Neutron Activation Analysis on Olmec Pottery: A View From La Venta

Research Year: 1997
Culture: Olmec
Chronology: Early Pre-Classic to Late Pre-Classic
Location: Gulf Coast, México
Sites: La Venta and San Lorenzo

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Introduction

Olmec La Venta (ca. 1000-400 B.C.) has received significant archaeological attention in the last 50 years of research (Grove, 1997). However, during that time the study of pottery has seemed to lag behind leaving many unanswered questions concerning chronology and interaction. Despite a modest ceramic bibliography for that site

(Drucker, 1947; 1952; Drucker *et al.*, 1955; Hallinan *et al.*, 1968), one dilemma that has persisted is the nature of interaction between the earliest occupation of La Venta and the Early Formative San Lorenzo phase at San Lorenzo.

The spatial patterning across the Olmec landscape of these two sites as well as the other two principal sites, Laguna de los Cerros and Tres Zapotes, occur at nearly equal distances from one another (Figure 1). Earle (1976) recognized this phenomenon to be a non-random occurrence and explained the separation as a result of inter-site competition and mutual antagonism. Later, Grove (1994) argued that because each Olmec site was situated in a unique ecological zone bearing certain resources, that a cooperative exchange model, or zonal complementarity, could also be a valid explanation. As Grove proposes, each Olmec site had abundant resources dictated by their local environment. For La Venta, the zone was characterized by resources unique to a coastal estuary. Also present were salt, cacao, and tar. For San Lorenzo, the zone was characterized by resources unique to a floodplain environment. Also present were hematite, limestone, and finer qualities of clays. According to Grove then, the spatial patterning of Olmec sites could also be explained by their alignment in distinct ecological niches that in turn promoted a cooperative exchange of abundant resources for deficient resources.

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Figure 1: Map of Olmec Sites.

The Problem

As part of the 1997 PALV field season, research was conducted to test the zonal exchange of ceramic resources to La Venta from San Lorenzo. Obviously both sites had abundant clay resources readily available, but the finer qualities of clays observed at San Lorenzo, which included bentonite and kaolin types, were absent at La Venta. Hypothetically, if Olmec zones did complement one another with abundant resources for deficient resources, then observable exchange of ceramic materials to La Venta from San Lorenzo would support a model of zonal complementarity. Furthermore, if foreign ceramic materials were found at La Venta, then it could be furthermore proposed that abundant resources at La Venta were cooperatively exchanged back to the deficient San Lorenzo. In the course of this research, three assumptions of zonal complementarity had to be addressed.

First, the specific types of materials that were exchanged for other materials in zonal complementarity was not addressed in Grove's model. It seemed logical, however, to suggest that if such a cooperative system was in play between the all four zones, then basalt was not traded only for tar, or clay was not traded only for salt. In other words,

zones containing multiple resources were probably exchanging for other multiple resources, not simply one resource for another.

Second, there existed a possibility that other zones outside the Olmec area also participated in a cooperative exchange for deficient resources. An immediate problem of the present model was to explain the occurrence of exotic goods foreign to all zones. Grove's model did account for the sharing of available resources between the four Olmec zones, but did not explain the importation of exotic goods such as jade and obsidian that have been sourced outside the Olmec area. Having examples in the archaeological record of resources non-local to all Olmec zones begs the question if zonal complementarity is an appropriate model when restricted to the Olmec area. Thus, when attempting to explain the occurrence of non-local and exotic goods, one would need to re-shape Grove's model to address resources foreign to these zones and explain what interaction took place to obtain those resources. Nevertheless, for this research, zonal complementarity remained a valid model for testing because ceramic resource exchange could be monitored between La Venta and San Lorenzo.

Finally, coeval occupations were required for active participation in such a system of exchange. Currently, it is held that San Lorenzo had its greatest successes during the San Lorenzo phase of the Early Formative (1200-900 B.C.). However, La Venta is generally viewed to have had its successes during the Middle Formative period (800-400 B.C.). In order for zonal complementarity to offer an explanation to the spatial patterning of Olmec sites, La Venta occupations must align with San Lorenzo occupations. More specifically, the bentonite and kaolin clays at San Lorenzo could not have been cooperatively exchanged for other resources at La Venta if that site was not yet occupied. Coe and Diehl (1980) have argued that because San Lorenzo phase diagnostic ceramic types (Calzadas Carved, Límon Incised, and Xochiltepec White) have not been recovered in any La Venta assemblage, that the main occupation at La Venta occurred later in time. Furthermore in Coe & Diehl (1980), Cyphers argued that nothing found at La Venta appears to be earlier than the Nacaste phase (ca. 900-700 B.C.) at San Lorenzo. Clearly the present evidence does suggest a later Middle Formative placement for La Venta's apogee. Yet, recent work by Rust and Sharer (1988) and Gonzalez Lauck (1988) at La Venta have identified a series of levee occupations located along an ancient river channel now called the Río Bari. As far as the Early Formative, occupations have been realized at La Venta and three of its peripheral levee site: Isla Alor, Isla Yucateca, and San Andrés (Figure 2). Radiometric dates confirm the temporal alignment with the San Lorenzo phase at San Lorenzo, but as yet none of the diagnostic markers have been recovered. Yet, the lack of ceramic evidence at La Venta to confirm contemporaneous occupations is not in itself a proof that concurrent occupations did not exist. Furthermore, to say that La Venta did not have an Early Formative occupation based on not having diagnostic markers from another sites assemblage does not view La Venta as an independent identity that could have existed on its own or interacted with other regions at that time. Lastly, if the scale of La Venta's emergent occupation, during the Early Formative, is not directly dependent upon participation in zonal complementarity, then such a test, at the ceramic level, is possible.

Unique to Olmec pottery at La Venta though, is a generally poor state of preservation. Most frequently, pottery remains are often excavated with little or no surface having been badly eroded from the post-depositional effects of La Venta's high acidic levels in the regions soil (Drucker, 1952). It seemed logical, however, that because two of the three diagnostics of San Lorenzo phase pottery require a decorative element on the surface of the sherd or vessel (Calzadas Carved and Límon Incised), that if these types were poorly preserved they could go unrecognized in earlier attempts at identification in various La Venta collections. The ultimate objective of this research was to see if La Venta and San Lorenzo were interacting during the Early Formative by monitoring vessel movement and test Grove's model at the ceramic level.

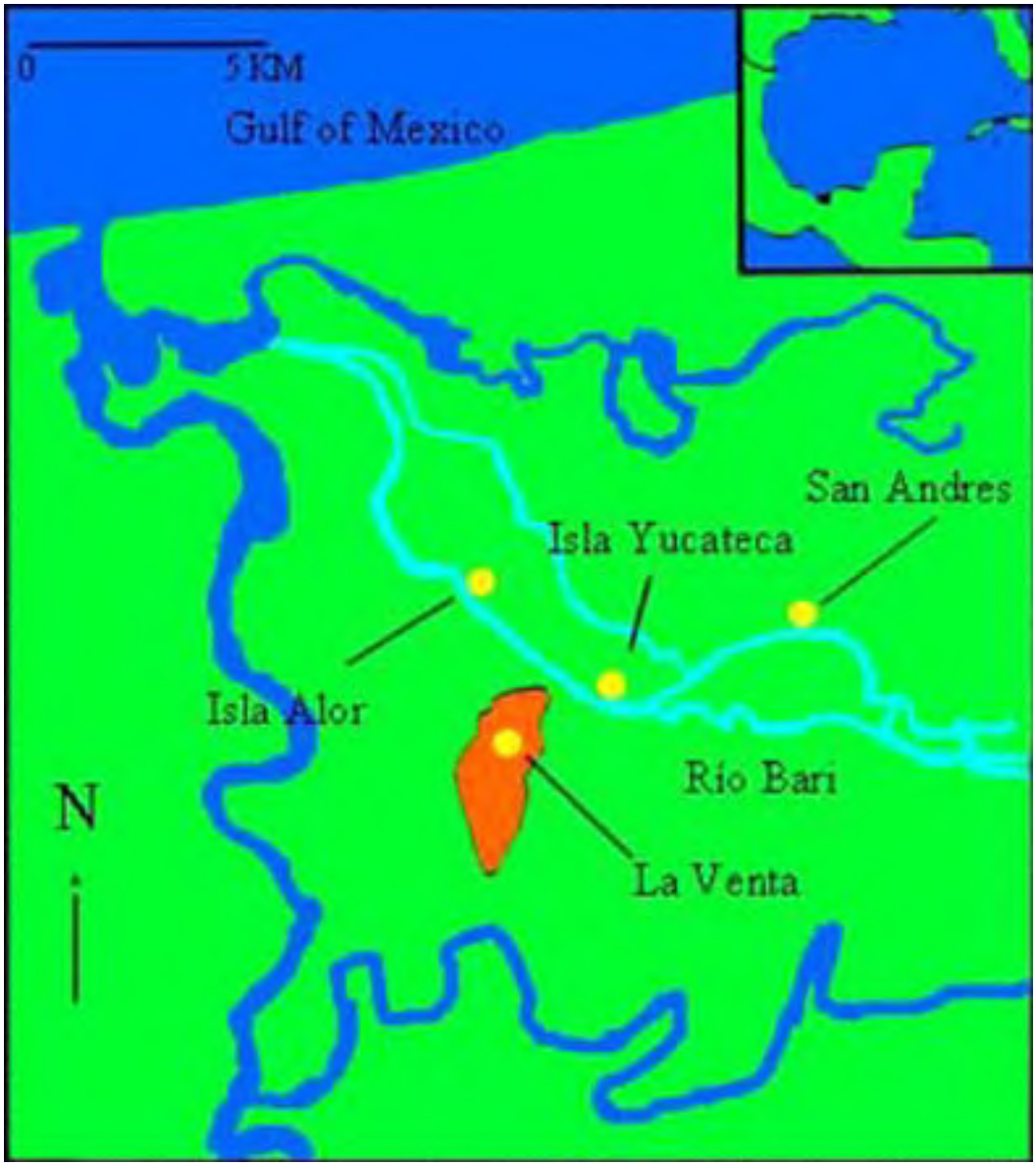

Figure 2: Early Formative La Venta.

Methods

In June of 1997, a raw materials survey of La Venta and its immediate periphery was conducted. The survey was extended to a 7-km distance from the La Venta site core and emphasizing the Early Formative levee sites located along the Río Bari (Figure 3). Estimates offered by Arnold (1985) for distances a potter is willing to travel for necessary resources do not exceed the 7-km distance. 62 clays and 11 sands were sampled and then assigned to geographic space using GPS. These 73 samples were used to characterize the elemental variability of ceramic raw material resources available to Olmec potters in ancient times. 174 pottery fragments were randomly sampled from three previously excavated collections. The first was from Robert J. Squier's 1964 excavation of Test pit C in complex B. The second was from William F. Rust III's 1986 excavation of operation 28, Test Pit 2 in Complex E. The third was from Raab *et al.*'s 1994-95 excavations of the levee site Bari #2 also called Isla Alor. Pottery from all proveniences was sampled where radiometric dates of charcoal confirm the material to be of Early Formative age and essentially coeval with the San Lorenzo phase.

From July 1997 - May 1998, a total of 247 samples were prepared, irradiated, and chemically characterized at the University of Missouri Research Reactor (MURR). This investigator preformed all sample preparations. In so doing, sample costs were reduced and allowed for increased sample size from the originally proposed 150 to a final 247 samples.

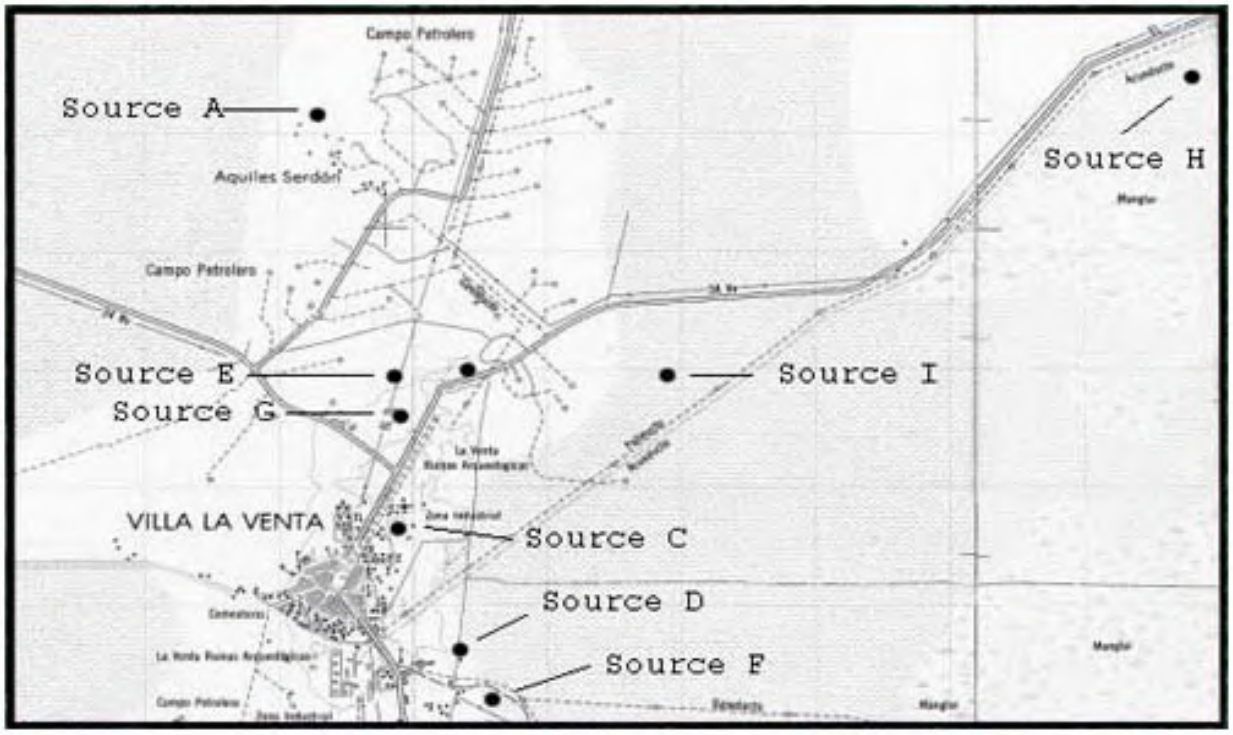

Figure 3: Raw Materials Survey Map.

Analysis

Inherent to compositional studies is the provenance postulate (Weigand *et al.*, 1977). In short, variation is greater between two spatially separated regions than the variation within a particular region. Thus, in order to recognize and monitor production and vessel movement from both Olmec sites, variation between San Lorenzo and La Venta must be greater than the variation within each particular site so that the chemical signatures of clays can be distinguished. In this bivariate plot, Figure 4, of chromium and antimony such is the case. Compositions of clays at La Venta ("+") tend to have both smaller concentrations of antimony and higher concentrations of chromium than the San Lorenzo clays ("x"). Having obtained all elemental data from the clays, sands, and pottery, the analysis continued by forming reference groups of the pottery based on elemental concentrations. Within the 174 samples, 2 compositional reference groups were realized (Figure 5). The first was a small, N = 13, group of pottery found only at operation 28 in complex E, while the other was a much larger, N = 147, pottery group found in all three proveniences. The remaining 14 pottery samples were unassigned. The two groups were distinguished by their varying amounts of the elements thorium and antimony. Group 1 has higher concentrations of both of these elements while group 2 has significantly smaller concentrations. Next, the newly formed compositional groups were compared against the backdrop of elemental concentrations of the local clays found at La Venta (Figure 6). This bivariate plot shows a strong correlation between reference group 2 and La Venta clays identifying the pottery samples of group 2 to be of local procurement and manufacture. Group 1 however, shows no compositional similarity to La Venta clays and was interpreted to be of non-local origin.

All pottery samples in this analysis were also typed using the 1955 type collection formulated by Drucker (1952). It was also realized in this research that Drucker's types are not compositionally sound (Figure 7). The 90% confidence ellipses of Drucker's wares indicates here that similar clays were used in the production all wares. It is interesting to note also that in an appendix to the Drucker report (1952), Anna Shepard carried out technical analyses on several fine paste wares. She concluded that at least two clays were used in the production of her sample. A finding that is compatible with the results offered here. However, the pottery she analyzed came from contexts of later temporal placement and was centered on fine paste wares.

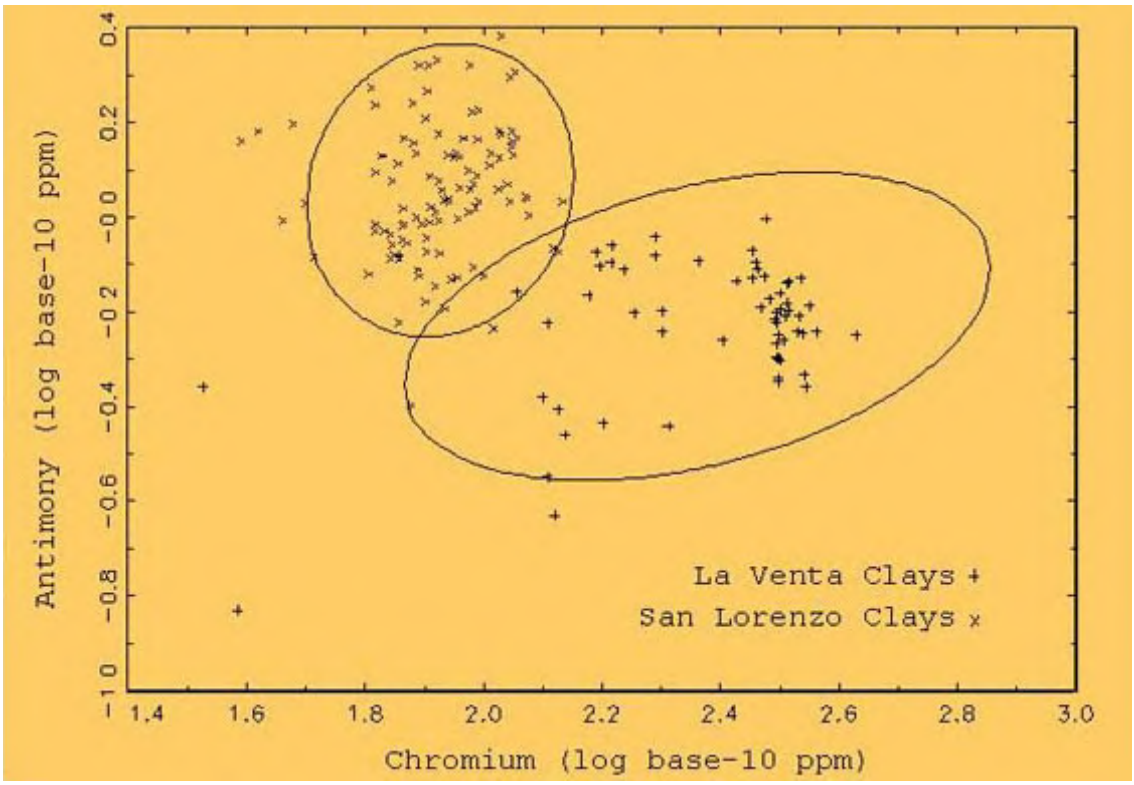

Figure 4: Comparison of La Venta and San Lorenzo Clays.

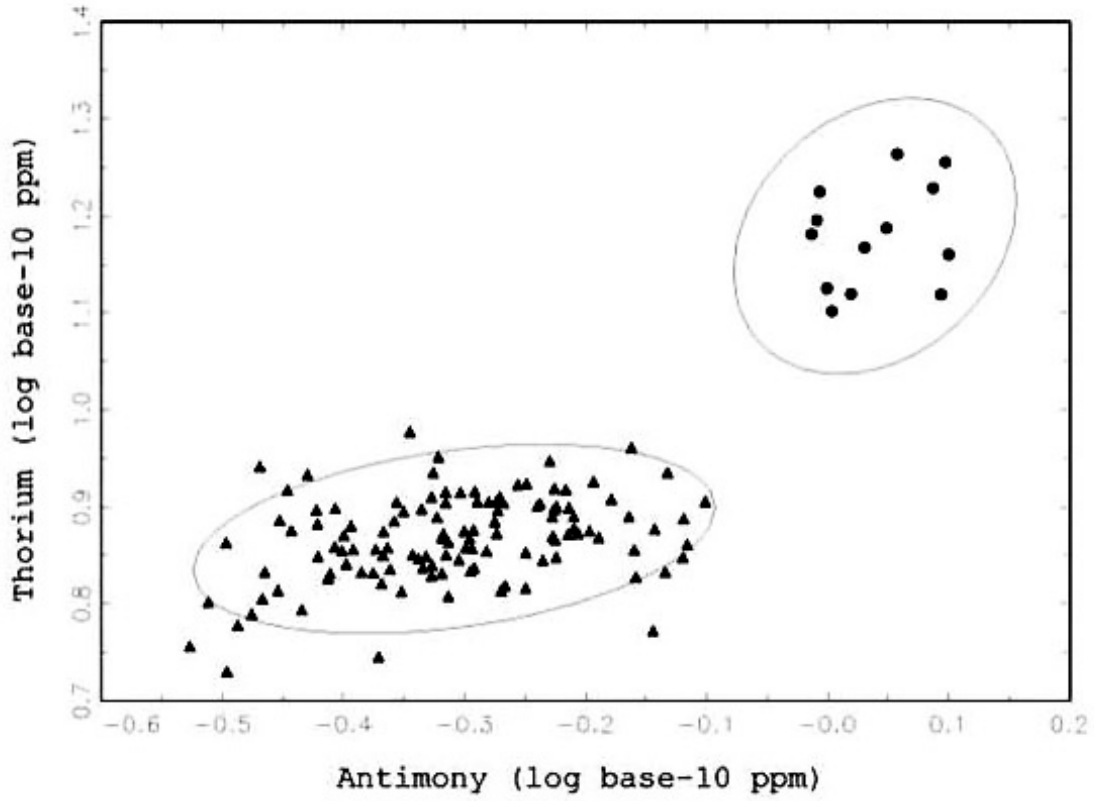

Figure 5: Bivariate Plot of La Venta Reference Groups.

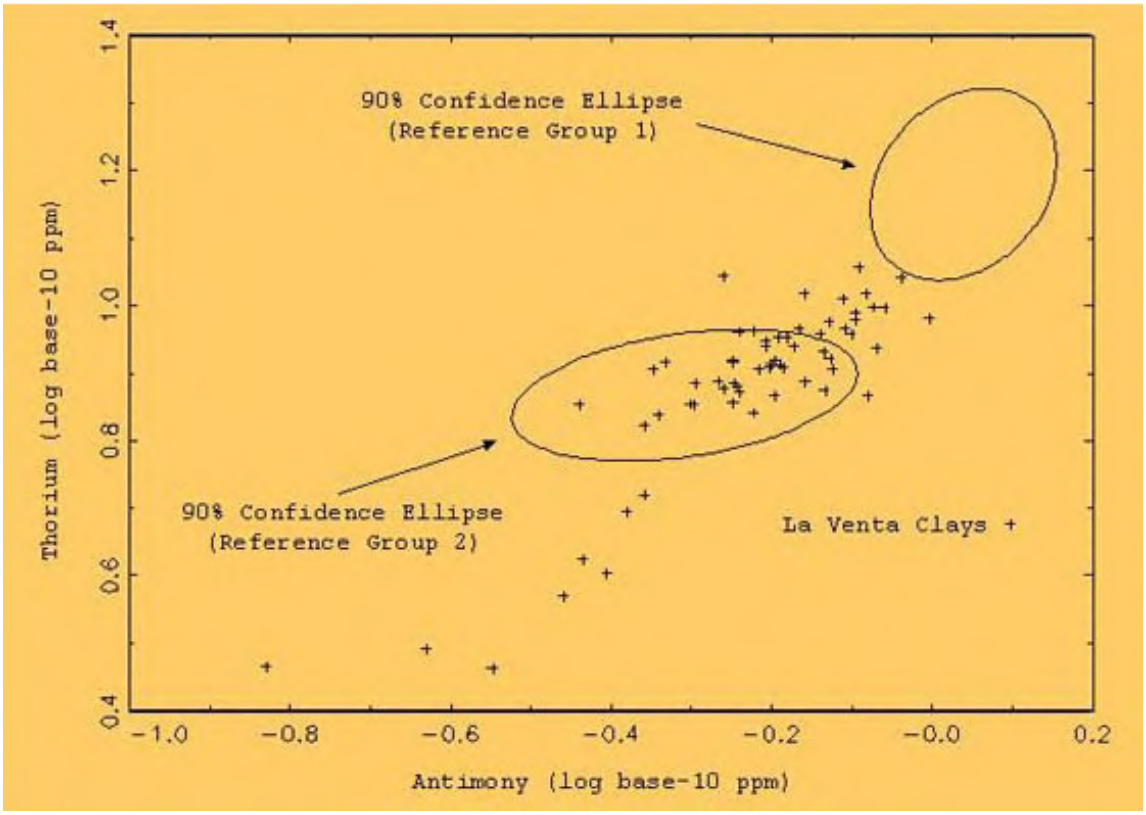

Figure 6: La Venta Pottery Groups with Local Clays.

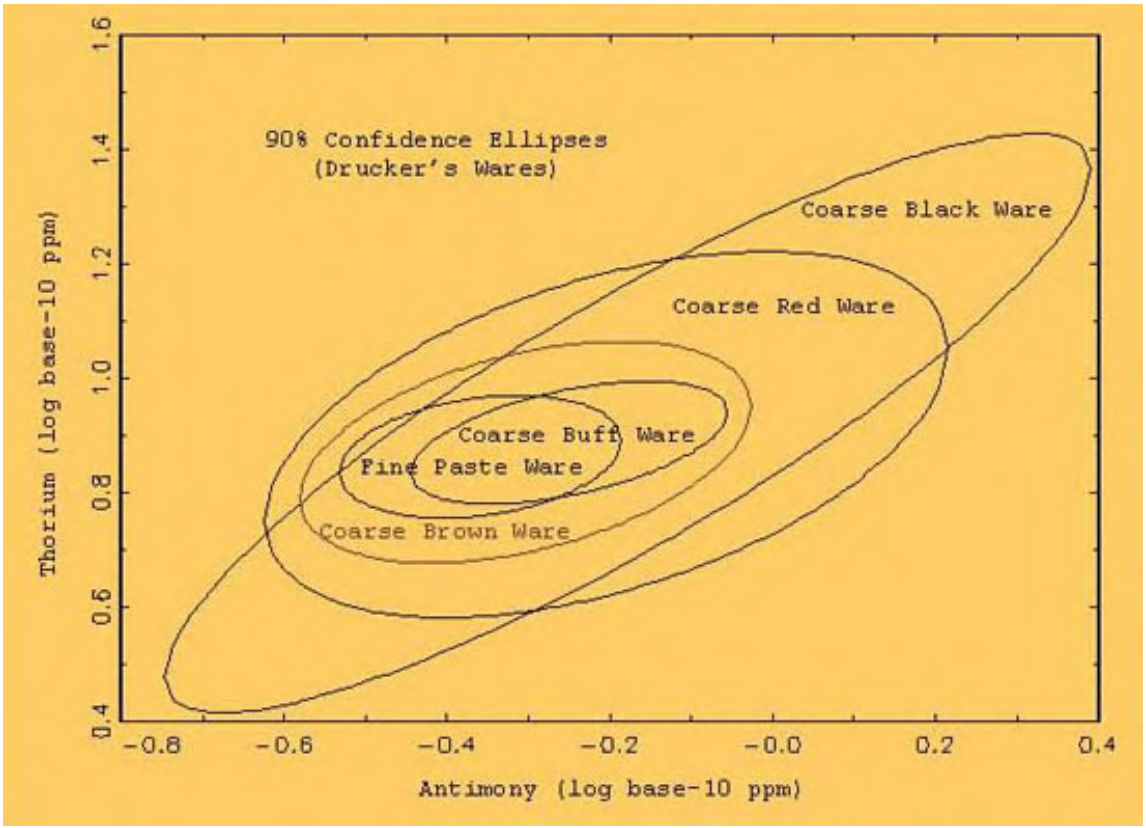

Figure 7: Elemental Comparison of Drucker's Wares.

A test of clay membership probability was then calculated using the GPS data converted to UTM coordinates for locally produced reference group 2 (Figure 8). In this figure, the solid circles represent the sample locations of clays. The darker shaded regions represent areas of clays sampled with higher probabilities of membership that may have been used in the production of the pottery sampled. It can be seen in this figure that the clays most similar to pottery group 2 are found around the levee site Isla Alor, suggesting the locale for procurement of materials in ancient times. Interestingly, the La Venta island itself which has an immense clay resource had the smallest probability (less than .50%) of membership. This indicates that the La Venta island was not exploited for clays used in the production of locally produced reference group 2.

Finally, the non-local pottery group 1 was compared to a clay database from San Lorenzo (Figure 9). All clay samples that were used in this comparison were obtained by R. Sergio Herrera (1998). In this bivariate plot of chromium and thorium, the San Lorenzo clays are designated by an "x" and are plotted against a 90% confidence ellipse for non-local reference group 1. Concentrations of these elements vary significantly to suggest that San Lorenzo was not the source of clay materials used in their production. Thus, other regions must be considered to find the provenance of these ceramics. Unfortunately, the present compositional database of Mesoamerican clays does not contain adequate analyses to test other regions against non-local reference group 1.

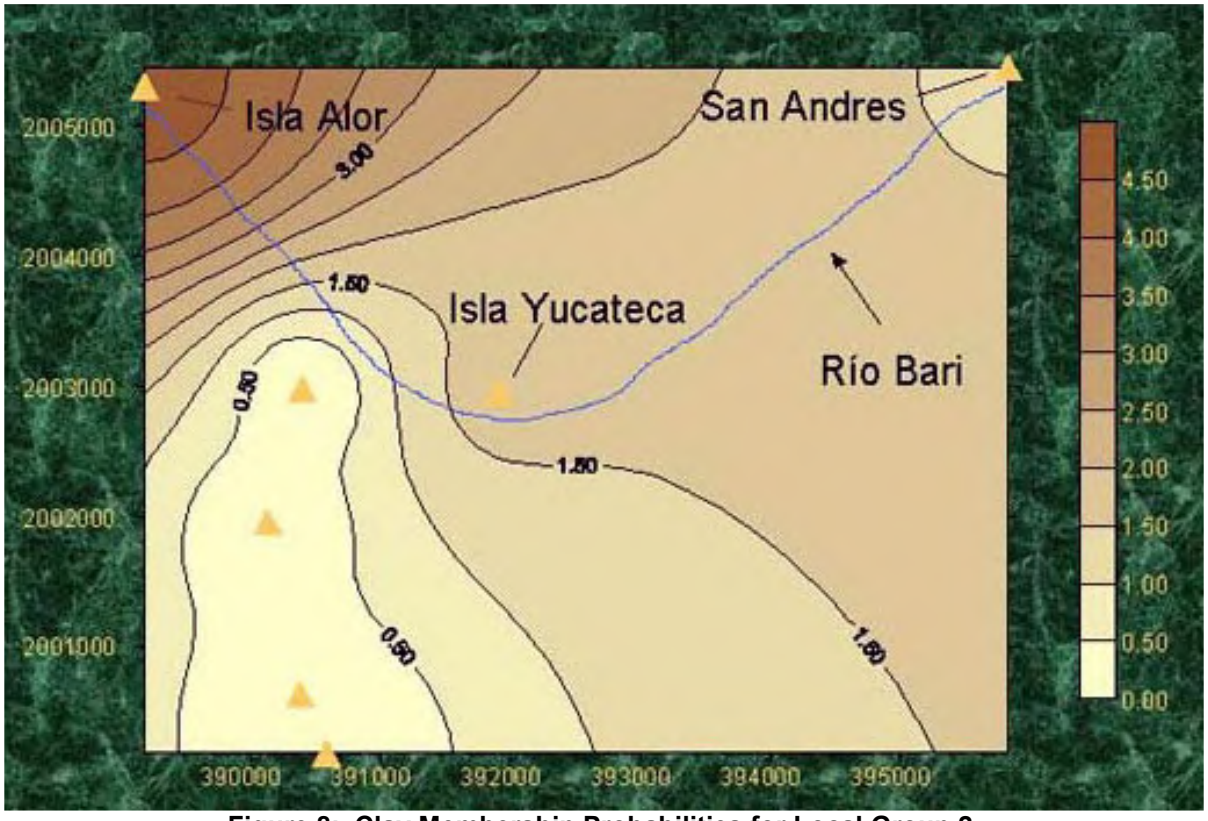

Figure 8: Clay Membership Probabilities for Local Group 2.

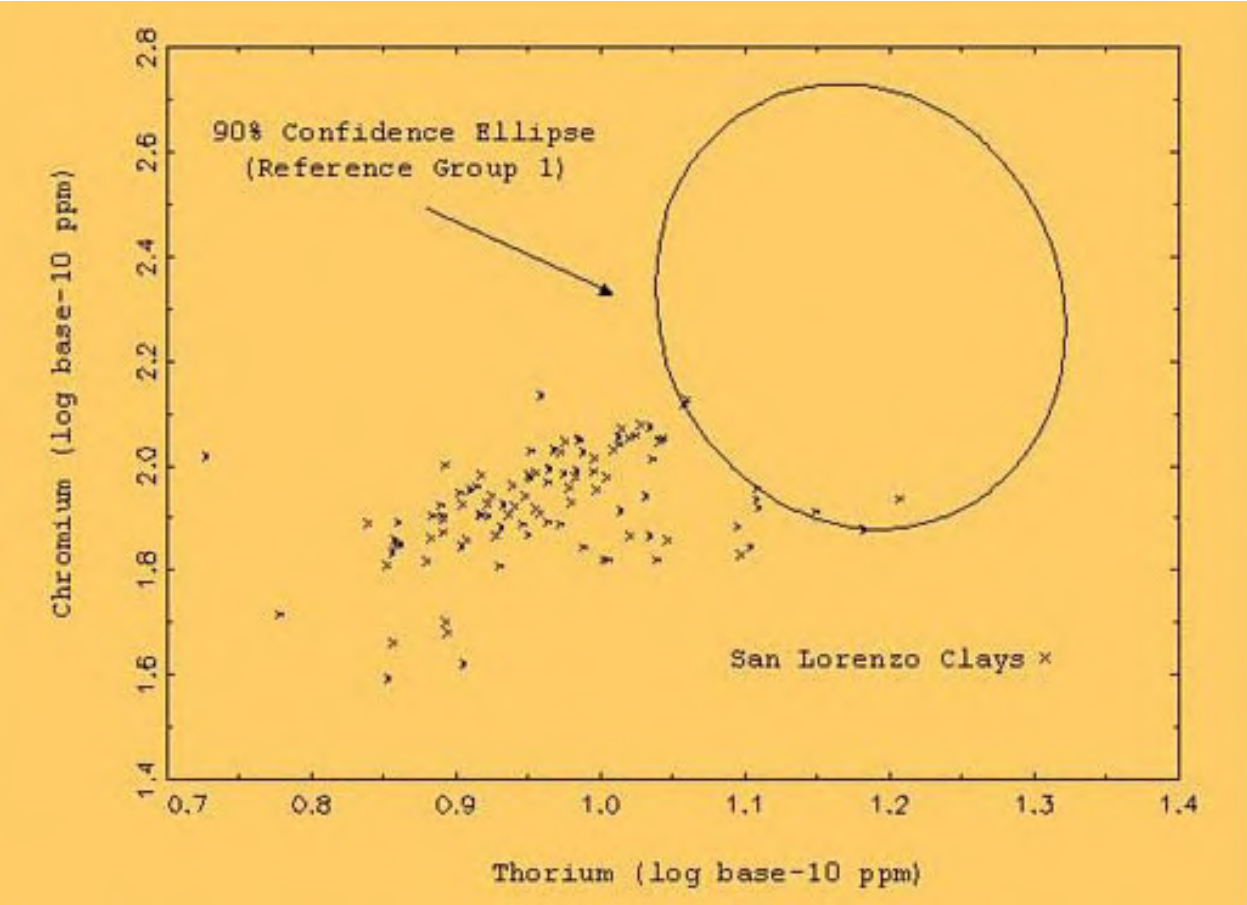

Figure 9: Non-local Group 1 and San Lorenzo Clays.

Conclusions

The goal of this project was to explore the nature of Olmec ceramic technology during the earliest occupation at La Venta and also the relationship between La Venta and San Lorenzo through testing Grove's model of zonal complementarity. The results of this project indicate that La Venta's ceramic technology was focused around a strong local procurement and production of their own pottery. Procurement patterns indicate that Isla Alor was an area where ancient Olmec potters were selecting their clay resources in the production of their pottery. A small non-local ceramic technology was also present during the earliest occupation of La Venta. However, at this time, the compositional database of Olmec pottery and ceramic raw materials is not capable of explaining where or whom La Venta was interacting. Yet, compositions of clays at San Lorenzo vary enough to conclude the non-locally produced group 1 could not be sourced to San Lorenzo. Of the two models that have been proposed to explain the spatial patterning between the 4 principal Olmec sites, "mutual antagonism" and "zonal complementarity",

neither can be rejected at this time. Further, the continuing debate of La Venta's Early Formative placement cannot be completely understood until the non-local pottery group 1 is provenanced. Still, as more ceramic analyses from various Olmec sites incorporate compositional studies, the chances of finding which region or regions were interacting with La Venta, during the Early Formative, can substantiate La Venta's temporal placement during the San Lorenzo phase. Previous ceramic analyses at La Venta, which have employed a typological method, have been stunted because preservation of ceramic materials is so poor. Using NAA as an analytical tool goes beyond the confines of preservation and enables characterization of a sample based solely on composition. The findings of this project show strong hope for understanding ceramic technology and catching up with other aspects of Olmec culture at La Venta.

Future Research

In the course of this project many avenues have opened up for further investigation. As more projects incorporate compositional analyses from Olmec sites, the database will be sufficient to monitor vessel movement of much larger spatial and temporal dimensions across Mesoamerica. One interest of mine is to monitor vessel procurement, production, and exchange at Olmec La Venta over its entire ceramic history. If it can be said here that San Lorenzo played little or no role in La Venta's Early Formative development based on the ceramic evidence, then who was exchanging pottery making knowledge evidenced in the non-local compositional group 1? Answering this question will be pivotal in broadening our understanding of the earliest occupation at La Venta.

Acknowledgements

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