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Applying a Multi-Analytical Approach to the Investigation of Ancient Egyptian Influence in Nubian Communities: The Socio-Cultural Implications of Chemical Variation in Ceramic Styles

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Abstract

This article reviews published archaeological research that explores the potential of combined chemical and petrographic analyses to distinguish manufacturing methods of ceramics made from Nile river silt. The methodology was initially applied to distinguish the production methods of Egyptian and Nubian-style vessels found in New Kingdom and Napatan Period Egyptian colonial centers in Upper Nubia. Conducted in the context of ongoing excavations and surveys at the third cataract, ceramic characterization can be used to explore the dynamic role pottery production may have played in Egyptian efforts to integrate with or alter native Nubian culture. Results reveal that, despite overall similar geochemistry, x-ray fluorescence (XRF), instrumental neutron activation analysis (INAA), and petrography can distinguish Egyptian and Nubian-style ceramic traditions based on the relative degree of compositional homogeneity and subtle differences in paste recipes. This in turn indicates that cultural differences in craft production were sustained over time within the ethnically mixed communities of Upper Nubia. Based on these positive results, the methodology shows potential for addressing additional research questions in the Nile Valley, and a current research plan by the authors applies these same techniques to an evaluation of the role of ceramic craft centralization in the rise of the native Nubian Kerma state.

The Problem of Chemical Compositional Characterization along the Nubian Nile Valley

Chemical compositional characterization of ceramics is an increasingly important tool for archaeologists. Its ultimate goal is the production of a unique and robust compositional fingerprint of ancient ceramics based on analysis of major, minor, and trace elements. Simplistically and most commonly, such a well defined chemical fingerprint, if obtainable, allows the archaeologist to pinpoint the geographical or temporal origin of the ceramic, with the attendant utility of answering archaeological questions about it, e.g., when was it made, and was it produced at the site where it was found or imported through interregional exchange or trade? (See, e.g., Gomez et al. 2002; Neff 2000; Neff et al. 2006a, 2006b; Vaughn and Van Gijseghem 2007.) Such provenance studies are widely applicable in many archaeological contexts where the regions of interest have very different geographical geochemistry.

Within the context of the study of ancient Egyptian and Nubian ceramics made from Nile silt, however, such provenance studies are much more problematic because the alluvium in large river systems like the Nile Valley is largely homogeneous, so different locations along the river may have very similar chemical profiles. For a number of reasons, this is particularly true in Upper Nubia. The Nile River consists of two major tributaries—the White Nile and Blue Nile—that merge at Khartoum, and about 300 km north of this point, the Atbara River with its headwaters in Ethiopia enters the main river system (Figure 1). A relatively detailed provenance study of the sand-sized sediment load carried by the major tributaries of the Nile River was recently completed by Garzanti et al. (2006), including a thorough thin section analysis. Their research reveals that the Atbara River contributes mostly volcanic rock fragments, brown augite, and olivine from basaltic rocks exposed in its headwaters. In contrast, levee sediments along the Blue Nile include mafic volcanic grains with subordinate quartz and plagioclase, and minor metamorphic and sedimentary grains, K-feldspar, and biotite. The dense mineral phase is dominated by brown augite, subordinate opaques, blue-green amphibole, and epidote, along with trace amounts of garnet and olivine. In coarser-grained bar deposits, sediment consists of abundant quartz with subordinate plagioclase, volcanic lithic grains, K-feldspar, and minor metamorphic and sedimentary rock fragments along with biotite.

In contrast, the White Nile carries almost exclusively rounded monocrystalline quartz, commonly showing dissolution pits and re-entrants, and significantly lesser amounts of feldspar. Dense mineral phases include epidote, amphibole, sillimanite, and subordinate zircon, rutile, garnet, kyanite, staurolite, and titanite. Such highly quartzose compositionally mature sediment reflects the extreme subequatorial weathering in southern Sudan, or fluvial and eolian recycling of ancient quartz arenites in hyperarid climates (i.e., Nubian sands).

While the differences in geochemistry between the tributaries may make it possible to characterize distinctive clay sources in areas close to the confluences of these three tributaries, most of the archaeological sites in Upper Nubia lie between about 400 to 600 km north of this point, and it is likely that Nile River sediment in these areas would be finer-grained, homogenized, and well mixed, accounting for the notorious ambiguity of provenance studies (for partially successful provenance studies involving the Egyptian Nile, including the Delta, see Bourriau 1998; Bourriau et al. 2006; Mallory-Greenough et al. 1998; Redmount and Morgenstein 1996; Tschegg et al. 2008).

In addition, finding a unique chemical signature that corresponds to ceramic fabric type or time period has proven even less successful. For instance, while researchers have detected some differences in the geochemistry of both archaeological sherds and raw Nile silt sediment from different time periods (Krom et al. 2002; Mallory-Greenough et al. 1998), results from tests on modern Egyptian pottery have found that contemporary Nile silt vessels are geochemically similar to predynastic Nile silts (Redmount and Morgenstein 1996). Similarly, De Paepe (1992) suggests basic compositional continuity among Nubian Kerma ceramics from different time periods. Ceramic fabrics used for classification by archaeologists (such as those used in the Vienna System) also do not yield particular chemical signatures under these conditions (Bourriau et al. 2006, 277).

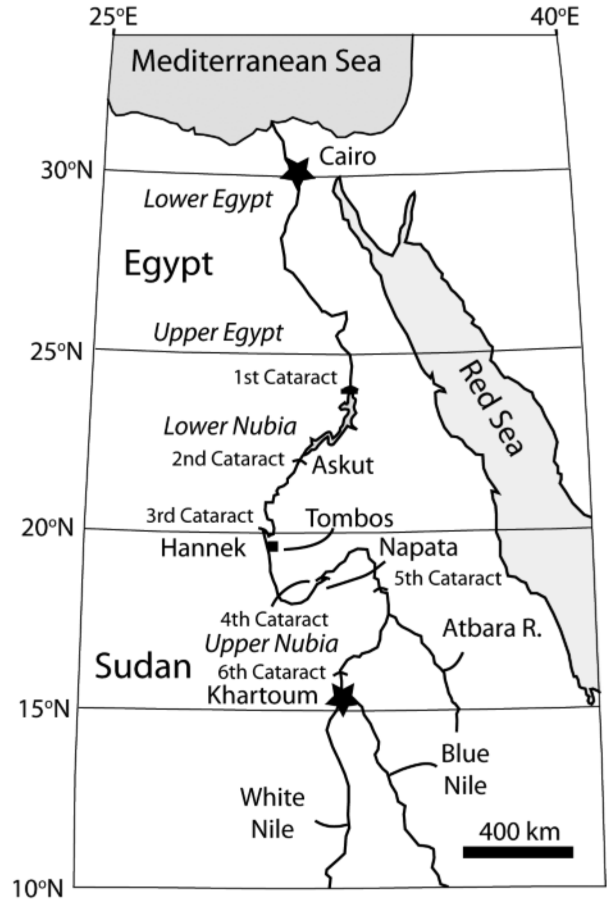

Figure 1. Map of Egypt and Nubia showing convergence of Nile river branches and archaeological sites from which samples were taken.

At present, therefore, the use of chemical compositional data to determine provenance remains difficult, particularly for ceramics composed primarily of Nile silt. Does such a failure then obviate the use of modern analytical methods to help answer archaeological questions concerning Egyptian and Nubian ceramics? The answer is of course no, and in this report we briefly review one case study of our own and propose future work amenable to elucidation by such methods. In particular, we propose that chemical characterization may be useful in the Nile Valley to differentiate manufacturing methods for vessel assemblages according to their degree of compositional homogeneity.

Chemical Compositional Variation between Ceramic Styles: Egyptians and Nubians at the Third Cataract

The use of a methodology that evaluates the relative homogeneity of ceramic chemical composition to distinguish cultural differences in vessel manufacturing was first tested in the context of the authors' ongoing research into the interactions of Egyptian and Nubians in Upper Nubia during the New Kingdom through Napatan periods (for background, see Török 2009). It has been hypothesized that, along with importing ceramics from Egypt itself, the Egyptian New Kingdom colonists used an Egyptian method of wheel-thrown ceramic manufacturing to produce vessels in their new communities, including Tombos at the third cataract and Askut at the second cataract. Under this theory, the Egyptian-style pottery at these sites would have been made by professional potters using recipes developed in Egypt and then distributed according to a relatively centralized pattern (Adams 1986; Kemp 1991). At the same time, traditional handmade Nubian-style ceramics are found at colonial sites in Upper Nubia. These vessels may have been traded from native Nubian towns; more likely, they were manufactured in colonial communities by unacculturated villagers, albeit perhaps using slightly altered techniques and on a relatively modest scale, given the pervasive influence of Egyptian ceramic technology.

When Egypt withdrew from Nubia at the end of the New Kingdom, it is expected that native Nubian ceramic techniques would have become more common again in the Third Intermediate post-colonial communities as Egyptian potters left the area or began to integrate with the local populations. If Egyptian-style vessels were still made locally, they may have been produced using modified (or "hybrid") techniques that reflect greater Nubian influence and the growing amalgamation of Egyptian and Nubian practices during the Napatan period (eventually the predecessors of the Napatan kingdom would briefly be able to rule Egypt itself, posing as true pharaohs and saviors of Egypt [Bianchi 2004, 156–59; Welsby 1996, 19]).[1] In contrast to the hypothesized changes in manufacturing and distribution in the colonial communities, at native Nubian sites such as Hannek, across the river from Tombos at the third cataract, the Nubian traditions of ceramic manufacturing would have remained entirely distinct from Egyptian influence and would show continuity across all time periods.

This situation, in which production differences are hypothesized between ceramic styles but are by no means well understood, was an ideal testing ground for ceramic compositional analysis.[2] Our project sought to discover which, if any, analytic method could separate the stylistic populations in a way we could correlate with different paste recipes, manufacturing techniques, or distribution patterns.

Eventually, our research design will include analyses of close to 350 sherds. Our pilot project consisted of thirty-two sherds (Egyptian=18, Nubian=14), which were analyzed using x-ray fluorescence (XRF) and loss on ignition (LOI).[3] Thirteen samples were from Tombos, eleven from Askut, and eight from Hannek; they ranged in date from the New Kingdom to Napatan periods (Table 1). Eighteen of these samples also underwent petrographic analysis via thin sectioning. XRF measured ten major elements (detected as compounds and recorded as percentages of total weight) and twenty-three trace elements (recorded as parts per million). Ninety sherds (Egyptian=53, Nubian=36)[4] were then analyzed using instrumental neutron activation analysis (INAA) (Table 2). In order to compare the methods and obtain verification of our initial data, eighteen of these samples were sherds that were previously analyzed using XRF. The sherds dated from the Kerma through Napatan periods (Figures 2–4). Thirty-two were from Askut, twenty from Hannek, and thirty-eight from Tombos. INAA measured thirty-two elements that were subsequently used in the statistical analysis of the data. The specific samples selected, analytic methods employed, and raw data from the analyses are published elsewhere and not repeated in detail here (Carrano et al. 2008a, forthcoming; Carrano et al. 2009; Ferguson and Glascock, unpublished report).

The three methodologies produced remarkably mutually reinforcing results. As we expected, no method produced clear evidence of distinct clay sources; instead, each provided a means of evaluating the differences and similarities between sample populations. For instance, XRF and INAA both confirmed that the two styles were chemically very similar and, as anticipated, composed of Nile silt alluvium. The chemical makeup also appeared to be within the range reported for Nile silt pottery found in Egypt (see, e.g., Mallory-Greenough et al. 1998; Redmount and Morgenstein 1996). In addition, despite the visual dissimilarity between the two styles, petrography revealed that the matrix compositions (or fired cryptocrystalline material surrounding the framework) appear to be quite similar to one another.[5]

Nevertheless, important differences in the two populations of vessels were detected. First, the Egyptian-style sherds had a lower average LOI (2.73) compared to Nubian-style sherds (4.52), suggesting that Nubian-style sherds were mixed with more volatile additions, most likely organics such as straw (Carrano et al. 2009). This was supported by petrographic analysis that showed Nubian-style sherds have a higher proportion of voids, more than half of which are due to the disintegration or dissolution of plant fragments. The petrographic analysis also showed that the framework for Nubian-style sherds was generally finer-grained than Egyptian-style sherds. This evidence suggests that Nubian potters were using a different mixing recipe or processing than their Egyptian counterparts, even if they were generally exploiting the same or similar clay resources.

The other primary difference between the two styles is the relative compositional variability in the populations. This is apparent from bivariate plots of elements from both the INAA and XRF data in which the Nubian population, at an 80% or 90% confidence level, subsumed the Egyptian population at the same con-

Table 1. Description of samples analyzed using XRF.

Sample No.	Sample Name	Site	Cultural Style	Period
1	ES-00-13	Tombos	Egyptian	New Kingdom
2	ES-00-132A	Tombos	Egyptian	New Kingdom
3	ES-00-132B	Tombos	Egyptian	New Kingdom
4	ES-00-134	Tombos	Egyptian	New Kingdom
5	ES-1391A	Askut	Egyptian	New Kingdom
6	ES-00-174	Tombos	Egyptian	New Kingdom
7	ES-00-30	Tombos	Egyptian	New Kingdom
8	ES-00-47A	Tombos	Egyptian	New Kingdom
9	ES-00-47B	Tombos	Egyptian	New Kingdom
10	ES-00-73	Tombos	Egyptian	New Kingdom
11	ES-05-131A	Tombos	Egyptian	Late/Napatan
12	ES-05-131B	Tombos	Egyptian	Late/Napatan
13	ES-05-387A	Tombos	Egyptian*	Late/Napatan
14	ES-05-387B	Tombos	Egyptian*	Late/Napatan
15	ES-1189A	Askut	Nubian	New Kingdom
16	ES-1189B	Askut	Nubian	New Kingdom
17	ES-1391B	Askut	Egyptian	New Kingdom
18	ES-2042	Askut	Egyptian	New Kingdom
19	ES-2049	Askut	Egyptian	New Kingdom
20	ES-2063	Askut	Egyptian	New Kingdom
21	ES-194	Hannek	Nubian	Kerma-P
22	ES-449	Hannek	Nubian	Kerma-LP
23	ES-1202A	Askut	Nubian	New Kingdom-TIP
24	ES-439	Hannek	Nubian	Kerma-LP
25	ES-462	Hannek	Nubian	Kerma-LP
26	ES-1202B	Askut	Nubian	New Kingdom-TIP
27	ES-434C	Hannek	Nubian	Kerma-LP
28	ES-1423A	Askut	Nubian	New Kingdom-TIP
29	ES-434A	Hannek	Nubian	Kerma-LP
30	ES-1423B	Askut	Nubian	New Kingdom-TIP
31	ES-434B	Hannek	Nubian	Kerma-LP
32	ES-438	Hannek	Nubian	Kerma-LP

*These samples (belonging to one vessel) are Egyptian in style except they are handmade rather than wheel-thrown.

fidence level (Figure 5A). This trend was somewhat more apparent in the major, rather than trace, element bivariates generated from the XRF data (Figure 5B) (Carrano et al. 2009). In addition, INAA was able to classify 83% of the Egyptian-style sherds into three chemical groups, whereas only 58% of Nubian-style sherds could be classified into any chemical group at all (Carrano et al., forthcoming). The greater homogeneity of the Egyptian-style population suggests that the recipes and/or manufacturing techniques employed by potters producing Egyptian-style vessels were more consistent than their Nubian counterparts. In addition, when the point-count data from the petrographic analysis is plotted on a ternary diagram of quartz-others-feldspar, the Nubian sherds fall into a broad scatter, while the Egyptian-style sherds form a relatively linear trend, with one member being quartz-rich and the other feldspar-rich (Figure 6). The trend likely represents a mixing line of framework quartz and feldspar-rich material; its linear nature confirms that Egyptian-style vessels were produced using a more consistent mixing recipe, in contrast to the variable mixing recipes employed by Nubian potters.

While each analytic method was able to detect differences between sample vessels based on style, it proved much more difficult to detect differences between samples from each site (Askut, Tombos, and Hannek) or between different time periods. Our inability to determine differences in samples from

Table 2. Description of samples analyzed using INAA (continued on following page).

Sample	Site	Form	Cultural Style	Period	Chemical Group
STS001	Askut	pot	Nubian	New Kingdom	Unclassified
STS002	Askut	pot	Nubian	Napatan	3
STS003	Askut	pot	Nubian	Napatan	3
STS004	Askut	bowl	Egyptian	Napatan	U
STS005	Askut	small bowl	Egyptian	New Kingdom	3
STS006	Askut	bowl	Egyptian	New Kingdom	3
STS007	Askut	jar	Egyptian	New Kingdom	U
STS008	Askut	stand	Egyptian	New Kingdom	5
STS009	Askut	stand	Egyptian	New Kingdom	3
STS010	Askut	stand	Egyptian	Middle Kingdom	5
STS011	Askut	pot	Egyptian	New Kingdom	U
STS012	Askut	bowl	Egyptian	New Kingdom	3
STS013	Askut	pot	Nubian	New Kingdom	U
STS014	Askut	plate	Egyptian	New Kingdom	3
STS015	Askut	pot	Nubian	Napatan	U
STS016	Askut	bowl?	Egyptian	Napatan	U
STS017	Askut	plate?	Egyptian	New Kingdom	3
STS018	Askut	plate	Egyptian	New Kingdom	U
STS019	Askut	cup	Egyptian	New Kingdom	3
STS020	Askut	jar	Egyptian	New Kingdom	3
STS021	Askut	cup	Egyptian	New Kingdom	3
STS022	Hannek	bowl?	Nubian	Kerma Classic	4
STS023	Hannek	bowl?	Nubian	Kerma Classic	U
STS024	Hannek	bowl?	Nubian	Kerma Classic	4
STS025	Hannek	bowl?	Nubian	Kerma Classic	U
STS026	Hannek	large bowl?	Nubian	Kerma Classic	5
STS027	Hannek	large bowl?	Nubian	Kerma Classic	U
STS028	Hannek	bowl?	Nubian	Kerma Classic	4
STS029	Hannek	jar	Nubian	Kerma Classic	U
STS030	Hannek	beaker	Nubian	Kerma Classic	4
STS031	Hannek	bowl?	Nubian	Kerma Classic	4
STS032	Hannek	bowl?	Nubian	Kerma Classic	U
STS033	Hannek	bowl?	Nubian	Kerma Classic	U
STS034	Hannek	bowl?	Nubian	Kerma Classic	U
STS035	Hannek	large bowl?	Nubian	Kerma Classic	3
STS036	Hannek	bowl?	Nubian	Kerma Classic	2
STS037	Hannek	bowl?	Nubian	Kerma Classic	2
STS038	Hannek	bowl?	Nubian	Kerma Classic	3
STS039	Hannek	bowl?	Nubian	Kerma Classic	U
STS040	Hannek	bowl?	Nubian	Kerma Classic	U
STS041	Hannek	bowl?	Nubian	Kerma Classic	4
STS042	Tombos	bowl	Egyptian	New Kingdom	4
STS043	Tombos	small jar	Egyptian	New Kingdom	5
STS044	Tombos	small bowl	Egyptian	New Kingdom	5
STS045	Tombos	jar	Egyptian	Napatan	5

Table 2. Description of samples analyzed using INAA (continued from previous page).

Sample	Site	Form	Cultural Style	Period	Chemical Group
STS046	Tombos	bowl	Egyptian	Napatan	3
STS047	Tombos	jar	Egyptian	Napatan	5
STS048	Tombos	bowl	Nubian	New Kingdom	U
STS049	Tombos	bowl	Nubian	New Kingdom	3
STS050	Tombos	base of bowl?	Egyptian	New Kingdom	3
STS051	Tombos	bowl	Egyptian	New Kingdom	U
STS052	Tombos	jar	Egyptian	New Kingdom	5
STS053	Tombos	bowl	Egyptian	New Kingdom	5
STS054	Tombos	small bowl	Egyptian	New Kingdom	4
STS055	Tombos	jar	Egyptian	New Kingdom	3
STS056	Tombos	pot	Nubian	Napatan	3
STS057	Tombos	base of jar	Egyptian	Napatan	5
STS058	Tombos	cup	Nubian	Napatan	1
STS059	Tombos	cup	Nubian	Napatan	1
STS060	Tombos	frag	Nubian	Napatan	3
STS061	Tombos	cup	Nubian	Napatan	5
STS062	Tombos	jar	Egyptian	Napatan	3
STS063	Tombos	large bowl?	Egyptian	Napatan	5
STS064	Tombos	cup	Nubian	Napatan	1
STS065	Tombos	cup	Egyptian	Napatan	3
STS066	Tombos	bowl	Egyptian	Napatan	U
STS067	Tombos	small bowl	Egyptian	Napatan	4
STS068	Tombos	bowl/cup	Nubian	Napatan	3
STS069	Askut	floor tile	n/a	?	3
STS070	Askut	pot	Egyptian	Napatan	U
STS071	Askut	bowl	Egyptian	Napatan	3
STS072	Askut	lid handle	Egyptian	Middle Kingdom	3
STS073	Tombos	amphora	Egyptian	New Kingdom	5
STS074	Askut	pot	Nubian	New Kingdom	U
STS075	Tombos	base of jar/pot	Egyptian	New Kingdom	5
STS076	Askut	plate	Egyptian	New Kingdom	5
STS077	Askut	base of cup/small bowl	Egyptian	New Kingdom	3
STS078	Tombos	pot/bowl	Egyptian	New Kingdom	3
STS079	Tombos	bowl	Egyptian	New Kingdom	U
STS080	Tombos	cup	Egyptian	Napatan	3
STS081	Askut	small jar	Egyptian	New Kingdom	3
STS082	Askut	bowl	Egyptian	New Kingdom	5
STS083	Tombos	(flower)pot	Egyptian	New Kingdom	5
STS084	Askut	pot	Nubian	New Kingdom	U
STS085	Tombos	cup/small jar	Egyptian	Napatan	5
STS086	Tombos	bowl	Egyptian	New Kingdom	3
STS087	Tombos	large cup/open jar	Egyptian	Napatan	4
STS088	Tombos	jar	Egyptian	New Kingdom	5
STS089	Tombos	cup	Egyptian	New Kingdom	5
STS090	Askut	cup	Egyptian	New Kingdom	3

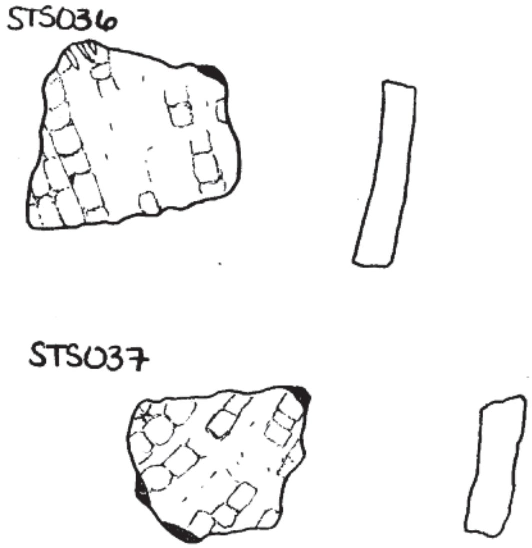

Figure 2. Kerma Classic period vessels from Hannek. Nubian-style, handmade bowls with mat impression surface decoration (INAA samples STS036 and STS037).

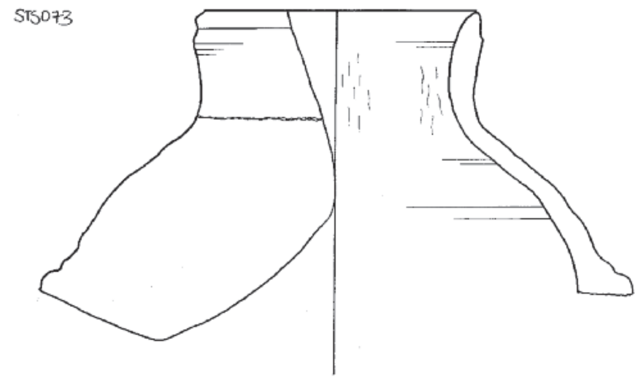

Figure 3. New Kingdom period vessel from Tombos. Egyptian-style, wheel-thrown amphora (INAA sample STS073, also submitted to petrographic thin section analysis and XRF).

each time period suggests, somewhat to our surprise, that there was considerable continuity in the method of manufacturing and paste recipes used by potters creating each style of ceramics, even during the withdrawal of Egyptian colonial influence at the end of the New Kingdom. The one exception is a Napatan period vessel that appears Egyptian in style except for being hand-formed, not wheel-thrown. This vessel (XRF samples 13 and 14) showed both chemical and petrographic affinities to Nubian-style vessels rather than other Egyptian-style sherds (these samples are also the outliers on the ternary diagram, Figure 6, discussed above), and may thus represent a "hybrid" technology that developed during the Napatan period. However, as this vessel is the only one of its kind in our sample population, the archaeological implications of the results are unclear.

The lack of correlation between site provenance and chemical composition may indicate that, as predicted, the compositional methods employed are not isolating the specific clay sources exploited by each site because of the general geological homogeneity of the resources in the area. Alternatively, it is possible that the chemical groupings do indeed relate to the place of manufacture, but that because each community was engaged in such pervasive trade, the site where a vessel was found has little correlation with its original place of manufacture. However, it seems very unlikely that native handmade Nubian vessels were traded long-distance to other communities as frequently as they were used within the original area of manufacture (this is unlikely with Egyptian-style vessels as well, but might be somewhat more conceivable given Egyptian redistribution methods). This, coupled with what we know about the difficulties inherent in detecting distinct clay sources in the Nile Valley, makes the first alternative more probable. In that case, our inability to find chemical compositional differences between Nubian-style vessels that were found at Hannek and Nubian-style vessels from the two colonial communities suggests that native production techniques were not substantially altered by Egyptian colonial control.

The conclusions from our multi-analytical ceramic compositional research are useful as an independent line of evidence to confirm and modify conclusions from our ongoing archaeological excavations at the colonial cemetery site of Tombos, from which a substantial portion of the samples were taken, including sherds of both styles from the New Kingdom and Napatan periods.[6] Tombos developed as an Egyptian colonial center during the New Kingdom, and archaeological evidence indicates that there was probably continuous occupation of the site through the Third Intermediate and into the Napatan period—in other words, even after the Egyptians officially withdrew from Upper Nubia (Smith 2008).

The New Kingdom component of the cemetery is dominated by Egyptian-style burials—in particular the pyramid of Siamun, a high-ranking colonial administrator, and his wife Weren—as well as additional, humbler pit and chamber tombs. The pyramid appears to be almost "hyper-Egyptian" in its style; on the other hand, there are several burials of women in Nubian-style positions (some with Nubian-style burials goods) in the other Egyptian-style tombs (Smith 2003). Egyptian-style vessels dominate the ceramic assemblage, but Nubian-style vessels, as mentioned above, were also found. This evidence supports the ceramic compositional results by revealing a heavily Egyptianized colonial community that consciously chose to remain distinct from the surrounding local population. It also confirms, however, that Nubian cultural traditions were maintained even in the face of the colonial influence—perhaps as the result of Nubian women, some of whom might have been part-time potters, marrying into the communities.[7]

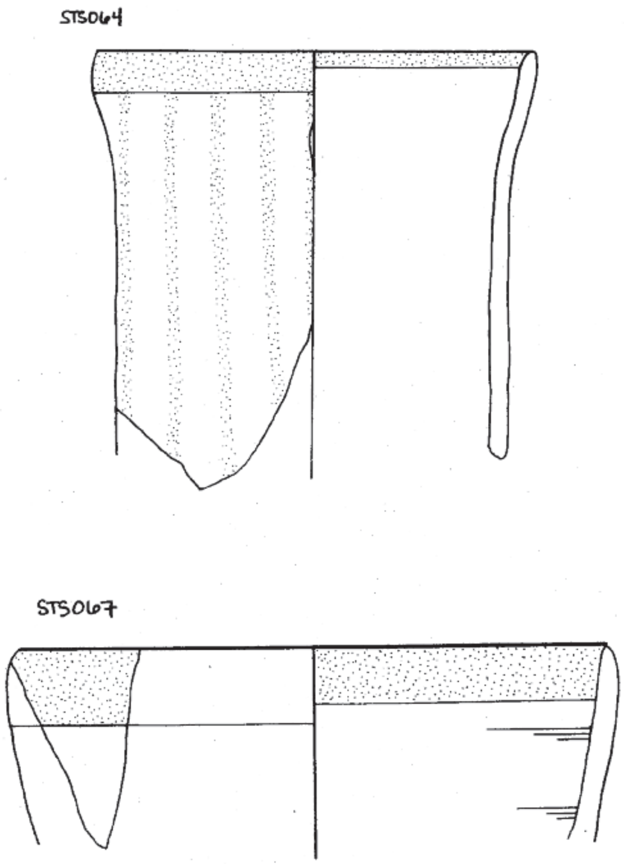

Figure 4. Napatan period vessels from Tombos. Sample STS064 is a Nubian-style, handmade cup; sample STS067 is an Egyptian-style wheel-thrown bowl.

The results of our ceramic compositional analysis, which show continuity across time periods within the styles but differences maintained over time between the styles, also suggest that the co-existence of Nubian and Egyptian ethnic identities, as evidenced in distinguishable pottery styles and methods of manufacture, probably continued during the Third Intermediate Period and into the Napatan Period. The evidence from Tombos supports the picture of a multicultural community that survived during this transitional period. For instance, an Egyptian-style pit tomb burial and a Nubian-style bed burial were found that likely date to the Third Intermediate Period, showing that both ethnic identities were retained relatively intact in the post-colonial community (Smith 2008).

During the Napatan Period at Tombos, archaeological evidence supports the continuation of both ethnic identities in the community, but also reflects a possible resurgence of native Nubian cultural traditions. During that period, a substantial Egyptian-style pyramid tomb and accompanying chamber tomb may have existed alongside several dozen native Nubian tumuli (Smith 2008). In keeping with the ceramic evidence, which reveals continuity in the manufacturing methods and recipes of Egyptian-style vessels from the New Kingdom through this period, it can be argued that the Egyptian-style pyramid burial reveals a continuation of Egyptian ethnic identity in Upper Nubia, particularly among the elite. If this is the case, then the Egyptian influence visible during the Napatan Period at colonial communities like Tombos should be seen as a *source* from which the leaders of the new Napatan kingdom could draw to revive an identity as the true saviors of Egypt, rather than a *product* of this new emphasis (Smith 2008).

At the same time, the introduction of the native tumuli after the Egyptian withdrawal (no recorded tumuli date to the New Kingdom) indicates that Nubian traditions may have had a very visible resurgence in the post-colonial community, including reviving or adopting methods of tomb construction that were used in the surrounding local population. Interestingly, as mentioned above, this revival of Nubian culture does not appear to have produced any significant change in ceramic production methods or style that could be designated a "hybrid" technology.

The one possible exception is the Napatan Period handmade Egyptian-style vessel that had an anomalous chemical composition, discussed above. To evaluate better whether this vessel is truly an outlier or whether it might represent a poorly represented change in ceramic manufacturing methods that accompanied the distinct change in burial practices at Tombos, a greater number of Third Intermediate and Napatan sherds will be submitted for INAA analysis as part of the remaining 210 samples in our research design. In addition, because the composition of Nubian pottery is so poorly documented and the projects discussed here analyzed fewer Nubian-style sherds than Egyptian, we also plan to focus on expanding the current database of Nubian samples to better understand the degree of variability present in this population. Finally, clay samples that have been collected from the third cataract region will be chemically analyzed. Ongoing excavations at Tombos, particularly of the later period tumuli, will provide a wealth of well-documented sherds for the remaining component of the project, as well as develop an increasingly clear archaeological context in which to interpret the results.

Expanding Research Questions: Pre-Kerma and Emerging Social Complexity at the Third and Fourth Cataracts

The multi-analytical methodological approach used in this paper has great potential beyond investigating ethnic interaction between Nubians and Egyptians. For example, the authors are currently seeking funding to apply these ceramic compositional methods to the question of emerging socio-economic complexity in Upper Nubia before the advent of Egyptian colonial control by investigating the degree of craft centralization present in the pre-Kerma material culture group.

The Kerma Kingdom (ca. 2500–1500 BCE), based at the third cataract, is famous as Egypt's earliest economic and

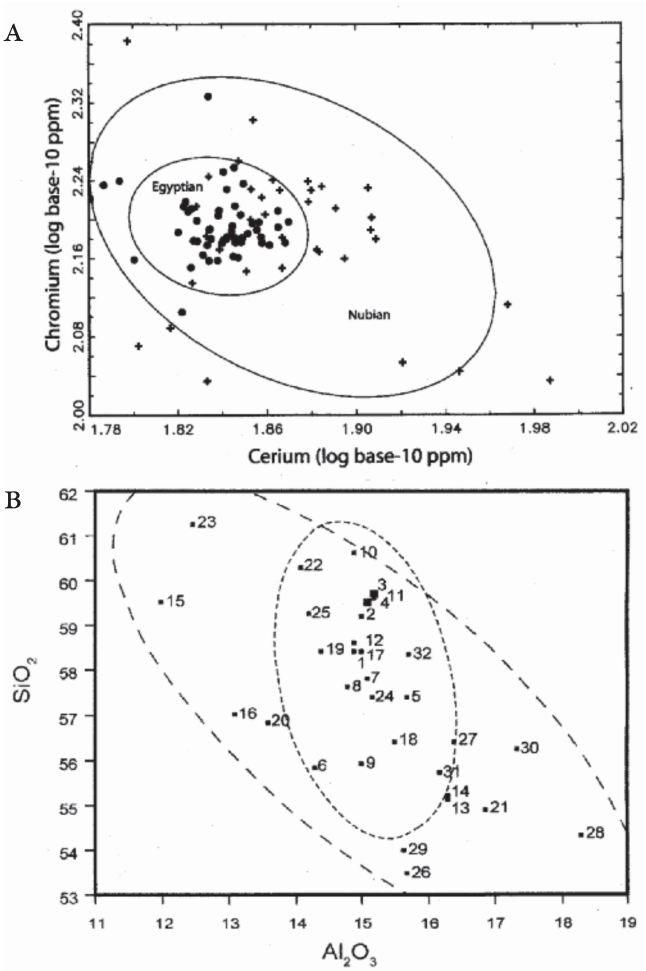

Figure 5. Bivariate plots from INAA data (a) and XRF data (b) showing the greater variability in the Nubian-style sherd population in comparison to the Egyptian-style sherd population, as revealed by both analytical methods. In both plots, the Nubian-style population is represented by the larger oval, while the Egyptian-style population is represented by the smaller oval.

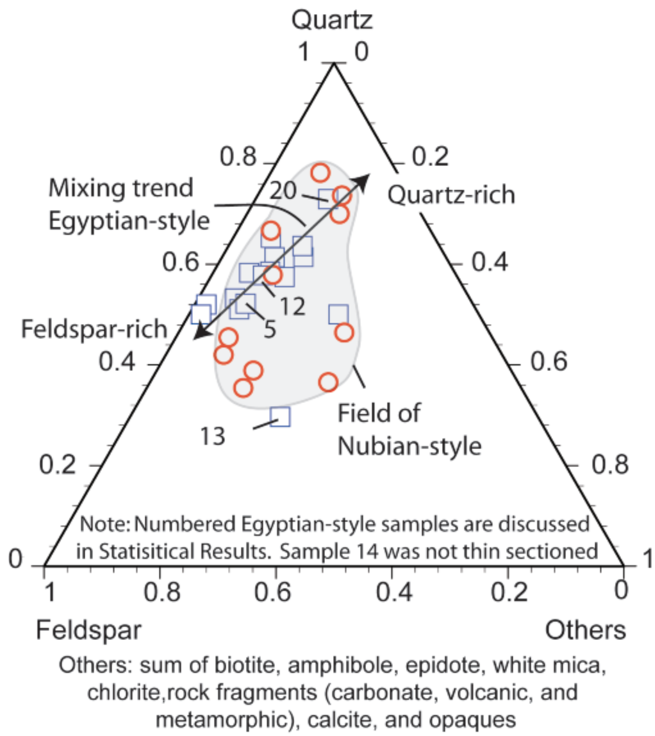

Figure 6. Quartz-others-feldspar ternary diagram based on point-count data. Note that linear trends in data are interpreted to be the result of mixing two end-member compositions approximated by the two most extreme samples plotting at opposite ends of the array.

political rival on the African continent. However, while research during the last decade has shed new light on Kerma's social antecedents, the organizational context of its development as an emergent state remains relatively unknown (Bianchi 2004, 75). The focus of the ceramic analysis would be to assess the degree of regional integration (i.e., centralization) of craft economy and how this changed during a crucial period of social and political transformation (approximately 4500 and 2500 BCE) in the region.

It is hypothesized that, as part of a progressive move toward greater economic and political influence in the region, control of pottery production and distribution throughout the Upper Nubian Nile Valley grew increasingly centralized around the material culture group known as the Pre-Kerma (3500–2500 BCE). Consequently, this development should be evident in the craft economy and material practice of potter communities at the third and fourth cataracts where Pre-Kerma material is found. Thus, pottery thin section analysis will be used along with INAA to determine the number and distribution of production groups as well as the degree of craft specialization based on the uniformity of manufacturing technique regionally. Comparing this information with formal style will serve to further inform the study on the nature of production organization by correlating overt social signaling related to formal style with covert manufacturing practices related to technical style.

As in our study on Egyptian and Nubian interactions described above, archaeological context will be important for interpreting the data obtained through the chemical and petrographic analyses; the samples will therefore be selected from materials collected by the authors during survey and excavation seasons carried out between 2003 and 2008 in the area around Tombos at the third cataract, as well as at the fourth cataract (Smith and Herbst 2005, 2008). At the fourth-cataract site of Ginefab, surface collection produced significant number of sherds with motifs associated with the Pre-Kerma culture as well as Kerma Ancien (Smith and Herbst 2008). Examples include ripple-burnished pieces (finely made, red exterior, and polished black interior) and sherds stamped with zigzag rockers. In addition, excavations uncovered remains of posthole structures and associated hearths that, from both pottery collected at the site and radiocarbon dating, appear to be pre-Kerma. The survey also produced pottery associated with every stage of Kerma settlement. This continuity in ceramics should prove useful in determining if and when methods of manufacturing changed and centralization increased.

Conclusion

This review sets out preliminary results and interpretations from the authors' several-year foray into the chemical composition analysis of Nile silt ceramics. Clearly, more work—including testing a greater sample size—is needed before our interpretations of the interaction between colonial Egyptian and native Nubian ethnic groups in Upper Nubia can harden into robust conclusions. However, in focusing on the potential of chemical compositional analysis to highlight different manufacturing techniques and the behavioral implications of these differences (rather than attempting to pinpoint specific production locales), we are encouraged by the possibility of such analysis to produce consistent and archaeologically meaningful data. Testing the methodology on different archaeological questions, as planned with future research both into the Third Intermediate Period/Napatan transition and the rise of complexity during the pre-Kerma/Kerma transition, will also strengthen our understanding and confidence in the techniques. Eventually, it is hoped, the application of a similar methodology by archaeologists working up and down the Nile River Valley will produce an interlocking data set that will allow meaningful comparisons throughout the region.

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Notes

1. For the concept of hybridization in general, see, e.g., van Dommelen 1995; for a discussion re-evaluating the distinction between wheel-made and handmade style vessels in later Nubian society, see Robertson and Hill 1999.
2. Our hypothesis that the two ceramic styles may represent different behavioral patterns that result in unique chemical compositions for the stylistic populations builds on discussions of the effects of behavior on ceramic composition analysis, e.g., Carpenter and Feinman 1998, as well as ethnographic accounts of ceramic production, e.g., Stark 2003.
3. LOI for each sample was calculated as the difference in weight prior to and after heating for 1 hour at 1000 °C and represents the sum of all volatile components in the sample.
4. One sample was a floor tile and therefore was not assigned a style.
5. On microscopic observation, both styles of sherds could be described as consisting of a coarse-grained framework composed of silicate minerals, quartz, and feldspar, a fired matrix of cryptocrystalline material surrounding the framework, scattered plant fragments, and voids.
6. Samples from Hannek were collected during surface survey. Samples from Askut were taken from a collection at the University of California, Los Angeles; for archaeological context of these sherds, see Smith 1995.
7. The dynamic interaction between ethnic groups during periods of colonization and dominance has become of increasing interest to archaeologists, for instance Alcock 1993 and 2002. In many areas of the world, this interaction is studied through ceramic style; thus, our conclusions regarding Egyptians and Nubians can be compared cross-culturally to other studies, including Dietler and Herbich 1998; Janusek 2002; MacEachern 1998; Santley et al. 1987.

References

Adams, W. 1986. *Ceramic industries of medieval Nubia.* Lexington, Kentucky: University Press of Kentucky.

Alcock, S. 1993. *Graecia Capta.* Cambridge: Cambridge University Press.

Alcock, S. 2002. *Archaeologies of the Greek past.* Cambridge: Cambridge University Press.

Bianchi, R. S. 2004. *Daily life of the Nubians.* Westport, CT: Greenwood Press.

Bourriau, J. 1998. *The role of chemical analysis in the study of Egyptian pottery.* Leuven: Peeters Publishers.

Bourriau, J., A. Bellido, N. Bryan, and V. Robinson. 2006. Egyptian pottery fabrics: A comparison between NAA groupings and the "Vienna System." In *Timelines: Studies in honour of Manfred Bietak,* vol. 3, edited by E. Czerny, I. Hein, H. Hunger, D. Melman, and A. Schwab. Leuven: Peeters Publishers. pp. 261–292.

Carrano, J., G. Girty, S. T. Smith, and C. J. Carrano. 2009. Re-examining the Egyptian colonial encounter in Nubia through a compositional, mineralogical, and textural comparison of ceramics. *Journal of Archaeological Science* 36: 785–797.

Carrano, J., J. Ferguson, G. Girty, S. T. Smith, and C. J. Carrano 2008a. Preliminary report: A chemical and mineralogical comparison of Nubian and Egyptian style ceramics and the implications for culture contact. *Sudan and Nubia* 12: 90–98.

Carrano, J., J. Ferguson, G. Girty, and C. J. Carrano. Forthcoming. A chemical analysis of ancient Nubian and Egyptian style ceramics: evaluating the substance of style. *Mitteilungen des Deutschen Archaeologischen Instituts* 64.

Carpenter, A. and G. Feinman. 1998. The effects of behavior on ceramic composition: Implications for the definition of production locations. *Journal of Archaeological Science* 26: 783–796.

de Paepe, P., B. Gratien, and B. Privati. 1992. Étude Comparative de Céramiques Kerma. *Cahier de Recherches de I'nstitut de Papyrologie et d'Egyptologie de Lille* 14: 63–81.

Dietler, M. and I. Herbich. 1998. Habitus, techniques, style: An integrated approach to the social understanding of material culture and boundaries. In *Archaeology of social boundaries*, edited by M. Stark. Washington, D.C.: Smithsonian Institution Press. pp. 232–263.

Ferguson, J. R. and M. D. Glascock. 2006. Instrumental activation analysis of Nubian and Egyptian pottery from Askut, Tombos, and Hannek. Unpublished report, University of Missouri Research Reactor Archaeometry Laboratory.

Garzanti, E., S. Ando, G. Vezzoli, A. A. A. Megid, and A. E. Kammar. 2006. Petrology of Nile River sands (Ethiopia and Sudan): Sediment budgets and erosion patterns. *Earth and Planetary Science Letters* 252: 327–341.

Gomez, B., H. Neff, M. L. Rautman, S. J. Vaughan, and M. D. Glascock. 2002. The source provenance of Bronze Age and Roman pottery from Cyprus. *Archaeometry* 44: 23–36.

Janusek, J. 2002. Out of many, one: Style and social boundaries in Tiwanaku. *Latin American Antiquity* 13: 35–62.

Kemp, B. 1991. *Ancient Egypt: Anatomy of a civilization.* London: Routledge.

Krom, M. D., J. D. Stanley, R. A. Cliff, and J. C. Woodward. 2002. Nile River sediment fluctuations over the past 7000 yrs and their key role in sapropel development. *Geology* 30: 71–74.

MacEachern, S. 1998. Scale, style, and cultural variation: Technological traditions in the Northern Mandara Mountains. In *Archaeology of social boundaries*, edited by M. Stark. Washington, D.C.: Smithsonian Institution Press. pp. 107–131.

Mallory-Greenough, L. M., J. D. Greenough, and J. V. Owen. 1998. A rapid INAA method to characterize Egyptian ceramics. *Journal of Archaeological Science* 13: 107–117.

Neff, H. 2000. Neutron activation analysis for provenance determination in archaeology. In *Modern analytical methods in art and archaeology*, edited by E. Ciliberto and G. Spoto. New York: Wiley. pp. 81–134.

Neff, H., J. Blomster, M. D. Glascock, R. L. Bishop, M. J. Blackman, M. D. Coe, G. L. Cowgill, R. A. Diehl, S. Houston, A. A. Joyce, C. P. Lipo, B. L. Stark, and M. Winter. 2006a. Methodological issues in the provenance investigation of Early Formative Mesoamerican ceramics. *Latin American Antiquity* 17: 54–23.

Neff, H., J. Blomster, M. D. Glascock, R. L. Bishop, M. J. Blackman, M. D. Coe, G. L. Cowgill, A. Cyphers, R. A. Diehl, S. Houston, A. A. Joyce, C. P. Lipo, B. L. Stark, and M. Winter. 2006b. Smokescreens in the provenance investigation of Early Formative Mesoamerican ceramics. *Latin American Antiquity* 17: 104–115.

Redmount, C. and M. Morgenstein 1996. Major and trace element analysis of modern Egyptian pottery. *Journal of Archaeological Science* 23: 741–762.

Robertson, J. H. and E. M. Hill. 1999. Two traditions or one? New interpretation of the hand-made/wheel-made ceramics from Meroe. In *Recent research in Kushite history and archaeology*, edited by D. Welsby. London: British Museum. pp. 321–330.

Santley, R., C. Yarborough, and B. Hall. 1987. Enclaves, ethnicity, and the archaeological record at Matacapan. In *Ethnicity and culture*, edited by R. Auger, M. Glass, S. MacEachern, and P. MacCartney. Calgary: University of Calgary Archaeological Association. pp. 85–100.

Smith, S. 1995. *Askut in Nubia.* London: Taylor and Francis.

Smith, S. 2003. *Wretched Kush.* London: Routledge.

Smith, S. and G. Herbst 2008. Neolithic through Kerma settlement at Ginefab. In *Cahier de recherches de l'Institut de papyrologie et égyptologie de Lille. Supplément 7. Actes de la 4e Conférence Internationale sur l'Archéologie de la 4e Cataracte du Nil, Villeneuve d'Asq, 22–23 juin 2007*, edited by B. Gratien. Lille: Université Charles-de-Gaulle Lille 3. pp. 347–352.

Smith, S. 2008. Tombos and the transition from the New Kingdom to the Napatan period in Upper Nubia. In *Between the Cataracts*, part one: Main papers, edited by W. Godlewski and A. Lajtar. Warsaw: Warsaw University Press. pp. 95–115.

Smith, S., and G. Herbst. 2005. The UCSB West (left) Bank archaeological survey from el-Kab to Mograt. In *Proceedings of the Archaeology of the Fourth Nile Cataract*, edited by H. Paner and S. Jakobielski. Gdansk Archaeological Museum African Reports 4. Gdansk: Archaeological Museum. pp. 133–144.

Stark, M. 2003. Current issues in ceramic ethnoarchaeology. *Journal of Archaeological Research* 11: 193–222.

Török, L. 2009. *Between two worlds: The frontier region between ancient Nubia and Egypt 3700 B.C.–A.D. 500.* Leiden: Brill Academic Publishers.

Tschegg, C., I. Hein, and Th. Ntaflos. 2008. State of the art multi-analytic geoscientific approach to identify Cypriot biochrome wheel-made ware reproduction in the eastern Nile Delta (Egypt). *Journal of Archaeological Science* 35: 1134–1147.

van Dommelen, P. 2005. Colonial interactions and hybrid practices: Phoenician and Carthaginian settlement in the ancient Mediterranean. In *The archaeology of colonial encounter*, edited by G. Stein. Santa Fe: SAR Press. pp. 109–142.

Vaughn, K. and H. van Gijseghem. 2007. A compositional perspective on the origins of the "Nasca cult" at Cahuachi. *Journal of Archaeological Science* 34: 814–822.

Welsby, D. 1996. *The kingdom of Kush.* London: Marcus Wiener.