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Ceramic Petrofacies: Modeling the Angelina River Basin in East Texas

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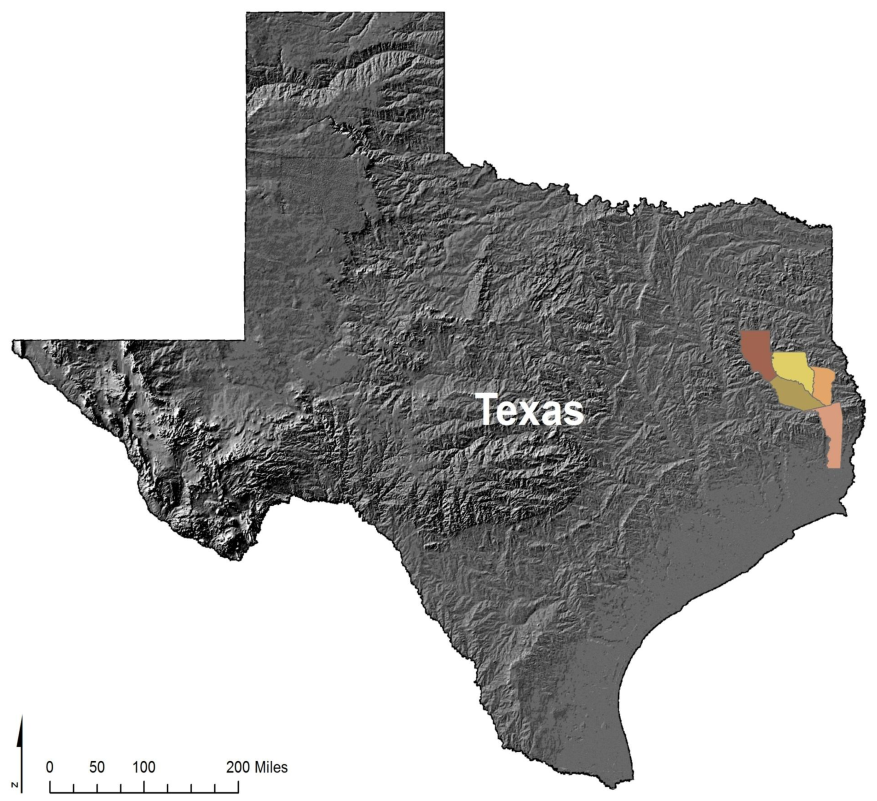
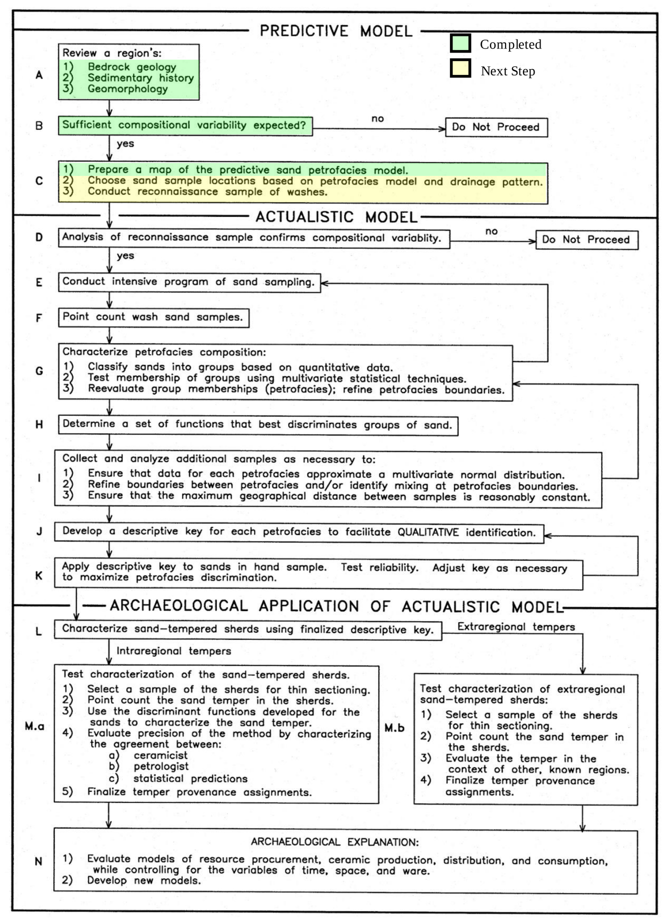
SIGNIFICANCE OF THE PETROFACIES MODEL

In archaeological application, petrofacies can be thought of as "temper resource procurement zones whose sand compositions are distinct from one another at a relevant scale of investigation" (Miksa et al. 2004). This project develops and tests a model of petrofacies for the lower Angelina River basin in East Texas. The temporal period of interest lies within two divisions, namely Woodland and Caddo, the former ranging from 500 B.C.-A.D. 800 and the latter is represented by four subdivisions: Formative Caddo (A.D. 800-1000), Early Caddo (A.D. 1000-1200), Middle Caddo (A.D. 1200-1400), and Late Caddo (A.D. 1400-1680). Recent difficulties in geochemical (INAA) research has made it challenging to locate areas of ceramic production; however, the elevated degree of geologic variability in the lower Angelina River makes it an ideal location to explore the viability of this method. Ceramic provenance is of particular import within the lower Angelina River, which is located along the southern border of the Caddo homeland. The region has not been well-explored as local archaeological projects tend to focus less upon data-recovery (Corbin 1994, Jelks 1965, Perttula 2008), than basic pedestrian and testing surveys (Austin 2006; Bonine et al. 2004; Brownlow 2002; Fields 1979; Fletcher 1980a, 1980b; Hubbard 1998; Jones 2009; Jones and Trierweiler 2005; Middlebrook 1994, 1997a, 1997b; Perttula et al. 2010; Rose and Jones 2010; Skinner and Trask 1996; Trierweiler and Bonine 2003; Trierweiler and Galan 2002). This indicates the possibility for significant returns within this case study, while the method can be expanded to include the peripheral drainage basins.





Modified from Miksa and Heidke 1995: Figure 9.3

GEOLOGY OF THE ANGELINA RIVER BASIN

The complex geology in East Texas perpendicularly intersects the course of the Angelina River, making it well suited for a model of petrofacies. Local rocks and sediments range from the Eocene to the present (TNRIS 2012), and the geology of the Angelina River basin is distinctly zoned, constituting a highly variable geologic composition . Due to the considerable degree of geologic variability throughout the study area, it is expected that erosion will produce unique compositions within stream sediments that appear decidedly different due to the distinct geology of each zone.

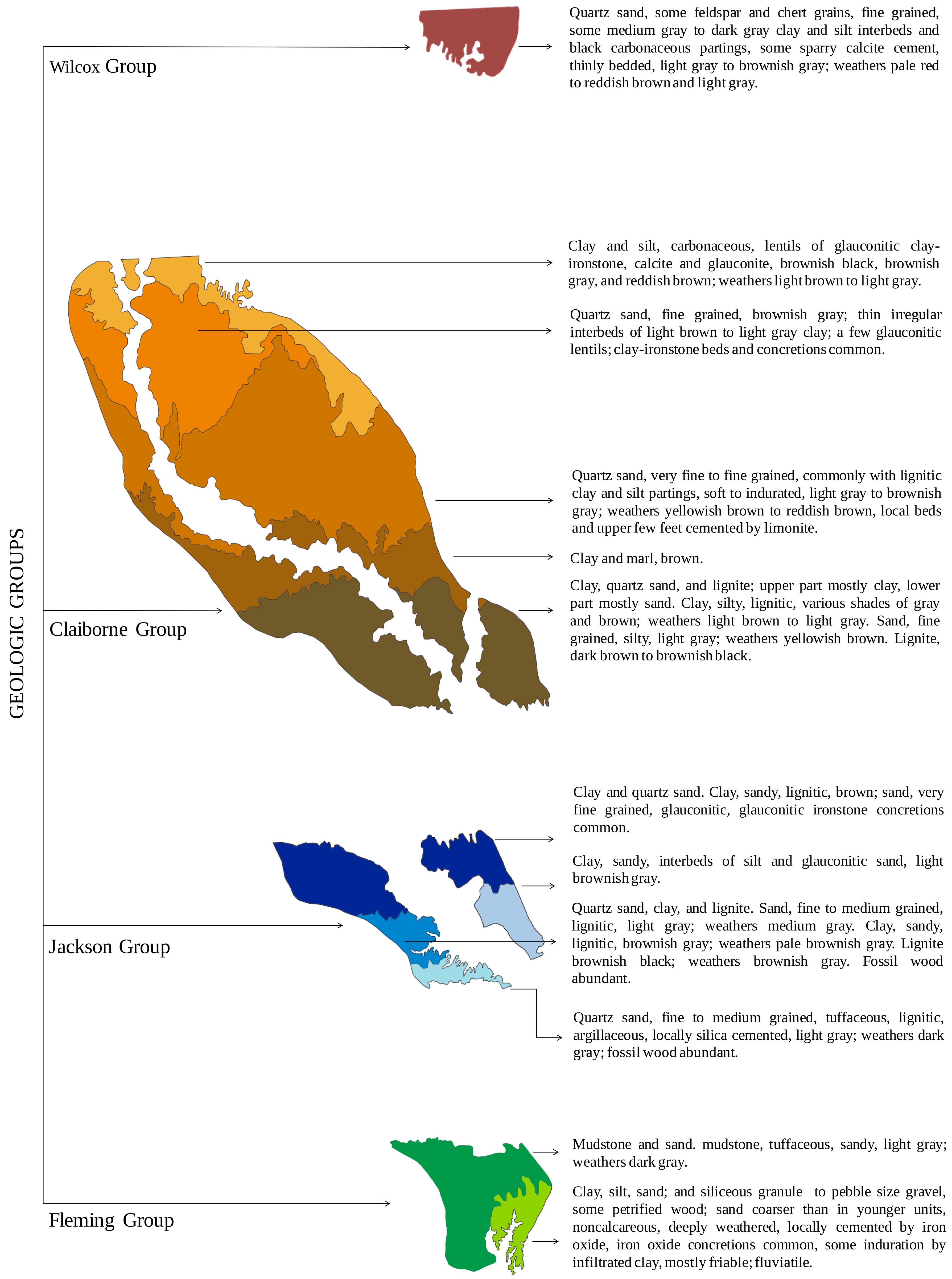
DEVELOPMENT OF THE HAND SAMPLE IDENTIFICATION MODEL

Advancement of petrofacies models based upon thin-section point counts allows for rigorous quantitative treatment for problems of temper provenance; however, the application of petrographic methods to prehistoric ceramics is limited by time and fiscal constraints (Miksa and Heidke 2001). To formulate a less imposing model, hand samples for each petrofacies will be created via point count and discriminant analysis as a means to construct the descriptive key (Miksa and Heidke 2001). This will allow for petrofacies assignment by binocular microscope, which can be substantiated by point counts and statistical analyses as an assessment of accuracy (Miksa and Heidke 2001).

Hand samples, consisting of raw sands, will be created using the remainder of the sample that was originally split and cleaned to create petrographic thin-sections. These will remain within the 30-dram vial with a magnifying lid to illustrate the variability within. Classification of these samples described as one of six ordinal categories (i.e., none [0%], trace [0% - not measurable], rare [0-2%], present [2-10%], common [10-40%], and abundant [<40%]) (Miksa et al. 2004).

ABSTRACT

Ceramic provenance studies remain the basis of worldwide archaeological research concerned with reconstructing exchange networks, tracing migrations, and informing upon ceramic economy. Unfortunately, Texas archaeologists have been plagued with an inability to trace ceramic production sources to the same extent as researchers within other regions. Ceramic petrofacies models have been employed successfully in archaeological contexts at the San Pedro Valley, Tonto basin, Tucson basin, Agua Fria, and Gila and Phoenix basins in Arizona, but have not yet been employed east of Arizona. Data resulting from the construction of an actualistic petrofacies model in the prehistoric coastal environment of East Texas could provide the necessary foundation for archaeologists to begin expanding upon the current dialogue regarding the provenance of ceramic vessels utilized by precolonial Woodland and Caddo populations.



USGS 2007

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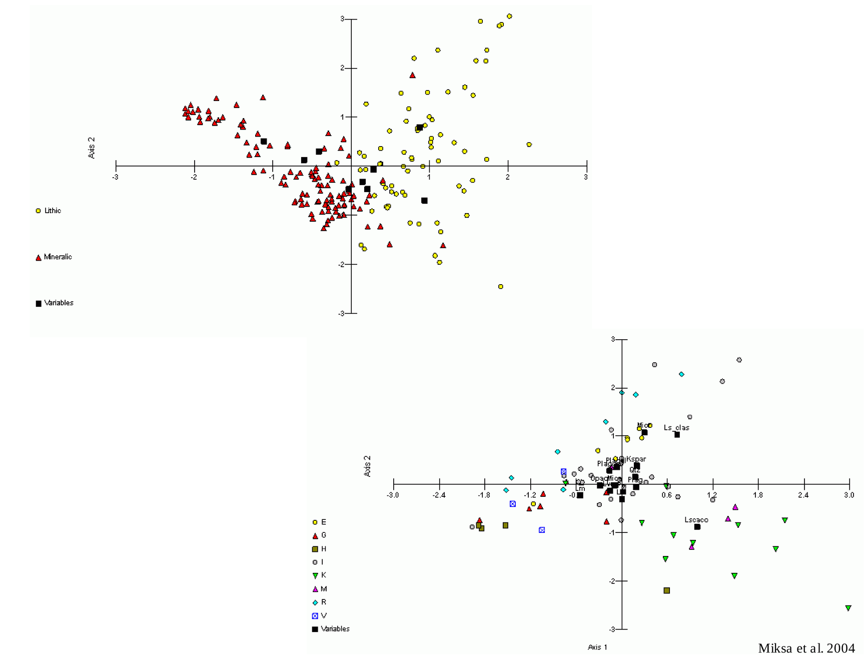
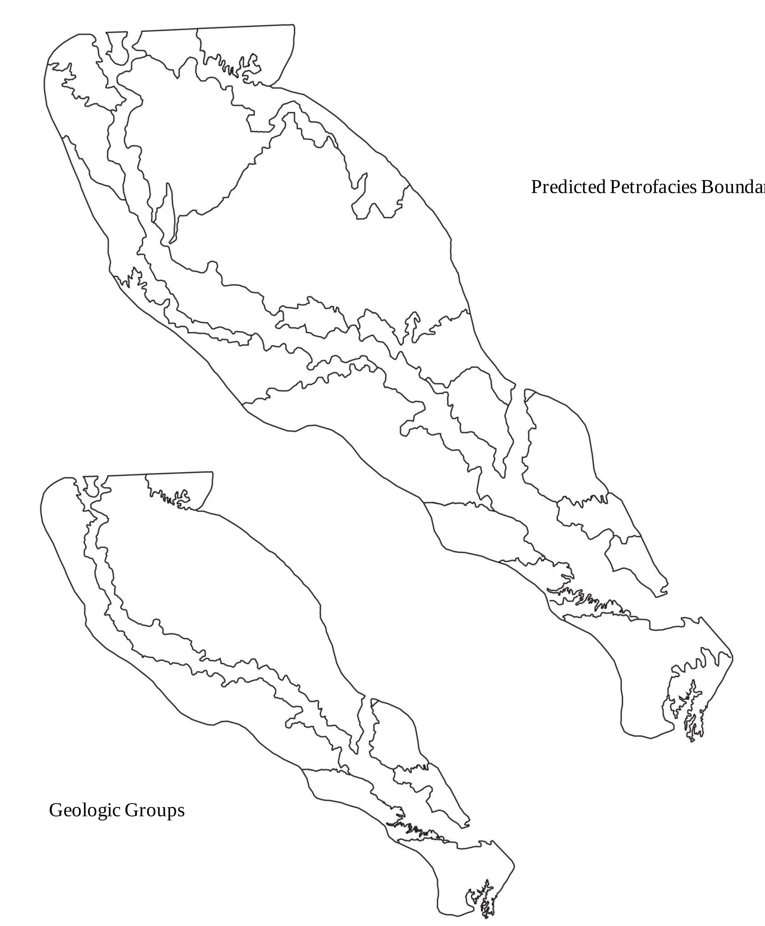
*References available upon request.



CERAMIC PETROGRAPHY

The use of petrofacies exponentially increases the scope and utility of ceramic petrography. By noting the relative abundance of local sands instead of only ubuquitous materials, petrofacies models provide a high-resolution method of assigning ceramic provenance (Miksa and Heidke 1995). Sherds selected as the representative sample will undergo analysis with a binocular stereomicroscope to characterize three variables to of temper composition (Miksa et al 2004). Those variables consist of temper type (i.e., sand, hematite, grog, etc.), generic temper source (i.e., geographic and tectonic origin), and specific temper source (petrofacies of origin) (Miksa et al. 2004). This can facilitate the production of increasingly complex research questions for ceramic-bearing sites (seen at right), providing the spatial and temporal resolution needed to inform more detailed discussions of manufacture and use, ceramic economy, migration, exchange networks, and regional temporal trends.



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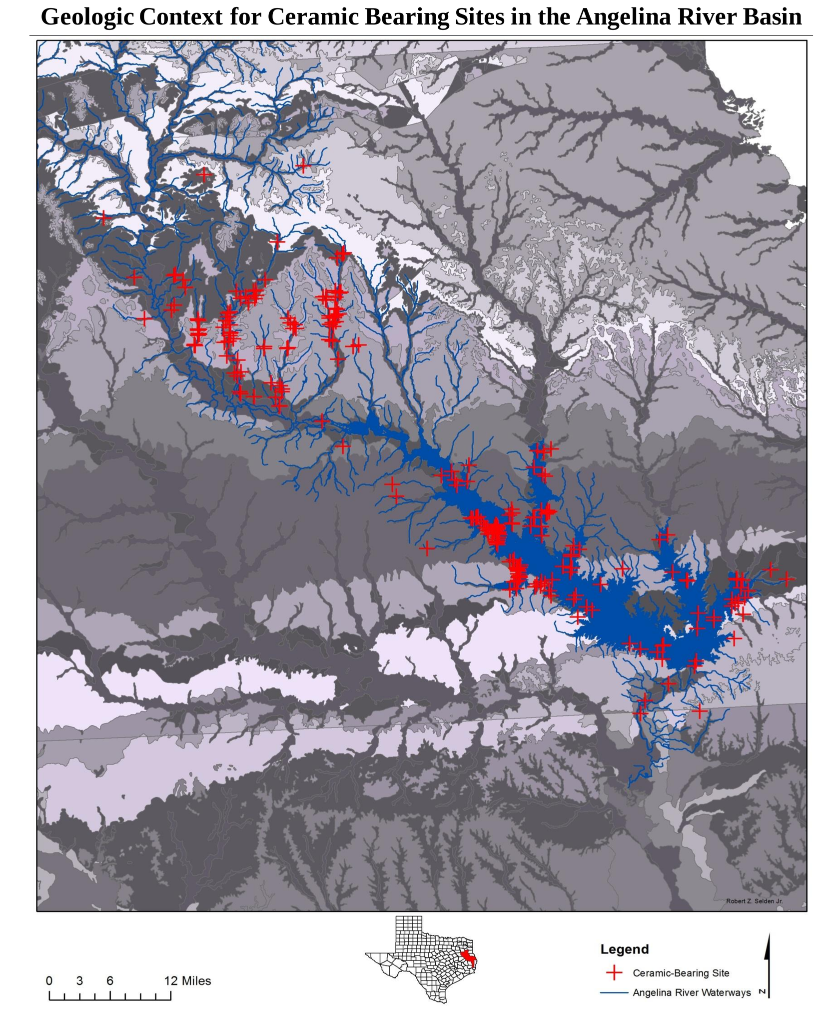
STATISTICAL ANALYSIS

Correspondence and discriminant analysis will be utilized to illustrate statistical correlations between the sand sample and point count data. Correspondence analysis will allow for a discussion of the relationships between the sand samples and point count parameters, while discriminant analysis (with sand and sherd samples as objects, and point counts as the variable) will be used to evaluate the degree of intrapetrofacies compositional variability within the river basin, and to assign sherds to a specific petrofacies (Heidke and Miksa 1999).

Geologic Context for Ceramic Bearing Sites in the Angelina River Basin



THE PREDICTIVE MODEL

The predictive model of sand composition zones (petrofacies) was created using the Geologic Database of Texas (USGS 2007), and geologic zones identified within the study area. By definition, the boundaries of petrofacies are a created construct, since abrupt changes in composition rarely occur within adjacent drainages (Miksa and Heidke 2001; Miksa et al. 2004). Boundaries for the predictive model – dubbed Lombard Lines in the context of this project – are named for Dr. James P. Lombard who pioneered the method, and illustrate areas where divisions in sand composition zones are expected to occur. This model will guide the sampling strategy, in which sands will be collected on a zone-by-zone basis within the river basin.