COMPOSITIONAL VARIABILITY IN PREHISTORIC NATIVE AMERICAN POTTERY FROM THE NORTH CAROLINA SANDHILLS: RESEARCH DESIGN

DRAFT

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INTRODUCTION

The scale of analysis relevant to the study of the archaeological traces of prehistoric hunter-gatherers ranges from intra-site activity patterns to regional settlement organization. As we accumulate information on thousands of archaeological sites and artifact occurrences through the CRM process at Fort Bragg, an Army installation of over 160,000 acres, assessing archaeological data on multiple scales is critical. The ceramic provenience study outlined here, employs a scale of analysis that includes Fort Bragg, the Sandhills, and the adjacent valleys of the Cape Fear, Haw, and Pee Dee Rivers. This scale is designed to be relevant to the cultural landscape of prehistoric hunter-gatherers whose subsistence economies included the resources of the Sandhills and adjacent river valleys. The goal of the study is to explore patterns of mobility and social territories in the Sandhills and adjacent regions during the Woodland era (ca. 1500 B.C.–A.D. 1600). The unit of analysis is pottery recovered from archaeological context and modern clay samples from the Sandhills and adjacent river basins.

Insofar as we are using established analytical techniques such as neutron activation, x-ray diffraction, and petrographic mineralogy in a unique combination to determine the geologic provenience of prehistoric pottery artifacts, the focus of this research is both methodological and interpretive. It is driven by particular research questions about the prehistoric conveyance of pottery, or the materials necessary for its manufacture, in the North Carolina Sandhills. The answers to these questions are critical to understanding local prehistoric cultural manifestations and, moreover, the determining the significance of archaeological remains found at sites on Fort Bragg. The results of the specific analytical techniques, however, will undoubtedly be applicable to problems of a more general nature concerning prehistoric ceramic research. Our research questions, the design of testing, and the interpretation of results are shaped by several assumptions derived from relevant ethnohistoric, ethnographic, and archaeological information. For example, we assume that women were the principal artisans responsible for the pottery discussed (Skibo and Schiffer 1995). Minimally, the production sequence comprised selection and preparation of the materials including clay and tempering agents, forming the vessel, drying, and firing (Rye 1981). Depending on weather conditions, the whole process would require no more than a few days. Based on modern standards, we assume the ratio of container capacity to raw clay weight to be roughly one pint per pound (Zug 1986:145). An average cook pot of one-gallon capacity would therefore require about six pounds of clay. Fired pots weigh considerably less; a sand-tempered, cord-marked, conical-based, replica jar with 1.7-gal liquid capacity, made with clay from the Wacamaw River valley, has a dry weight of about three pounds. We reason that the most parsimonious solution with least cost would likely have prevailed and, therefore, we assume that women procured clay directly from the source and made their pots nearby. Once fired, weighing less, pots were no doubt transported far and wide. Just how far and how wide, from where and by whom, are the questions we hope to answer.

Through the identification of the source areas of the clay used in the making of pots that moved through the Sandhills, we are mapping what Binford (1979:261) called the "mobility scale" of hunter-gatherer or horticulturalist settlement systems. Ultimately, by recognizing patterns of movement across the landscape of specific pottery types, we may detect evidence of the territories formed by hunter-gatherers with respect to the resources upon which they relied, the social alliances that facilitated cultural interaction, or the antagonisms that may have hampered it. Furthermore, modeling systems of clay procurement and pottery conveyance will allow the refinement of existing settlement models through the integration of ceramic technology as an element in the model.

BACKGROUND

Project Team

The research outlined here is the second and final phase of a project initiated by Fort Bragg and contracted through the U.S. Army's Construction Engineering Research Laboratory (CERL); the present work is conducted under Contract _____, Task Order __, entitled Further Studies of Patterns in the Mineral and Chemical Composition of Prehistoric Pottery: Phase II of a Pilot Study for Identifying Raw Material Source Areas for Prehistoric Ceramic Artifacts from Fort Bragg, North Carolina.

As multiple organizations and professional consultants have been called upon to develop this project, a project team has been assembled. The following individuals are key players on this team: Mr. Tad Britt (CERL), Dr. Joseph M. Herbert (Fort Bragg), Mr. Jeffrey D. Irwin (Fort Bragg), Ms. Theresa McReynolds (UNC, Chapel Hill), Dr. Vincas P. Steponaitis (UNC, Chapel Hill), and Mr. Paul Webb (TRC). The specific responsibilities of each individual and institution are outlined below, and selected resumes are attached.

Fort Bragg Archaeology

Our perception of prehistoric human ecology in the Sandhills is strongly influenced by our understanding of the modern landscape as a marginal-resource region. Located in the upper Coastal Plain of North Carolina, the Sandhills have been referred to historically as the "Pine Barrens," "Pine Plains," or even the "Sahara of the Carolinas." The Sandhills are the remnants of an ancient coastal environment that today consists of fluvially dissected sedimentary terraces formed during the Cretaceous era as the Atlantic Ocean receded east of the Orangeburg scarp (Figure 1). On Fort Bragg today, we have the unique perspective of a landscape that, for management purposes, is subjected to frequent controlled burning. As wildfires are estimated to have occurred every one to three years in the Sandhills in pre-contact times (Frost 1993), current vegetation communities on Fort Bragg are assumed to be accurate analogs for Woodland-era conditions. Today, deep, acidic, arid sands, fluvially dissected by gently sloping streams and narrow wetlands, characterize the uplands. Pine-savannah, pine-scrub oak Sandhill, and xeric Sandhill scrub communities are the most common vegetation on the xeric interfluves (Russo et al. 1993; Schafale and Weakley 1990). Coastal Plain bottomland hardwoods, Coastal Plain small stream swamps, and cypress-gum swamps characterize the bottomlands. Overall, mast-bearing trees are thinly distributed in a patchy mosaic, making the region generally less productive in terms of plant and faunal resources than the neighboring Piedmont. Nevertheless, the area appears to have been used to some extent in every culture period throughout prehistory, as indicated by the presence of approximately 3,200 prehistoric sites and occurrences found thus far on Fort Bragg.

Land-use patterns (including resource procurement practices and residential-mobility) may have been very similar, whether practiced in an Archaic-era hunter-gatherer economy or a Woodland-era horticulturalist economy, but this cannot be assumed a priori. Paleoenvironmental models based on global records of solar activity and regional records of tree-ring and sea-level deviations reveal parallels between global and regional climate events such as the Vandal and Little Ice Ages minima, and Medieval Maximum episodes (Gunn 2002; Gunn et al. 2004). The consequences of such events may have been exaggerated in the North Carolina Sandhills, where deep Coastal Plain sediments lying astride the elevated Cape Fear Arch are unusually susceptible to drought.

Gunn (2002) has introduced the concept of the “cultural anvil” to describe the process whereby “sensitive regions attract immigration during episodes of favorable [climatic] conditions, i.e., conditions to which some surrounding regional culture is preadapted.” During unfavorable periods when resources become more scarce, or dispersed, populations are compelled to abandon sensitive regions, crushed as it were on the Sandhills anvil. Thus the model predicts that the scale of population influxes and effluxes varied in the Sandhills as climate shifts resulted in cycles characterized by environments favorable or unfavorable to longer-term settlement or more sustained resource procurement.

Recently, the results of palynological and paleoenvironmental studies at two sites on Fort Bragg have been used to characterize broad-scale patterns during the Quaternary (Goman 2003; Goman and Leigh 2004). Late Pleistocene times (29–19 kybp) are characterized as cold and dry with precipitation rates lower than at present. The Fort Bragg region supported pine and scrubby oaks with a diverse prairie-like herbaceous assemblage of taxa. Following a hiatus in the sedimentation record, the climate at the close of the Pleistocene and in the early Holocene (16–11 kybp) appears to have been cool and moist, with vegetation consisting of a pine-oak woodland with riparian species, such as alder, being locally important. Enhanced summer monsoons encouraged the expansion of moist rich bottomland in which gum species (*Nyssa sp.*) flourished and where, notably, pine was only a minor component. Inferred climatic conditions during the middle Holocene (10–6 kybp) indicate a significant positive anomaly in insulation and warmer winter and summer temperatures than today. This period is characterized by higher precipitation rates, or a shift in precipitation timing (drier than present July, with more rain in the spring) that enhanced the expansion of several species of pine. The late Holocene (6–0 kybp) climate is characterized as being essentially similar to today. Active human modification of the local environment is only indicated the latest or youngest zone, possibly relating to the activities of Native American groups who occupied the site during the Middle Woodland period.

Some evidence for cultural influx and efflux may be seen in the archaeological record represented in the sample of artifacts collected through the systematic survey of large portions of the North Carolina Sandhills. In a summation of these data, Irwin and Culpepper (2000) present information about the frequency of projectile points of various types from sites on Fort Bragg. Their data reflect possible differences in the intensity of land use in the Sandhills during various Archaic and Woodland culture periods (Table 1).

Table 1. Variation in Fort Bragg Projectile Point Frequency through Time.

Period	Age Range	Duration	Point Count	Point/Years
Woodland	1500 B.C.-A.D. 1600	3100	269	0.09
Late Archaic	3000-1500 B.C.	1500	231	0.15
Middle Archaic	6000-3000 B.C.	3000	360	0.12
Early Archaic	7900-6000 B.C.	1900	238	0.13
Late Paleoindian	8500-7900 B.C.	600	117	0.20

Although significant caveats exist with these data (e.g., a constant relationship between projectile point frequency and population frequency cannot be assumed, and differences in point frequencies among periods may relate to technological differences rather than variation in regional population density), they are, nevertheless, suggestive. Point frequencies among the three Archaic periods vary only slightly about the median value (.13), while the earliest (and shortest) period is characterized by exceptionally high point frequency (.20) and the latest (longest) period is characterized by notably low point frequency (.09). Although the low frequency of points attributable to the Woodland era may relate to a major technological shift following the Archaic period that attenuated hunting in favor of horticultural practices, these data also suggest a reduction in the use of the Sandhills as a primary resource extraction area.

The structure of sites found on Fort Bragg typically reflects short-term occupations or limited activities conducted throughout the Woodland era in this marginal, upland Coastal Plain setting. Archaic and Woodland assemblages typically consist of a small number of artifacts exhibiting relatively low-density with a low-diversity of tool types. The ephemeral nature of most sites and the apparent small size of procurement parties who made them suggest that these hunter-gatherers employed a foraging strategy characterized by high residential mobility over a wide geographic area to encounter dispersed resource patches. Indeed we know from ethnographic and archaeological studies that the foraging ranges of hunter-gatherers inhabiting regions with higher resource density than found in the Sandhills can cover hundreds or thousands of square kilometers (Kelly 1995; Jones et al. 2003).

Stone raw material use at Fort Bragg corroborates this scenario. We know that the majority of diagnostic projectile points from the Archaic period derive from non-local materials, most often metavolcanic stone from the Slate Belt. Use of metavolcanic stone was particularly common in the Archaic — 59 to 79 percent of projectile points from this period are made of metavolcanic material. This pattern is nearly reversed in the Middle-to-Late Woodland when increased use of quartz is associated with the shift to triangular arrow tips. Still, metavolcanic stone occurs in more than a third of all such points.

Evidence of non-local resource procurement is also exhibited in the Woodland pottery from the Sandhills. Several types of non-local stone that occur as temper in pottery from sites on Fort Bragg have been identified through petrographic analyses as a polymineralic granitic rock. As no such stone occurs locally in the Sandhills, it is presumed that the source of this granitic-rock temper was in the Piedmont. Although the technological process of preparing temper by crushing rock occurred throughout the Woodland era (including the Late Woodland period, post A.D. 900) in the Piedmont (Ward and Davis 2002), it appears to be restricted to the period before A.D. 400 in the Sandhills (Herbert et al. 2002). Evidence of pottery resource pressure is also suggested by evidence of mend holes and well-fired coil separations, behaviors practiced to conserve pottery vessels or vessel fragments or extend their use life (Herbert 2004).

As we become more familiar with the archaeological record of the Sandhills and Cape Fear region, we find that the tethering effect of the stone-rich Slate Belt, so characteristic of Archaic-era economies, is mirrored in an apparent economy of clay procurement and pottery vessel conservation. Prehistoric groups were able to extend their foraging range from the location of the clay or stone sources by periodically provisioning themselves with raw materials, and by conserving and caching resources as they moved away from the resource-procurement areas. Early Archaic tools, in particular, appear to be highly curated. Caching behavior appears in the Middle Archaic, with several flake blank caches occurring in the Sandhills and upper Cape Fear area. Pottery vessel assemblages also exhibit evidence of intensive conservation. Commonly occurring mends, repeatedly fired coil-seam failures, and the absence of whole vessels suggest that senile pots or partial vessels were coaxed into continued service long past their prime use life. But whereas locally available stone resources such as quartz were used to supplement the stone-tool kit throughout prehistory, most of the marine sedimentary clays native to the Sandhills are unsuitable for making pots.

The objectives of the current study may be summarized as follows:

- To characterize the local clays to determine if serviceable clays do exist locally, and if not, then to identify areas nearby where serviceable potting clays can be obtained.
- To connect, through the analysis of elemental and mineralogical evidence, archaeological potsherds with regions, areas, or localities of specific clay resources.
- To produce information useful for modeling the cultural landscape in terms of mobility patterns and social boundaries by connecting pottery vessel fragments found on Fort Bragg sites to potentially distant regions of procurement.

PHASE I

We make several assumptions at the outset of this study. First we assume that the potsherds that compose our sample are fragments of vessels that were produced at the household level. As in other clay composition and pottery provenience studies (e.g., Steponaitis et al. 1998) we assume that prehistoric potters procured their clay locally. However, the pottery found at sites on Fort Bragg is not generally associated with villages or sites of significant occupation duration, but rather, pottery sites are ephemeral, typically consisting of one to two vessels represented by partially reconstructable sections. Obviously, assuming this risks the possibility exists that vessels were transported some distance from their source before they were discarded at sites on Fort Bragg.

Sampling Strategy and Methods

The ceramic sample used in the first phase of this project consisted of archaeological potsherds drawn from 19 sites situated in three different major river drainages: (1) the Haw-Cape Fear, (2) the Lumber, and (3) the Yadkin-Pee Dee (Figure 1,Table 2). Ten potsherds were considered the minimum sample size necessary to characterize a single drainage or vicinity. Ten potsherds were drawn from the Haw River site (31Ch29). This sample represented the eastern Piedmont source area of the lower Haw River, now impounded as Everett B. Jordan Lake, above its confluence with the Deep River where it becomes the Cape Fear. Ten potsherds were also drawn from the Breece site (31CD8) located on the Cape Fear River just north of Fayetteville, adjacent to the McLean Mound site. This sample represented a clay source area in the middle Cape Fear basin on the upper Coastal Plain. Note also that the Breece site sample comprises three culture-chronological periods (Early Woodland, Middle Woodland, and Late Woodland, also see Table 2), in order to assess how materials may have changed through time. Ten potsherds were drawn from the Doershuk site (31Mg22), located on the Yadkin River, just above its confluence with the Uwharrie River, where it becomes the Pee Dee River. This sample represented the eastern Piedmont source area of the lower Yadkin River. One potsherd each was drawn from ten sites in the Lower Little River basin in Cumberland, Hoke and Harnett Counties on Fort Bragg. These samples represent the Sandhills area of the upper Coastal Plain. Ten potsherds were also drawn from six sites in the Drowning Creek basin in Moore and Scotland Counties on Fort Bragg. This sample also represented the Sandhills area of the upper Coastal Plain, although that portion within the upper reaches of the Lumber River basin.

These samples, therefore, were selected to represent the clay resources in three different river valleys, and also differences that may exist between the clay resources in the Piedmont and Coastal Plain. It should be noted that both the Lower Little River and Drowning Creek are situated entirely within the Coastal Plain Sandhills, with none of their tributaries originating in the Piedmont. The Breece site, although in the Coastal Plain, lies along the Cape Fear River that flows from Piedmont sources. At the outset then, it is expected that the clay resources found along the main trunk of the Cape Fear in the Coastal Plain might be composed in some part of redeposited alluvial sediments derived from the Piedmont. In contrast, clays found along the Lower Little River and Drowning Creek are expected to derive entirely from residual, in-situ marine sediments deposited on the upper Coastal Plain in the Cretaceous era.

In general, the clays found in ancient Atlantic Coastal Plain province are mostly smectite (Steponaitis et al. 1996:564, Table 4), although preliminary field assessments suggest that the residual clays found in the Fort Bragg area are rich in kaolinite. Kaolinitic clays tend to occur in the stratigraphically earliest (Cretaceous) and stratigraphically latest (Pleistocene) sediments of the Atlantic Coast (Olive et al. 1989). Alluvial clays deposited by rivers with Piedmont sources are commonly kaolin-rich, while the alluvial clays of Coastal Plain rivers are typically rich in smectite (Hathaway 1972; Neiheisel and Weaver 1967; Pevear 1972; Windom et al. 1971).

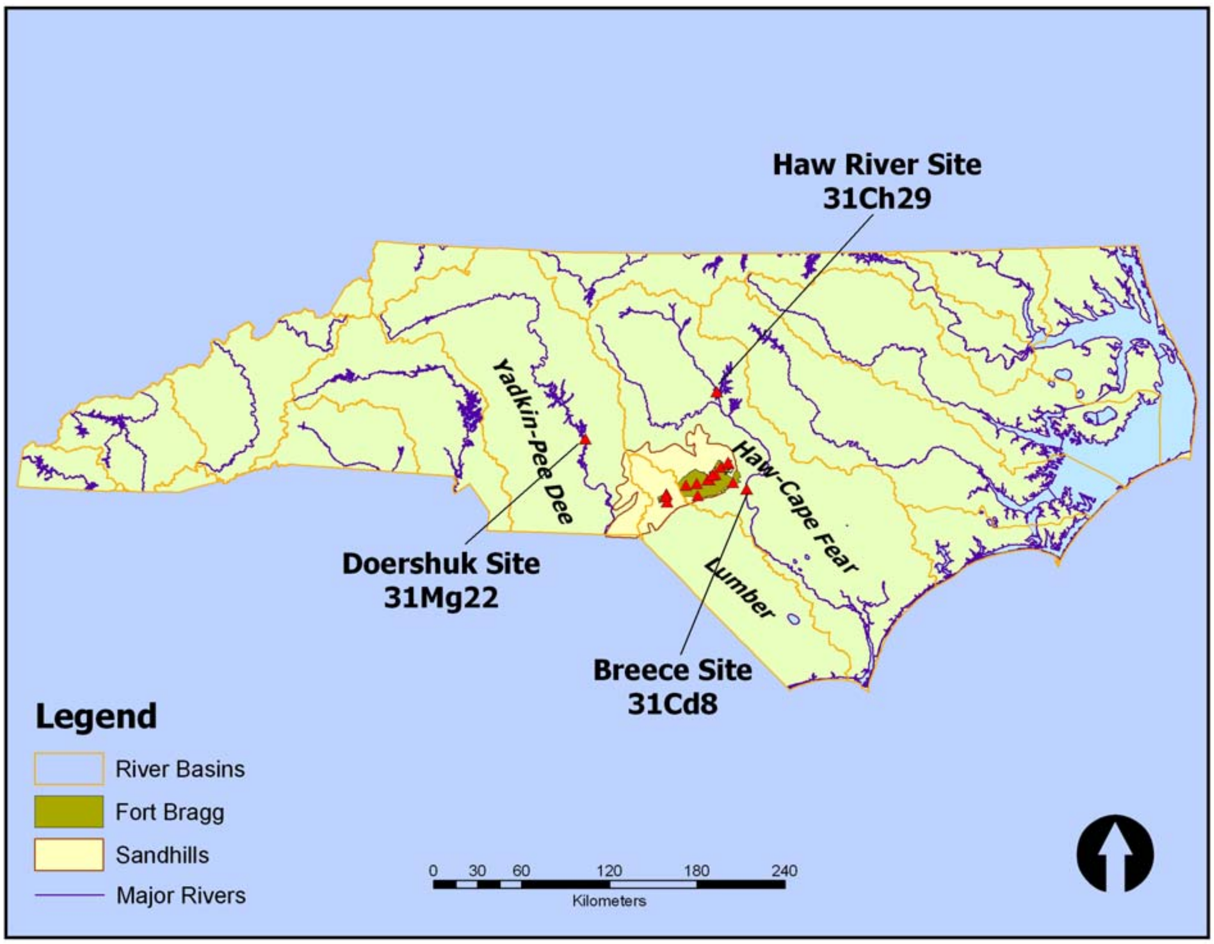

Figure 1. Locations of site samples representing three river basins. Each potsherd in the sample was photographed and described, then sawed into three pieces. One piece was retained (in the original collection) as a reference, a second piece was thin sectioned and submitted to Michael Smith (UNC-W) for petrographic analysis, and the third piece was submitted to Robert Speakman at the Missouri University Research Reactor, for instrumental neutron activation analysis (INAA). Technical reports describing the methods of these analyses are provided in Appendix A and Appendix B.

Table 2. Provenience and General Description of Characterized Sherds.

Sample	Site	Provenience	Drainage	Pottery Type	Culture Period	Chemical Group	Mineralogical Group
JMH001	31Hk868	522n778e	Lower Little River	Hanover II Fabric Impressed	Middle-Late Woodland	4	3
JMH002	31Ht392	TU 2	Lower Little River	Hanover II Fabric Impressed	Middle-Late Woodland	3	3
JMH003	31Ht273	TU 2	Lower Little River	Cape Fear	Middle-Late Woodland	2	3
JMH004	31Hk127	surface	Lower Little River	Hanover II Fabric Impressed	Middle-Late Woodland	3	3
JMH005	31Hk59	surface	Lower Little River	Hanover I Cord Marked	Middle Woodland	3	3
JMH006	31Hk123	surface	Lower Little River	Hanover I Fabric Impressed	Middle Woodland	1	1
JMH007	31Cd750	TU 4	Lower Little River	New River	Early Woodland	4	3
JMH008	31Ht269	TU 2	Lower Little River	Mount Pleasant Cord Marked	Middle Woodland	2	3
JMH009	31Cd486	A&C	Lower Little River	Cape Fear Cord Marked	Middle Woodland	4	3
JMH010	31Hk715	TU 2	Lower Little River	Hanover Fabric Impressed	Middle Woodland	unx	3
JMH011	31Mr241	TU 2b	Drowning Creek	Hanover I Cord Marked	Middle Woodland	3	3
JMH012	31Mr259	shovel test	Drowning Creek	Hanover II Fabric Impressed	Middle-Late Woodland	4	3
JMH013	31Mr241	TU 6	Drowning Creek	Deptford Linear Check Stamped	Middle Woodland	4	3
JMH014	31Mr253		Drowning Creek	Yadkin Fabric Impressed	Early-Middle Woodland	unx	3
JMH015	31Mr241	TU 7	Drowning Creek	Sand-tempered Plain		unx	3
JMH016	31Sc71	surface	Drowning Creek	New River Net Impressed	Early Woodland	2	3
JMH017	31Mr93	TU 2	Lower Little River	New River Cord Marked Marked	Early Woodland	unx	3
JMH018	31Sc87	surface	Drowning Creek	?	?	3	3
JMH019	31Mr93	TU 2	Lower Little River	?	?	4	3
JMH020	31Mr241	surface	Drowning Creek	New River Cord Marked Marked	Early Woodland	3	3
JMH021	31Cd8	surface	Cape Fear River	Hanover II Paddle-edge Stamped	Middle Woodland	3	3
JMH022	31Cd8	surface	Cape Fear River	New River Fabric Impressed	Early Woodland	unx	3
JMH023	31Cd8	surface	Cape Fear River	Hanover II Fabric Impressed	Middle-Late Woodland	3	3
JMH024	31Cd8	surface	Cape Fear River	Hanover II Fabric Impressed	Middle-Late Woodland	3	3
JMH025	31Cd8	surface	Cape Fear River	Cape Fear Cord Marked	Middle Woodland	3	3

Sample	Site	Provenience	Drainage	Pottery Type	Culture Period	Chemical Group	Mineralogical Group
JMH026	31Cd8	surface	Cape Fear River	Hanover II Fabric Impressed	Middle Woodland	3	3
JMH027	31Cd8	surface	Cape Fear River	Hanover I Fabric Impressed	Middle Woodland	3	3
JMH028	31Cd8	surface	Cape Fear River	Hanover I Fabric Impressed	Middle Woodland	3	3
JMH029	31Cd8	surface	Cape Fear River	Hanover I Fabric Impressed	Middle Woodland	3	3
JMH030	31Cd8	surface	Cape Fear River	Hanover II Fabric Impressed	Middle-Late Woodland	3	3
JMH031	31Ch29	Plowzone	Haw River	Yadkin Paddle-edge	Early-Middle Woodland	5	1
JMH032	31Ch29	Plowzone	Haw River	Yadkin Cord Marked	Early-Middle Woodland	1	2a
JMH033	31Ch29	Plowzone	Haw River	Yadkin Plain	Early-Middle Woodland	5	2a
JMH034	31Ch29	Plowzone	Haw River	Cape Fear Fabric Impressed	Middle Woodland	1	2a
JMH035	31Ch29	Plowzone	Haw River	Yadkin Plain	Early-Middle Woodland	unx	2b
JMH036	31Ch29	Plowzone	Haw River	Yadkin Plain	Early-Middle Woodland	5	2b
JMH037	31Ch29	Plowzone	Haw River	Yadkin eroded	Early-Middle Woodland	unx	2b
JMH038	31Ch29	Plowzone	Haw River	Yadkin Plain	Early-Middle Woodland	unx	2b
JMH039	31Ch29	Plowzone	Haw River	Yadkin eroded	Early-Middle Woodland	2	2b
JMH040	31Ch29	Plowzone	Haw River	Yadkin eroded	Early-Middle Woodland	5	2b
JMH041	31Mg22	wall slump	Pee Dee River	Yadkin Fabric Impressed	Early-Middle Woodland	2	2b
JMH042	31Mg22	wall slump	Pee Dee River	New River Simple Stamped	Early Woodland	2	2b
JMH043	31Mg22	wall slump	Pee Dee River	Yadkin Fabric Impressed	Early-Middle Woodland	2	2b
JMH044	31Mg22	wall slump	Pee Dee River	?	?	unx	2b
JMH045	31Mg22	wall slump	Pee Dee River	New River Cord Marked Marked	Early Woodland	5	2b
JMH046	31Mg22	wall slump	Pee Dee River	New River Net Impressed	Early Woodland	1	1
JMH047	31Mg22	wall slump	Pee Dee River	Yadkin Check Stamped	Early-Middle Woodland	1	1
JMH048	31Mg22	wall slump	Pee Dee River	New River Cord Marked Paddle Marked	Early Woodland	5	2b
JMH049	31Mg22	wall slump	Pee Dee River	?	?	unx	2b
JMH050	31Mg22	wall slump	Pee Dee River	Yadkin Net Impressed Impressed	Early-Middle Woodland	2	2b

Results

Instrumental Neutron Activation Analysis

As none of the potsherds used in this study were tempered with shell or limestone it was not necessary to apply corrective measures to account for variability in calcium and strontium due to the addition of these tempering materials. Varying amounts of quartz sand added as temper does introduce the problem of dilution, but as neutron activation does not detect quartz, no correction for this effect could be applied. The results of previous studies suggest that the distortions caused by quartz temper were not great enough to obscure broad geographic patterns (Steponaitis et al. 1996:559), and it appears that broad patterns are apparent in the present sample despite this effect.

The INAA analysis produced elemental concentration values for 32 or 33 elements in most of the samples. These data were explored to assess the similarity and dissimilarity among the regions sampled. This was accomplished by standard procedures for the analysis of data of this kind (Bieber et al. 1976; Bishop and Neff 1989; Harbottle 42-60; 1976; Neff 2002; Sayre 1975) as described in full by Speakman and Glasscock (2002, see Appendix A).

Principal components analysis (PCA) of the 50-specimen data set indicated that there were five recognizable compositional groups in the data. Ten specimens remained unassigned to a compositional group (Chemical Groups in Table 1). Probabilities of membership in the five compositional groups calculated on the first three principal components of the data subsume a little over 77% of total variation in the data. It is clear that probabilities were influenced by small sample size. Because of this group-size problem, subjective criteria were used along with the Mahalanobis distance calculations in deciding which specimens to assign to the five compositional groups. The five-group structure in the data set appears on the first two principal components derived from the PCA of the data set variance-covariance matrix. The groups separate primarily along Principal Component 2, which expresses a large share of the variation in calcium concentrations in the data (Figure 2). Groups 3 and 4 are low in calcium, while Groups 1, 2, and 5 are high in calcium (Figure 3).

Seventy-five percent of the samples from the Doershuk site (Pee Dee river) and Haw River site (Haw river) have membership in Groups 1,2, or 5 (Figure 4). The five remaining samples from these sites are unassigned but also have high calcium, sodium, and manganese concentrations.

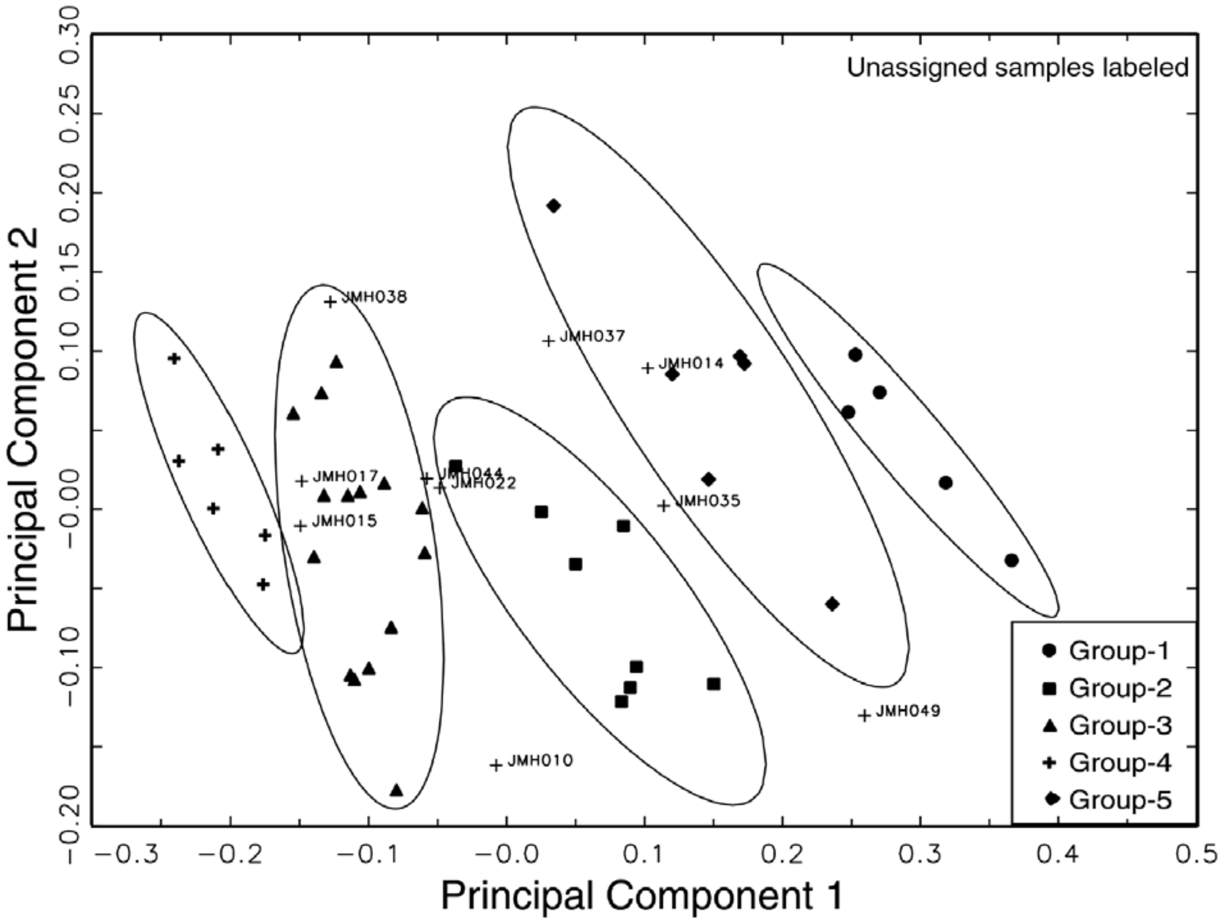

Figure 2. PCA biplot of principal components 1 and 2 of the correlation matrix for 30 elements determined in the Fort Bragg Pottery sample. Ellipses represent 90% confidence level for membership in the groups.

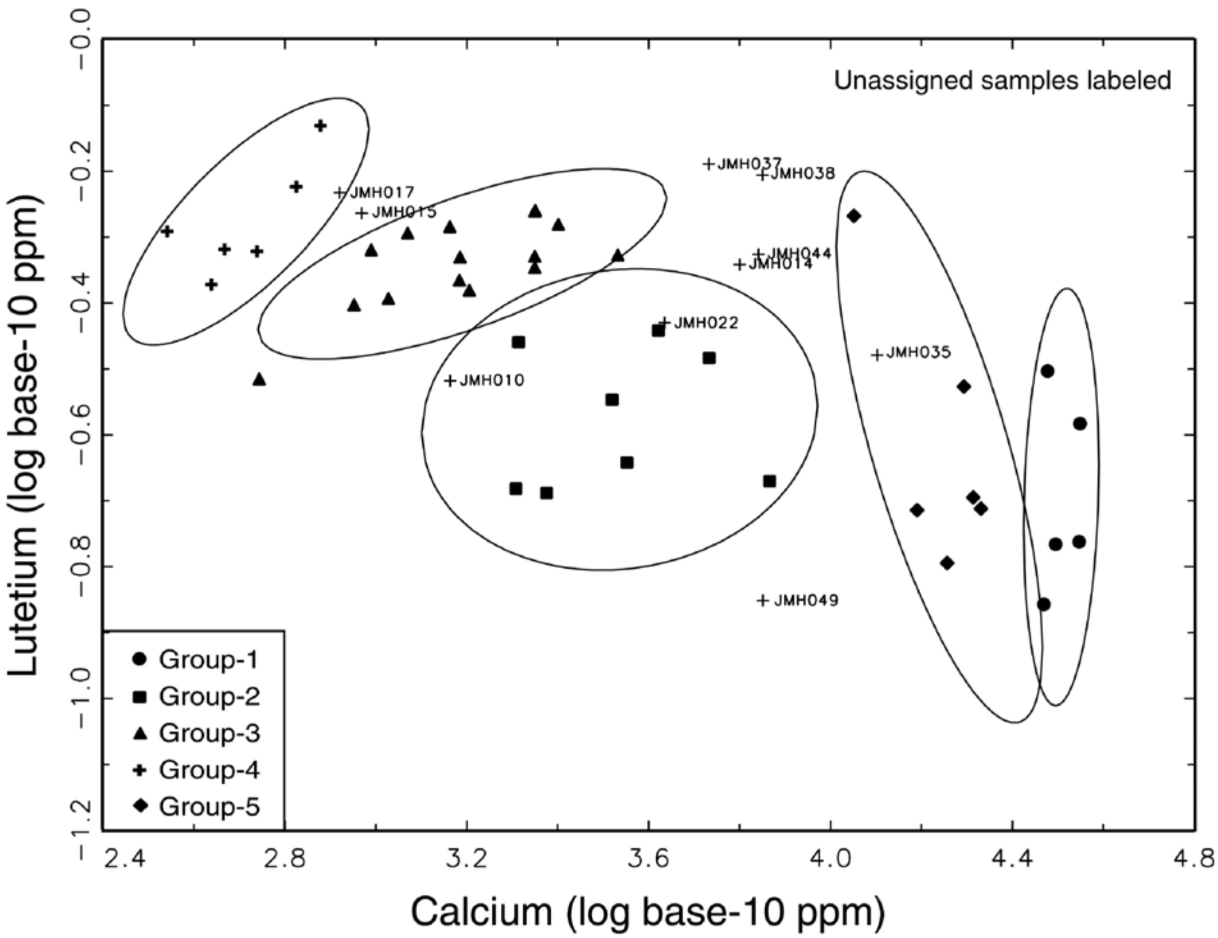

Figure 3. Bivariate plot of calcium and lutetium concentrations in the Fort Bragg data. Ellipses represent 90% confidence level for group membership.

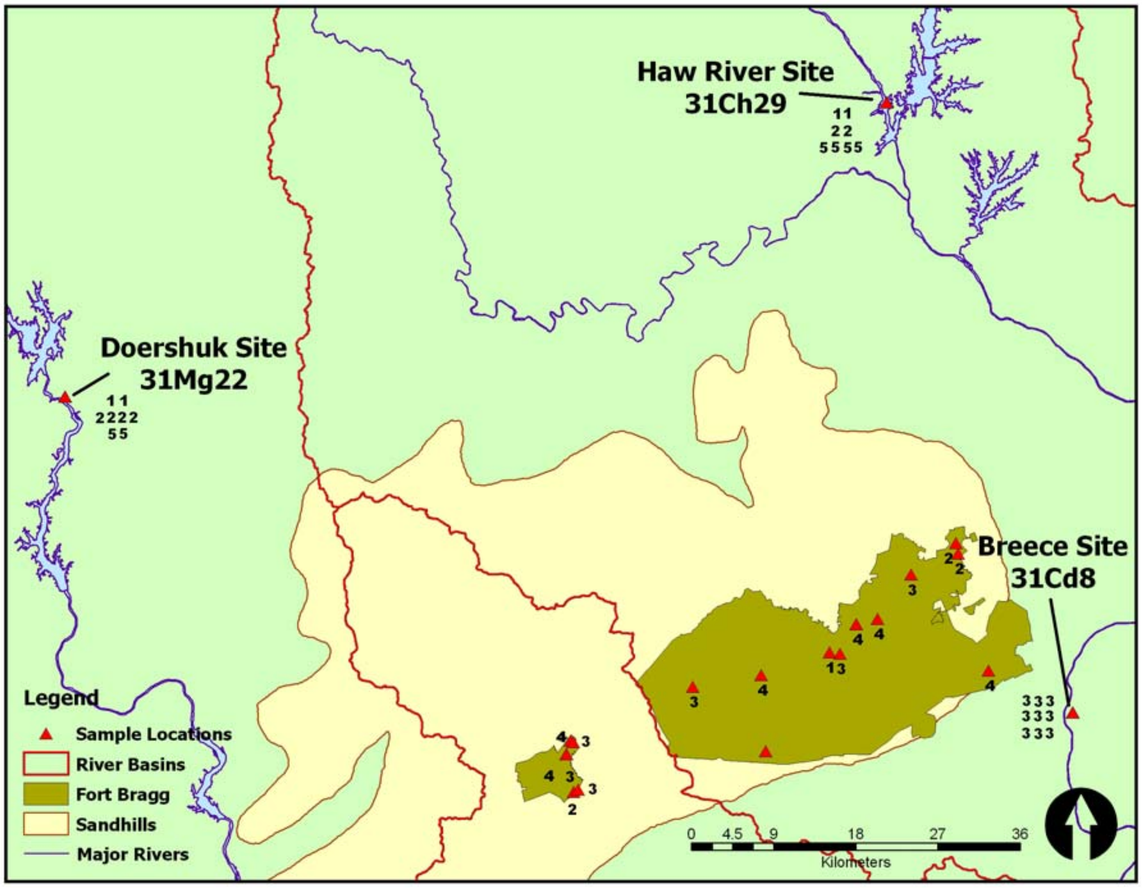

Figure 4. Sample locations and chemical groups (labeled for each site provenience). Unassigned groups are not shown.

Chemical groups 1, 2, and 5 are the only groups represented in sherds from the Doershuk and Haw River sites. It would appear that the distance between these sites (ca. 60 miles) argues against vessel exchange between occupants of the two sites, rather Speakman and Glasscock (2003:6) hypothesize that the similarity of chemical groups represents “the influence of these group compositional profiles of calcareous materials derived from Pleistocene and more recent deposition of alluvial clays along the rivers and creeks north and west of Fort Bragg.” This hypothesis includes two important points: (1) that the clays in this region are calcareous and, (2) that they are alluvial. As will be described below, the mineralogical data indicate that the source of the calcium is not fossil shell or carbonate rock, but rather, calcium- and potassium-rich rocks included as temper. Nevertheless, it is clear that the chemical signatures of our ceramic samples from the Piedmont sites are distinctive when compared to those from sherds recovered on Sandhills sites and the Breece site.

The geographic distribution of chemical groups among our sample also shows that the Breece site (Cape Fear River) sample of 10 sherds is very homogeneous (nine of nine assignable samples are members of Group 3). Group-3 sherds also occur on Fort Bragg sites along with Group-4 samples (combined, these two groups represent 75% of the samples found on Fort Bragg sites). Speakman and Glasscock (2003:6) offer two hypotheses for this pattern: (1) that pottery in this group originated from the Cape Fear vicinity, or (2) that different clay resources in the Fort Bragg region share similar ranges of variation and that potters at the Breece site utilized a specific clay type, whereas Sandhills potters utilized clays from multiple locations, some of which resembled Cape Fear clay.

Plotted in the same PCA space as Figures 2 and 3, there appears to be a clear change through time in selection of resource area (Figure 5). Based on these data, three resource-procurement phases are apparent: (1) a combination of high-calcium/sodium and low-calcium/sodium resources were used during the Early Woodland period; (2) high-calcium/sodium resources were used exclusively in the Early/Middle period; (3) low-calcium/sodium resources were almost exclusively used (three samples deviate from the pattern) during the Middle and Middle/Late culture periods.

There is, however, a major bias in the data deriving from the sampling process. The sample of potsherds selected from the Doershuk (Pee Dee river) and Haw River sites represents the Early Woodland and Early/Middle Woodland periods, exclusively. Nine of the ten sherds drawn from the Breece site collection (Cape Fear river) represent the Middle/Late, or Late-Woodland periods (Table 3). Sherd samples drawn from several sites in the Drowning Creek and Lower Little river valleys on Fort Bragg are more diverse or evenly distributed among the culture periods. Until a more diverse assortment of sherds from the drainage basins outside of Fort Bragg is submitted for INAA, the interpretation of a temporal trend in ceramic technology should be regarded with caution.

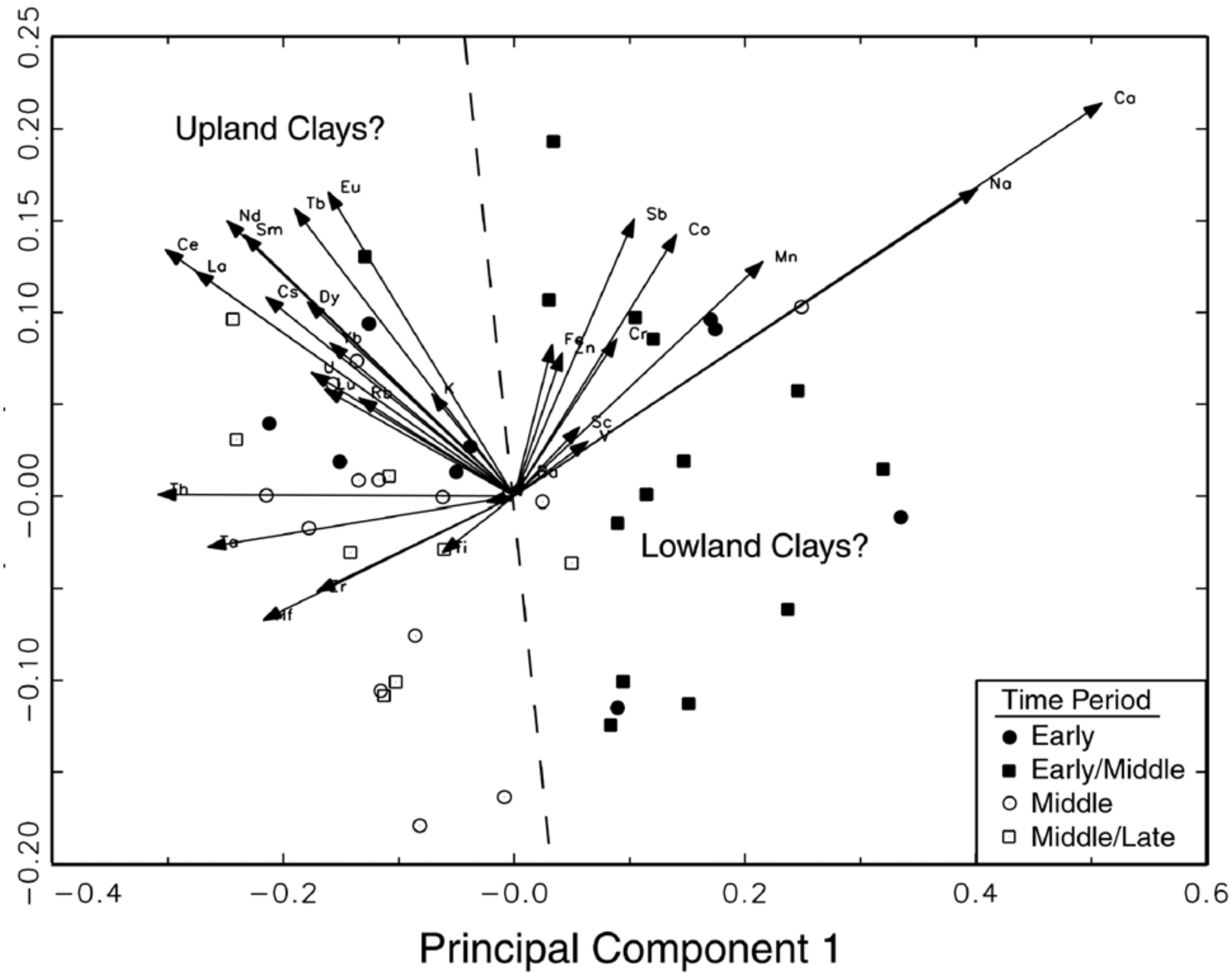

Figure 5. Biplot of principal components 1 and 2 of the correlation matrix for 30 elements. Samples are identified not by compositional group, but by culture period. Dashed line indicates hypothetical division between high-calcium/sodium- and low-calcium/sodium resource regions.

Table 3. Culture Periods Represented in Each Drainage Area (Phase I).

Culture Period	Drainage Source Area: Pee Dee River	Haw River	Drowning Creek	Lower Little River	Cape Fear River	Total
Early Woodland	4		2	2	1	9
Early-Middle Woodland	4	9	1			14
Middle Woodland			2	5	6	13
Middle-Late Woodland			1	4	3	8
(blank)	2	1	2	1		6
Total	10	10	8	12	10	50

Mineralogical Petrographic Analysis

Thin sections were made from each of the 50 pottery samples and petrographic analysis was conducted in a manner consistent with practices standard in optical mineralogy (Smith 2003; Appendix B). On the basis of mineralogical data, the samples were sorted into three categories: (1) those including a mineral suite composed mostly of pyroxene and plagioclase derived from igneous rock; (2) those including quartz, feldspar, biotite, muscovite, amphibole, and opaque igneous rock fragments, variation being controlled by the amount of mafic minerals and opaques; and (3) a group composed of sherds including muscovite mica, monocrystalline quartz, and polygranular quartz rock fragments.

Group I is represented by one sherd from the Haw River site, two sherds from the Doershuk site, and one sherd from a site on the Lower Little river on Fort Bragg. These sherds include very coarse igneous rock fragments including pyroxene and plagioclase, probably derived from the Jurassic-age diabase dikes that crosscut eastern and central Piedmont North Carolina. The ceramic matrixes of these sherds consists of about 30% diabase rock fragments, some of which are in "nearly pristine condition …[which] suggests a source close to an exposure of the diabase," while other samples exhibit a "more altered nature…[which] suggests more time for these weathering process to act" (Smith 2003:6). Almost certainly, the sherd found on Fort Bragg originated in the eastern Piedmont. Modern comparative samples from an exposure of diabase near Albemarle in Stanly county appear identical to the fragments found in this sherd.

Group II is subdivided into two subgroups based primarily on mineral components, especially variation in the amount of mafic minerals (amphibole, muscovite, and biotite) and opaques. The first subgroup comprises three sherds from the Haw River site. The matrixes of these sherds include fragments of either polygranular quartz rock, or igneous rock comprising quartz, microline, plagioclase, amphibole, muscovite, and biotite minerals. Fourteen sherds predominantly from the Haw River and Doershuk sites represent the second subgroup. The major aplastic components of this group are quartz, feldspar, biotite, amphibole, and opaque igneous and polygranular quartz rock fragments. The primary petrographic distinction between this subgroup the first is that the majority of the igneous rock fragments have little to no mafic minerals and the quartz and feldspar rock and mineral fragments are often heavily altered, suggesting that these rock fragments are derived from a felsic plutonic source.

The remainder of the samples (n=29) comprises the third group, characterized by quartz monocrystalline mineral grains, quartz polygranular rock fragments and, in about half the 29 specimens, grog.

These petrographic data shed light on several questions raised by the results of the chemical study. Petrography provided definitive evidence for the absence of any calcareous material in the sherds; no fossil or recent shell or carbonate rock such as limestone, mudstone, or caliche was observed. The calcium/sodium-rich samples identified by the INAA study, however, correspond to mineral Groups I and II, which include calcium-rich minerals such as clinopyroxene (augite), plagioclase (labradorite), amphibole, and potassium feldspar. Sherds identified by the INAA study as having low calcium/sodium content correspond to the quartz-rich samples in Group III.

Although the petrographic data provided a more accurate interpretation of the nature of the variation in composition among the 50 sherds, the basic pattern of differentiation based on the amount of calcium and sodium identified in the INAA study were little altered by the mineralogical data (Table 4). Calcium/sodium-rich chemical Groups 1, 2, and 5, correspond to mineral Groups I, IIa, and IIb; calcium/sodium-poor chemical Groups 3 and 4 correspond to mineral Group III. The geographic distribution of sites based on mineral groups replicates the basic pattern illustrated by the chemical data (Figure 6).

Table 4. Crosstabultation of Chemical and Mineral Groups.

Mineralogical Groups	Chemical Groups						
	1	2	3	4	5	unx	Total
1	3				1		4
2a	2				1		3
2b		5			4	5	14
3		3	15	6		5	29
Total	5	8	15	6	6	10	50

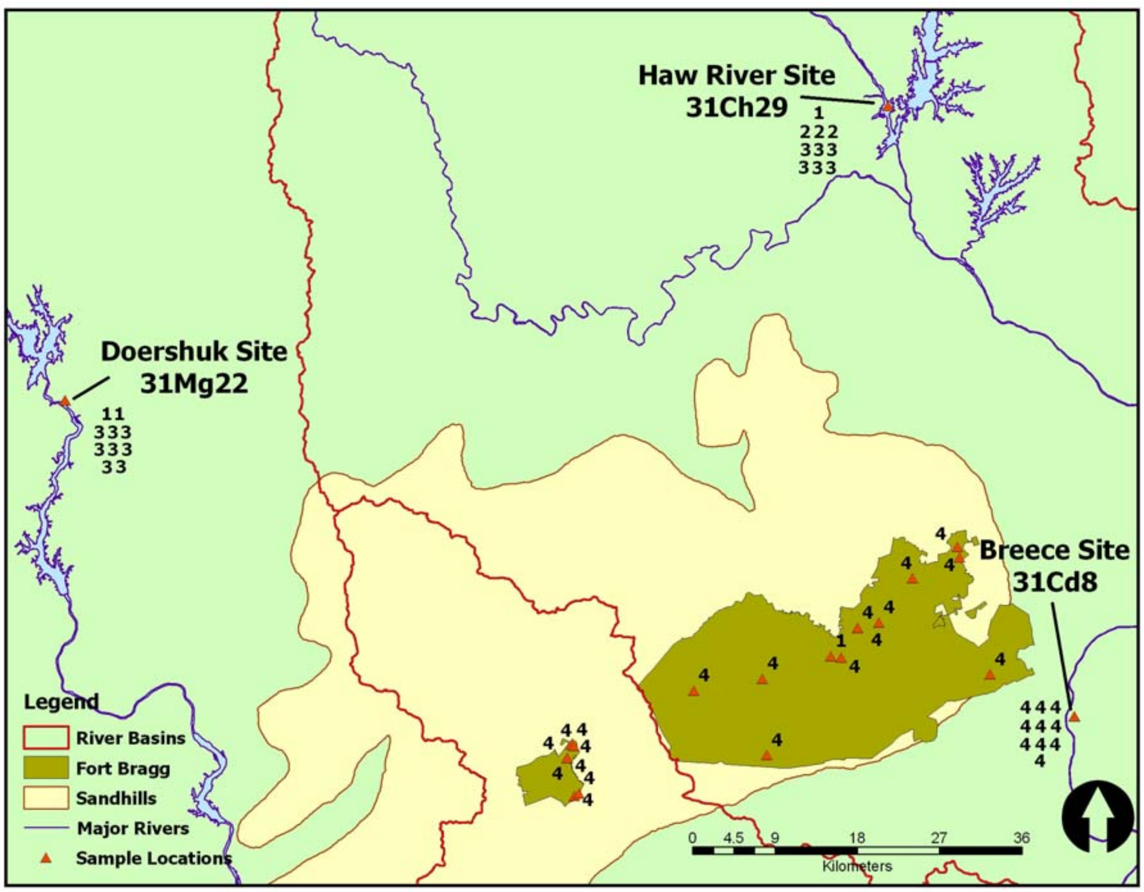

Figure 6. Sample locations and mineral groups (labeled for each site provenience). Mineral Groups IIa and IIb are labeled as Group 2 and 3, respectively; Group III is labeled as 4.

Mineral Groups I, IIa and IIb are almost exclusively represented among the sherds from the Doershuk and Haw River sites. The sample from the Breece site is composed solely of mineral Group III. The mineralogical data differ from the chemical data slightly as regards geographic distributions on Fort Bragg; two samples from the Lower Little river and one from Drowning Creek, identified as members of the high-calcium/sodium chemical Group 2, are subsumed in mineral Group III, characterized by low calcium and sodium minerals. The result is that the pattern in the chemical data of mixed high- and low-calcium categories represented among sherds from Sandhills sites is not so apparent in the mineralogical data, thereby lending less support to the hypothesis that ceramic vessels were moving into the Sandhills from Piedmont and Coastal Plain sources.

The distribution of mineral groups among pottery types reflects ceramic typological definitions based on differences in temper. With a few exceptions, sherds in mineral classes I, IIa, or IIb are mostly classified as Yadkin. The typological definition for the Yadkin series specifies crushed rock temper — in this case, crushed igneous rock composed of high-calcium minerals (Table 5). Sherds tempered primarily with sand and grit, or sand and grog are mostly found in mineral Group III.

Table 5. Distribution of Mineral Groups among Pottery Types.

	Pottery Type								
Mineral Group	New River	Deptford	Yadkin	Cape Fear	Mount Pleasant	Hanover	Sand-tempered	Unid.	Total
I	1		3						4
IIa			2	1					3
IIb	3		9					2	14
III	5	1	1	3	1	15	1	2	29
Total	9	1	15	4	1	15	1	4	50

Summary of Results and Recommendations

The results of neutron activation and petrographic analyses appear to distinguish two broad geographic source areas that correspond to the Piedmont and Coastal Plain provinces. Mineralogical data indicate that almost all of the pottery in the 20-sherd Fort Bragg sample were derived from Coastal Plain resources. Chemical data provide a somewhat more complex picture suggesting the possibility that pottery was imported into the Sandhills from both Coastal Plain and Piedmont sources. The homogeneity of chemical signatures of the sherds sampled from the Doershuk, Haw River and Breece sites suggests that potters at these locations were consistently relying upon the same, presumably locally available, resources. Greater variability in the samples from Fort Bragg suggests that either (1) potters were importing some vessels (or bringing vessels along as they immigrated) into the Sandhills, or (2) that clay and temper sources in the Fort Bragg region are more chemically variable than their Piedmont counterparts. The strength of these interpretations, however, is diminished by sampling constraints. Only one site each in the Pee Dee, Haw, and Cape Fear valleys was sampled, and only 10 sherds were analyzed from each of these sites. The range of chronological periods is currently uneven, with no Early Woodland sites represented in the Piedmont sample. Increasing the number of samples, culture periods, and sites in each region would enhance our ability to test the idea that chemical homogeneity among samples is either a reflection of the local resources, or of the technological practices of the Woodland potters at different points in time.

Ultimately, the ability to discriminate between these two sources of variation (environmental or cultural) will require that we systematically sample the resources independent of the technological practices reflected in the potsherds comprising the sample in the first phase of research. INAA of multiple clay samples from Fort Bragg source areas will enable the assessment of chemical variability of the aplastic constituents in the clay resoureces over this region of the Sandhills. Additional sampling of raw clays from sources near the Haw River and Doershuk sites will aid in refining chemical Groups 1, 2, and 5. Analysis of clay samples from source areas near the Breece site will help to refine chemical Group 3, and will aid in resolving ambiguity regarding natural or cultural causes for the homogeneity of the sherds sampled in the first phase of research.

In addition to the use of INAA and petrography to characterize the elemental and mineral constituents of the source-area clays and temper, x-ray diffraction (XRD) is suggested as a means of further discriminating the type of clay minerals (e.g., kaolinite, illite, or smectite) present in each sample area. Identifying these clay minerals could be very useful for further discriminating between source areas and may also provide some insights into the nature (from a potter's perspective) of the clay in each region. Raw clay must be used for this identification as the crystaline structure of clay minerals changes to silicate (glass) when fired to ceramic. INNA and petrography do not identify clay minerals.

While additional chemical, petrographic, and XRD information will help to answer the question of where potters were obtaining resources for making the vessels represented by potsherds found on sites at Fort Bragg, the question of why these particular resources were selected — the anthropological question of interest — requires that we understand more about the way the resources perform technologically. Underlying the current phase of research, for example, is the notion that the clays found in erosional features in this part of the Sandhills are unsuitable for making low-fired earthenwares. To test this proposition, clay sampled from the Fort Bragg region should be analyzed using XRD to characterize the clay minerals. In addtion, the performance characteristics of these clays should be assessed through replication experiments.

PHASE II

Research Problems

Phase I of this project initiated the study of chemical and mineralogical variability in pottery from particular sites in the Carolina Sandhills, Piedmont and Coastal Plain. This second phase of the project will advance the study with two major objectives. First, through a new sampling strategy informed by the results of Phase I and through the addition of analytical techniques not employed in the first phase, the characterization of prehistoric clay resources will be continued. The overall sample of sites and pottery samples will be expanded and the characterization of ceramic composition and our capacity to discriminate source areas refined through the application of XRD analysis of clays from the five resource areas (corresponding to five drainage basins). Secondly, by conducting limited replication experiments to determine the suitability of the clay for making coil-built, conical-based, pots it will be possible to relate the information gathered in the Phases I and II to an archaeological research problem, i.e., the prehistoric cultural landscape that included the Sandhills. Such analysis will add insight into how we can compare the compositional variability of sherds to pottery-making resource areas and facilitate an examination of the practical application of the methods being developed in this project. With these general objectives as guiding parameters, the following research problems serve to direct this phase of the study:

- Characterize chemical and mineralogical composition of sherds and raw clays from each of the five resource regions and analyze the potential to discriminate among the resource groups based on these data and, if possible, on the characteristics of the pottery made from these materials.

- Gather information on the utility of each relevant resource for making and using ceramic vessels that replicate archaeological vessels from the Woodland period. Address the ability of the anthropological data to inform the provenience data developed by characterizing pottery composition through the analysis of chemical and mineral variability in each area.

- Evaluate the proposition that prehistoric potters used local clay resources.

Interpreting the implications of the results of these analyses for modeling prehistoric cultural landscapes at Fort Bragg, in the Carolina Sandhills, and in other regions is a primary goal. Modeling landscape-scale resource variation and hunter-gatherer settlement pattering on a regional scale is also critical for the management of archaeological sites on Fort Bragg. Finally, a thorough self-evaluation of the methodology developed in this project is warranted, with particular attention towards its future application in archaeology. Included in this assessment should be recommendations on the practical application of the techniques utilized in this study including the design of research, model building, sampling, analysis, and interpretation.

Model Building

The anthropological hermeneutic that informs this study concerns one aspect of prehistoric technology — pottery making and use — within the broader context of the history of the adaptive strategies of hunter-gatherer societies in the Sandhills over approximately 3000 years. Developing a narrative of human adaptive behavior over several millennia is an endeavor for which evolutionary biology is well suited. It is important therefore to attempt to determine how an adaptive problem would have manifested itself in prehistory and to develop a theory that integrates the model of the adaptive problem with as much knowledge as possible regarding relevant prehistoric conditions. The theory may then be used to identify design features that any cognitive and behavioral program capable of solving the problem must have, and to develop models of such programs that might have evolved to solve the adaptive problem. Alternative candidate models may then be eliminated by experimentation and observation, and ultimately models may be compared against modern behavior patterns (Cosmides and Tooby 1987:302–303).

Any model of human adaptive strategies, however, must be situated in the appropriate social context. Considering the social aspects of prehistoric pottery production, we can assume that although it is possible that men occasionally made pots, most ethnohistoric accounts from North America (Skibo and Schiffer 1995), including those more geographically proximate, portray women making pots for use at the household level. Minimally, the production sequence entailed selection and preparation of the materials including clay and tempering agents, forming the vessel, drying, and firing (Rye 1981). In the Carolina Sandhills, as elsewhere in the Southeast, by Middle Woodland times (about 400 B.C.) the practice of building conical-based cooking and storage pots made with the coil-built, paddle-and-anvil system was well entrenched. Upon this basic, very effective technological system were superimposed variations in tempering materials and surface treatments. As might be expected, tempering practices seem to be geographically or, more precisely, geologically influenced by the nature of local clay. Unraveling the nature of those influences and how they may have affected resource selection, ceramic technical performance, and even residential mobility among groups using the Sandhills is the proximate objective of this study, developing models of the prehistoric decision-making processes the ultimate goal.

Sampling

The sampling strategy employed in this study will be designed based on the ecological and social models developed along the lines suggested in the preceding section. The sampling design will also be informed by the results of the first phase of analysis. The following sections propose sampling strategies for archaeological pottery and raw clay.

Archaeological Pottery

The second phase of sampling pottery is designed to boost the number of specimens from with chemical (trace element) and mineral composition is assessed. It is proposed that samples be drawn from the same geographic areas as the first phase of the study. This includes:

- The Doershuk site and/or additional sites along the lower Yadkin and upper Pee Dee rivers.
- The Haw River site and/or additional sites along the lower Haw River.
- The Breece site and/or additional sites along the upper Cape Fear River.
- Site on Fort Bragg in the Lower Little River drainage.
- Sites on Camp Mackall in the Lumber River drainage.

The proportion of sherds to be sampled from these site regions is 10 each from the Yadkin/Pee Dee, Haw River, and Cape Fear valleys, 10 from Fort Bragg, and 10 from Camp Mackall. This totals 50 new sherd samples, which together with the Phase-I data provide a grand total of 100 samples, or 20 samples from each potential source area. In selecting pottery samples every effort should be made to see that major culture periods (as reflected in pottery types) are evenly represented. In most cases, this effort will entail increasing the diversity of the sample by increasing the number of samples of pottery types under-represented in the Phase I study.

Raw Clay Resources

Ten clay samples are to be collected in each of the five regions (50 total). Clay samples should be collected from exposed or near-surface clay deposits (e.g., in streambeds or road cuts) near the archaeological site locations from which sherd samples have been drawn. If no clays are found in the immediate site localities, the search universe should be extended until the target number of samples is collected. The results of Phase-I petrographic analysis may also guide clay sampling as it provides specific information about the mineral content of the aplastic particles found in pottery from each region. In some cases, sherds were found to include rock fragments such as granite or diabase that crop out in the Piedmont west of Fort Bragg. Selecting clay samples from these localities may provide information about the natural presence of those rock fragments in native clays.

In addition to characterizations of clays from broad regions of the Southeast, more regionally specific descriptions may also be useful. For example in *Clay Deposits and Clay Industry in North Carolina,* Ries (1897) describes major chemical constituents (using classical wet methods) and physical properties of clays sampled at the black clay bluffs along the Cape Fear River at Fayetteville (Figure 7) and from the "Poe & Bros.' yard, a half mile south of Fayetteville" (Figure 8). The Poe Brothers' commercial pottery provided stoneware vessels to Fayetteville and the surrounding region in the late 19th century. It may be possible to relocate these historic sources for comparison to prehistoric materials.

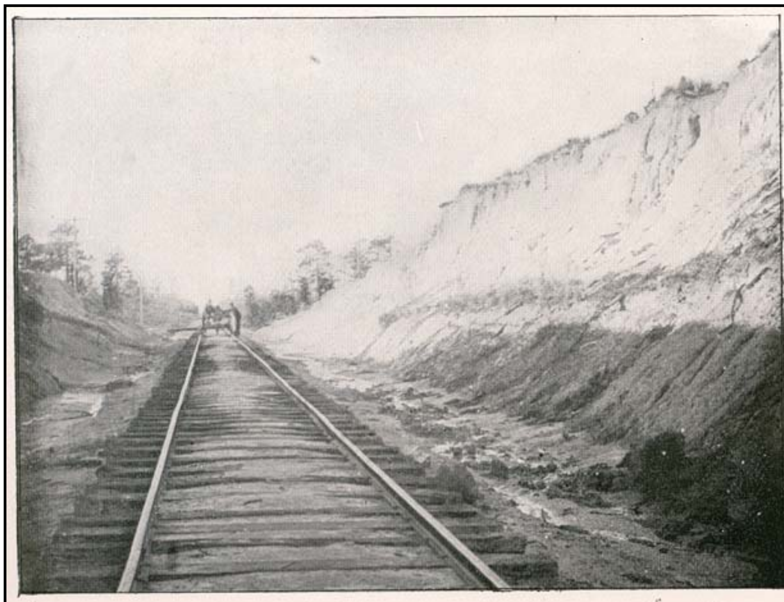

FIG. 2.—CLAY DEPOSIT IN RAILWAY CUT, SPOUT SPRINGS, C. F. & Y. V. RAILROAD.

Figure 7. Clay deposit exposed in railroad cut at mile 100, Spout Springs, Harnett County, North Carolina (from Ries 1897:121).

FIG. 1.—BLACK CLAY ALONG CAPE FEAR RIVER, AT PROSPECT HALL.
(See page 102.)

FIG. 2.—POE BROTHERS' CLAY BANK, FAYETTEVILLE, N. C.

Figure 8. Clay deposit exposed in the bank of the Cape Fear River near Fayetteville, and Poe Brothers' clay mine one half mile south of Fayetteville, Cumberland County, NC (from Ries 1897:111).

Analysis

Chemical Analysis with INAA

Chemical analysis will employ INAA of sherds sampled as described above. Sites from which sherds are to be drawn will be selected after consideration of the research model and availability of expendable specimens (this is a destructive process). Samples could be drawn from the collections housed at the University of North Carolina Research Laboratories of Archaeology, the Fort Bragg Cultural Resources Program, and the North Carolina Office of State Archaeology, or Department of Transportation. Once the sample is selected, sherds should be fully described (e.g., size, weight, porosity, surface treatment, temper description, and typological classification), photographed and recorded. Samples should be large enough to provide a portion for thin sectioning, a portion for INAA, and a portion to be stored for comparative purposes. INAA is to be performed by the Missouri University Research Reactor (MURR), for whom Robert Speakman is the principal consultant.

Mineral Analysis with Petrography

Thin sections should be prepared commercially. In the past we have had good results with Spectrum Petrographics. Grinding and polishing flat sections has also been found to be useful, and we should investigate having this done along with thin sections. Petrographic analysis should include point-count data including information on particles size and shape, type and systematically quantified proportion of minerals and voids, along with a record of the magnification and light conditions under which observations are made. Every effort should be made to distinguish between naturally occurring inclusions and materials purposefully added as a tempering agent, and this determination, along with a description of the basis for determining, should be reported. In addition to aplastic constituents, information about matrix color, the homogeneity of the distribution of particles, the relationship of the sherd to others in the sample, and a description of the clay and temper source inferred from the data, should be provided for each sample. This information should be presented as a form for each sherd, and tabulated in spreadsheet for the sample collection.

Mineral Analysis with XRD

X-ray diffraction (XRD) analysis is a method of identifying minerals by their crystalline structure. X rays produced when electrons bombard a target have sharply defined wavelengths that closely resemble the pattern of spacing of lattice planes in mineral crystals. Diffraction refers to the coherent scattering of waves and the constructive interference among them that occurs along certain directions (Rice 1987:383). XRD analysis is one of the few methods for identifying clay mineral constituents and, although not always successful, it is this feature that is of most interest in this study. With elemental and mineralogical constituents identified by INAA and petrography, it is hoped that XRD analysis will help to characterize differences in clay minerals among the sample locations.

It is proposed that 10 samples be analyzed from clay sources in each of the five river-valley regions described above. Drawing several samples from a single clay pit, road cut, streambed, or erosion feature is reasonable, as the constituents and properties of clay may vary considerably within a single deposit. However, field tests may narrow the range of possible choices by eliminating clays that are inappropriate for pottery making.

Analysis of Physical Properties of Clays

Although the physical properties such as plasticity and shrinkage of the major classes of clay minerals (e.g., kaolin, smectite, and illite), and the properties of the pottery made from them (e.g., tinsel strength, and temperatures of fusion and vitrification), have long been known in a general sense, the actual properties of any particular clay are unique as reflects its specific admixture of clay-mineral constituents. As it is the specific properties of clay that are important to modern potters, and would have been important to prehistoric potters, we propose to quantify some of these properties. Physical properties that could be measured for each clay sample are listed below.

- Percent water added to give workable paste.
- Plasticity (judgmentally assigned to ordinal classes, e.g., lean, slightly, moderate, good, very good, fat).
- Air shrinkage.
- Tensile strength of air-dried briquette.
- Speed of slaking (judgmentally assigned to ordinal classes, e.g., slow, moderately slow, moderate, moderately fast, fast).

- Color.
- Texture.
- Type and proportion of aplastics.

Analysis of Physical Properties and Performance Characteristics of Pottery

In addition to the properties of raw clay, it is the properties of the pottery made from the samples that are most important. In addition to gathering clay samples for XRD analysis, and measuring the physical properties of the samples, a limited suit of replication experiments are proposed. Briquettes should be made to standard dimensions so that shrinkage conditions and measurements are consistent. Some properties important to measure are listed below.

- Fired shrinkage.
- Tensile strength of fired briquette.
- Temperature at which fusion occurs.
- Fired color.
- Porosity.

Although the firing of test tiles could best be accomplished in a commercial kiln, the process should be designed to be analogous, or appropriate, to prehistoric technologies. We know, for example, that prehistoric potters used no kilns, so the characteristics of briquettes fired at temperatures commonly obtained in an open-firing process (650–900ºC) are those of most interest.

Reporting

A significant component of this research exists in the reporting process. Beyond the descriptive results of independent consultant reports, some analysis and synthesis of results should be accomplished to produce a more interdisciplinary rather than multidisciplinary study.

A final report will be produced as an edited volume with contributions by individual consultants and project team members. This report will summarize the cumulative results of project Phases I and II. Emphasis will be placed on description of research objectives, presentation of data and results, synthesis of independent analyses, and interpretation of the results for managing archaeological sites at Fort Bragg. A preliminary report outline is presented below, with tentative authorship noted. The report will be co-edited by Herbert, Irwin, McReynolds, Steponaitis, and Webb, of the RLA will perform final technical editing.

Roles, Duties and Services

Preliminary Report Outline

I. Introduction (Herbert, McReynolds, and Steponaitis)

- A. Project History and Key Players
- B. General Objectives

II. Research Design

- A. Background (Herbert)
  - 1. Archaeology of Fort Bragg
  - 2. Archaeological Treatment of the Study Area
- B. Research Problems (Herbert)
- C. Methodology (Herbert and McReynolds)

III. Data Collection

- A. Geology of the Project Area (petrographer and XRD specialist)
- B. Clay Sources (Herbert and McReynolds)
- C. Artifacts (Herbert)

IV. Analysis (Herbert, McReynolds, petrographer, INAA specialist, and XRD specialist)

- A. Consultant Reports (specialists)
  - 1. Petrography
  - 2. Geochemistry
  - 3. X-ray Diffraction
  - 4. Clay and Ceramic Properties (Herbert and McReynolds)
  - 5. Summary

B. Synthesis and Interpretations (Herbert, McReynolds, and Steponaitis)

V. Conclusions

A. Project Summary (Herbert and McReynolds)

B. Ceramic Provenience and the Sandhills (Herbert)

C. Methodological Implications (Herbert, McReynolds, petrographer, INAA specialist, and XRD specialist)

VI. Appendix: Guide to Pottery Clays of the Southeastern Piedmont and Coastal Plain of North Carolina

CURATION

Fort Bragg will be the final repository for all thin-sections, thin-section blanks, and clay samples produced in the course of this project. Fort Bragg will maintain a type collection for all samples analyzed in the project.

DIVISION OF LABOR

This project involves personnel from eight different organizations: Fort Bragg; the University of North Carolina at Chapel Hill, the institution of affiliation for the petrographic analyst; the Missouri University Research Reactor, University of Missouri at Columbia; North Carolina State University; TRC Garrow Associates, Inc.; CERL-ERDC; and Spectrum Petrographics. Hence it is useful at this point to reiterate the various activities that will be undertaken, emphasizing the division of labor among the organizations.

Fort Bragg. Personnel from Fort Bragg will provide advice and support in all phases of the project. They will be actively involved in choosing the samples for analysis, and in retrieving the actual specimens housed in the archaeological collections on their base. Joe Herbert of Fort Bragg will coordinate the visits to the clay-source sites and be responsible for collecting the samples that will be gathered there. Fort Bragg and UNC-Chapel Hill personnel will also be responsible for compiling the various study reports and results into the final report, for subsequent editing and production by the RLA.

University of North Carolina at Chapel Hill. The Research Laboratories of Archaeology (RLA) will administer TRC's subcontract to UNC-Chapel Hill. The RLA staff will provide sherd samples from their collections and photograph specimens as needed. Theresa McReynolds (RLA) will work with Joe Herbert (Bragg) in selecting, gathering and recording information on sherd and clay samples. McReynolds will also conduct the analysis of physical properties of clays and fired briquettes, report on these findings, and coauthor sections of the report. Vin Steponaitis of the RLA will review the individual study reports and provide comments for consideration during development of the draft final report. The RLA will also edit the draft report to be compiled by Fort Bragg and will produce the report in its Research Reports series. Theresa McReynolds will conduct the technical editing under the direction of Vin Steponaitis of the RLA.

University of Missouri at Columbia. Jeff Speakman and Michael Glascock of MURR will conduct the neutron activation analyses of the lithic samples and produce a report of their results.

North Carolina State University. Edward Stoddard (MEAS) may assist in identifying locations for obtaining raw material samples, and will conduct the XRD analysis of those samples. He will also produce a report of his results.

TRC Garrow Associates (TRC). TRC will serve as ERDC-CERL's contractor for the project (see below), and will provide overall administration for the project. Joe Herbert, Fort Bragg, will coordinate the visits to the clay-source sites and be responsible for collecting the samples that will be gathered there. TRC will also be responsible for delivering the sherd samples to MURR for neutron activation analysis, sherd samples to Spectrum Petrographics for thin sectioning, thin sections to petrographic analysist, clay samples to NC State for XRD, and clay samples to the RLA for physical properties analysis. Paul Webb of TRC will review the individual study reports, provide comments for consideration during development of the draft final report, and contribute to the Introduction and Synthesis and Analysis sections of the report. He will also conduct a final review of the edited report prior to its production.

Corps of Engineers Research Laboratories (CERL). CERL is the government contracting authority for this project. The CERL Contracting Officer's Technical Representative (COTR), Mr. Tad Britt, will provide final technical review of all deliverables prepared for this project.

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