Instrumental Neutron Activation Analysis Late Saladoid Pottery from St. Croix, U.S. Virgin Islands

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Introduction

Pottery (n=73) and clays (n=11) from the island of St. Croix, U.S. Virgin Islands were analyzed by instrumental neutron activation analysis (INAA) at the University of Missouri Research Reactor Center (MURR). Here, we describe sample preparation and analytical techniques used at MURR. Previous research on the island provided a small sample of 50 sherds from Salt River Site allowed for a more robust statistical analysis of the data. The samples from the current project compared well with the previous samples, and in fact, allowed for some revision of the previous chemical group structure. Unfortunately, the vast majority of the samples from the island are assigned to the same chemical group. This suggests that pottery manufactured on St. Croix is quite uniform with regard to elemental composition, and thus production locations on the island are difficult if not impossible to differentiate using the current database.

Sample Preparation

Pottery samples were prepared for INAA using procedures standard at MURR. Fragments of about $1cm^2$ were removed from each sample and abraded using a silicon carbide burr in order to remove glaze, slip, paint, and adhering soil, thereby reducing the risk of measuring contamination. The samples were washed in deionized water and allowed to dry in the laboratory. Once dry, the individual sherds were ground to powder in an agate mortar to homogenize the samples. Archival samples were retained from each sherd (when possible) for future research.

Two analytical samples were prepared from each source specimen. Portions of approximately 150 mg of powder were weighed into clean high-density polyethylene vials used for short irradiations at MURR. At the same time, 200 mg of each sample was weighed into clean high-purity quartz vials used for long irradiations. Individual sample weights were recorded to the nearest 0.01 mg using an analytical balance. Both vials were sealed prior to irradiation. Along with the unknown samples, Standards made from National Institute of Standards and Technology (NIST) certified standard reference materials of SRM-1633a (coal fly ash) and SRM-688 (basalt rock) were similarly prepared, as were quality control samples (e.g., standards treated as unknowns) of SRM-278 (obsidian rock) and Ohio Red Clay (a standard developed for in-house applications).

Irradiation and Gamma-Ray Spectroscopy

Neutron activation analysis of ceramics at MURR, which consists of two irradiations and a total of three gamma counts, constitutes a superset of the procedures used at most other NAA laboratories (Glascock 1992; Neff 1992, 2000). As discussed in detail by Glascock (1992), a short irradiation is carried out through the pneumatic tube irradiation system. Samples in the polyvials are sequentially irradiated, two at a time, for five seconds by a neutron flux of 8×10^{13} n cm^{-2} s^{-1} The 720-second count yields gamma spectra containing peaks for nine short-lived elements aluminum (Al), barium (Ba), calcium (Ca), dysprosium (Dy), potassium (K), manganese (Mn), sodium (Na), titanium (Ti), and vanadium (V). The samples are encapsulated in quartz vials and are subjected to a 24–hour irradiation at a neutron flux of 5×10^{13} n cm^{-2} s^{-1}. This long irradiation is analogous to the single irradiation utilized at most other laboratories. After the long irradiation, samples decay for seven days, and then are counted for 1,800 seconds

(the "middle count") on a high-resolution germanium detector coupled to an automatic sample changer. The middle count yields determinations of seven medium half-life elements, namely arsenic (As), lanthanum (La), lutetium (Lu), neodymium (Nd), samarium (Sm), uranium (U), and ytterbium (Yb). After an additional three- or four-week decay, a final count of 8,500 seconds is carried out on each sample. The latter measurement yields the following 17 long half-life elements: cerium (Ce), cobalt (Co), chromium (Cr), cesium (Cs), europium (Eu), iron (Fe), hafnium (Hf), nickel (Ni), rubidium (Rb), antimony (Sb), scandium (Sc), strontium (Sr), tantalum (Ta), terbium (Tb), thorium (Th), zinc (Zn), and zirconium (Zr).

The element concentration data from the three measurements are tabulated in parts per million using the EXCEL spreadsheet program. Descriptive data for the archaeological samples were appended to the concentration spreadsheet. The data are also stored in a dBASE/FOXPRO database file useful for organizing, sorting, and extracting sample information. The data file enclosed with this report contains the sample database in EXCEL format.

Interpreting Chemical Data

The analyses at MURR described previously produced elemental concentration values for 33 elements in most of the analyzed samples. Data for nickel in most samples was below detection limits (as is the norm for most New World ceramic analyses) and was removed from consideration during the statistical analysis. After a microscopic examination of the ceramic and clay samples, we determined that the samples had a high frequency of calcite that may affect the results. Because calcium has the potential to affect (dilute) the concentrations of other elements in the analysis, all samples were mathematically corrected to compensate for any possible calcium included effects (the data were examined before and after calcium correction and the results were similar). The following mathematical correction was used as it has been proven to be effective in other calcium-rich datasets (Cogswell et al. 1998:64; Steponaitis et al. 1988):

$$e' = \frac{10^6 e}{10^6 - 2.5c}$$

where e' is the corrected concentration of a given element in ppm, e is the measured concentration of that element in ppm, and c is the concentration of elemental calcium in ppm. After the calcium correction, statistical analysis was subsequently carried out on base-10 logarithms of concentrations on the remaining 31 elements. Use of log concentrations rather than raw data compensates for differences in magnitude between the major elements, such as calcium, on one hand and trace elements, such as the rare earth or lanthanide elements (REEs). Transformation to base-10 logarithms also yields a more normal distribution for many trace elements.

The interpretation of compositional data obtained from the analysis of archaeological materials is discussed in detail elsewhere (e.g., Baxter and Buck 2000; Bieber et al. 1976; Bishop and Neff 1989; Glascock 1992; Harbottle 1976; Neff 2000) and will only be summarized here. The main goal of data analysis is to identify distinct homogeneous groups within the analytical database. Based on the provenance postulate of Weigand *et al*. (1977), different chemical groups may be assumed to represent geographically restricted sources. For lithic materials such as

obsidian, basalt, and cryptocrystalline silicates (e.g., chert, flint, or jasper), raw material samples are frequently collected from known outcrops or secondary deposits and the compositional data obtained on the samples is used to define the source localities or boundaries. The locations of sources can also be inferred by comparing unknown specimens (i.e., ceramic artifacts) to knowns (i.e., clay samples) or by indirect methods such as the "criterion of abundance" (Bishop *et al*. 1992) or by arguments based on geological and sedimentological characteristics (e.g., Steponaitis *et al*. 1996). The ubiquity of ceramic raw materials usually makes it impossible to sample all potential "sources" intensively enough to create groups of knowns to which unknowns can be compared. Lithic sources tend to be more localized and compositionally homogeneous in the case of obsidian or compositionally heterogeneous as is the case for most cherts.

Compositional groups can be viewed as "centers of mass" in the compositional hyperspace described by the measured elemental data. Groups are characterized by the locations of their centroids and the unique relationships (i.e., correlations) between the elements. Decisions about whether to assign a specimen to a particular compositional group are based on the overall probability that the measured concentrations for the specimen could have been obtained from that group.

Initial hypotheses about source-related subgroups in the compositional data can be derived from non-compositional information (e.g., archaeological context, decorative attributes, etc.) or from application of various pattern-recognition technique to the multivariate chemical data. Some of the pattern recognition techniques that have been used to investigate archaeological data sets are cluster analysis (CA), principal components analysis (PCA), and discriminant analysis (DA). Each of the techniques has it own advantages and disadvantages which may depend upon the types and quantity of data available for interpretation.

The variables (measured elements) in archaeological and geological data sets are often correlated and frequently large in number. This makes handling and interpreting patterns within the data difficult. Therefore, it is often useful to transform the original variables into a smaller set of uncorrelated variables in order to make data interpretation easier. Of the above-mentioned pattern recognition techniques, PCA is a technique that transforms from the data from the original correlated variables into uncorrelated variables most easily.

PCA creates a new set of reference axes arranged in decreasing order of variance subsumed. The individual PCs are linear combinations of the original variables. The data can be displayed on combinations of the new axes, just as they can be displayed on the original elemental concentration axes. PCA can be used in a pure pattern-recognition mode, i.e., to search for subgroups in an undifferentiated data set, or in a more evaluative mode, i.e., to assess the coherence of hypothetical groups suggested by other criteria. Generally, compositional differences between specimens can be expected to be larger for specimens in different groups than for specimens in the same group, and this implies that groups should be detectable as distinct areas of high point density on plots of the first few components.

It is well known that PCA of chemical data is scale dependent (Mardia *et al*. 1979), and analyses tend to be dominated by those elements or isotopes for which the concentrations are

relatively large. As a result, standardization methods are common to most statistical packages. A common approach it to transform the data into logarithms (e.g., base 10). As an initial step in the PCA of most chemical data at MURR, the data are transformed into log concentrations to equalize the differences in variance between the major elements such as Al, Ca and Fe, on one hand and trace elements, such as the rare-earth elements (REEs), on the other hand. An additional advantage of the transformation is that it appears to produce more nearly normal distributions for the trace elements.

One frequently exploited strength of PCA, discussed by Baxter (1992), Baxter and Buck (2000z), and Neff (1994, 2002), is that it can be applied as a simultaneous R- and Q-mode technique, with both variables (elements) and objects (individual analyzed samples) displayed on the same set of principal component reference axes. A plot using the first two principal components as axes is usually the best possible two-dimensional representation of the correlation or variance-covariance structure within the data set. Small angles between the vectors from the origin to variable coordinates indicate strong positive correlation; angles at 90 degrees indicate no correlation; and angles close to 180 degrees indicate strong negative correlation. Likewise, a plot of sample coordinates on these same axes will be the best two-dimensional representation of Euclidean relations among the samples in log-concentration space (if the PCA was based on the variance-covariance matrix) or standardized log-concentration space (if the PCA was based on the correlation matrix). Displaying both objects and variables on the same plot makes it possible to observe the contributions of specific elements to group separation and to the distinctive shapes of the various groups. Such a plot is commonly referred to as a "biplot" in reference to the simultaneous plotting of objects and variables. The variable inter-relationships inferred from a biplot can be verified directly by inspecting bivariate elemental concentration plots. [Note that a bivariate plot of elemental concentrations is not a biplot.]

Whether a group can be discriminated easily from other groups can be evaluated visually in two dimensions or statistically in multiple dimensions. A metric known as the Mahalanobis distance (or generalized distance) makes it possible to describe the separation between groups or between individual samples and groups on multiple dimensions. The Mahalanobis distance of a specimen from a group centroid (Bieber *et al*. 1976, Bishop and Neff 1989) is defined by:

$$D^2_{y,X} = [y - \overline{X}]^t \, I_x [y - \overline{X}]$$

where y is the 1 x m array of logged elemental concentrations for the specimen of interest, X is the n x m data matrix of logged concentrations for the group to which the point is being compared with $\overline{X}$ being it 1 x m centroid, and I_x is the inverse of the m x m variance-covariance matrix of group X. Because Mahalanobis distance takes into account variances and covariances in the multivariate group it is analogous to expressing distance from a univariate mean in standard deviation units. Like standard deviation units, Mahalanobis distances can be converted into probabilities of group membership for individual specimens. For relatively small sample sizes, it is appropriate to base probabilities on Hotelling's T^2, which is the multivariate extension of the univariate Student's t.

When group sizes are small, Mahalanobis distance-based probabilities can fluctuate dramatically depending upon whether or not each specimen is assumed to be a member of the group to which it is being compared. Harbottle (1976) calls this phenomenon "stretchability" in reference to the tendency of an included specimen to stretch the group in the direction of its own location in elemental concentration space. This problem can be circumvented by cross-validation, that is, by removing each specimen from its presumed group before calculating its own probability of membership (Baxter 1994; Leese and Main 1994). This is a conservative approach to group evaluation that may sometimes exclude true group members.

Small sample and group sizes place further constraints on the use of Mahalanobis distance: with more elements than samples, the group variance-covariance matrix is singular thus rendering calculation of I_x (and D^2 itself) impossible. Therefore, the dimensionality of the groups must somehow be reduced. One approach would be to eliminate elements considered irrelevant or redundant. The problem with this approach is that the investigator's preconceptions about which elements should be discriminate may not be valid. It also squanders the main advantage of multielement analysis, namely the capability to measure a large number of elements. An alternative approach is to calculate Mahalanobis distances with the scores on principal components extracted from the variance-covariance or correlation matrix for the complete data set. This approach entails only the assumption, entirely reasonable in light of the above discussion of PCA, that most group-separating differences should be visible on the first several PCs. Unless a data set is extremely complex, containing numerous distinct groups, using enough components to subsume at least 90% of the total variance in the data can be generally assumed to yield Mahalanobis distances that approximate Mahalanobis distances in full elemental concentration space.

Lastly, Mahalanobis distance calculations are also quite useful for handling missing data (Sayre 1975). When many specimens are analyzed for a large number of elements, it is almost certain that a few element concentrations will be missed for some of the specimens. This occurs most frequently when the concentration for an element is near the detection limit. Rather than eliminate the specimen or the element from consideration, it is possible to substitute a missing value by replacing it with a value that minimizes the Mahalanobis distance for the specimen from the group centroid. Thus, those few specimens which are missing a single concentration value can still be used in group calculations.

Results and Conclusions

Analytical ID numbers

Before examining the results of this study, it is important to note that the analytical identification numbers originally assigned to the samples are identical to those that are reported here. Please see Table 1 for a cross-referenced listing of IDs along with some of the descriptive information for each sample. There are a couple other discrepancies that should be noted. The confusion about the sample numbers developed because the field numbers and the analytical IDs were very similar. Initially the samples were inadvertently prepared using both sets of numbers and then in correcting the sample numbers we discovered a couple problems. First, the sample with field ID number 63C was not included in the shipment, and thus could not be analyzed.

Second, there was a sample with a field ID 60A that was not listed on the spreadsheet sent with the samples. 60A was not analyzed given the absence of descriptive information. For this report, I have used the column of IDs on the far left of Table 1 called "ANID". Please note that there are some differences from the ID numbers initially submitted with the samples. We apologize for any possible confusion and we have taken steps to ensure that this problem does not happen again.

Chemical Group Structure

In order to achieve a more statistically robust sample size, the samples from this project were analyzed along with a previous database of fifty samples from the Salt River site. The previous chemical group structure developed by Christopher Descantes and reported by Glascock et al. (2006) was based primarily on principal component analysis. With the addition of the 84 new samples the two large groups originally reported merged into one large group. Descantes felt that this might happen with a larger sample, and the large group reported here (Group 2) is quite well defined. Neither elemental nor principal component (a summary of the principal component values are listed in Table 2) plots revealed any separation within Group 2. The majority of the sample from the previous project from the Salt River site also fit quite well into the new group. The probability of Group 2 two membership calculated by Mahalanobis distance projections are listed for members of Group1, Group 2, and the unassigned specimens in Table 3. The reference group used to calculate the probability of Group 2 membership in Table 3 included all members of Group 2 from St. Croix, including the samples analyzed in the previous project. Even the sample with the lowest probability of group membership (MYH030) has nearly a ten percent probability of membership. By comparison the two members of Group 1 and the 15 unassigned specimens from this project all have less than a 0.03 percent chance of belonging to Group 2. This strong of a statistical backing of the group structure is rare in pottery studies.

The dominance of Group 2 in the St. Croix assemblage would suggest that members of this group were produced on the island. The clay samples submitted further support this statement. Of the eleven raw clay samples submitted, five fit well in Group 2. A search of all of the Caribbean pottery in the MURR database revealed an interesting pattern. Table 4 lists the probability of membership in Group 2 based on a Mahalanobis distance projection for all Caribbean samples in the MURR database. Datasets from most other islands have no likely members of Group 2, but one sample from Puerto Rico and ten from the Dominican Republic have high probabilities of membership in Group 2. These eleven sherds are quite likely exports from St. Croix and are an interesting avenue for further research.

Group 1 members reveal the opposite pattern of Group 2 members. Descantes assigned three samples to this outlier group in the previous study of St. Croix pottery, and two of the new samples also fit in this group. As shown in Table 3, this is a distinct group from Group 2, at least according to a Mahalanobis distance projection. This group separates according to some elements, as shown in the bivariate plot of scandium and uranium (Figure 1). Members of Group 1 differ from Members of Group 2 primarily in lower concentrations of lower-molecular weight transition metals and higher concentrations of some elements in the lanthanide and actinide series. Much like St. Croix, the pottery sample from Puerto Rico is dominated by a single, probably locally produced, chemical group; Group 4. Figure 2 shows the strong overlap between the Group 4 from Puerto Rico. This link is not as strong as the connection between Group 2 and

the samples from the Dominican Republic, but it does suggest a possible source for members of Group 1. None of the clay samples from St. Croix plot consistently within Group 1.

There are 15 samples (18 percent) that remain unassigned. Table 3 shows the very low probability that any of the unassigned specimens belong in Group 2. There is no clear explanation for this, but 18% is not a high percentage of unassigned samples. There were no strong links between any of the unassigned samples and datasets from other islands, so it is not possible to conclude that they are imports, although this is certainly a possibility.

Contextual Patterns

Table 5 breaks down the chemical group assignments by site for both the pottery and clay samples. There are no obvious patterns in this distribution except for the both Group 1 members coming from the same site, but this is a very small sample size to make and significant conclusions. The same lack of patterning is seen in the breakdown by ware type as shown in Table 6.

Conclusions

The pottery sample from St. Croix revealed a surprising uniformity, with the majority of the samples belonging to a single group most likely manufacture on St. Croix. Interestingly, there is some evidence of an export of ceramics to the Dominical Republic, and possibly an import of pottery manufactured in Puerto Rico.

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Table 1: Chemical group assignments and descriptive data for St. Croix pottery and clay samples.

ANID	old anid	field_id	Chem06_JF	site_name	material	ware
MHY001	MHY001	1B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY002	MHY002	2B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY003	MHY003	3B	Group 2	Judith's Fancy	Pottery	ate
MHY004	MHY004	4B	Group 2	Judith's Fancy	Pottery	ate
MHY005	MHY005	5B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY006	MHY006	6B	Unassigned	Judith's Fancy	Pottery	Longford
MHY007	MHY007	7B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY008	MHY008	8B	Group 2	Judith's Fancy	Pottery	ate
MHY009	MHY009	9B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY010	MHY010	10B	Group 2	Judith's Fancy	Pottery	ate
MHY011	MHY011	11B	Group 2	Judith's Fancy	Pottery	Longford
MHY012	MHY012	12B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY013	MHY013	13B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY014	MHY014	14B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY015	MHY015	15B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY016	MHY016	16B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY017	MHY017	17B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY018	MHY018	18B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY019	MHY019	19B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY020	MHY020	20B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY021	MHY021	21B	Group 2	Judith's Fancy	Pottery	Longford
MHY022	MHY022	22B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY023	MHY023	23B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY024	MHY024	24B	Unassigned	Judith's Fancy	Pottery	Longford
MHY025	MHY025	25B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY026	MHY026	26B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY027	MHY027	27B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY028	MHY029	29B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY029	MHY030	30B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY030	MHY031	31B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY031	MHY032	32B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY032	MHY033	33B	Group 2	Judith's Fancy	Pottery	Longford
MHY033	MHY034	34B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY034	MHY035	35B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY035	MHY036	36B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY036	MHY037B	37B	Unassigned	Judith's Fancy	Pottery	Bay-Salt

MHY037	MHY037C	37C	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY038	MHY038	38B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY039	MHY039	39B	Group 2	Prosperity	Pottery	Prosperity
MHY040	MHY040	40B	Group 2	Prosperity	Pottery	ate
MHY041	MHY041	41B	Unassigned	Prosperity	Pottery	Prosperity
MHY042	MHY042	42B	Unassigned	Prosperity	Pottery	Prosperity
MHY043	MHY043	43B	Group 2	Columbus	Pottery	ate
MHY044	MHY044	44B	Group 2	Columbus	Pottery	ate
MHY045	MHY045	45B	Group 2	Columbus	Pottery	Bay-Salt
MHY046	MHY046	46B	Group 2	Columbus	Pottery	Bay-Salt
MHY047	MHY047	47B	Group 2	Windsor	Pottery	Longford
MHY048	MHY048	48B	Group 2	Windsor	Pottery	Longford
MHY049	MHY049	49B	Unassigned	Windsor	Pottery	Prosperity
MHY050	MHY051	51B	Unassigned	Richmond	Pottery	ate
MHY051	MHY052	52B	Group 2	Richmond	Pottery	ate
MHY052	MHY053	53B	Group 2	Glynn	Pottery	Longford
MHY053	MHY054	54B	Group 2	Glynn	Pottery	ate
MHY054	MHY055	55B	Group 2	Glynn	Pottery	Bay-Salt
MHY055	MHY056	56B	Group 2	Glynn	Pottery	Longford
MHY056	MHY057	57B	Group 2	St. Georges	Pottery	ate
MHY057	MHY058	58B	Group 2	St. Georges	Pottery	Prosperity
MHY058	MHY059	59B	Group 2	St. Georges	Pottery	Prosperity
MHY059	MHY061	61B	Group 2	St. Georges	Pottery	Longford
MHY060	MHY062	62B	Group 2	St. Georges	Pottery	ate
MHY061	MHY063	63B	Group 2	St. Georges	Pottery	Longford
MHY063	MHY064	64B	Group 2	St. Georges	Pottery	Prosperity
MHY064	MHY065	65B	Group 1	St. Georges	Pottery	Prosperity
MHY065	MHY066	66B	Group 2	St. Georges	Pottery	ate
MHY066	MHY067	67B	Group 1	St. Georges	Pottery	Bay-Salt
MHY067	MHY068	68B	Group 2	St. Georges	Pottery	ate
MHY068	MHY069	69B	Unassigned	St. Georges	Pottery	ate
MHY069	MHY070	70B	Group 2	Aklis	Pottery	ate
MHY070	MHY071	71B	Group 2	Aklis	Pottery	ate
MHY071	MHY072	72B	Group 2	Aklis	Pottery	ate
MHY072	MHY073	73B	Group 2	Aklis	Pottery	ate
MHY073	MHY074	74B	Group 2	Aklis	Pottery	ate
MHY074	MHY075	75B	Group 2	Aklis	Pottery	ate
MHY075	MHY076	76B	Unassigned	Aklis	Clay	
MHY076	MHY077	77B	Group 2	Manchenil	Clay	
MHY077	MHY078	78B	Group 2	Prosperity	Clay	
MHY078	MHY079	79B	Group 2	Grange	Clay	
MHY079	MHY080	80B	Group 2	St. Georges	Clay	

MHY080	MHY081	81B	Unassigned	Bethlehem	Clay
MHY081	MHY082	82B	Unassigned	Caliche mine	Clay
MHY082	MHY083	83B	Group 2	Cane Bay	Clay
MHY083	MHY084	84B	Unassigned	Judith's Fancy	Clay
MHY084	MHY085	85B	Unassigned	Columbus	Clay
MHY085	MHY086	86B	Unassigned	Mountain Top	Clay

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Table 2: Table 3: Principal component analysis of St. Croix ceramics (R-Q factor analysis based on variance-covariance matrix).

Principal Components Analysis
Date: 12/11/06

Simultaneous R-Q Factor Analysis Based on Variance-Covariance Matrix

Eigenvalues and Percentage of Variance Explained:

	Eigenvalue	%Variance	Cum. %Var.
1	0.3138	27.5526	27.5526
2	0.2637	23.1598	50.7124
3	0.1109	9.7414	60.4538
4	0.0909	7.9806	68.4344
5	0.0693	6.0823	74.5167
6	0.0457	4.0126	78.5293
7	0.0398	3.4948	82.0241
8	0.0343	3.0109	85.0350
9	0.0275	2.4171	87.4521
10	0.0240	2.1055	89.5576

Eigenvectors (largest to smallest):

As	-0.0355	0.0319	-0.3885	0.1183	0.1770	-0.3765	0.2326	0.2424	-0.5327	0.2236
La	-0.2368	0.1410	0.1231	0.0901	0.1876	0.0966	0.0703	0.0450	-0.0829	-0.1632
Lu	-0.0127	0.1204	-0.0174	-0.1149	0.1838	0.0006	0.0816	-0.0203	0.0897	0.2461
Nd	-0.1321	0.2037	0.0696	0.0083	0.1263	0.2024	0.1458	-0.0658	-0.0280	-0.1114
Sm	-0.0794	0.1841	0.0297	-0.0157	0.1135	0.0544	0.1592	0.0195	0.0111	-0.0780
U	-0.1778	-0.0470	-0.0813	-0.0446	0.0091	0.3936	0.0614	-0.3740	-0.1805	0.3282
Yb	0.0245	0.1441	-0.0384	-0.0931	0.1500	-0.0814	0.1787	0.0578	0.1158	0.1768
Ce	-0.2228	0.1661	0.1437	0.0446	0.1772	0.0802	0.0835	0.1476	-0.0325	-0.1232
Co	0.1340	0.4314	0.0751	0.0666	-0.0241	-0.1225	-0.0379	0.0768	0.0366	-0.0895
Cr	0.0151	0.3425	-0.2001	0.5458	-0.3604	0.2242	-0.2315	0.3098	-0.0103	0.0517
Cs	-0.3175	0.0057	-0.1852	0.1903	0.2724	-0.2588	-0.0407	-0.3322	0.3940	-0.0499
Eu	-0.0307	0.2106	0.0833	-0.0255	0.0904	-0.0096	0.1260	-0.0020	-0.0025	-0.0837
Fe	0.0970	0.2766	-0.0126	-0.1027	-0.0656	0.0416	0.0098	-0.1230	0.0321	-0.0893
Hf	-0.2301	-0.0265	-0.0253	-0.1225	-0.0562	0.0749	0.0230	0.1385	-0.0768	0.3182
Rb	-0.3762	0.0464	0.0668	0.1284	-0.0434	-0.1296	-0.2104	0.0275	0.1472	-0.0026
Sb	-0.0305	0.0057	-0.3645	0.3476	0.1596	-0.1091	-0.1820	-0.3318	-0.0617	0.0961
Sc	0.1413	0.2566	-0.1302	-0.0828	-0.1180	0.0276	0.0601	-0.1354	0.0406	0.1455
Sr	0.0119	0.0375	0.3208	0.0993	-0.0482	-0.1037	0.0492	-0.3705	-0.4144	-0.1281
Ta	-0.1799	0.0725	-0.1369	-0.0813	0.1406	0.3886	-0.1101	-0.0203	-0.0548	-0.1637
Tb	-0.0221	0.1599	-0.0310	-0.0146	0.1713	-0.0713	0.2970	0.1292	0.1120	-0.0608
Th	-0.4272	-0.0394	0.0103	-0.0448	0.0207	0.1457	0.0308	0.2245	-0.1935	-0.1363
Zn	0.0274	0.1563	-0.1576	-0.0939	-0.0299	0.0643	-0.0165	-0.2400	-0.0257	0.0414
Zr	-0.1721	0.0339	0.0500	-0.0981	0.0376	0.1429	-0.2017	0.0964	-0.0879	0.3845
Al	-0.0447	0.0741	-0.0074	-0.1663	-0.0328	0.0566	-0.0430	-0.1317	-0.0447	0.1460
Ba	-0.2951	0.0198	0.1744	0.1268	-0.4983	-0.2380	0.3623	-0.2028	-0.1616	-0.0242
Ca	0.1946	-0.1185	0.4656	0.5477	0.2405	0.2070	0.1742	-0.0259	0.0734	0.3353
Dy	-0.0035	0.1518	-0.0452	-0.0061	0.0704	-0.0202	0.3702	0.0718	0.2286	0.1815
K	-0.2916	0.0672	0.1187	0.0486	-0.0780	-0.1962	-0.1834	-0.0516	0.1701	0.0669
Mn	0.1460	0.3287	0.1420	-0.0494	0.3198	-0.0813	-0.3229	-0.1144	-0.3172	-0.0869
Na	-0.0768	0.1423	0.3506	-0.1979	0.0033	-0.3065	-0.3114	0.1199	0.0102	0.3407
Ti	-0.0341	0.2110	-0.0184	-0.1324	-0.2243	0.1141	0.0902	-0.0919	0.1135	0.0947
V	0.0768	0.2568	-0.0202	-0.0195	-0.1742	-0.0035	0.0513	-0.1372	0.0346	0.1045

Table 3: Mahalanobis distance projection and probabilities of group membership for St. Croix pottery.

MAHALANOBIS DISTANCE CALCULATION FOR MISCELLANEOUS SPECIMENS
PROJECTED AGAINST TWO OR MORE GROUPS.

Reference groups and numbers of specimens:
1 G2 119
Variables used:
AS LA LU ND SM U YB CE CO CR CS EU FE HF RB SB SC SR TA TB TH ZN ZR
AL BA CA DY K MN NA TI V

The following specimens are in the file Group 1
Probabilities:

ID. NO.	G2	BEST GP.
MHY064	0.000	1
MHY066	0.008	1

The following specimens are in the file Group 2
Probabilities:

ID. NO.	G2	BEST GP.
MHY003	98.749	1
MHY004	93.298	1
MHY005	94.821	1
MHY007	91.140	1
MHY008	14.271	1
MHY009	99.809	1
MHY010	99.849	1
MHY011	75.344	1
MHY012	91.792	1
MHY013	99.576	1
MHY015	84.829	1
MHY016	88.884	1
MHY017	90.178	1
MHY019	70.724	1
MHY020	94.885	1
MHY021	99.507	1
MHY022	99.986	1
MHY023	32.036	1
MHY025	94.151	1
MHY026	99.940	1
MHY027	99.712	1
MHY028	99.004	1
MHY030	9.326	1
MHY032	86.802	1
MHY033	72.337	1
MHY034	41.867	1
MHY035	96.171	1
MHY038	95.981	1
MHY039	55.780	1
MHY040	82.582	1
MHY043	92.732	1
MHY044	35.371	1
MHY045	87.298	1
MHY046	87.729	1
MHY047	69.022	1
MHY048	99.069	1
MHY051	73.760	1
MHY052	75.938	1
MHY053	92.544	1
MHY054	98.435	1
MHY055	27.661	1
MHY056	98.836	1
MHY057	87.649	1
MHY058	80.386	1
MHY059	99.188	1
MHY060	98.763	1
MHY061	86.530	1
MHY063	93.468	1
MHY065	18.933	1
MHY067	81.240	1
MHY069	97.891	1
MHY070	81.508	1
MHY071	95.373	1
MHY072	99.073	1

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MHY073     91.712         1
MHY074     69.677         1
MHY076     80.359         1

The following specimens are in the file  HDYUNAS
          Probabilities:
ID. NO.         G2  BEST GP.
MHY001       0.000         1
MHY002       0.025         1
MHY006       0.000         1
MHY014       0.027         1
MHY018       0.000         1
MHY024       0.001         1
MHY029       0.024         1
MHY031       0.000         1
MHY036       0.020         1
MHY037       0.000         1
MHY041       0.000         1
MHY042       0.000         1
MHY049       0.000         1
MHY050       0.000         1
MHY068       0.001         1


Summary of Probabilities for Specimens in the file  HDYG1

                        Probability Cutoff Values:
Group:       0.01    0.10    1.00    5.00   10.00   20.00  100.00
G2              2       2       2       2       2       2       2
Summary of Probabilities for Specimens in the file  HDYG2

                        Probability Cutoff Values:
Group:       0.01    0.10    1.00    5.00   10.00   20.00  100.00
G2              0       0       0       0       1       3      57
Summary of Probabilities for Specimens in the file  HDYUNAS

                        Probability Cutoff Values:
Group:       0.01    0.10    1.00    5.00   10.00   20.00  100.00
G2             11      15      15      15      15      15      15

Summary of Best Classification of Projected Specimens:
               Into:
From:           G2     Total
HDYG1           2         2
HDYG2          57        57
HDYUNAS        15        15
Total          74        74
```

Table 4: Mahalanobis distance projection and probabilities of St. Croix Group 2 membership for all MURR Carribean samples.

MAHALANOBIS DISTANCE CALCULATION FOR MISCELLANEOUS SPECIMENS
PROJECTED AGAINST TWO OR MORE GROUPS.

Date:12/15/06
File:lhdy

Reference groups and numbers of specimens:
1 STCXG2 100
Variables used:

AS	LA	LU	ND	SM	U	YB
CE	CO	CR	CS	EU	FE	HF
RB	SB	SC	SR	TA	TB	TH
ZN	ZR	AL	BA	CA	DY	K
MN	NA	TI	V			

The following specimens are in the file LANG

ID. NO.	Probabilities: STCXG2	BEST GP.
ANG001	0.000	1
ANG002	0.000	1
ANG003	0.000	1
ANG004	0.000	1
ANG005	0.001	1
ANG006	0.003	1
ANG007	0.000	1
ANG008	0.000	1
ANG009	0.000	1
ANG010	0.000	1
ANG011	0.000	1
ANG012	0.009	1
ANG013	0.000	1
ANG014	0.000	1
ANG015	0.000	1
ANG016	0.000	1
ANG017	0.000	1
ANG018	0.000	1
ANG019	0.000	1
ANG020	0.000	1
ANG021	0.000	1
ANG022	0.000	1
ANG023	0.000	1
ANG024	0.000	1
ANG025	0.000	1
ANG026	0.000	1
ANG027	0.000	1
ANG028	0.000	1
ANG029	0.000	1
ANG030	0.000	1
ANG031	0.000	1
ANG032	0.000	1
ANG033	0.000	1
ANG034	0.143	1
ANG035	0.000	1
ANG036	0.000	1
ANG037	0.000	1
ANG038	0.000	1
ANG039	0.000	1
ANG040	0.000	1
ANG041	0.000	1
ANG042	0.014	1
ANG043	0.000	1
ANG044	0.000	1
ANG045	0.000	1
ANG046	0.000	1
ANG047	0.000	1
ANG048	0.000	1
ANG049	0.000	1
ANG050	0.000	1

The following specimens are in the file LCANT

ID. NO.	Probabilities: STCXG2	BEST GP.
CANT001	0.000	1
CANT002	0.000	1
CANT003	0.000	1
CANT004	0.000	1
CANT005	0.000	1
CANT006	0.000	1
CANT007	0.002	1
CANT008	0.006	1
CANT009	0.000	1
CANT010	0.000	1
CANT011	0.009	1
CANT012	0.000	1
CANT013	0.000	1
CANT014	0.000	1
CANT015	0.000	1
CANT016	0.000	1
CANT017	0.000	1
CANT018	0.000	1
CANT019	0.000	1
CANT020	0.001	1
CANT021	0.000	1
CANT022	0.002	1
CANT023	0.000	1
CANT024	0.000	1
CANT025	0.000	1
CANT026	0.000	1
CANT027	0.000	1
CANT028	0.000	1
CANT029	0.000	1
CANT030	0.000	1
CANT031	0.000	1
CANT032	0.000	1
CANT033	0.000	1
CANT034	0.001	1
CANT035	0.000	1
CANT036	0.000	1
CANT037	0.000	1
CANT038	0.000	1
CANT039	0.000	1
CANT040	0.000	1
CANT041	0.000	1
CANT042	0.000	1
CANT043	0.000	1
CANT044	0.000	1
CANT045	0.000	1
CANT046	0.000	1
CANT047	0.000	1
CANT048	0.000	1
CANT049	0.000	1
CANT050	0.000	1
CANT051	0.000	1
CANT052	0.000	1
CANT053	0.000	1
CANT054	0.000	1
CANT055	0.000	1
CANT056	0.000	1

CANT057	0.000	1
CANT058	0.000	1
CANT059	0.000	1
CANT060	0.000	1
CANT061	0.000	1
CANT062	0.000	1

The following specimens are in the file LSMF

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
SMF001	0.000	1
SMF002	0.000	1
SMF003	0.000	1
SMF004	0.000	1
SMF005	0.000	1
SMF006	0.000	1
SMF007	0.000	1
SMF008	0.000	1
SMF009	0.000	1
SMF010	0.000	1
SMF011	0.000	1
SMF012	0.000	1
SMF013	0.000	1
SMF014	0.000	1
SMF015	0.000	1
SMF016	0.000	1
SMF017	0.000	1
SMF018	0.000	1
SMF019	0.000	1
SMF020	0.000	1
SMF021	0.000	1
SMF022	0.000	1
SMF023	0.000	1
SMF024	0.000	1
SMF025	0.000	1
SMF026	0.000	1
SMF027	0.000	1
SMF028	0.000	1
SMF029	0.000	1
SMF030	0.000	1
SMF031	0.000	1
SMF032	0.000	1
SMF033	0.000	1
SMF034	0.000	1
SMF035	0.000	1
SMF036	0.000	1
SMF037	0.000	1
SMF038	0.000	1
SMF039	0.000	1
SMF040	0.000	1
SMF041	0.000	1
SMF042	0.000	1
SMF043	0.000	1
SMF044	0.000	1
SMF045	0.000	1
SMF046	0.000	1
SMF047	0.000	1
SMF048	0.000	1
SMF049	0.000	1
SMF050	0.000	1
SMF051	0.000	1
SMF052	0.000	1
SMF053	0.000	1
SMF054	0.000	1
SMF055	0.000	1
SMF056	0.000	1

The following specimens are in the file LDOR

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
DOR001	0.000	1
DOR002	0.000	1
DOR003	0.000	1
DOR004	0.000	1
DOR005	0.000	1
DOR006	0.000	1
DOR007	0.000	1
DOR008	0.000	1
DOR009	0.000	1
DOR010	0.000	1
DOR011	0.000	1
DOR012	0.000	1
DOR013	0.000	1
DOR014	0.000	1
DOR015	0.000	1
DOR016	0.000	1
DOR017	0.000	1
DOR018	0.000	1
DOR019	0.000	1
DOR020	0.000	1
DOR021	0.000	1
DOR022	0.000	1
DOR023	0.000	1
DOR024	0.000	1
DOR025	0.000	1
DOR026	0.021	1
DOR027	0.000	1
DOR028	0.000	1
DOR029	0.015	1
DOR030	0.000	1
DOR031	0.000	1
DOR032	0.012	1
DOR033	0.001	1
DOR034	0.000	1
DOR035	0.003	1
DOR036	0.000	1
DOR037	0.000	1
DOR038	0.000	1
DOR039	0.428	1
DOR040	0.000	1
DOR041	0.000	1
DOR042	0.269	1
DOR043	0.000	1
DOR044	1.137	1
DOR045	0.000	1
DOR046	0.000	1
DOR047	0.000	1
DOR048	0.000	1
DOR049	0.000	1
DOR050	0.000	1
DOR051	0.000	1
DOR052	0.000	1
DOR053	0.000	1
DOR054	0.000	1
DOR055	0.000	1
DOR056	0.000	1
DOR057	0.000	1
DOR058	0.000	1
DOR059	0.000	1
DOR060	0.000	1
DOR061	0.000	1
DOR062	0.000	1
DOR063	0.000	1
DOR064	0.000	1
DOR065	0.000	1
DOR066	0.000	1
DOR067	0.000	1
DOR068	0.000	1
DOR069	0.000	1
DOR070	0.000	1
DOR071	0.000	1
DOR072	0.000	1
DOR073	0.000	1
DOR074	0.000	1
DOR075	0.000	1
DOR076	0.000	1
DOR077	0.000	1
DOR078	0.828	1
DOR079	0.000	1
DOR080	0.000	1
DOR081	0.000	1
DOR082	0.000	1
DOR083	0.000	1
DOR084	0.000	1
DOR085	0.000	1
DOR086	0.000	1

DOR087	0.000	1
DOR088	0.000	1
DOR089	0.000	1
DOR090	0.000	1
DOR091	0.000	1
DOR092	0.000	1
DOR093	0.000	1
DOR094	0.000	1
DOR095	0.000	1
DOR096	0.000	1
DOR097	0.025	1
DOR098	0.000	1
DOR099	0.000	1
DOR100	0.000	1
DOR101	0.000	1
DOR102	0.000	1
DOR103	0.000	1
DOR104	0.000	1
DOR105	0.000	1
DOR106	0.000	1
DOR107	0.000	1
DOR108	**15.448**	1
DOR109	0.000	1
DOR110	0.000	1
DOR111	0.000	1
DOR112	0.000	1
DOR113	0.000	1
DOR114	0.000	1
DOR115	0.000	1
DOR116	0.000	1
DOR117	0.000	1
DOR118	0.000	1
DOR119	0.000	1
DOR120	0.000	1
DOR121	0.000	1
DOR122	0.000	1
DOR123	0.000	1
DOR124	0.000	1
DOR125	0.000	1
DOR126	0.000	1
DOR127	0.000	1
DOR128	0.000	1
DOR129	0.006	1
DOR130	1.008	1
DOR131	0.000	1
DOR132	0.000	1
DOR133	0.000	1
DOR134	0.000	1
DOR135	0.000	1
DOR136	0.000	1
DOR137	0.000	1
DOR138	0.000	1
DOR139	0.000	1
DOR140	0.000	1
DOR141	0.000	1
DOR142	0.000	1
DOR143	0.000	1
DOR144	0.000	1
DOR145	0.000	1
DOR146	0.000	1
DOR147	0.000	1
DOR148	0.000	1
DOR149	0.000	1
DOR150	0.000	1
DOR151	**44.437**	1
DOR152	3.291	1
DOR153	0.012	1
DOR154	0.835	1
DOR155	0.000	1
DOR156	**7.655**	1
DOR157	1.100	1
DOR158	**15.054**	1
DOR159	**10.163**	1
DOR160	0.043	1
DOR161	0.716	1
DOR162	0.000	1
DOR163	**44.950**	1
DOR164	**11.029**	1
DOR165	0.000	1
DOR166	0.000	1
DOR167	0.000	1
DOR168	0.001	1
DOR169	**8.811**	1
DOR170	**8.951**	1
DOR171	0.587	1
DOR172	0.000	1
DOR173	0.138	1
DOR174	**12.540**	1
DOR175	0.000	1

The following specimens are in the file LGUA

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
GUA001	0.000	1
GUA002	0.000	1
GUA003	0.000	1
GUA004	0.000	1
GUA005	0.000	1
GUA006	0.000	1
GUA007	0.000	1
GUA008	0.000	1
GUA009	0.000	1
GUA010	0.000	1
GUA011	0.000	1
GUA012	0.000	1
GUA013	0.000	1
GUA014	0.000	1
GUA015	0.000	1
GUA016	0.000	1
GUA017	0.000	1
GUA018	0.000	1
GUA019	0.000	1
GUA020	0.000	1
GUA021	0.000	1
GUA022	0.000	1
GUA023	0.000	1
GUA024	0.000	1
GUA025	0.000	1
GUA026	0.000	1
GUA027	0.000	1
GUA028	0.000	1
GUA029	0.000	1
GUA030	0.000	1
GUA031	0.000	1
GUA032	0.000	1
GUA033	0.000	1
GUA034	0.000	1
GUA035	0.000	1
GUA036	0.000	1
GUA037	0.000	1
GUA038	0.000	1
GUA039	0.000	1
GUA040	0.000	1
GUA041	0.000	1
GUA042	0.000	1
GUA043	0.000	1
GUA044	0.000	1
GUA045	0.000	1
GUA046	0.000	1
GUA047	0.047	1
GUA048	0.000	1
GUA049	0.000	1
GUA050	0.000	1

The following specimens are in the file LJAM

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
JAM001	0.002	1
JAM002	0.000	1
JAM003	0.000	1
JAM004	0.000	1
JAM005	0.000	1
JAM006	0.000	1
JAM007	0.000	1
JAM008	0.005	1
JAM009	0.000	1

JAM010	0.004	1
JAM011	0.000	1
JAM012	0.000	1
JAM013	0.000	1
JAM014	0.000	1
JAM015	0.000	1
JAM016	0.000	1
JAM017	0.000	1
JAM018	0.165	1
JAM019	0.000	1
JAM020	0.000	1
JAM021	0.013	1
JAM022	0.000	1
JAM023	0.003	1
JAM024	0.000	1
JAM025	0.000	1
JAM026	0.000	1
JAM027	0.000	1
JAM028	0.000	1
JAM029	0.000	1
JAM030	0.000	1
JAM031	0.000	1
JAM032	0.000	1
JAM033	0.000	1
JAM034	0.000	1
JAM035	0.000	1
JAM036	0.000	1
JAM037	0.000	1
JAM038	0.000	1
JAM039	0.000	1
JAM040	0.003	1
JAM041	0.000	1
JAM042	0.020	1
JAM043	0.000	1
JAM044	0.000	1
JAM045	0.000	1
JAM046	0.000	1
JAM047	0.000	1
JAM048	0.000	1
JAM049	0.000	1
JAM050	0.000	1
JAM051	0.000	1

The following specimens are in the file LPUR

ID. NO.	Probabilities: STCXG2	BEST GP.
PUR001	0.000	1
PUR002	0.254	1
PUR003	0.000	1
PUR004	0.000	1
PUR005	0.000	1
PUR006	0.000	1
PUR007	0.000	1
PUR008	0.000	1
PUR009	0.018	1
PUR010	0.000	1
PUR011	0.000	1
PUR012	0.000	1
PUR013	0.000	1
PUR014	0.000	1
PUR015	0.000	1
PUR016	0.000	1
PUR017	0.000	1
PUR018	0.000	1
PUR019	0.000	1
PUR020	0.030	1
PUR021	0.000	1
PUR022	0.000	1
PUR023	0.000	1
PUR024	0.001	1
PUR025	0.000	1
PUR026	0.002	1
PUR027	0.000	1
PUR028	0.000	1
PUR029	0.012	1
PUR030	0.000	1
PUR031	0.001	1
PUR032	0.000	1
PUR033	0.000	1
PUR034	0.000	1
PUR035	0.000	1
PUR036	0.000	1
PUR037	**56.507**	**1**
PUR038	0.000	1
PUR039	0.000	1
PUR040	0.001	1
PUR041	0.000	1
PUR042	0.000	1
PUR043	0.000	1
PUR044	0.000	1
PUR045	0.000	1
PUR046	0.000	1
PUR047	0.000	1
PUR048	0.000	1
PUR049	0.000	1
PUR050	0.002	1
PUR051	0.000	1
PUR052	0.000	1
PUR053	0.000	1

The following specimens are in the file LTMA

ID. NO.	Probabilities: STCXG2	BEST GP.
TMA001	0.000	1
TMA002	0.000	1
TMA003	0.000	1
TMA004	0.000	1
TMA005	0.000	1
TMA006	0.000	1
TMA007	0.000	1
TMA008	0.000	1
TMA009	0.000	1
TMA010	0.000	1
TMA011	0.000	1
TMA012	0.000	1
TMA013	0.000	1
TMA014	0.000	1
TMA015	0.000	1
TMA016	0.000	1
TMA017	0.000	1
TMA018	0.000	1
TMA019	0.000	1
TMA020	0.000	1
TMA021	0.000	1
TMA022	0.000	1
TMA023	0.000	1
TMA024	0.002	1
TMA025	0.000	1
TMA026	0.000	1
TMA027	0.000	1
TMA028	0.000	1
TMA029	0.000	1
TMA030	0.000	1
TMA031	0.000	1
TMA032	0.000	1
TMA033	0.000	1
TMA034	0.000	1
TMA035	0.000	1
TMA036	0.000	1
TMA037	0.000	1
TMA038	0.000	1
TMA039	0.000	1
TMA040	0.000	1
TMA041	0.000	1
TMA042	0.000	1
TMA043	0.000	1
TMA044	0.000	1
TMA045	0.000	1

Summary of Probabilities for Specimens in the file LANG

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	49	50	50	50	50	50

Summary of Probabilities for Specimens in the file LCANT

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	62	62	62	62	62	62	62

Summary of Probabilities for Specimens in the file LSMF

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	56	56	56	56	56	56	56

Summary of Probabilities for Specimens in the file LDOR

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	148	154	161	165	168	173	175

Summary of Probabilities for Specimens in the file LGUA

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	49	50	50	50	50	50	50

Summary of Probabilities for Specimens in the file LJAM

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	50	51	51	51	51	51

Summary of Probabilities for Specimens in the file LPUR

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	51	52	52	52	52	53

Summary of Probabilities for Specimens in the file LTMA

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	45	45	45	45	45	45	45

Summary of Best Classification of Projected Specimens:

	Into:	
From:	STCXG2	Total
LANG	50	50
LCANT	62	62
LSMF	56	56
LDOR	175	175
LGUA	50	50
LJAM	51	51
LPUR	53	53
LTMA	45	45
Total	542	542

Table 5: Breakdown of chemical group assignment by site.

Site	Group 1 Pottery	Group 2 Pottery	Unassigned Pottery	Group 2 Clay	Unassigned Clay
Aklis		6			1
Bethlehem					1
Caliche Mine					1
Cave Bay				1	
Columbus		4			1
Glynn		4			
Grange				1	
Judith's Fancy		28	11		1
Manchenil				1	
Mountain Top					1
Prosperity		2	2	1	
Richmond		1	1		
St. Georges	2	9	1	1	
Windsor		2	1		

Table 6: Breakdown of chemical group assignment by ware type.

Ware Type	Group 1 Pottery	Group 2 Pottery	Unassigned Pottery
Ate		19	2
Bay-Salt	1	24	8
Longford		9	2
Prosperity	1	4	3

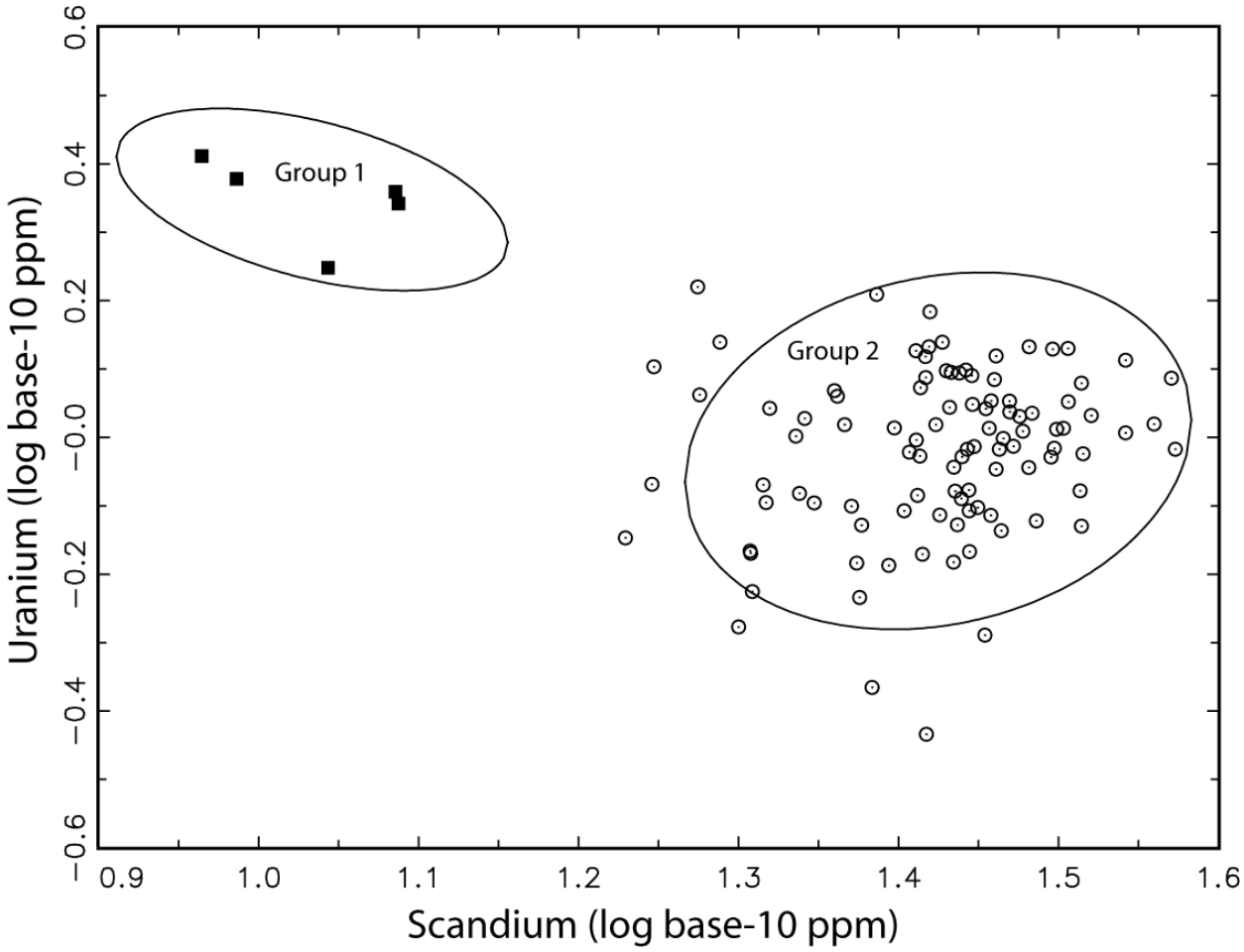


Figure 1. Bivariate plot of scandium and uranium base-10 logged concentrations showing the separation of Groups 1 and 2. Plot includes all members from both projects analyzed from St. Croix. Ellipses represent 90% confidence level for membership in the groups.

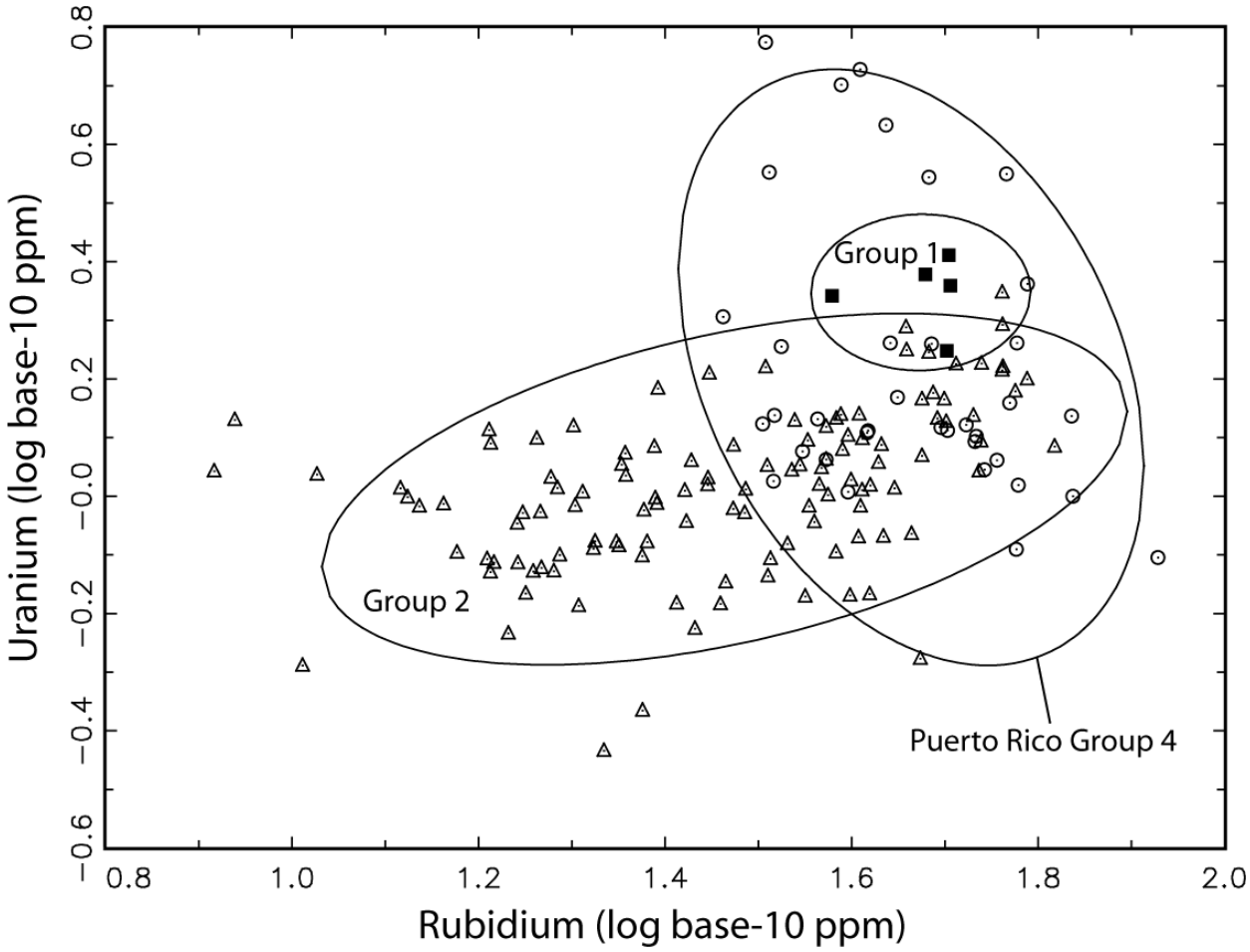


Figure 2. Bivariate plot of rubidium and uranium base-10 logged concentrations showing the similarity between Group 1 from St. Croix and Group 4 from Puerto Rico. Ellipses represent 90% confidence level for membership in the groups.