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In This Issue

This issue's lead article might be appropriately subtitled *we've come a long way baby* in light of the two pieces selected from our archives. Twenty-five years ago A. H. Warren discussed the revival of interest in petrographic analyses of Southwestern pottery. Warren abstracts some of Ana Shepard's (1965) observations relating to technical studies of Southwestern ceramics. Fifty years prior to that Florence Hawley's 1930 paper from *American Anthropologist* elaborated on her chemical analysis of smudge ware. That paper was inserted to follow Warren's article in the October 1980 issue of *Pottery Southwest*. In the Inquiries and Updates section, Leslie Cohen and Ted Oppelt offer two views on basket impressed wares. Finally, we are providing some technical tips on submissions. The availability of *Pottery Southwest* in electronic format provides an opportunity to reach a broader audience. At the same time, an electronic version creates formatting challenges beyond those of conventional printing and/or photocopying. We created these tips to make publishing in *Pottery Southwest* easier for our contributors. We hope you will take advantage of them and send in your submissions (see Page 25 for how-to).

CONTENTS

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Migration or Local Development? Technological Analysis of Corrugated Wares at the Pinnacle Ruin, Southwest New Mexico

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The diversity of ceramic types at the Pinnacle Ruin, located in southwestern New Mexico, suggests that the prehistoric inhabitants maintained contact with a number of different regions and may also have included a Mesa Verde migrant population. In light of these possibilities, we investigate the nature of corrugated ware production at the site through a comparison of technological attributes of two corrugated wares, Reserve Indented Corrugated and Seco Corrugated. Specifically, we address whether these wares were produced by migrants or were the product of local development. The results, while preliminary, indicate similarities in traits associated with firing and differences in traits associated with forming methods.

Residents of the Pinnacle Ruin (LA 2292), a 13th-14th century site located in southwestern New Mexico (Figure 1), may have included a migrant population from the Mesa Verde region, based on the presence of Magdalena Black-on-white, a decorated ceramic type similar to the Mesa Verde Region McElmo Black-on-white, and architectural similarities (Lekson et al. 2002). In this article, we examine two corrugated wares, Seco Corrugated and Reserve Indented Corrugated, to determine differences in the technological style that may be indicative of production by different potting groups and may shed additional light on the subject of migration.

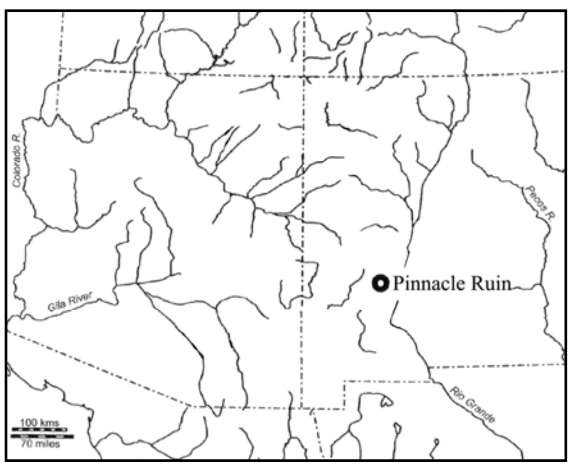

Figure 1. Location of Pinnacle Ruin (adapted from Lekson et al. 2002)

Background

Pinnacle Ruin is located on a rhyolitic butte along the Rio Alamosa, a tributary of the Rio Grande, in southwestern New Mexico (Lekson et al. 2002: 81). The site was excavated by the 1999 Eastern New Mexico University field school and again in 2000 by the University of Colorado. Both of these projects were conducted in conjunction with the Cañada Alamosa Project (Lekson et al. 2002: 82). Approximately 3,900 ceramic sherds were excavated during the 2000 season. These ceramics comprise the sampling population for the current analysis.

Pinnacle Ruin, along with Gallinas Springs (LA 1178) and the Roadmap site (LA 4515), contain Magdalena Black-on-white pottery (Lekson et al. 2002), which is argued to be a variety of Mesa Verde or McElmo Black-on-white (Davis 1964, Warren 1974). The presence of this type of pottery on sites far south of the Mesa Verde region has been called “the Magdalena problem” (Lekson et al. 2002:76). The presence of Magalena Black-on-white, along with carefully coursed masonry unlike the architecture style indigenous to the region, has led Lekson and others (2002) to argue that the residents of Pinnacle Ruin may have included migrants from the Mesa Verde Region.

The goal of the current research is to further investigate the possibility of migrant populations at the Pinnacle Ruin through an analysis of corrugated ceramics. Reserve Indented Corrugated (Figure 2), dating to the 13th and early 14th centuries (Rinaldo and Bluhm 1956), is the most prevalent utility ware on the site. Reserve Indented Corrugated is characterized by smudged and polished interiors with coils that are affixed through downward finger indentation; this pinching technique often results in a wavy pattern or series of triangular shapes (Rinaldo and Bluhm 1956). Seco Corrugated (Figure 3), first defined by Wilson and Warren (1973), is the second most common utility ware. Seco Corrugated is also smudged and polished on the interior, but the indentations occur inward into the vessel body as opposed to downward; this method of pinching coils results in a pattern that resembles a series of squares (Wilson and Warren 1973). While the cultural affiliation of Seco Corrugated is unclear, the ware is typically observed in large 14th century pueblos in southwestern and south-central New Mexico (Lekson et al. 2002:88). Although these two wares do not resemble Mesa Verde corrugated wares and both may be “local” styles, we believe that, if some residents of the Pinnacle Ruin were migrants, there is the possibility that migrants may have made some of this pottery and that differences in the manufacture and technology of the wares may shed light on the group composition at the site.

Figure 2. Reserve Indented Corrugated

Figure 3. Seco Corrugated

Technological Style & Corrugated Ceramics

Because technological aspects of pottery manufacture require face-to-face interaction and are not easily imitated, technological attributes may be a good indicator of migration and exchange (Van Hoose and Schleher 2002; Zedeño 1994). Other researchers have used technology of corrugated ceramics to investigate migration and interaction (Brunson 1985; Ennes 1999; Hegmon et al. 2000). In this research, we use the concept of technological style, developed by Heather Lechtman (1977), who defines the term as the combination of technological attributes used to create an item.

A potting group’s technological style is directly related to a group’s learning framework, or the way information is transmitted within a group. Potters within a group interact closely enough to permit the transfer of ideas and technology. Because transfer of technological style requires face-to-face interaction, different potting groups are expected to exhibit different technological styles. Since, as we discuss below, learning frameworks are culturally dependent, it is assumed that these groups represent some sort of cultural unit.

Ethnoarchaeological research conducted worldwide documents that style, and specifically the technological component of style, is transmitted within cultural groups (e.g., Lathrap 1983; Stanislawski and Stanislawski 1978). As shown in these studies, learning the correct technology is of greater importance than learning specific decoration. Within the Shipibo-Conibo society of Peru, Lathrap (1983) found that there was extreme technological standardization of ceramic production, but that there was more flexibility in decorative style. Stanislawski and Stanislawski (1978:72), in an ethnoarchaeological analysis of Hopi ceramic training, showed that concepts of technology are taught, whereas decorative elements of ceramics are not. A review of the ethnographic literature conducted by Rice (1984) also supports these examples. She found that cross-culturally, technological elements—such as the raw materials used, vessel forms, and manufacturing techniques—are more resistant to change than decorative elements of pottery. The above research indicates that the technological component of ceramics, rather than the decorative component, may be a better indicator of learning networks within a society.

The level of group inclusiveness that different aspects of technology represent is another theoretical issue considered in this research. Attributes that are visible only in production (i.e., clay or paint composition) are confined to closely interacting artisans because they cannot be copied without tutorial interaction (Carr 1995). Ethnoarchaeological studies have documented that the visibility of attributes corresponds to different levels of interaction. Wobst (1977) argues that the more visible the attribute, the wider the social unit it reflects, and the lower the visibility of an attribute, the smaller the social unit. Friedrich (1970) found that, in a Tarascan village in Mexico, attributes that were more difficult to decode (i.e., those with low visibility) signaled interaction among closely interacting social units. These ethnoarchaeological observations are also supported archaeologically. Zedeño (1995) demonstrated that local potters in the Grasshopper region of east-central Arizona maintained a consistent set of technological criteria (low visibility), while decorative style (high visibility) was uniform over a wider area. Duff (1993) used compositional analysis of clay sources (a low-visibility attribute) to define potting groups in the Cibola area. Non-visible or less visible attributes of technological style are more indicative of close social units than the highly visible attributes of decoration because they suggest close interaction during the manufacturing of ceramics.

Based on the finding of these ethnoarchaeological studies, we have chosen to examine technological attributes of utility wares in order to determine if multiple potting groups may have been present at the site, and thus if migrants may have been responsible for manufacturing some of the pottery. Differences in technological style are assumed to indicate the presence of different potting groups due to the stable nature of technology and the focus of learning networks on teaching the correct technology. Similarities in technological style are assumed to indicate a more closely interacting social unit.

Methods

Following the perspective presented above, we examine the technological style of Reserve Indented Corrugated and Seco Corrugated through an analysis of technological attributes at a variety of visibility levels. A total of 133 Reserve Indented Corrugated and 130 Seco Corrugated sherds excavated in the 2000 field season were selected for analysis based on a random sample stratified by excavation level. Reserve Indented Corrugated and Seco Corrugated are found together in all but the lower levels of one feature—where the slightly earlier Reserve Indented Corrugated type is found without Seco Corrugated (Laumbach in press).

The attributes examined include sherd thickness, breakage pattern, thickness of corrugation, surface finish, core pattern and firing temperature. These attributes were selected for analysis for a number of reasons. First, rim sherds were not numerous, so we selected attributes that could be examined on body sherds. Because we were not able to exclusively examine rim sherds, we were not able to determine if there are general differences in vessel size between the two types. Second, the attributes selected give a view of various steps in the manufacturing process: forming, finishing, and firing. Third, the attributes were selected based on level of visibility—the lower visibility attributes require closer interaction to copy and the lower the likelihood that techniques can be copied from a final product (Van Hoose and Schleher 2000). The attributes examined can be grouped into low, medium, and high visibility.

Low-visibility attributes are those that are not visible in the final product and are most indicative of the learning framework, which is closely tied to potting group membership. Low-visibility attributes include all those that are based on the motor skills that go into forming a vessel. These skills are learned at an early age and are difficult to change (Rice 1984). In the current research, sherd thickness, breakage pattern and thickness of corrugation are low-visibility attributes. Sherd thickness was determined by taking three measurements of thickness per sherd and averaging them. Corrugation thickness was determined by averaging three measurements of the maximum width of the corrugation. Breakage pattern is based on how coils are joined together during manufacture—this is a skill based on motor habits, which are stable and resistant to change (Rice 1984). Breakage pattern was determined by examining the cross-section. If a break occurred on a coil, it was recorded as flat, angled, or both (Figure 4).

Figure 4. Breakage Pattern Categories

Medium-visibility attributes are those that are only partially visible in a final product or in the production process. These aspects of technology are easier to copy from neighboring potters than low-visibility attributes, but are not as apparent on a final product as high-visibility attributes such as style of painted decoration or surface treatment. Firing technology, as seen in firing temperature and core pattern, is a medium-visibility characteristic because firing must be done in the open and, hence, may be copied by other potters. Of course, the visibility levels discussed here might be different depending on the individual site involved. Here, we argue that firing technology is a medium visibility attribute because we assume that the majority of potters producing the pottery recovered from Pinnacle lived at the site. If one of our types was traded in from a neighboring community, then firing technology could be a low visibility attribute because the potters would not have been able to observe other potters firing. Core pattern is related to firing technique and/or cooking methods. Sherd cross-sections were examined and core patterns classified into 8 categories (Figure 5) based on categories developed by Pierce (1999). To determine firing temperature, chips of sherds were removed and refired in a kiln at 50˚C intervals starting at 500˚C. After each refiring, color and hardness were recorded using a Munsell color chart and the Moh's hardness scale. Original firing temperature was assumed to be exceeded after one change in hardness and two color changes occurred.

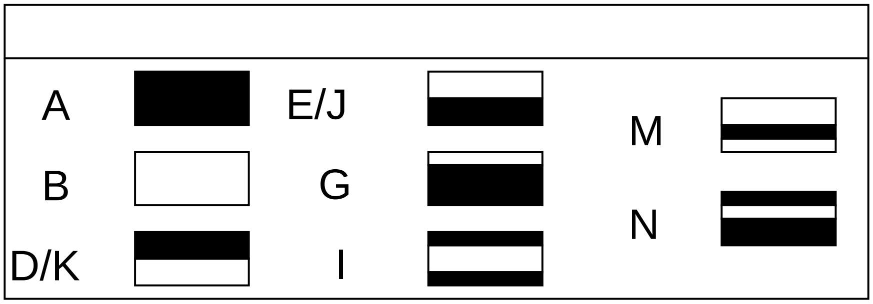

Figure 5. Core color pattern (based on Pierce 1999).

Interior surface finish is a high-visibility attribute because it can be copied more easily from a final product (a whole pot) than low or medium-visibility attributes, requiring no face-to-face interaction of potters. Interior surface finish was classified into 7 categories: 1) carbon: indicating an unpolished surface with coating of carbon likely due to cooking, 2) eroded: indicating a rough, eroded surface, 3) polished: a shiny finish, 4) residue: a deposit of residue on the surface 5) rough, 6) smoothed: smooth, but not shiny finish, and 7) smudged: a black, shiny surface with carbon imbedded into the body of the sherd.

Results

The results for the low-visibility attributes show the greatest differences between ceramic wares. There is a difference of 0.232 mm between the average sherd thickness for Seco Corrugated at 6.195 mm and for Reserve Indented Corrugated at 6.427 mm, which is a statistically significant difference at the 95 percent confidence level as shown by a t-test (Table 1). There are statistically significant differences in mean corrugation thickness. Mean corrugation thickness for each ware differs by approximately 1 mm (Seco = 6.93 mm, Reserve = 5.76 mm). T-tests reveal a statistically significant difference at 95 percent confidence level between the two wares for corrugation thickness (Table 2).

Type	N	Mean	Standard Deviation	SE Mean
Reserve Indented Corrugated	133	6.427	0.883	0.077
Seco Corrugated	130	6.19	0.804	0.070
T-value = 2.22; P-value = 0.027				

Table 1. T-Test of sherd thickness

Type	N	Mean	Standard Deviation	SE Mean
Reserve Indented Corrugated	120	5.76	1.29	0.12
Seco Corrugated	112	6.96	1.51	0.14
T-value = -6.50; P-value = 0.000				

Table 2. T-Test of corrugation thickness

Differences are also apparent in breakage pattern. Breakage patterns (Figure 6) for Seco Corrugated are more often flat, whereas Reserve Indented Corrugated is more often angled or angled and flat. Chi-square analysis reveals that there is a statistically significant difference at the 0.05 level for breakage pattern (Table 3). Thus, differences in this attribute could indicate multiple potting groups.

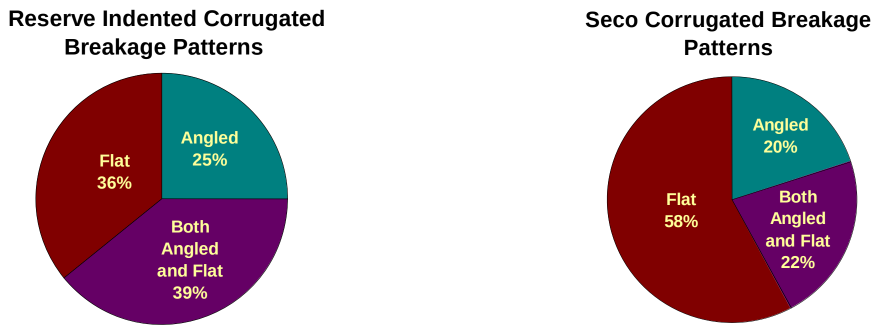

Figure 6. Breakage Patterns by Type.

Breakage Pattern		Reserve Indented Corrugated	Seco Corrugated	Totals
Angled	Observed	21	17	38
	Expected	19.70	18.30	38
Flat	Observed	30	49	79
	Expected	40.96	38.04	79
Both Angled & Flat	Observed	33	12	45
	Expected	23.33	21.67	45
Pearson Chi-Square= 14.588; DF = 2; P-value = 0.001				

Table 3. Chi-square analysis of breakage pattern

The results for the medium-visibility attributes are more similar for both Seco and Reserve Indented. Both wares show similar core patterns (Figure 7). Both wares are dominated by oxidized (B) or partially oxidized vessels (E/J). The next most prominent for both types is fully reduced (A) and reduced/ carbon deposited margins with an oxidized core (I). There is not a statistically significant difference as seen in the chi- square analysis at the 0.05 level for core pattern (Table 4). The range of firing temperatures is also similar, but a chi-square analysis indicates statistically significant differences in firing temperatures at the 0.05 level (Table 5). However, given the range of variability expected in open pit or bonfire firings only clear-cut differences are really suggestive of actual differences in firing technology. Original firing temperatures range from approximately 600 to 900 degrees Celsius for both types, representing a normal range for open pit or bonfire firings (Shepard 1995).

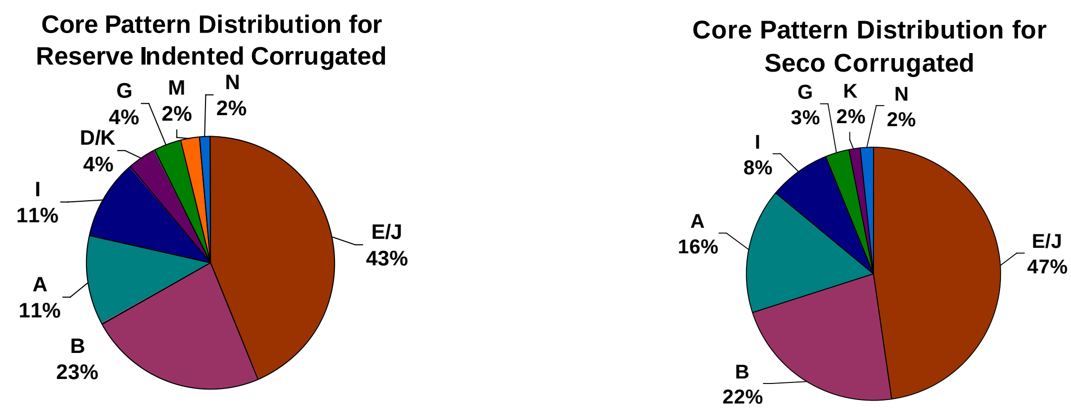

Figure 7. Core Pattern Distribution by Type.

Core Pattern		Reserve Indented Corrugated	Seco Corrugated	Totals
A	Observed	15	21	36
	Expected	18.21	17.79	36
B	Observed	31	29	60
	Expected	30.34	29.66	60
D/K	Observed	5	2	7
	Expected	3.54	3.46	7
E/J	Observed	58	62	120
	Expected	60.68	59.32	120
G	Observed	5	4	9
	Expected	4.55	4.45	9
I	Observed	14	10	24
	Expected	12.14	11.86	24
M	Observed	3	0	3
	Expected	1.52	1.48	3
N	Observed	2	2	4
	Expected	2.02	1.98	4
Pearson Chi-Square = 6.230; DF = 7; P-value = 0.513				

Table 4. Chi-square analysis of core pattern

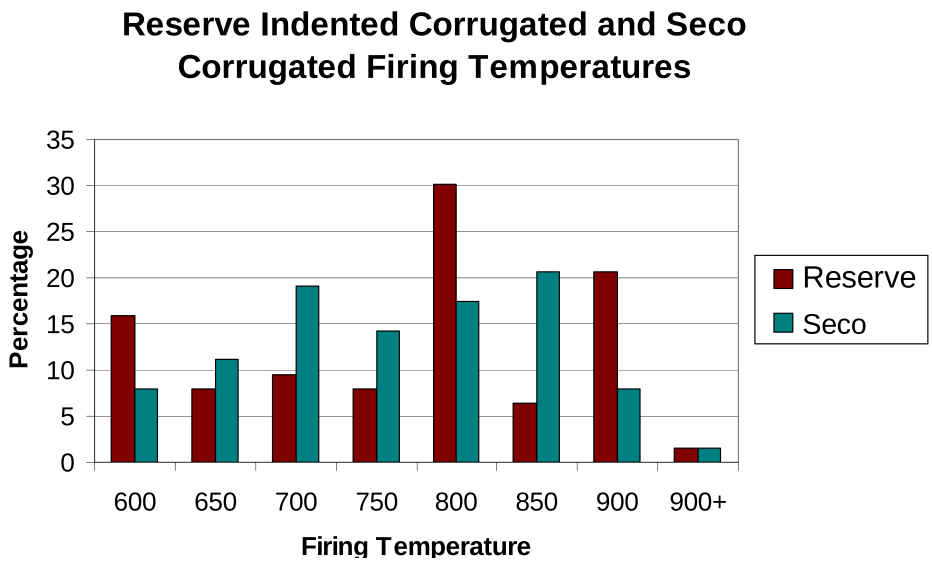

Figure 8. Reserve and Seco Firing Temperatures.

Firing Temperature		Reserve Indented Corrugated	Seco Corrugated	Totals
600	Observed	10	5	15
	Expected	7.500	7.500	15
650	Observed	5	7	12
	Expected	6.000	6.000	12
700	Observed	6	12	18
	Expected	9.000	9.000	18
750	Observed	5	9	14
	Expected	7.000	7.000	14
800	Observed	19	11	30
	Expected	15.000	15.000	30
850	Observed	4	13	17
	Expected	8.500	8.500	17
900	Observed	13	5	18
	Expected	9.000	9.000	18
950	Observed	1	1	2
	Expected	1.000	1.000	2
Pearson Chi-Square = 15.596; DF = 7; P-value = 0.029				

Table 5. Chi-square analysis of firing temperature

For the higher visibility attribute of interior surface finish, the dominant type of finish for both wares in smudged—a well-polished carbon impregnated surface (Figure 9). Very little difference is seen between the two types—there is not a statistically significant difference as seen in the chi-square analysis at the 0.05 level (Table 6).

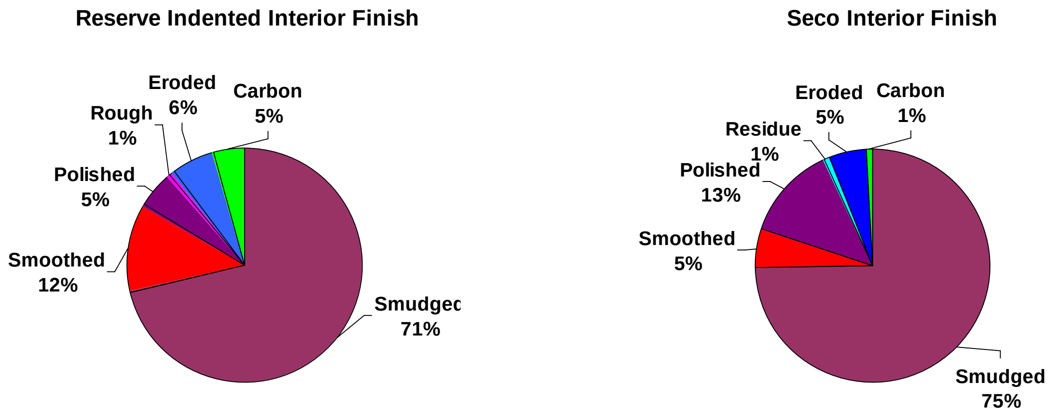

Figure 9. Interior Surface Finish by Type.

Interior Surface Finish		Reserve Indented Corrugated	Seco Corrugated	Totals
Carbon	Observed	6	1	7
	Expected	3.44	3.56	7
Eroded	Observed	8	7	15
	Expected	7.38	7.62	15
Polished	Observed	7	17	24
	Expected	11.81	12.19	24
Smoothed	Observed	9	7	16
	Expected	7.87	8.13	16
Smudged	Observed	95	97	192
	Expected	94.49	97.51	192
Pearson Chi-Square = 8.015; DF = 4; P-value = 0.091				

Table 6. Chi-square analysis of interior surface finish

In addition to the six technological attributes examined, we detected an interesting pattern in the high-visibility attribute of the pattern of corrugation. Corrugation pattern or style is the determining factor in placing a sherd into type categories. As seen above in Figures 2 and 3, there is a marked difference in the two types. Reserve Indented corrugation style, as seen below in the far left of Figure 10, is wavy where as the Seco corrugated style, in the far right, is a more box-like square pattern. While conducting our technological analysis, we noted that there were a number of sherds that were more difficult to place into either defined type. Some, while still being classified as Reserve Indented, were less wavy and had more perpendicular indentations than the traditional Reserve Indented. An example of this is second from the left in Figure 10.

Some, while still being classified as Seco, were not quite square and box-like, these tended to have slightly off-set indentations in comparison to the perpendicular and parallel indentations of traditionally defined Seco corrugated.

Figure 10. Possible continuum from Reserve Indented Corrugated (left) to Seco Corrugated (right). Note the gradual change from an angled corrugation pattern to a perpendicular pattern.

Discussion and Conclusion

The technological styles of the two wares overlap, but also exhibit differences in a number of attributes. Similarities in core pattern, firing temperature, and interior surface finish, suggest continuity in technology for the two wares. However, sherd thickness, breakage pattern, and corrugation thickness are somewhat different. These results, along with the continuum of corrugation style noted above in Figure 10, suggest two possibilities.

The overlaps in style and technology suggest that the patterns in the two wares could represent (1) an evolution from one ware to the other manufactured by a single group, or alternatively, (2) a blending of ceramic technological style between different groups.

The first possible interpretation is that there is an evolution of characteristics in manufacture between the two wares—suggesting that the types are really more two ends of a continuum of the corrugated wares being produced during the 13th and 14th centuries in southwestern New Mexico. Although Seco is associated with all but the earliest stratigraphic levels at Pinnacle Ruin, is it traditionally dated slightly later than Reserve Indented. Seco Corrugated is traditionally dated as a 14th-century type, while Reserve Indented Corrugated spans both the 13th and 14th centuries in the region (Laumbach in press). With this in mind, the continuum in style noted above could simply depict temporal changes in corrugated pottery, produced by local populations.

It should also be noted that the average thickness difference between the two wares, with Reserve Indented Corrugated slightly thicker, may be suggestive of different vessel sizes dominating the different wares. Thicker wall thickness is generally associated with larger vessels, so this change in vessel size may suggest a decrease in average vessel size through time.

This question of a continuum of local development in corrugated wares could be easily examined in the future by breaking down the analysis of the types by stratigraphic levels. If the differences between the wares represent simple local development over time, gradual change in corrugation styles should be evident through close examination of the vertical context. In addition, comparison of Reserve Indented Corrugated ceramics from an earlier site, such as the nearby Victorio site (Laumbach in press: 139) to the ceramics at Pinnacle Ruin, would help in determining whether the corrugated wares at Pinnacle are similar or different than the clearly non-Mesa Verde style wares.

The second possibility is that multiple potting groups manufactured the two types. This could represent two groups living at the site making just slightly different corrugated wares. The attributes that exhibit differences, sherd thickness, corrugation thickness, and breakage patterns, are significant in that they represent low-visibility attributes that are likely to be the most indicative of differences in potting group. Even though only some of the six attributes examined exhibit statistically significant differences, the data suggest that there may be differences in the groups manufacturing corrugated wares at the site. The similarities in firing technology, as seen in core pattern and firing temperature, could indicate pan-site firing of ceramics while the differences in forming methods suggest multiple potting groups, perhaps local and migrant populations, involved in the manufacturing process.

Although the corrugated wares found on the site appear typologically to be “local” types, if a different group of potters was manufacturing the Mesa Verde style Magdalena Black-on-white decorated ware, suggested by Lekson and others (2002), at the site, then there is the possibility that one of these “local” corrugated types might also be being made by migrant potters as well. We argue that it is the low-visibility technological attributes that can allow us a view of variation in the potting groups.

As suggested by Lekson and others (2002:89), the situation at the Pinnacle Ruin may be similar to what Haury (1958) documents at Point of Pines, Arizona. After a late 13^{th-} century migration to Point of Pines from the Kayenta region, the culinary and storage pots were of the local variety while only the decorated wares exhibited the Kayenta style. Yet, what is interesting to note about the current research at the Pinnacle Ruin is that there are differences in some of the low-visibility technological attributes that may represent different groups living side-by-side at the site. The technological styles of Seco and Reserve Indented Corrugated are similar, but they are not identical. Based on what we know about the stability of technological skills (Rice 1984), this suggests some differences in the potting groups producing utilitarian wares at the site.

While Mesa Verde migrants may have been responsible for the manufacture of some of the utility wares, other non-local ceramics at the site, such as El Paso Polychrome, may indicate that inhabitants originating from other areas may have contributed to pottery production at the site as well. Exchange in of one of the ceramic types from a nearby site may also explain differences in the technological style of the types. Future research into the composition of clay or temper of the ceramics from Pinnacle Ruin and other nearby sites would help elucidate this possibility.

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INQUIRIES AND UPDATES

A Query: Basket-Impressed Pottery in the Mimbres Region

by Leslie Cohen

LA 6538 (Diablo) was excavated in 1966 as a part of the highway project that created a paved road (Highway 15) along the West Fork River that leads to the Gila Cliff Dwellings National Monument, in southwestern New Mexico. Because time and money were in especially short supply during the early days of CRM archaeology, only a brief preliminary report was produced by the original excavator (Hammack 1966). Recently, volunteers working with Chris Turnbow, Deputy Director of the Museum of Indian Arts and Culture/Laboratory of Anthropology, undertook an analysis of Diablo's ceramic assemblage. The appearance of 30 basket-impressed sherds at LA 6538 is presenting the researchers with a puzzle because a search of reports on Mimbres Mogollon sites like Diablo has not yielded any information about this ceramic type. A recent, unsystematic search of the surface artifacts at another site, approximately 1.5 kilometers south of Diablo, has produced three more basket-impressed sherds. There are several possible explanations for the sherds identified as basket-impressed. The Lab researchers may have typed them incorrectly. The basket-impressed vessels could have been an anomalous intrusion from the north, near the Reserve area, where several basket-impressed sherds and one bowl have been reported (Kayser 1975; Wendorf 1956:71). Production may have been localized at or around Diablo and the vessels may have not moved out of the West Fork drainage. It is also possible that basket-impressed sherds at other Mimbres sites in the Gila and Mimbres river drainages have gone unreported due to their low frequency or because they were typed as something else, like indented corrugated. This query is a call for assistance from colleagues who have worked in the Upper Gila and Mimbres Valleys. We are looking for other occurrences of basket-impressed pottery.

The site's architecture and ceramics indicate it was occupied twice, first during the Georgetown pithouse phase (A.D. 550-650) and later during the Mimbres Classic period (A.D. 1000-1140). The Georgetown component is by far the largest, with a minimum of 15 round or bean-shaped pitstructures. Superpositioning of the small classic roomblock is minimal; in essence Diablo is like two single component sites. The pithouse village ceramic assemblage consists of Mogollon brownwares typical of the Georgetown phase – the Alma series, and both matte and polished red slipped brownware (San Francisco Red). Anyon, LeBlanc and Diehl have dated the appearance of matte red slip ceramics (Mogollon Early Red) to the mid 500's in the Mimbres Valley (2001:108-112). Placement of the basket-impressed sherds in the Georgetown phase or the Mimbres Classic is tentative due to the extensive rodent disturbance in every excavated feature. Four sherds came from the Classic period communal structure and one from an instrusive Classic burial in a pitstructure. The remaining 25 sherds were recovered from either general pithouse fill, intramural pits associated with pitstructures or the surface. Based on this evidence, it appears the basket-impressed ceramics were associated with the pithouse phase of the site's occupation.

Basketry impressions on bowl exteriors represent a forming and a decorative technique. Basket impressions are produced when plastic clay coils are pressed into a basket. The basket acts like a very large puki, supporting the walls of the vessel being formed rather than only the base. Due to shrinkage during drying, a pot can be easily popped out of the basket when it has dried, leaving negative impressions of the basket's stitching and coils on the exterior (Shepard 1936:385). Basket-impressed bowls appear in very low proportions in both the northern San Juan and the northern Rio Grande regions, primarily from late PII through Middle PIII (Merewether &

Ortman 2004; Oppelt 1999:5; Shepard 1936:383). Typically, the interiors of these northern examples of basket-impressed bowls are slipped and painted. Earlier, Basketmaker II examples were unfired mudware, probably used as basket liners. Indentations around the bases of Rosa Gray, Chapin Gray and Chapin B/w vessels indicate these early fired vessels from the northern San Juan region had been formed in basket pukies, with most or all of the basket impressions obliterated before firing (Oppelt 1999:7).

Impressions on the Diablo rim sherds indicate vessel height was the same as the basket, with an additional coil added to form the rim. Interior surface treatment suggests all basket-impressed vessels were bowls, with interior finishing evenly divided between a plain burnished or red-slipped surface. The sherds were fired in an oxidizing atmosphere; clay bodies ranged in color from dark brown to buff. No petrographic or chemical characterization analyses have been conducted on the Diablo ceramic assemblage, however microscopic examination of a sample of the basket-impressed and San Francisco Red bowl sherds reveals clay bodies with similar aplastics.

The possibility that the Lab researchers misidentified the basket-impressed sherds was explored informally at the 2004 Mogollon Conference in Silver City, NM. When a sample was offered to several archaeologists who have worked in the Mimbres region, they identified it as indented corrugated or stated they had never seen the type on a Mimbres site. On close examination, however, the difference between basket-impressed and indented corrugated is quite clear.

Figure 1. Indented Corrugated

Figure 2. Basket-Impressed

Indented corrugated pottery has wider coils which are often smoothed (Figure 1), basket impressions on the other hand leave rows of narrow indentations with sharp rather than smoothed peaks (Figure 2). It appears neither fingers nor tools can produce the tightly spaced, uniform indentations of coiled basketry impressions.

At this point in our search, we cannot rule out the possibility that the Diablo sherds represent several bowls brought to the site from the Reserve area or further north, above the Mogollon rim. However, the similarities between the clay bodies and aplastics of the basket-impressed and red-slipped sherds would seem to argue against this. But only petrographic or chemical characterization studies could begin to answer the source question. On the other hand, the Lab researchers, who have also had experience with the ceramics of the Galisteo Basin and the Mesa Verde region, where basket-impressed vessels are present, are confident that their identification of the Diablo sherds is correct. We ask colleagues who have worked in the Mimbres Mogollon region to revisit the ceramics they have sorted and classified over the years and let us know whether any basket-impressed sherds are present.

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A New Provisional Type Description

By Norman "Ted" Oppelt

While I was doing research for a study of basket impressed pottery in the northern San Juan, Larry Nordby, archaeologist at Mesa Verde National Park, told me of a site he had excavated at Pecos National Historical Park that has an unusually large proportion of basket impressed ceramics. This is the Sewer Line Site (PECO207) excavated by Nordby in 1976. It is a Basketmaker pithouse with an experimental roof design that was remodeled prehistorically. The pithouse burned while it was occupied, leaving many artifacts in place on the floor. Archeomagnetic and tree-ring dates indicate a construction date of AD 832, and remodeling circa AD 841.

A total of 459 sherds were recovered from the excavation of this site. Of these 225 were gray and culinary wares including plain gray, blind and smeared corrugated, Kapo Black and a number of basket impressed plain gray sherds. The 115 basket impressed gray sherds comprise 51% of the gray and culinary wares. Several complete or partially restorable basket impressed vessels were also found on the floor.

These gray basket impressed sherds and vessels were given the provisional type name: Glorieta Plain Gray (Nordby and Creutz 1993). This type is similar in most attributes to Lino Gray, but differs sufficiently to be considered a new provisional type. The distinguishing characteristics of Glorieta Plain Gray are quartz sand temper, micaceous paste, basket impressed bases, and unique shapes. The baskets used as supports during construction were poorly suited in size to the clay vessel. Small baskets were used to start medium sized vessels. This was accomplished by adding a thick coil to the wall when the rim of the basket was reached, expanding the circumference to the desired size. This formed a ridge and a bulge in the wall around the vessel at this point. The small baskets have flat bottoms and nearly vertical walls. Above the basket impressed portion of the vessel the walls were coiled and scraped.

A second pithouse of similar age was excavated at Pecos by Nordby in 1977. It is known as Hoagland’s Haven (LA14154). Only .8% of the gray and culinary sherds at this site were basket impressed. Three restorable or nearly complete Glorieta Plain Gray vessels were found near the floor of this pithouse. One was a small canteen with two small perforated lug handles. Also found was a medium sized olla with opposing cylindrical handles on the neck. It has an overall height of 6.4 cm and a maximum diameter of 14.5 cm. The third vessel is a larger olla, 22-30 cm in diameter, that is not well restored (Nordby and Creutz 1993).
The following description is based on the sherds and vessels from these sites that I examined at the Southwest Resource Center in Santa Fe and the unpublished report of the excavations by Nordby and Creutz 1993.

TYPE DESCRIPTION

Name	Glorieta Plain Gray
Named by	Larry Nordby and Bill Creutz 1993.
Based upon	Ten sherds and three restored vessels at the Southwest Resource Center, Santa Fe, New Mexico.
Construction	Coiled and Scraped

Finishing	Surface is bumpy and shows scraping marks.
Firing atmosphere	Reducing at the end
Paste	**Clay** heavily micaceous **Color** gray to brown **Temper** Primarily quartz sand **Wall thickness** .5cm to .9cm, mean= .65cm
Surface	**Color** Pale yellow, 10TR, 6/2 to olive gray, 5Y 4/1, Munsell Color Chart. **Firing clouds** Sooting common from use in cooking or burning of pithouse. **Slip** None
Forms	Ollas, jars and canteens, lower wall of the vessels have a ridge and a bulge above the basket impressed area. **Sizes** 6.7cm to 12cm in diameter **Rims** tapered **Baskets** Small, coiled, flat bottom with low vertical sides, coils-7-8 per inch, stitches - 10-13 per inch.
Decoration	No painted decoration
Function	Sooting indicates probable use in cooking.
Time and place of manufacture	**Period** Basketmaker **Dates** Mid 9th century **Range** Unknown
Type sites	Sewer Line Site (PECO207) and Hoagland's Haven (LA14154) both at Pecos National Historic Park, New Mexico.
Comparison to other types	Most similar to Lino Gray except for the high mica content of the paste, the basket impressed bases, and the unique shapes.
Remarks	If pottery matching this description is found at other Basketmaker sites in this area, a permanent name would be warranted.

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Views: Potsherds: the records of prehistory

by A. H. Warren
Albuquerque, New Mexico

During the past few years there has been a revival of interest in mineral (or petrographic) analyses of Southwestern pottery, which has been reflected in many of the articles published in *Pottery Southwest.* Indirectly, I suppose, I may have been partly responsible for this more recent spate of studies relating to temper and other aspects of ceramic technology. I am also reminded of my own beginnings in this area more than 15 years ago, and still feel very lucky that so many excellent publications on the subject of methods were available.

As we are all aware, mineral analyses, along with numerous other ceramic technological analytical methods, were introduced to the field of American archaeology by Dr. Anna O. Shepard in the early 1930's during the excavations of Pecos Pueblo. Subsequently, she worked in many other areas of the Southwest and Central America. An evaluation of her studies entitled "Rio Grande Glaze-paint pottery: A test of petrographic analysis" (1965) summarizes many of the more important observations relating to the subject of technical studies of Southwestern ceramics. For those who are interested but who do not have access to the publication, I have abstracted some of the most pertinent conclusions in the following paragraphs. These seem even more important today than when published 15 years ago.

(1) The petrographic microscope remains the classic instrument for identification of minerals and rocks, over more recently developed instrumental methods of chemical analysis. Shepard (1965: 82) remarks that "the story [of Pecos pottery] would never have unfolded had we depended on chemical analysis alone. Differences in composition would have been meaningless in terms of sources of material." [Comment: for those unfamiliar with the use of the petrographic microscope for temper studies, differences in textural features, microstructures, crystal form or color, microcrystal inclusions, grain shape, etc., may be more diagnostic than the mineral content of the rock itself. Shepard suggested that chemical analyses would be essential in the study of paints, however. She also recommended the use of the stereomicroscope (binocular) prior to selection of sherds for thin sections. Once the characteristics of the temper of a source area were established, identifications could be made with the stereomicroscope or even with a hand lens.

(2) The importance of area-wide studies of prehistoric ceramics utilizing surface collections was established in the study of Rio Grande glaze-paint wares.

Shepard examined 14,700 sherds from 170 sites in order to establish geographic districts reflecting similar temper usage during three different time periods (Shepard 1942). Subsequent studies of surface collections from the upper Middle Rio Grande established the site locations of numerous ceramic industries between A.D. 1300 to 1700, for the six Rio Grande glaze paint groups (Warren 1969:1970).

(3) Acquaintance with the physiography and geology of the study was considered imperative.

(4) In contrast to the value of petrography, Shepard (1965) considered that most of the tests of physical properties were unnecessary or of little value.

(5) "The importance of problem formulation and adequate sampling need not be labored; it is sufficiently clear. The naive over-optimism of the archaeologist who submits a handful of 'representative sherds' for identification was understandable [in the 1930's], but is no longer." (Shepard 1965:83).

(6) "The advantages of full and free exchange of information and frequent discussion between archeologist and analyst should be equally clear. But there are still archeologists who argue that information relating to provenance, dating, and stylistic characteristics of pottery should be withheld from the analyst in order to avoid influencing his judgments. There are two curious assumptions implicit in this stand. First, that it is essential to guard against the bias of the analyst who is dealing largely with data secured by instrumental means, but that such precautions are unnecessary for the archeologist who must often rely on personal impressions; and second, that the interpretation of data should be left entirely to the archeologist, that he can recognize all implications of results obtained from methods with which he is unfamiliar, and that the analyst has nothing to contribute other than bare facts.

"Had Dr. Kidder acted on this idea, the results of the Pecos study would have been very different. The analytical data would have said nothing more to me than that pottery from Pecos contained a number of kinds of tempering material. . ." (Shepard 1965: 83-84).

The petrographic research methods resulted in the discovery of extensive exchange systems in ceramics in the Southwest, in the identification of numerous production centers for ceramics, and in the realization that contrary to popular belief, pottery-making was not merely a household task. Studies since Shepard have added additional applications of the analytical technique of mineral analysis by expanding the research methods established by Shepard. These include means to separate environmental from cultural influences in pottery making; refinements of ceramic sequences and chronologies; recognition of ceramic traditions of individual manufacture centers; and many new questions, if not answers, concerning cultural relations and population shifts (Warren 1977).

Contrary to some existing concepts, centers of manufacture are not confirmed by finding the source of the rock used for temper; such centers can only be inferred by established distribution patterns of a pottery type within a region. As in the Rio Grande studies, this generally involves the examination with low power magnification of hundreds, but more often thousands, of sherd specimens. Adequate samples are often difficult to obtain, but may be estimated by use of the cumulative curve test.

The archaeometrist who is directly involved in the application of analytical techniques to the archaeological artifacts is continually reviewing his goals as well as his methods. Prehistory is composed primarily of artifacts and "unknowable" facts, and too often we do not even understand the first.

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Chemical Examination of Prehistoric Smudged Wares

by Florence M. Hawley

Reprinted from *American Anthropologist,* Vol. 32, No.3, July-Sept., 1930

In a former paper on Prehistoric Pottery Paints *(American Anthropologist*, 31: 731-749) the subject of composition and method of application of the black color which covers the interior of some Southwestern wares was taken up. Since then the question has arisen concerning the possibility of this black coloring, heretofore called a smudge, being black iron oxide, magnetite, Fe_3O_4, produced by heating in a reducing atmosphere the vessel over which a slip of red iron oxide, hematite, Fe_2O_3, had previously been applied. As both smudging and the reduction of Fe_2O_3 to Fe_2O_4 require a reducing atmosphere, which the Indian probably produced by covering the surface of the vessel with smoldering organic matter, the chemical reaction rather than the method of color application was in question. As examples of the type of ware concerned may be cited the red with black burnished interior so common at Flagstaff, the plain red and the corrugated with black burnished interior found on the Upper and Middle Gila, and the late red-on-buff with black interior of the southern middle Gila.

Although this subject had been previously considered, it seemed advisable to obtain further and more detailed chemical tests. For this a sherd from a vessel that looked typical of the black interior type was used. Its black coloring disappeared when subjected to red heat in an oxidizing atmosphere, in the manner typical of the sherds previously tested and described in the former paper. While sweeping statements can not be made on the evidence of a single sherd, we know from its examination that smudging does account for the black interiors of some of this ware, and the fact that the sherd tested appeared to be in all ways typical of the type concerned would suggest that the results obtained on it might be characteristic of a large proportion of the black interior types if not of them all.

The following tests were performed by F. G. Hawley, who had collaborated in some of the original chemical work on pottery paints.

TESTS ON POTTERY SMUDGE

These tests were made on a broken bowl about 8 or 9 inches in diameter which was found at Burch near Miami, Arizona. The vessel wall was about 1/8 to $_3$/16 inch thick, rather soft and porous. On the outside was a reddish slip; on the inside it was very smooth, glossy, and black, and except for the unusually thin walls the vessels seemed to be a typical piece. There was no black streak of unburned carbonaceous matter to be seen in the interior center of the walls, as the thinness of the pottery, together with the thorough burning it had received, had completely oxidized any carbonaceous matter that originally may have been present. The wall for about one-third of the way through was dark, which the following experiments indicated was due to penetration of that carbon smudge which produced the black surface.

Careful examination with a good microscope showed plainly that the black color did not have the nature of a coating of paint on the surface of the pottery; the carbon had penetrated the pores in the body of the sherd and acted more like a dye than a paint. When it was ignited in a muffle, the carbon quickly burned out, leaving the sherd a light creamy buff color, as smooth and polished as before.

With a steel scraper, 0.6 gm. of fine scrapings was removed from about 15 square inches of the inner surface of the bowl. The scraping penetrated less than 0.01 of an inch. The material was pulverized still finer and 0.5 gm put in a platinum dish with an excess of HCI and H_2F_2 (HF). This mixture will dissolve any ordinary constituent of pottery including iron, but does not dissolve carbon. The treatment was repeated and then the residue was evaporated dry several times with HCl to remove all fluorides. On dissolving the residue in dilute HCI, there was left some black amorphous carbon that was so light and fine it would not settle for a long time. It looked and acted like lampblack. This was filtered off on an asbestos pad, and the carbon was oxidized to CO_2, absorbed in the standard manner and weighed *1.3070* carbon was found. This is not very much but since it exists in the interstices of the clay, not as a surface coating, is extremely light, and has a remarkably high covering power, it seems to be sufficient to account for all of the black color.

Before making this determination, a piece of pottery was slowly heated to see if any fumes or smoke would come off, which would indicate that there might be volatile carbonaceous matter present, such as grease, oil, vegetal extracts, etc. that might vitiate the assay for carbon. None was seen.

The filtrate from the carbon determination was run for iron and 4.4% was found. This is about a normal amount for an impure clay that burns to a creamy buff color. Some of the bowl was broken up rather finely and a lot of small pieces showing little or no black color were taken, ground and tested for iron 4.5*070* was found, indicating that no more iron oxide was present in the black surface than in the interior paste of the wall.

Undoubtedly much of the iron exists as some form of silicate, but some may exist as free oxide which, when burned to Fe_2O_3 gives the slight reddish cast to the clay. This, on heating in a reducing atmosphere should form a little Fe_3O_4. This is black, but considering that it does not exist as a coating on the surface but is diffused throughout the clay and that Fe_3O_4 is a very inefficient pigment it should not have much to do with the black color.

When making experiments on reducing the Fe_2O_3 in pottery sherds it should be remembered that if they are heated in a reducing gas containing carbon. in addition to reducing Fe_2O_3 to Fe_3O_4, there generally will be much carbon liberated by catalytic action and deposited on the sherd. The reduction can be easily done by hydrogen at a comparatively low temperature and no carbon can be deposited; at a high temperature it would be further reduced to metallic iron. A sherd of this bowl that had been well oxidized so that the color was a very light buff was reduced by hydrogen as described. The color darkened perceptibly but still it was only a light brownish gray proving that while a small amount of Fe_3O_4 might be present, it had little effect on the color. Scrapings from the reduced piece were tested by a strong electromagnet but showed little or no magnetism, as they would if much Fe_3O_4 (magnetite) had been present. On a control one percent of Fe_3O_4 mixed with day showed considerable magnetism.

The last test was to determine whether a sherd would gain or lose weight when heated. It was first well extracted with dilute HCI to remove carbonates, then thoroughly washed many times in boiling distilled water and finally heated some time in a muffle. The heat was kept just below redness so as not to burn out the carbon. It was cooled and weighed and then heated to medium redness until all carbon was oxidized and again cooled and weighed.

Original weight after first heating --2.9794 gm
Weight after burning off carbon ----2.9550 gm
Weight of carbon----------------------- .0244 gm

This is nearly .0183070. It is lower than the regular carbon assay because part of the sherd contained no carbon, and possibly because there was a very little Fe_3O_4 present which took on a little weight. It shows, however, that any Fe_3O_4 is entirely subordinate to carbon.

Finally, it may be added that since Fe_2O_3 is a more efficient pigment than Fe_3O_4, any black piece of pottery presumably containing Fe_3O_4 should turn to a strong red color when it was oxidized to Fe_2O_3. This, however, was not the case. When the black paint was oxidized, only a very faint trace of red was found.

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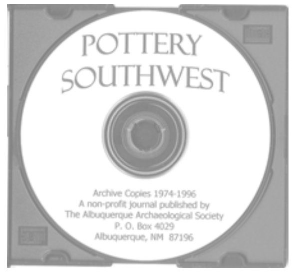

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