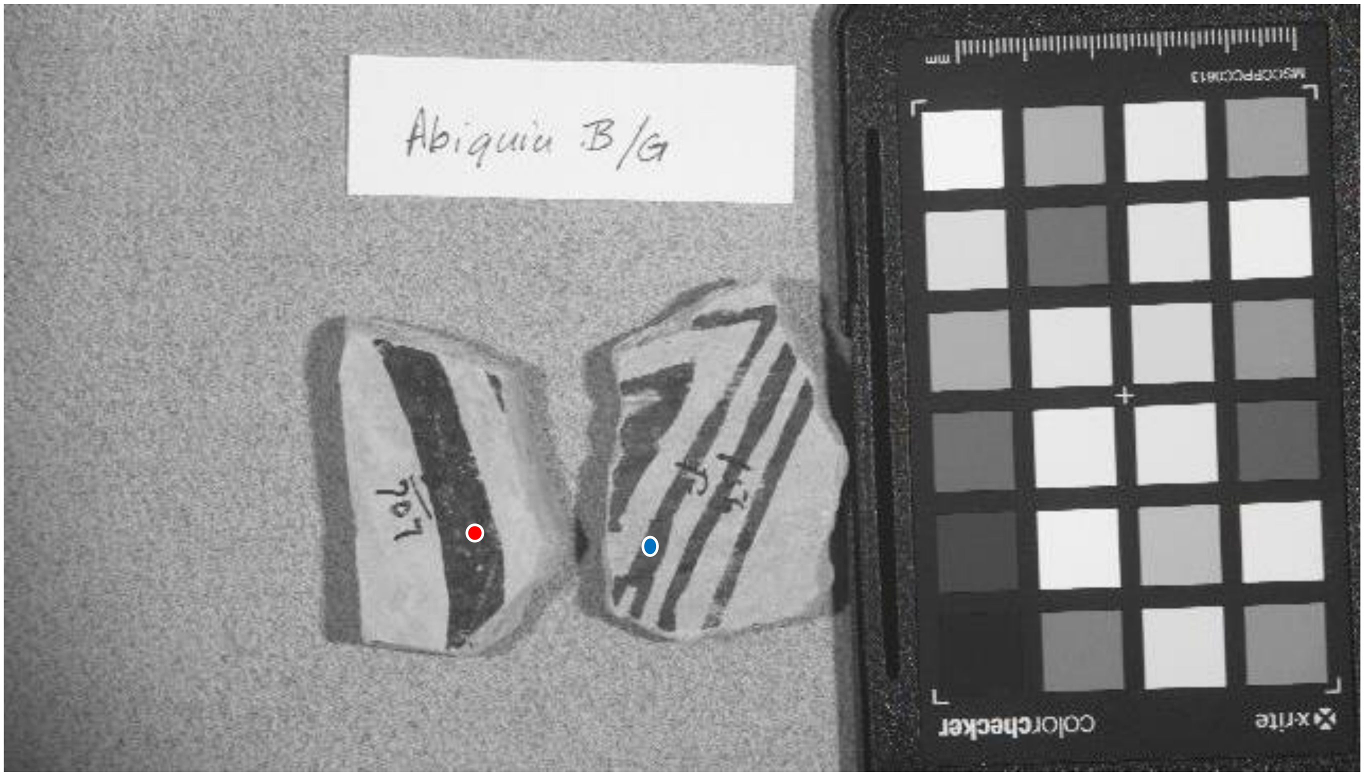


Figure 5. Chuska Black-on-white sherds multispectral imaged for the study. The red and blue dots correspond to the area that reflectance values were taken from and plotted in the adjacent graph. Collections of the Museum of Indian Arts & Culture/Laboratory of Anthropology, Museum of New Mexico, Santa Fe, NM.



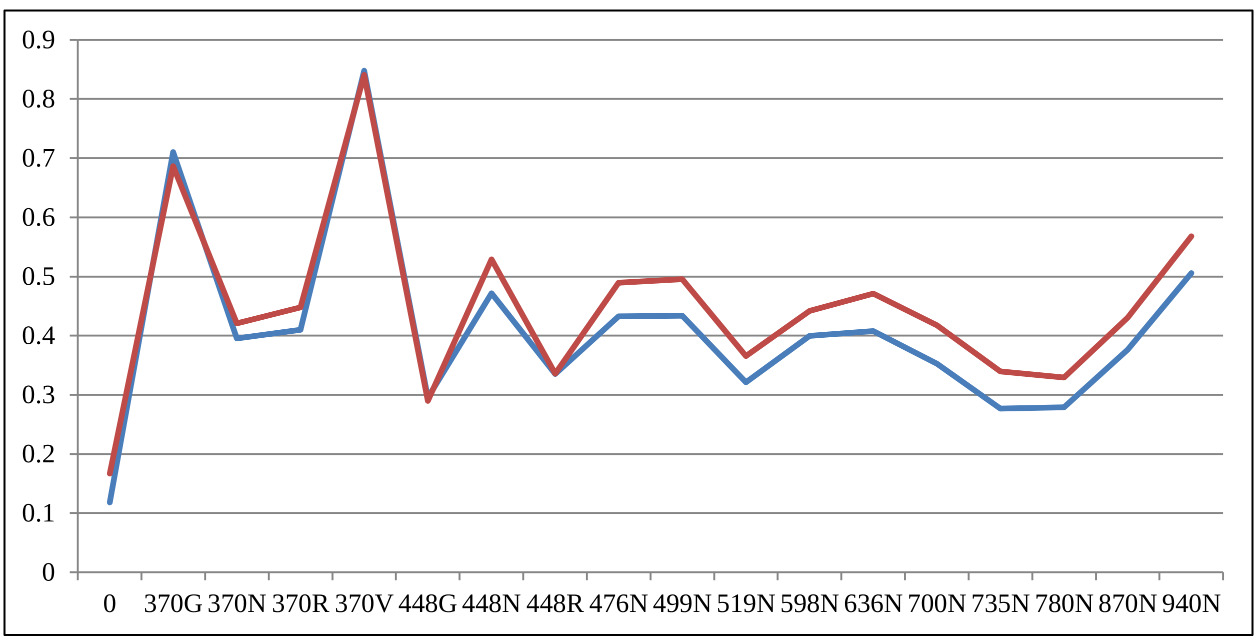


Figure 6. Abiquiu Black-on-white sherds multispectral-imaged for the study. The red and blue dots correspond to the area that reflectance values were taken from and plotted in the adjacent graph. Collections of the Museum of New Mexico, Santa Fe, NM.

Table 1. Reflectance values from each wavelength that multispectral images were taken.

Wavelength	Jemez (red)	Jemez (blue)	Cortez (red)	Cortez (blue)	Red Mesa (red)	Red Mesa (blue)	Chuska (red)	Chuska (blue)	Abiquiu (red)	Abiquiu (blue)
0	0.13185	0.17577	0.11590	0.18539	0.29167	0.08333	0.13837	0.11323	0.16661	0.11804
370G	0.73913	0.76377	0.75746	0.73772	0.71229	0.73685	0.75487	0.72617	0.68626	0.71030
370N	0.36744	0.66249	0.57708	0.52903	0.62617	0.52730	0.53791	0.51871	0.42073	0.39540
370R	0.45276	0.55161	0.46512	0.46391	0.58480	0.55402	0.54064	0.44375	0.44790	0.40985
370V	0.85196	0.85054	0.88729	0.85949	0.89439	0.85180	0.87487	0.85215	0.84078	0.84806
448G	0.29493	0.31817	0.32403	0.30661	0.33576	0.31409	0.32186	0.30479	0.28982	0.29484
448N	0.49510	0.78497	0.75882	0.66275	0.80196	0.64314	0.69216	0.60980	0.52913	0.47157
448R	0.36002	0.35737	0.37157	0.33456	0.48442	0.41983	0.37541	0.35395	0.33564	0.33525
476N	0.46765	0.75948	0.72451	0.62451	0.76667	0.59216	0.65425	0.57157	0.48936	0.43268
499N	0.49118	0.78562	0.72843	0.63676	0.78235	0.60392	0.66928	0.58333	0.49552	0.43366
519N	0.58725	0.86078	0.55784	0.48775	0.61176	0.45882	0.52026	0.43627	0.36527	0.32124
598N	0.78333	0.95948	0.68333	0.66569	0.75686	0.62353	0.66405	0.55098	0.44202	0.39967
636N	0.60000	0.82876	0.74216	0.71471	0.80196	0.71373	0.71961	0.57451	0.47115	0.40784
700N	0.80686	0.94379	0.60588	0.62059	0.70000	0.61569	0.65098	0.48431	0.41765	0.35229
735N	0.46250	0.60877	0.47902	0.48216	0.55781	0.50242	0.52090	0.37980	0.33938	0.27693
780N	0.44464	0.55110	0.43927	0.44060	0.50183	0.44013	0.48613	0.36922	0.32908	0.27903
870N	0.54414	0.57104	0.53579	0.48895	0.56529	0.51766	0.56323	0.44782	0.43062	0.37610
940N	0.67690	0.65023	0.66790	0.59940	0.67544	0.63233	0.69649	0.56602	0.56816	0.50544

Table 2. Results for one-way ANOVA results of pigment reflectance of all sherds in the study. P-values of ≤ 0.05 are indicated in red.

	Jemez (blue)	Chuska (blue)	Abiquiu (blue)	Cortez (blue)	Red Mesa (blue)	Jemez (red)	Chuska (red)	Abiquiu (red)	Cortez (red)	Red Mesa (red)
Jemez (blue)		0.011406	0.000315	0.074275	0.075355	0.055655	0.183481	0.001366	0.211275	0.647117
Chuska (blue)	0.011406		0.131177	0.344948	0.355337	0.533237	0.150165	0.392797	0.15999	0.013394
Abiquiu (blue)	0.000315	0.131177		0.01736	0.019032	0.046388	0.00516	0.463931	0.006892	0.000189
Cortez (blue)	0.074275	0.344948	0.01736		0.992341	0.793578	0.600241	0.071991	0.592482	0.112953
Red Mesa (blue)	0.075355	0.355337	0.019032	0.992341		0.802506	0.597678	0.076978	0.589952	0.114897
Jemez (red)	0.055655	0.533237	0.046388	0.793578	0.802506		0.455307	0.156052	0.45394	0.08307
Chuska (red)	0.183481	0.150165	0.00516	0.600241	0.597678	0.455307		0.023438	0.970919	0.296491
Abiquiu (red)	0.001366	0.392797	0.463931	0.071991	0.076978	0.156052	0.023438		0.028675	0.00102
Cortez (red)	0.211275	0.15999	0.006892	0.592482	0.589952	0.45394	0.970919	0.028675		0.339293
Red Mesa (red)	0.647117	0.013394	0.000189	0.112953	0.114897	0.08307	0.296491	0.00102	0.339293	

Table 3. Paired t-test for 2 independent means (one-tailed) results of pigment reflectance of all sherds in the study. P-values of ≤ 0.05 are indicated in red.

	Jemez (blue)	Chuska (blue)	Abiquiu (blue)	Cortez (blue)	Red Mesa (blue)	Jemez (red)	Chuska (red)	Abiquiu (red)	Cortez (red)	Red Mesa (red)
Jemez (blue)		0.0057	0.0002	0.0371	0.0377	0.0278	0.0917	0.0007	0.1056	0.3236
Chuska (blue)	0.0057		0.0656	0.1725	0.1777	0.2666	0.0751	0.1964	0.0800	0.0067
Abiquiu (blue)	0.0002	0.0656		0.0087	0.0095	0.0232	0.0026	0.2320	0.0034	0.0001
Cortez (blue)	0.0371	0.1725	0.0087		0.4962	0.3968	0.3001	0.0360	0.2962	0.0565
Red Mesa (blue)	0.0377	0.1777	0.0095	0.4962		0.4013	0.2988	0.0385	0.2950	0.0574
Jemez (red)	0.0278	0.2666	0.0232	0.3968	0.4013		0.2277	0.7803	0.2270	0.0415
Chuska (red)	0.0917	0.0751	0.0026	0.3001	0.2988	0.2277		0.0117	0.4855	0.1482
Abiquiu (red)	0.0007	0.1964	0.2320	0.0360	0.0385	0.7803	0.0117		0.0143	0.0143
Cortez (red)	0.1056	0.0800	0.0034	0.0296	0.2950	0.2270	0.4855	0.0143		0.1696
Red Mesa (red)	0.3236	0.0067	0.0001	0.0565	0.0574	0.0415	0.1482	0.0143	0.1696	

Results

As Figure 7 demonstrates, there are noticeable differences in the spectral reflectance graphs between the types, and even slight differences within the types (Figures 2 through 6). These slight variations would be expected due to slight differences between pigment recipes and firing temperatures. Some of these differences within types are great enough that in some cases one sherd was statistically different from another type, while the other sherd was not statistically different. This is true with data produced by the paired t-test as well as the more robust ANOVA.

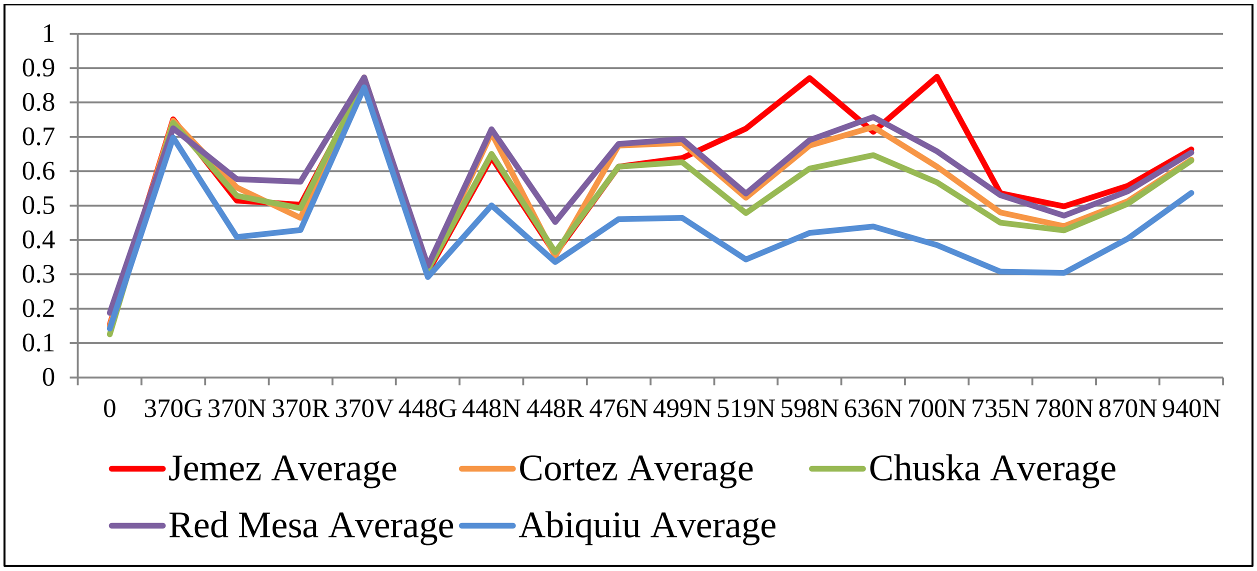


Figure 7. Average reflectance values from the two sherds for the different types imaged in this study.

Many sherds had statistical differences from other sherds (Tables 2 and 3), with no obvious pattern noted. Paired t-tests and one-way ANOVA results noted significant statistical differences for reflectance values between both sherds of the Abiquiu Black-on-white (organic pigment) and all other types included in the study except the Chuska Black-on-white types. The most significant difference was noted between the Abiquiu Black-on-white and the Red-Mesa Black-on-white (mineral pigment) sherds. In a similar manner, but at a less significant level, differences were noticed between reflectance values for Cortex Black-on-white (mineral) and Abiquiu Black-on-white (organic pigment) at a $p<0.05$ level for the ANOVA tests (with the exception of Abiquiu Sherd 2 compared to Cortez Sherd 1). Consistent statistical differences between organic and mineral paints were not noted.

Discussion

The paired t-tests and ANOVA tests that revealed a statistically significant difference of reflectance values between Abiquiu Black-on-white (organic pigment) and Red-Mesa Black-on-white (mineral pigment) are noteworthy. Both of these ceramic types are considered part of the Greater Tewa Basin Tradition and part of the Northern Rio Grande Ware, but the Red Mesa type is believed to have not been made locally (Wilson 2012).

However, the inconsistent statistical differences between organic and mineral paints indicate that this technique cannot distinguish between the two paints. Oddly, there is no consistent pattern between the other mineral based paints (Cortez Black-on-white and Red Mesa Black-on-white) and the organic based pigments. Thus, this technique seems capable of picking up on some differences between organic and mineral pigment recipes, but not all. Thus, it seems possible that this method may be picking up on similar ingredients being exploited by different cultural groups.

Future Research and Conclusions

The inconsistencies within types raise some concern, especially when only one of the two sherds is statistically different from another type. This indicates that further research is needed. Hopefully larger sample sizes could remove outlying sherds that may be caused by slight regional differences in recipes (due to resources or different artists), variations in firing attributed to lack of control, or even post-depositional taphonomic processes.

Ideally a larger study would also have better geographical provenience for the material being analyzed. The sherds for this preliminary study were taken from a type collection that did not maintain this information for every sherd in the collection. It is possible that the statistical differences between types noted in this study may be due to different recipes at different production centers. Therefore, larger, type-specific studies should be conducted over large geographical areas in order to see variation over space. Similarly, if temporal information is available, changes within a type over time could be determined.

Further statistical analysis may also be helpful with this technique. With larger sample sizes, and more focused statistical analysis at specific wavelengths (possibly with a focus on the visible wavelengths), these statistical comparisons could highlight differences and similarities between and within types.

Ultimately, this preliminary study shows some potential that, with larger samples and future modification of techniques, multispectral imaging may be useful in investigations of black pigment in the American Southwest, thus possibly opening up a new avenue of non-destructive analysis to ceramicists trying to learn more from the past.

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REVIEW

The Colors of Ancestral Pueblo Pottery. Kelley Hays-Gilpin and Jill E. Neitzel. 2019. In *Color in the Ancestral Pueblo Southwest*, edited by Marit K. Munson and Kelley-Hays Gilpin, pp.45-60. University of Utah Press, Salt Lake City.

Reviewed by Peter J. McKenna

A review of the source book for this paper is currently available in *Kiva*, though the reviewer does not foreground the contribution of pottery to the subject (Turner 2020). The consideration of color has been a focus of renewed interest and development at least since Plog's 2003 paper on symbolism in "Pueblo" or "Anasazi" region black-on-white pottery. With the passage of further study, the authors are able to offer the reader an excellent survey of the use of, and increasingly complex, interpretation of color variation in Southwestern prehistoric pottery. Color is found to reflect overlapping sets of technical, social, and ideological characteristics which convey information about the producer and, by extension, the group which produced the vessel. The authors briefly review the technical factors of how color is achieved through the consideration of basic ceramic ecology for raw materials (clays, pigments, paints), and firing techniques for attaining desired colors. They summarize past and current thinking on the temporal and spatial variations of color, maturing from a focus on typological-time constructs to increasing complexity of color combinations particularly when contextualized by matters such as trade and site function. Expanding on the dimensions of color variability, more recent studies on the conjunction of vessel form and design with colors and the more esoteric matter of color symbolism are discussed. The importance of social factors and religious symbolism is highlighted with respect to more recent studies, though, at least for the latter, much of this is drawn from the ethnographic record. Of particular interest is the discussion on "Breaking the Rules," where the use of color breaks norms of pottery making (not design), and reminds us that potters were, even within the confines of "*costumbre,*" creative people and that this dimension in pottery production is one where change is initiated, the study of change being dear to the hearts of anthropologists. This paper is well written, richly illustrated, and lays a solid foundation to anticipate further studies of color in regional ceramics.

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EXHIBITS AND EVENTS

Spring 2021 continues to be the Age of Coronavirus. We have no events to report. We can say that museums are trying to make the best of a bad situation, and many have special online exhibits.

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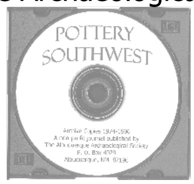

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