COMPOSITIONAL VARIABILITY IN PREHISTORIC NATIVE AMERICAN POTTERY FROM NORTH CAROLINA

A Report of Clay Sources and Performance Trials

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Management Summary

This report describes a ceramic provenience study conducted jointly by archaeologists from Fort Bragg's Cultural Resources Program and the University of North Carolina's Research Laboratories of Archaeology, especially as it pertains to the collection of clay samples in the vicinity of the Doerschuk site (31Mg22), Montgomery County. Clay samples from the Doerschuk site area were collected pursuant to Archaeological Resources Protection Act Permit 62, issued by the North Carolina Department of Cultural Resources, Office of State Archaeology for the period of July 1 – December 31, 2004. These samples were collected as part of a larger study, the description of which is the purpose of this report, including specific information about the samples collected in the area near the Doerschuk site.

The goal of the overall project is to explore Woodland period mobility and social territories in the Sandhills and adjacent Coastal Plain and Piedmont regions through the analysis of pottery and clay samples from Fort Bragg and surrounding regions. Twelve clay samples were collected in Montgomery County, all within 5.1 mi (8.3 km) of the Doerschuk site (31Mg22) on July 28 and 29, 2004. Clay sample locations were predicted using topographic quad sheet, soils, and geologic maps, and samples were taken from streambeds and banks with a 10-cm bucket auger to depths not exceeding one meter. One auger test was placed in the streambed at the Doerschuk site, but no suitable clay was found and no sample was taken from the site. No artifacts were collected at the site, although piles of flakes and bifaces along the stream bank suggested non-authorized disturbance at some prior time.

Field and laboratory analyses of the samples collected from the Doerschuk site area indicate that the clays found in alluvial settings along the lower Yadkin and Uwharrie drainages have the plasticity, but not the stiffness or strength, to be suitable for making pottery. These

results suggest that more suitable clay might be found in the upland settings near the site and it is recommended that further sampling be focused in the uplands. While the current suite of laboratory analyses of the Doerschuk-area clay samples has provided useful information, no additional analyses are planned for these samples and no further sampling in the region is proposed. During the fieldwork stage of the project, a small sample of artifacts including Yadkin Cord Marked pottery, a Guilford projectile point, and a range of metavolcanic flakes and bifaces (see Appendix D), was collected from a submerged shoreline site. After conferring with OSA, it has been determined that the site was 31Mg14. An accession number was issued and Site Form III is included in Appendix D. Delivery of these artifacts to the OSA will follow shortly on the submission of this report.

Introduction

In 2003, archaeologists from Fort Bragg's Cultural Resources Program and the University of North Carolina's Research Laboratories of Archaeology initiated a ceramic provenience study entitled "Compositional Variability in Prehistoric Native American Pottery from the North Carolina Sandhills." The ultimate goal of this project is to explore patterning in mobility and social territories in the North Carolina Sandhills and adjacent Coastal Plain and Piedmont regions during the Woodland period (ca. 1500 B.C. – A.D. 1600). In order to achieve this goal, three specific objectives have been identified: a) to connect archaeological potsherds with regions, areas, or localities of specific clay and temper resources through the analysis of elemental and mineralogical evidence; b) to characterize Sandhills clays to determine if serviceable clays do exist locally, and, if not, to identify the nearest non-local areas where serviceable potting clays can be obtained; and c) to develop models of the prehistoric cultural landscape in terms of group mobility patterns and social boundaries by identifying the potential source areas of clay and tempering agents used to make pottery found in the Sandhills. Models of group mobility and social interaction should in turn shed light on the significance of archaeological sites found on Fort Bragg, which encompasses about 250 mi^2 of the Sandhills.

Phase I employed instrumental neutron activation analysis (INAA) and optical petrography to examine elemental and mineralogical variability in prehistoric pottery from sites in the Sandhills, Coastal Plain, and Piedmont (Figure 1). Correlations within the pottery samples were explored to distinguish geologic or geographic areas where ceramic vessels were produced.

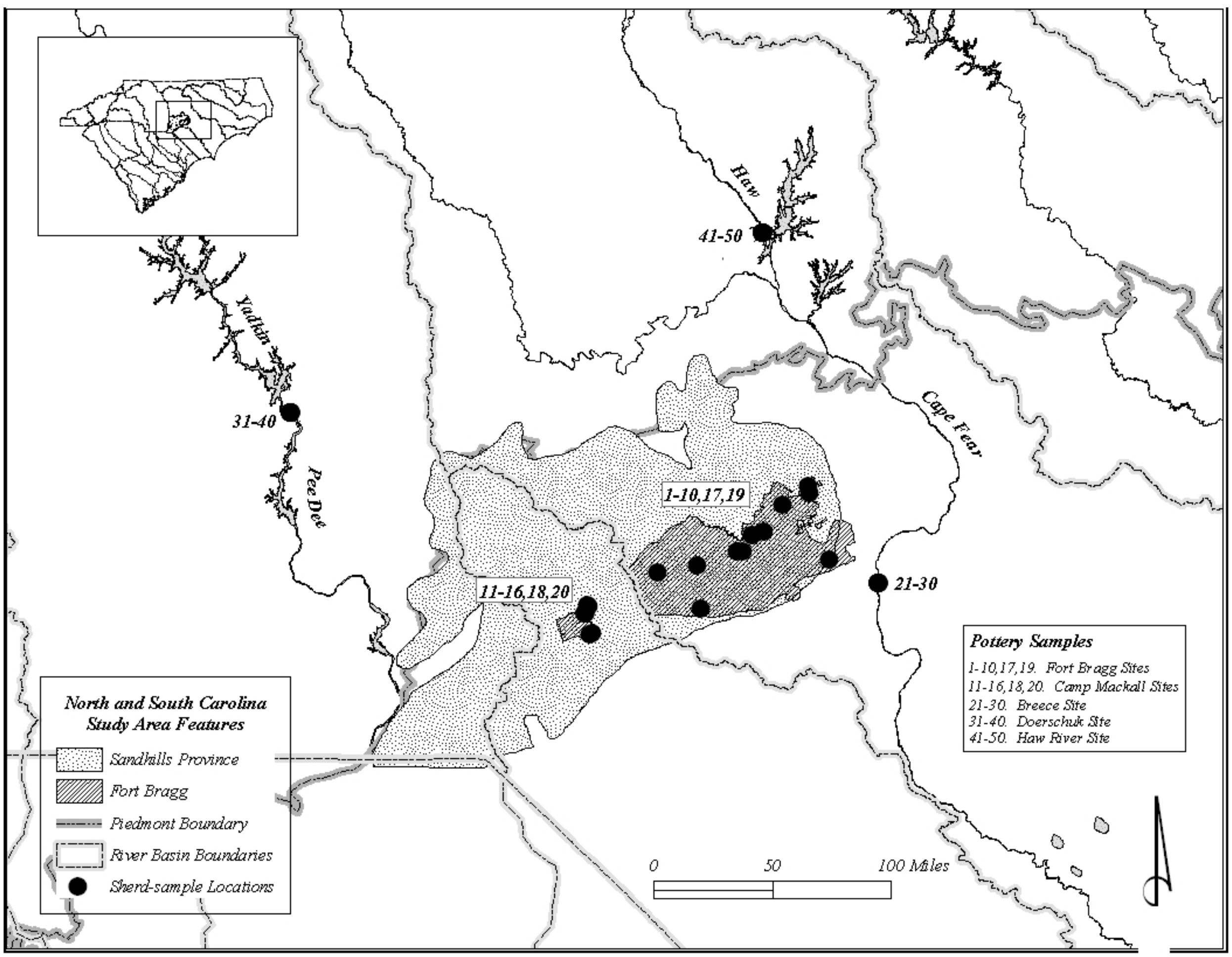

Figure 1. Geographic distribution of pottery samples from archaeological sites in the North Carolina Sandhills, Coastal Plain and Piedmont.

Phase II of the project consists of a ceramic raw materials survey designed to meet the second specific objective. This phase was launched in 2004 and entails gathering information on the utility of clay resources in the Sandhills, Coastal Plain, and Piedmont. As part of this study, Joseph Herbert (Principal Investigator) and Theresa McReynolds collected 57 clay samples from the vicinities of key sites in the Sandhills and four surrounding regions of the Carolina Piedmont and Coastal Plain (Figure 2). The investigators subjected these samples to a series of field and laboratory performance tests designed to evaluate their suitability for making low-fired earthenwares.

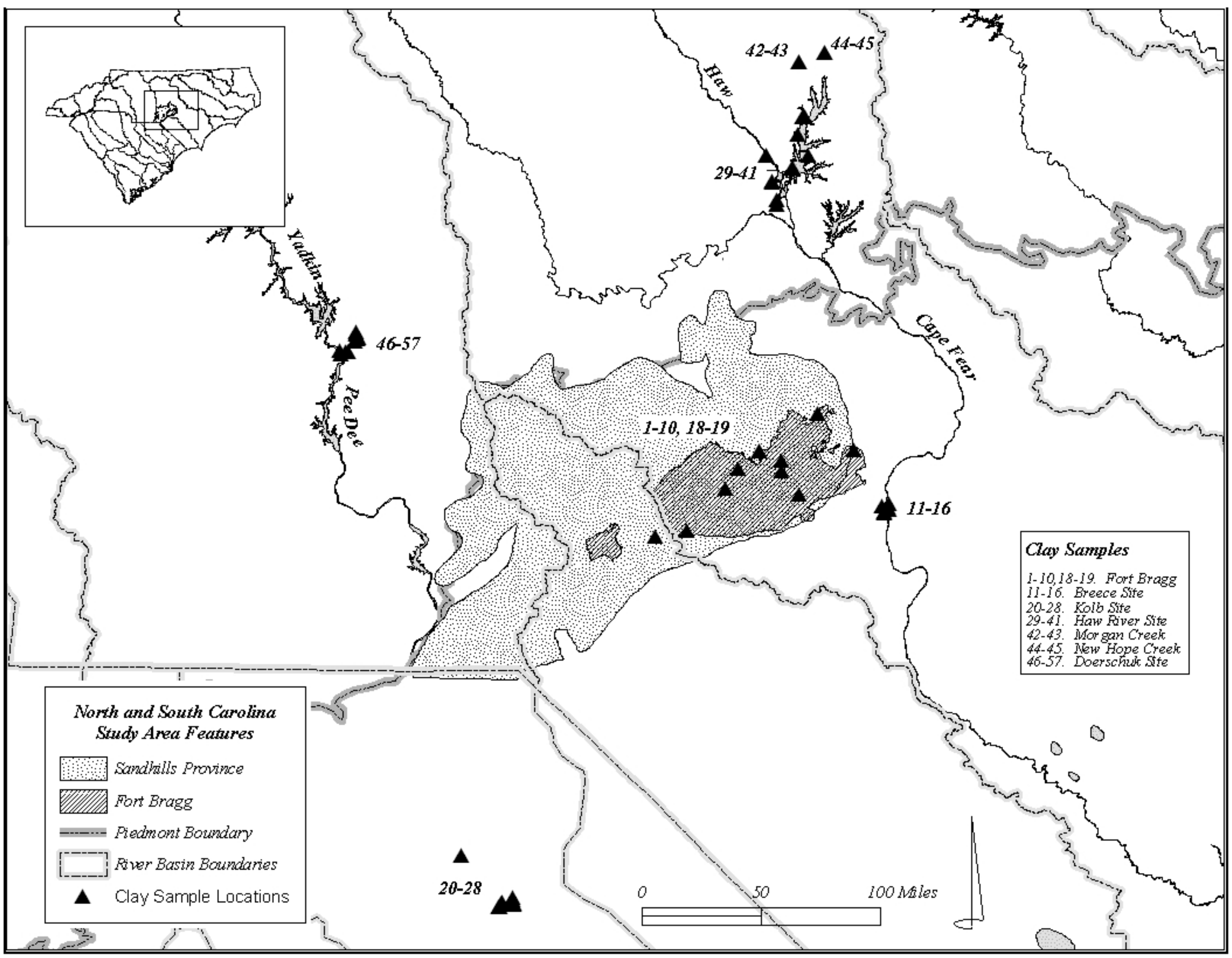

Figure 2. Geographic distribution of clay samples from the North Carolina Sandhills, Coastal Plain and Piedmont.

Physical Environment

The scale of analysis relevant to the study of prehistoric hunter-gatherers ranges from intra-site to inter-regional. This project uses data drawn from the vicinities of multiple sites in four major river drainages of the Carolina Coastal Plain and Piedmont to discern regional patterns in the use of ceramic raw materials. Consequently, the effective environment relevant to this project consists of the general geological characteristics of the Coastal Plain and Piedmont physiographic provinces and the Lower Little River, Lumber River, Haw-Cape Fear, and Yadkin-Pee Dee drainages. A slightly more detailed description of the Sandhills region, the area of principal interest for this study, is also provided.

The Carolina Coastal Plain and Piedmont

The Carolina Coastal Plain consists of a series of broad, relatively flat terraces comprised of sands, clays, and other sedimentary materials. These terraces slope seaward, obtaining their highest elevations at 600 feet above sea level in the Sandhills region of the southwestern Coastal Plain and reaching their lowest elevations at sea level along the coast. Clays in this province are predominantly smectite (Steponaitis et al. 1996:Table 4), and alluvial clays of Coastal Plain rivers are typically enriched in this clay mineral (Hathaway 1972; Neiheisel and Weaver 1967; Pevear 1972; Windom et al. 1971). However, preliminary field assessments suggest that clays found in the Fort Bragg area of the Sandhills are rich in kaolinite. Kaolinitic clays tend to occur in the stratigraphically earliest (Cretaceous) and latest (Pleistocene) sediments of the Atlantic Coast (Olive et al. 1989).

In contrast, the Carolina Piedmont is a region of gently rolling hills and long, low ridges underlain by igneous and metamorphic rocks. Elevations in the Piedmont vary from 300 feet above sea level in the east to 1500 feet above sea level in the west. Alluvial clays deposited by rivers with Piedmont sources are commonly kaolin-rich.

Two of the river drainages from which pottery and clay samples were drawn span both the Piedmont and Coastal Plain. The lower Haw River area of the Haw-Cape Fear drainage is located in the eastern Piedmont, while the middle Cape Fear basin is in the upper Coastal Plain. Likewise, the Uwharrie and Yadkin Rivers of the Yadkin-Pee Dee drainage are located in the eastern Piedmont, while the Pee Dee River in South Carolina is located in the Coastal Plain. Alluvial clays found throughout the extent of the Haw-Cape Fear and Yadkin-Pee Dee drainages are therefore likely to be composed in part of redeposited alluvial sediments derived from Piedmont sources.

Samples were also drawn from two river drainages situated entirely within the Coastal Plain. The Lower Little River basin in the Cape Fear drainage and the Drowning Creek basin in the upper Lumber River drainage are both in the Sandhills region; none of their tributaries originate in the Piedmont. Marine sedimentary clays in these basins were deposited on the upper Coastal Plain during the Cretaceous era.

The Sandhills

The Sandhills region of the Coastal Plain is the area of principal concern to this project. The Sandhills represent the remnants of an ancient coastal environment that today appears as sedimentary terraces dissected by gently sloping streams and narrow wetlands. This area of predominantly pine forests is regarded as a marginal-resource region and has been referred to historically as the “Pine Barrens,” “Pine Plains,” and even the “Sahara of the Carolinas.” Pine-savannah, pine-scrub oak Sandhill, and xeric Sandhill scrub communities are common in the uplands (Russo et al. 1993; Schafale and Weakley 1990), while hardwoods, 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 presence of approximately 3,200 prehistoric sites on Fort Bragg suggests that the area was used to some extent in every culture period throughout prehistory.

Sandhills Prehistory

Gunn's (2002) "cultural anvil" model predicts that the scale of human presence in the Sandhills varied over time as changes in climate created environments favorable or unfavorable to long-term settlement and sustained resource procurement. Evidence for such population flux can indeed be found in the lithics data available for this area.

Projectile point type frequency data compiled by Irwin and Culpepper (2000) suggest possible differences in the intensity of land use in the Sandhills during the Archaic and Woodland culture periods (Table 1). Although the relationship between projectile point frequency and population frequency may not have been constant over time, these data suggest a decrease in population or a reduction in the use of the Sandhills as a primary resource extraction area over time. The Late Paleoindian period is characterized by an exceptionally high projectile point frequency (0.20 points per year), while the Woodland period is characterized by a notably low projectile point frequency (0.09 points per year). Projectile point frequencies during the three Archaic periods vary only slightly about the median value of 0.13 points per year.

This study is concerned solely with the Woodland period. Sites found on Fort Bragg that date to this period typically reflect short-term occupations or limited activities. Woodland

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

Period	Dates	Duration (years)	Point Count	Points per Year
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

assemblages typically consist of a small number of artifacts with a relatively low diversity of tool types. The ephemeral nature of most sites and the apparent small size of the parties who used them suggests that Woodland period hunter-gatherers employed a foraging strategy designed to exploit dispersed resource patches through high residential mobility.

The geographic area exploited by these hunter-gatherers would presumably have been very large. Ethnographic and archaeological studies have shown that the foraging ranges of hunter-gatherers inhabiting regions with higher resource densities than the Sandhills can cover hundreds or thousands of square kilometers (Kelly 1995; Jones et al. 2003), and the available lithic and ceramic evidence indicates that the range of Woodland period hunter-gatherers in the Sandhills would have been similar.

Both projectile points and ceramics deriving from non-local materials have been recovered from Fort Bragg sites. The majority of diagnostic Archaic projectile points and more than one-third of all Middle-to-Late Woodland projectile points are fashioned from metavolcanic stone from the Slate Belt in the Piedmont. Fragments of a polymineralic granitic rock that are found in some potsherds likewise sites derive from a non-local, presumably Piedmont source.

Additionally, evidence of mend holes and repeatedly fired coil-seam failures reflect prehistoric efforts to extend the use-life of pottery vessels or fragments; such efforts in turn imply pressure to conserve pottery resources. Herbert and Irwin (2003) propose that this apparent economy of clay procurement and vessel conservation reflects a reliance on non-local clays resembling the "tethering effect" of high-quality stone resources in the Slate Belt during the Archaic period. According to the analogy, Woodland groups would have been able to extend their foraging ranges away from clay locations by periodically provisioning themselves with raw materials and then conserving and caching those resources as they moved away from the procurement areas. However, whereas Archaic tool-makers living in the Sandhills were able to supplement their tool kits with locally available stone resources such as quartz, most of the marine sedimentary clays native to the Sandhills are unsuitable for making pots.

These observations regarding non-local procurement of resources by Sandhills groups are the impetus for the current project, which attempts to refine our understanding of Woodland period procurement behaviors in order to explore patterning in mobility and social territories in the North Carolina Sandhills and adjacent Coastal Plain and Piedmont regions. By identifying movement across the landscape of specific pottery types, we hope to ultimately detect evidence of the territories formed by hunter-gatherers with respect to the resources upon which they relied and the social circumstances that facilitated (or hampered) cultural interaction. In addition, we expect to refine existing settlement models through the incorporation of new data pertaining to ceramic technology.

Previous Research: Phase I

From the outset, several assumptions derived from relevant ethnohistoric, ethnographic, and archaeological studies shaped the project's design. First, we follow modern standards in assuming a ratio of container capacity to raw clay weight of approximately one pint per pound (Zug 1986:145). Given this ratio, an average cook pot of one-gallon capacity requires approximately six pounds of raw clay. Fired pots weigh considerably less, however: a sand-tempered, conical-based replica jar with 1.7-gallon liquid capacity has a dry weight of approximately three pounds. Reasoning that the most parsimonious solution likely prevailed, we make the second assumption that prehistoric potters procured clay directly from its source and made their pots nearby. Lighter-weight, fired pots could then be readily transported. The purpose of the project is to determine where these pots were made, how far they were subsequently transported, and the nature of their transportation.

The first phase of the project examined elemental and mineralogical variability in 50 prehistoric pottery samples from the Sandhills, Coastal Plain, and Piedmont to establish associations between the samples and general areas of clay and temper resources. The pottery samples were classified according to standard descriptive techniques, and the chemical and mineral constituents of each sherd were determined through instrumental neutron activation analysis (INAA) and optical petrography. Chemical, mineralogical, and typological correlations within the samples were then identified and explored in an attempt to distinguish the various geologic or geographic areas where the samples were produced.

Samples

The Phase I pottery samples were drawn from 19 sites situated in three river drainages: (1) the Haw-Cape Fear, (2) the Lumber, and (3) the Yadkin-Pee Dee (Figure 1). Ten potsherds selected from the Haw River site (31Ch29) on the lower Haw River (now impounded as B. Everett Jordan Lake) represent an eastern Piedmont source area. An equal amount of sherds from the Breece site (31Cd8) in the middle Cape Fear basin represent the upper Coastal Plain. Twelve sherds drawn from Fort Bragg sites in the Lower Little River basin represent the Sandhills area in the Cape Fear drainage, while eight sherds from six sites in the Drowning Creek basin on Camp Mackall represent the Sandhills area in the Lumber River drainage. Finally, ten samples drawn from the Doerschuk site (31Mg22) represent an eastern Piedmont source area on the lower Yadkin River. Appendix A provides a general description of each sample sherd.

Instrumental Neutron Activation Analysis

INAA produced elemental concentration values for 32 or 33 elements in most of the samples. These data were explored through standard procedures to assess the similarities or dissimilarities between pottery samples from different regions (Bieber et al. 1976; Bishop and Neff 1989; Harbottle 1976: 42-60; Neff 2002; Sayre 1975; Speakman and Glasscock 2002).

Principal components analysis (PCA) of the dataset revealed five recognizable compositional groups. When membership in these five chemical groups is calculated on the first three principal components, approximately 77 percent of the total variation in the dataset is explained. Groups separate primarily along Principal Component 2 (Figure 3), which captures a large share of the variation in calcium concentrations. Chemical Groups 3 and 4 are low in calcium, while Chemical Groups 1, 2, and 5 are relatively high in calcium. Forty of the 50 samples can be confidently assigned to one of these five groups (see Appendix A).

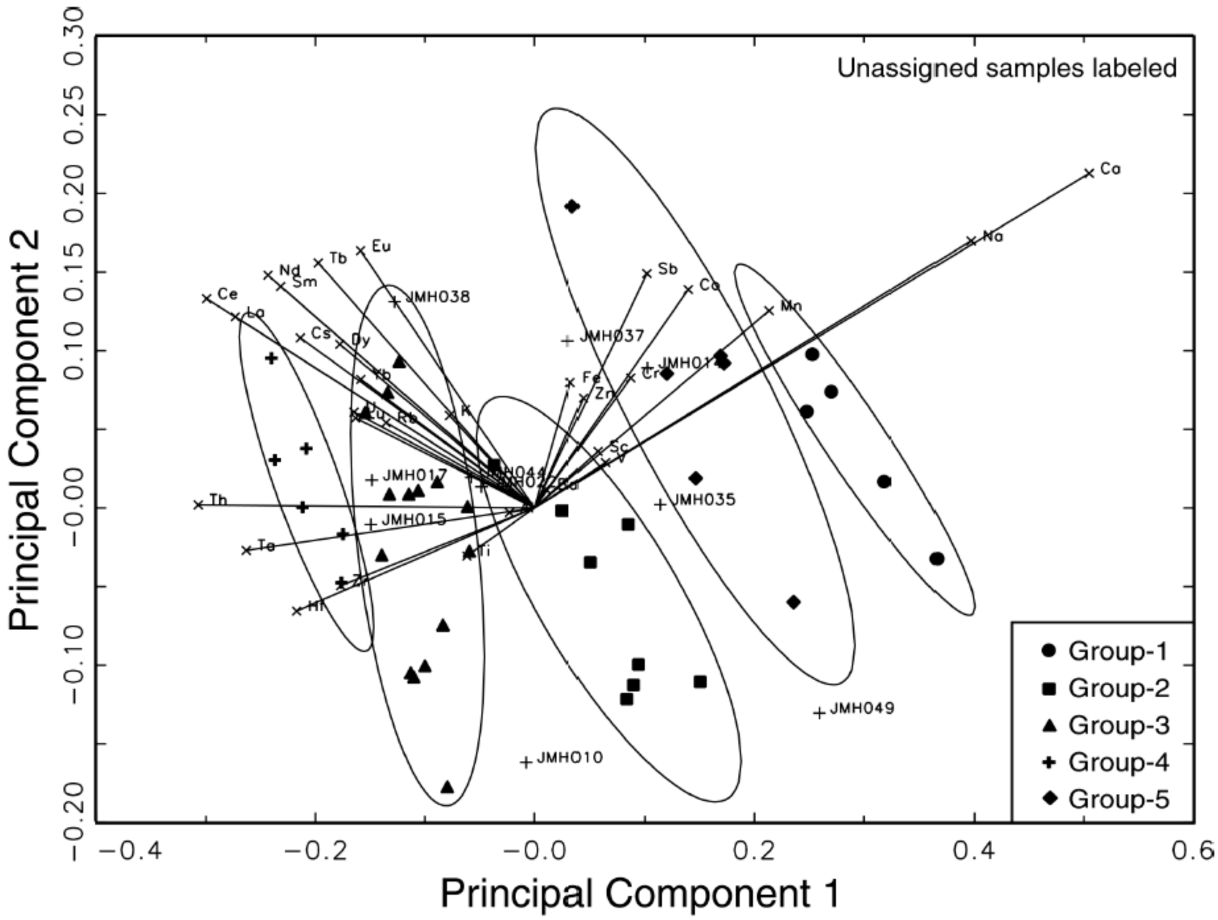

Figure 3. PCA biplot of principal components 1 and 2 of the correlation matrix for 30 elements detected through INAA. Ellipses represent 90% confidence level for membership in the five chemical groups.

Seventy-five percent of the samples from the Doerschuk and Haw River sites in the Piedmont are assigned to Chemical Groups 1, 2, or 5 (Table 2; Figure 4). Five samples from these sites remain unassigned but also exhibit relatively high calcium, sodium, and manganese concentrations. Initially, the higher calcium and sodium contents of sherds in Chemical Groups 1, 2, and 5 were believed to reflect the influence of calcareous materials in Piedmont clays and thus a local origin for the samples from Doerschuk and the Haw River site. However, mineralogical analyses (summarized below) reveal that the source of the calcium in the pottery

Table 2. Contingency Table of Chemical Groups and River Basin / Site Locations.

	River Basin / Site(s)					
Chemical Groups	**Pee Dee/ Doerschuk**	**Haw/ Haw River**	**Cape Fear/ Breece**	**Lower Little/ Fort Bragg**	**Lumber/ Camp Mackall**	**Total**
1	2	2		1		5
2	1	4		2	1	8
3			9	3	3	15
4				4	2	6
5	4	2				6
Unx	3	2	1	2	2	10
Total	**10**	**10**	**10**	**12**	**8**	**50**

samples is not calcareous clay, but rather calcium- and potassium-rich igneous rock inclusions that may have been added to the pottery as tempering material.

Regardless of the actual source of the high calcium concentrations, it is clear that the chemical signatures of ceramic samples from the Piedmont are distinctive compared to most potsherds recovered from Coastal Plain contexts at the Breece site and in the Sandhills. Most Coastal Plain samples fall into low-calcium Chemical Groups 3 and 4. However, there are interesting compositional differences between sherds found at the Breece site in the middle Cape Fear drainage and those from Fort Bragg and Camp Mackall in the Sandhills. The Breece samples are chemically homogeneous, with all assigned specimens falling into Chemical Group 3. In contrast, the Sandhills samples are more heterogeneous, with approximately 44 percent of sherds in Chemical Group 3, 31 percent in Chemical Group 4, and 25 percent in high-calcium Chemical Groups 1 and 2.

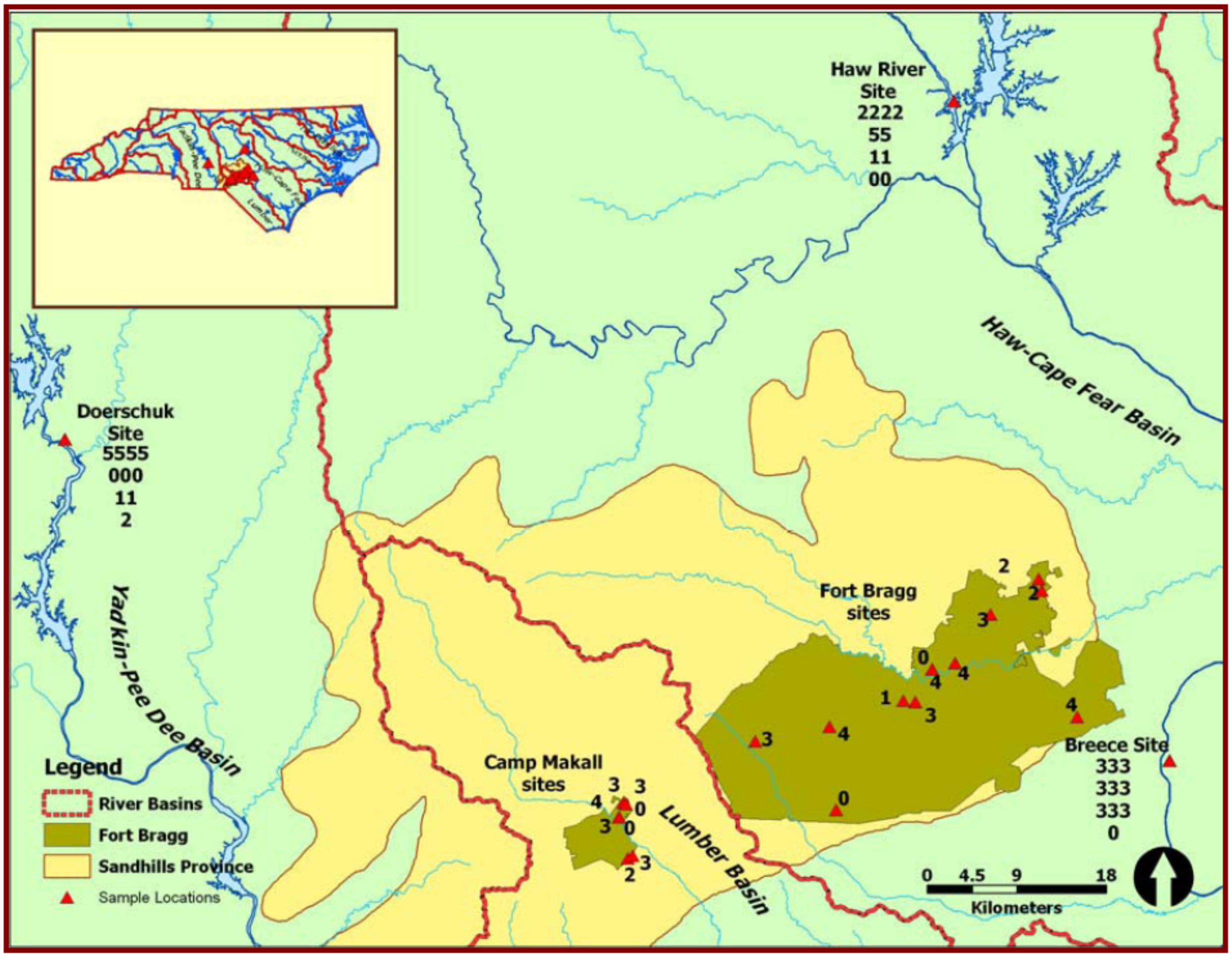

Figure 4. Distribution of chemical groups (1, 2, 3, 4, and 5) by sample for each site. Samples unassigned to one of the five recognized chemical groups are labeled 0. Note the differences in chemical composition between pottery from the Piedmont sites (Doerschuk and the Haw River site) and the Coastal Plain sites.

The homogeneity of the Breece samples suggests a specific local clay source in the vicinity of the site, whereas the presence of four distinct chemical groups in the Sandhills indicates that potters in this region utilized clays from multiple locations. If the Breece samples do in fact represent a single Cape Fear source, it is possible that all pottery samples belonging to Chemical Group 3 share a common origin in the middle Cape Fear basin. A common origin for all Chemical Group 3 pottery in turn suggests that almost half of the samples from the Lumber and Lower Little River drainages were imported into the Sandhills from the Cape Fear area.

Likewise, it is possible that the Sandhills samples assigned to Groups 1 and 2 were moved into the region from the Piedmont. Alternatively, ceramic resources in the Sandhills may be highly variable, with some resembling Cape Fear or Piedmont clays in terms of chemical composition.

Mineralogical Petrographic Analysis

Thin sections were also prepared from each of the 50 pottery samples and analyzed according to petrographic procedures standard in optical mineralogy (Smith 2003). On the basis of the mineralogical data, the samples were separated into three groups. Samples in Mineral Group 1 include a mineral suite composed primarily of pyroxene and plagioclase derived from mafic igneous rock. Samples in Mineral Group 2 incorporate quartz, feldspar, biotite, muscovite, amphibole, opaque minerals, and igneous rock fragments. Samples in Mineral Group 3 contain muscovite mica, monocrystalline quartz, and polygranular quartz rock fragments. All 50 samples can be confidently assigned to one of these three groups (see Appendix A).

Mineral Group 1 is represented by one potsherd from the Doerschuk site, two from the Haw River site, and one from a site on Fort Bragg. The ceramic matrix of these sherds consists of approximately 30 percent pyroxene and plagioclase rock fragments. Some of these fragments are in nearly pristine condition and suggest a source close to an exposure, while others appear to be more highly weathered (Smith 2003:6). The source or sources of the fragments are believed to be Jurassic-age diabase dikes that crosscut the eastern and central Piedmont of North Carolina. Modern comparative samples from a diabase exposure near Albemarle in Stanly County appear identical to the fragments found in some Mineral Group 1 samples.

Mineral Group 2 is divided into subgroups 2a and 2b according to the mafic and opaque mineral content of the igneous rock fragments. Subgroup 2a consists of three samples from the

Doerschuk site. The matrix of these sherds includes fragments of either polygranular quartz rock or igneous rock composed of quartz, microcline, plagioclase, and the mafic minerals amphibole, muscovite, and biotite. Subgroup 2b is represented by fifteen samples, all but one of which come from the Doerschuk and Haw River sites. The major aplastic components of this subgroup are quartz, feldspar, biotite, amphibole, and opaque minerals; igneous rock fragments with little or no mafic minerals; and polygranular quartz rock fragments. In addition, the feldspar rock and mineral fragments in subgroup 2b are often heavily altered, suggesting derivation from a felsic plutonic source.

Mineral Group 3 includes the remaining 28 samples and is characterized by monocrystalline quartz mineral grains, polygranular quartz rock fragments and, in about half of the specimens, grog (crushed pottery used as a tempering agent).

These petrographic data (Table 3) corroborate the basic patterning suggested by INAA and provide a more accurate understanding of the nature of compositional variation among the 50 pottery samples. The geographic distribution of samples based on mineral groups (Figure 5) closely resembles the distribution of samples based on chemical data (Figure 4). Mineral Groups 1, 2a, and 2b include calcium-rich minerals such as clinopyroxene (augite), plagioclase (labradorite), and amphibole and correspond to the calcium/sodium-rich Chemical Groups 1, 2, and 5. The quartz-rich samples in Mineral Group 3 correspond to the calcium/sodium-poor Chemical Groups 3 and 4.

Furthermore, the petrographic data provide no evidence for the presence of calcareous materials (e.g., shell, carbonate rock) that could account for the high calcium and sodium contents of samples in Chemical Groups 1, 2, and 5. Instead, the high concentrations of these

Table 3. Contingency Table of Mineralogical Groups and River Basin / Site Locations.

	River Basin / Site(s)					
Mineral Groups	**Pee Dee/ Doerschuk**	**Haw/ Haw River**	**Cape Fear/ Breece**	**Lower Little/ Fort Bragg**	**Lumber/ Camp Mackall**	**Total**
1	1	2		1		4
2a	3					3
2b	6	8			1	15
3			10	11	7	28
Total	**10**	**10**	**10**	**12**	**8**	**50**

elements seem to be attributable to igneous rock fragments occurring as either natural aplastic constituents of clay or artificially added temper.

Phase I Conclusions

INAA and petrographic analysis of 50 pottery samples distinguish two broad geographic source areas of ceramic raw materials corresponding to the North Carolina Piedmont and Coastal Plain provinces. Table 4 illustrates associations between Chemical Groups 1, 2 and 5 and Mineral Groups 1, 2a and 2b and between Chemical Groups 3 and 4 and Mineral Group 3. Samples falling within the former chemical/mineral group association primarily include those from Piedmont sites in the Haw and Pee Dee River basins, while samples falling within the latter association include those from Coastal Plain sites in the Sandhills and Cape Fear basin. A few anomalous samples (circled in Table 4) do not fit the pattern.

The intrasite homogeneity of chemical and mineralogical signatures for samples from the Doerschuk, Haw River and Breece sites suggests that potters at these locations relied consistently

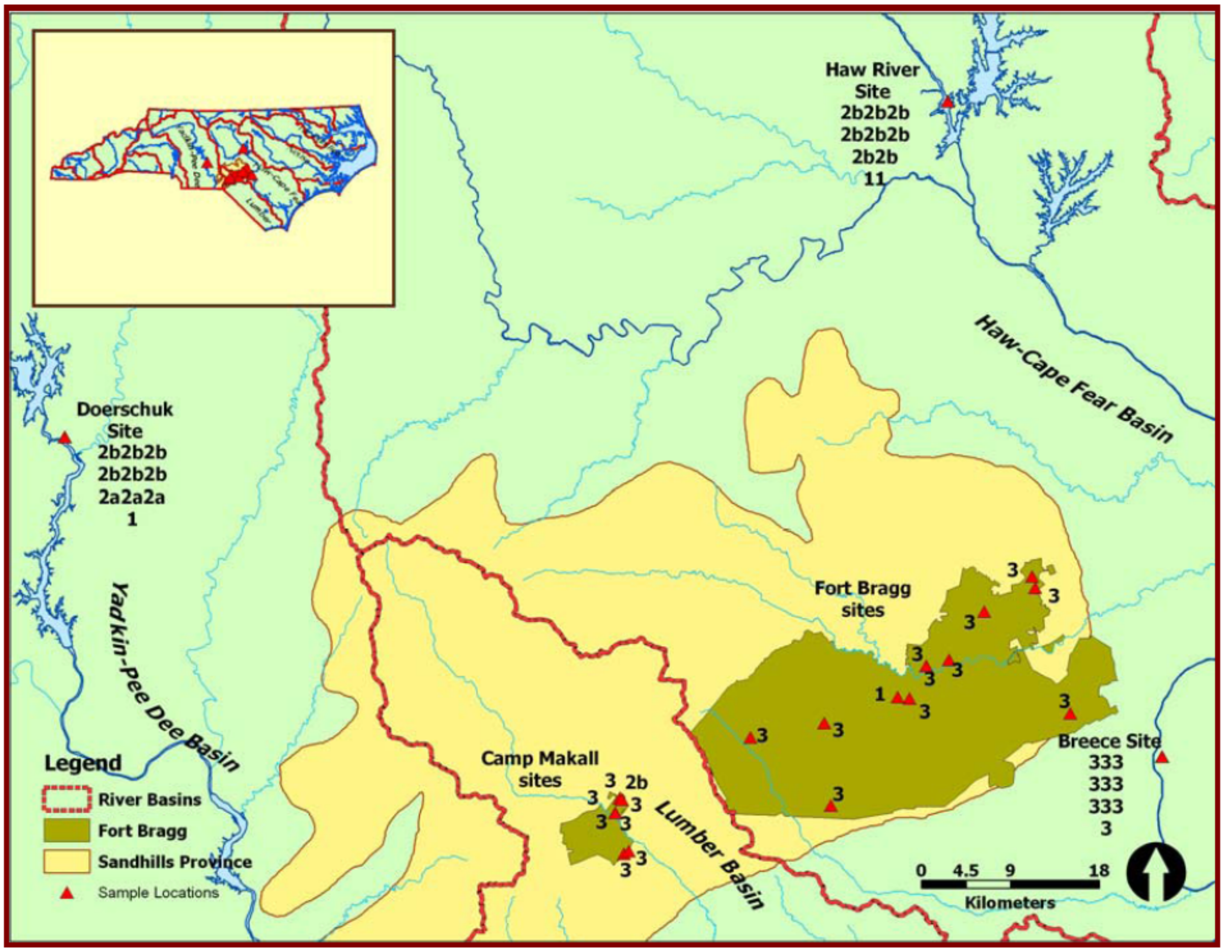

Figure 5. Distribution of mineral groups (1, 2a, 2b, and 3) by sample for each site. Note the differences in mineralogical composition between pottery from the Piedmont sites (Doerschuk and the Haw River site) and the Coastal Plain sites.

Table 4. Contingency Table of Mineralogical and Chemical Groups.

	Chemical Groups						
Mineral Groups	1	2	5	3	4	unx	Total
1	3		1				4
2a	2		1				3
2b		5	4			6	15
3		3		15	6	4	28
Total	5	8	6	15	6	10	50

upon the same, presumably locally available, resources. Likewise, the mineralogical data indicate that almost all of the specimens from the Sandhills are mineralogically homogeneous and probably derived from Coastal Plain resources. The chemical signatures for the Sandhills samples, however, are more heterogeneous. This chemical variability presumably reflects one of two possible scenarios: (a) pots were brought into the Sandhills from surrounding Piedmont and Coastal Plain regions, or (b) clay and temper sources in the Sandhills are more chemically variable than their Pee Dee, Haw, and Cape Fear River counterparts. Phase II of the project was conceived as a means of evaluating these two scenarios.

Phase II: Raw Materials Survey

The primary objective of Phase II is to achieve a better understanding of the chemical variability of ceramic resources in the Sandhills, Coastal Plain, and Piedmont. To meet this objective, we are currently expanding the available dataset through study of additional pottery samples as well as raw clay samples from each region. Analysis of additional potsherds should enable us to refine the existing chemical and mineralogical groups identified in Phase I, while a raw materials survey allows us to characterize Sandhills clays to determine if serviceable clays exist locally, and, if not, to identify the nearest non-local areas where serviceable potting clays can be obtained. The remainder of this report describes the raw materials survey component of Phase II.

Samples and Methods

The Phase II clay samples were collected during the spring and summer of 2004. Operating under the assumption that prehistoric potters procured clay resources within five kilometers of their pottery-making activity areas (Arnold 1985), the majority of samples were obtained in the vicinities of the same sites from which the archaeological pottery samples considered in Phase I were drawn.

Potential clay sample locations were predicted using topographic quad sheets and, where available, soils and geologic maps. Nevertheless, we found it necessary to cover a great deal of territory in order to find suitable clays. We systematically surveyed riverbanks and lower-order streambeds near pottery site locations, a process that required canoeing and hiking miles of shoreline. Samples were taken with a 10-cm bucket auger at depths not exceeding one meter.

Once an exposed or near-surface deposit of clay was located in the field, a simple plasticity "coil" test was performed. This test entails rolling the clay into a foot-long, ½-inch-diameter coil and wrapping it around a finger. With the exception of the Sandhills samples, clays whose coils broke in half during the coil test were not collected; the importance of demonstrating the suitability or unsuitability of clays in the Sandhills compelled us to collect any clay encountered regardless of its coil test results. Approximately two liters of every clay that did pass the initial coil test were collected (usually by bucket auger) for additional analyses.

In all, 57 clay samples were obtained from four drainages in the Carolina Piedmont and Coastal Plain: (1) the Haw-Cape Fear, (2) the Lower Little River, (3) the Lumber River, and (4) the Yadkin-Pee Dee (Figure 2; Appendix B). Eighteen of the samples represent the eastern Piedmont source area of the lower Haw River: 14 came from the banks of the Haw River and B. Everett Jordan Lake in the vicinity of the now-submerged Haw River site, two came from the banks of Morgan Creek, and two came from the banks of New Hope Creek. An additional six samples collected near the Breece site represent a clay source area in the middle Cape Fear basin on the upper Coastal Plain. Eleven samples collected on Fort Bragg represent the Lower Little River basin in the Sandhills, while a twelfth sample also obtained in the Sandhills but slightly west of Bragg is the sole representative of the upper Lumber River basin. Finally, 12 samples encountered along the banks of the Uwharrie and Yadkin rivers close to the Doerschuk site represent the eastern Piedmont source area of the lower Yadkin River (Figure 6), while nine samples taken near the Kolb site (38DA75) in South Carolina represent the Coastal Plain Pee Dee basin.

The 12 samples (numbers 46-57) from the vicinity of the Doerschuk site were collected on July 28th and 29th, 2004. Although we canoed to the perimeter of the Doerschuk site, no suitable clay was found at this location and thus no sample was taken from the site. The sample location nearest to the Doerschuk site is that of Sample 57, which was collected approximately 1.5 km downstream (Figure 6).

At the same time the clay samples were collected, several non-plastic samples were also obtained for possible use as tempering materials. Sand samples were collected from the banks of B. Everett Jordan Lake and Morgan Creek, quartz was acquired in the Sandhills, and chunks of diabase were attained from dikes cropping out along the Deep River in Carbonton.

Performance Tests

The suitability of each clay sample for making coil-built, conical-based pots was further assessed through a four-stage series of performance and replication experiments. These experiments were designed to yield information about the plasticity of clays, their rates of shrinkage, and other factors affecting potting performance. At the end of every stage, all clay samples deemed unsuitable for making pottery were eliminated from further experimentation.

The paragraphs that follow describe the nature of the performance and replication experiments. The results of these experiments are discussed in a later section.

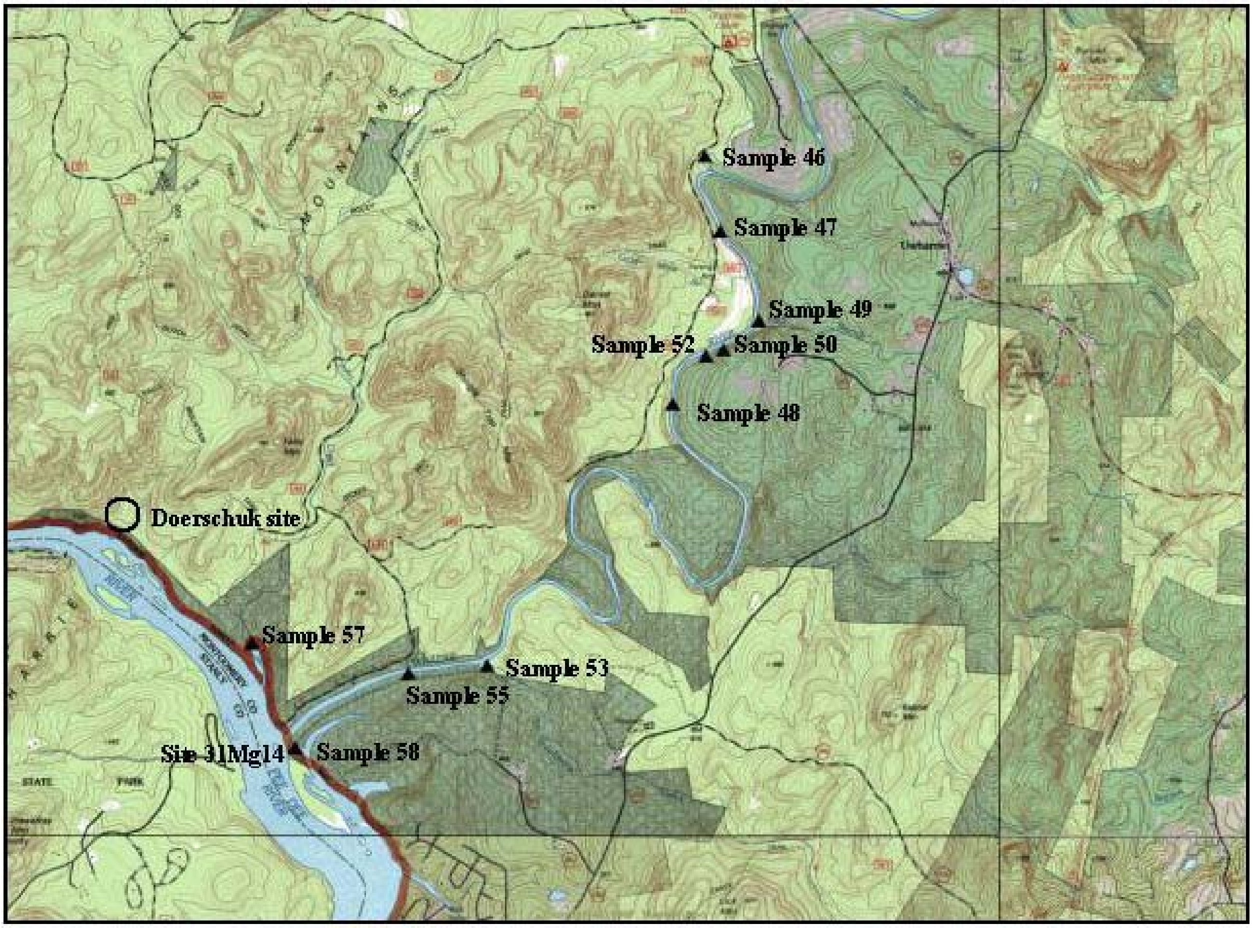

Figure 6. Location of clay samples collected along the Uwharrie and Yadkin Rivers near the Doerschuk site. Note that no samples were collected from the Doerschuk site itself.

Stage 1: Plasticity. The first stage of experimentation aimed at quantifying, albeit subjectively, the plasticity of the sample clays. Samples were assigned to ordinal classes designated as "lean," "moderately lean," or "good" on the basis of three tests: the "coil test," the "loop test," and the "ball test." This particular suite of tests enabled us to characterize the sample clays in terms of plasticity, stiffness, and strength.

Every sample was subjected to a coil test under the controlled conditions of the lab, regardless of whether a similar test had already been performed in the field. The clay was rolled on a tabletop into a rope with a diameter of approximately 0.5 inches and then wrapped around a finger to observe the tendency to crack. The “loop” test entails rolling the sample clay into a six-inch rope, coiling the rope into a ring or “loop” with a 6- to 8-cm diameter, and then setting the ring upright on its edge for several minutes to monitor sagging (Bjørn 1969). For the “ball” test, the sample clay was formed into a golf ball-sized ball and compressed with the thumb to approximately one centimeter in thickness.

In general, lean clays are defined as those having coils that break completely when wrapped, rings that sag significantly when stood on edge, and balls that develop deep cracks when compressed (Figure 7A). Moderately lean clays form coils that crack but do not break, rings that sag slightly, and balls that develop shallow cracks when compressed (Figure 7B). Good clays coil and wrap without breaking or cracking, stand up proudly in their loop without sagging, and do not develop cracks when compressed (Figure 7C). In practice, however, many of the sample clays exhibit characteristics of plasticity, stiffness, and strength that are intermediate between these categories. In such cases, samples were typically assigned to the leaner of the two workability categories.

(A) Sample 18, Jumping Run Creek, Fort Bragg.

(B) Sample 44, New Hope Creek, Orange County.

(C) Sample 40, B. Everett Jordan Lake shore.

Figure 7. Clays exhibiting varying degrees of plasticity: (A) lean clay; note that the coil has broken into short segments, the ring is sagging and twisting, and the ball has developed deep cracks; (B) moderately lean clay; note that the coil has cracked, the ring is sagging slightly, and the ball has developed shallow cracks; and (C) good clay; note that the coils have not cracked, the ring does not sag, and the ball has not cracked.

Stage 2: Drying Behavior. While the physical properties of raw clays are important to understand, it is the properties of the pottery made from the clay samples that are most relevant to an archaeological study. All clays characterized as good and most moderately lean samples were therefore fashioned into standard 10 x 10 x 1 cm test tiles for firing. While still in the plastic (wet) state, the test tiles were weighed and assigned Munsell color readings. They were then allowed to dry for 72 hours, with the final 24 hours of drying achieved in a 105°C oven (Ries 1927). Each tile was monitored for weight loss, linear drying shrinkage (following methods developed by Binns [1947], Rice [1987], and Ries [1927]), cracking, and warping after approximately 24, 48, and 72 hours of drying. A second Munsell color reading was assigned to the oven-dried tiles.

Tempered test tiles were also produced for all of the good and a few of the moderately lean clays. Choice of temper for Sandhills, Breece, and Haw River clays was based on the mineralogical evidence obtained for the Phase I pottery samples. Clays collected near the Fort Bragg and Breece sites were thus tempered with grog, which was obtained by crushing fired test tiles made from the same sample clays. Haw River site pottery was tempered with either sand or crushed quartz, and consequently sample clays from the Haw River area were tempered in both ways. Likewise, sherds from the Kolb site (which were not considered in Phase I) appear to be tempered with either sand or grog, and sample clays from the Kolb area were tempered accordingly. Note that because no good clays were found in the vicinity of the Doerschuk site, tempered test tiles have not yet been made from Yadkin River clays.

All tempered test tiles were subjected to the same drying and monitoring regimen described for the untempered tiles.

Stage 3: Firing Behavior. After drying, the test tiles were fired at 893°C in an electric kiln at UNC's art lab. The fired tiles were weighed and measured to determine firing shrinkage, and any changes in Munsell color, cracking, or warping were noted. Ultimately, segments of the fired tiles will be subjected to chemical and petrographic analyses, the results of which can be compared to those obtained for the archaeological ceramic specimens.

Stage 4: Vessel Replication. The final stage of experimentation involves complete replication of coil-built ceramic vessels and is still underway. We are currently attempting to fashion replica pots from those tempered clay samples that did not exhibit excessive shrinkage or warping during firing. Several pots that have been successfully built and fired in open-fire settings at UNC's art lab and the North Carolina Pottery Center provide the ultimate proof of clay's suitability for pottery making (Figure 8).

Results

Given the improbability of sampling the very same clays exploited by Woodland potters (Neff et al. 1992), the results of the four stages of experimentation are couched in terms of relatively general regional trends in clay properties.

Stage 1 results (summarized in Appendix C) indicate that only 14, or approximately 25%, of 57 clay samples can be characterized as having good workability (Table 5). Approximately 54% of the samples are classified as moderately lean and 21% are lean.

Only one good clay sample came from the Fort Bragg area, and in fact the majority of Sandhills clays lack the plasticity necessary for building pots. Doerschuk-area clays from the banks of the Uwharrie and Yadkin Rivers likewise appear to be unsuitable for pottery-making. Two moderately lean Doerschuk samples were retained for making test tiles in the second stage of experimentation; the bulk of the remaining samples was discarded, with only a small amount being retained for comparative purposes.

In contrast, clays obtained east of the Sandhills near the Breece site on the Cape Fear River tend to be scored as good or moderately lean in lab tests. The clays most consistently rated as good, however, came from the Kolb site area on the Pee Dee River south and west of the Sandhills. Good clay sources were also found near the Haw River site in the Piedmont.

Figure 8. Steps in the vessel replication process: (A, B) forming and decorating replica vessels, (C) firing the vessels, and (D) cooling the finished vessels.

Table 5. Workability of Clays by Region.

	Workability		
Sample Region	**Lean (%)**	**Moderately Lean (%)**	**Good (%)**
Sandhills	75	17	8
Breece	0	50	50
Kolb	0	33	67
Haw River	0	78	22
Doerschuk	25	75	0
Total	**21**	**54**	**25**

Data collected during the second and third stages of experimentation are somewhat more difficult to interpret. None of the test tiles broke or cracked excessively during drying or firing. As expected, however, box plots showing the percentage of linear shrinkage during drying and firing indicate that, in general, the addition of a tempering material tends to reduce overall shrinkage (Figure 9). In all regions, the median shrinkage values for raw clays exceed the median values for tempered clays. It is also tempting to infer from the box plot data that Sandhills clays may exhibit high shrinkage relative to clays from other regions while Doerschuk-area clays exhibit low relative shrinkage (Figure 10), but small sample sizes are affecting these results.

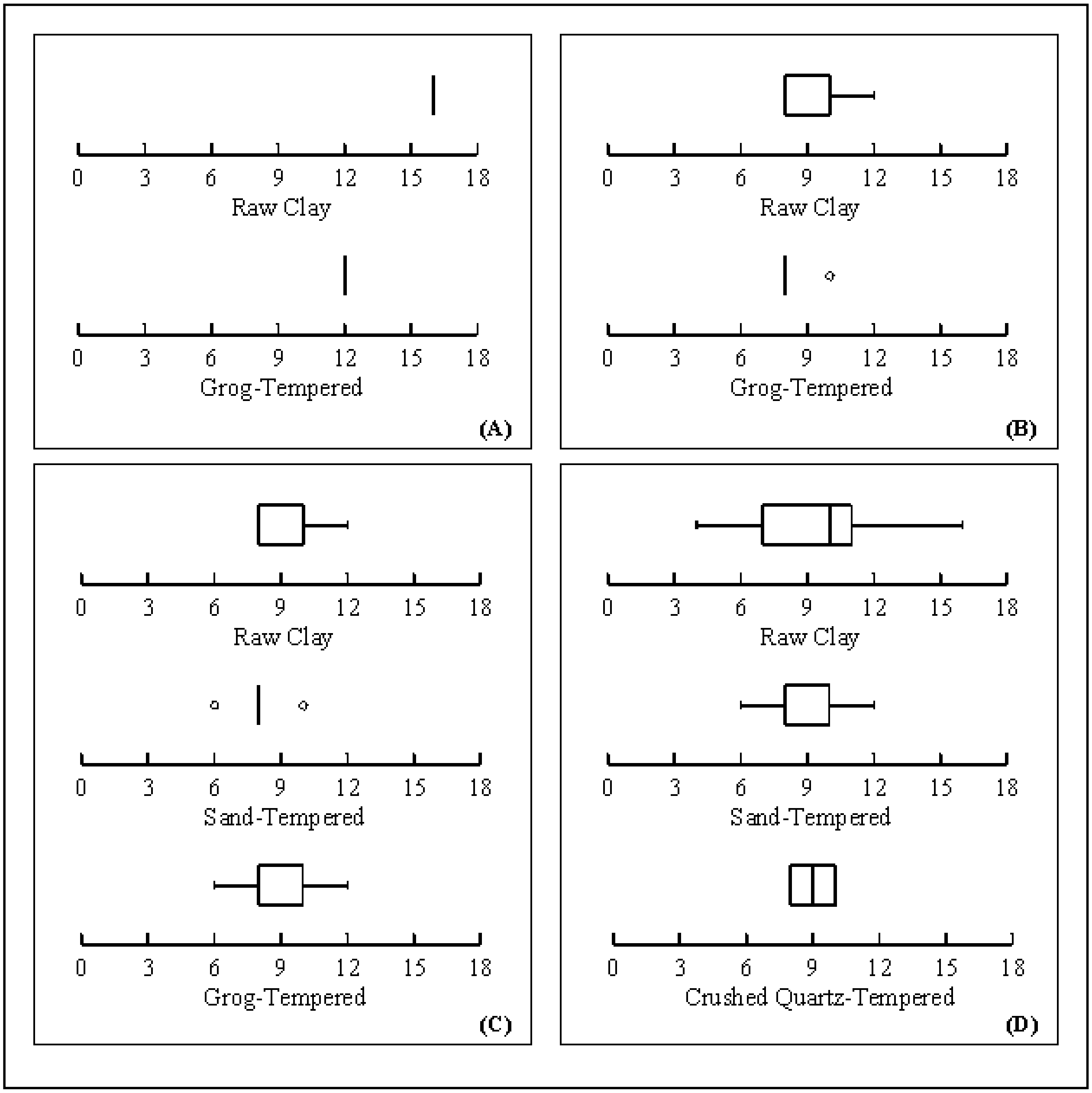

Figure 9. Box plots showing the percentage of linear shrinkage during drying and firing of raw and tempered clays from (A) the Sandhills, (B) the vicinity of the Breece site, (D) the vicinity of the Kolb site, and (D) the vicinity of the Haw River site.

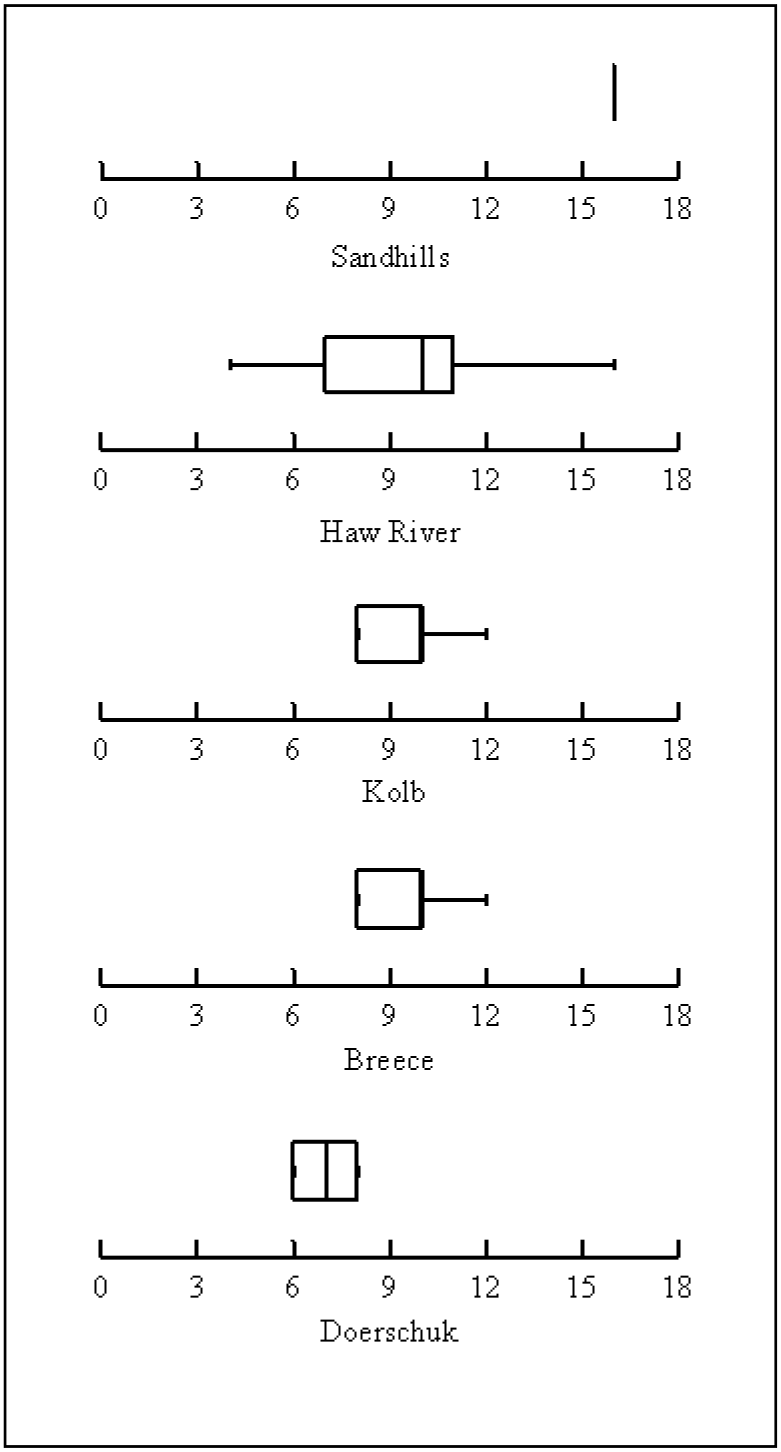

Figure 10. Box plots showing the percentage of linear shrinkage during drying and firing of raw clays from the Sandhills and the vicinities of the Haw River, Kolb, Breece, and Doerschuk sites.

Most significantly, however, the vessel replication experiments in stage 4 reveal that even clays exhibiting good workability and no excessive cracking, warping, or shrinkage during drying and firing may still not be suitable for potting! Although this final stage of experimentation has not yet concluded, at present only a few clay samples from the Haw River area have had the right combination of plasticity and strength to withstand building up, drying, and open-air firing. Conical bases made of these exceptional samples retain their shapes perfectly during the building process, even when additional coils are added to build up the vessel walls (Figure 11).

In contrast, most of the clay samples collected from alluvial settings tend to be what some potters might refer to as “fat:” they have ample plasticity (too much in fact) and are “fluffy” and soft. These fat clays require little water to achieve a workable state, become excessively sticky or slimy if too much water is added, and do not have the strength to support vessel walls in the building process (Figure 12). A conical base or pinch pot made of these clays rapidly slumps into a pancake without a crack.

On the other end of the spectrum, many of the non-alluvial clays from the Piedmont and Sandhills regions are adequately stiff to support vessel construction, but lack the necessary plasticity. These samples typically require more water and a great deal of elbow grease to become workable. Conical bases made from these clays have plenty of strength to retain their shapes on a flat surface, but as additional coils are added the walls come apart with large, vertical cracks (Figure 13).

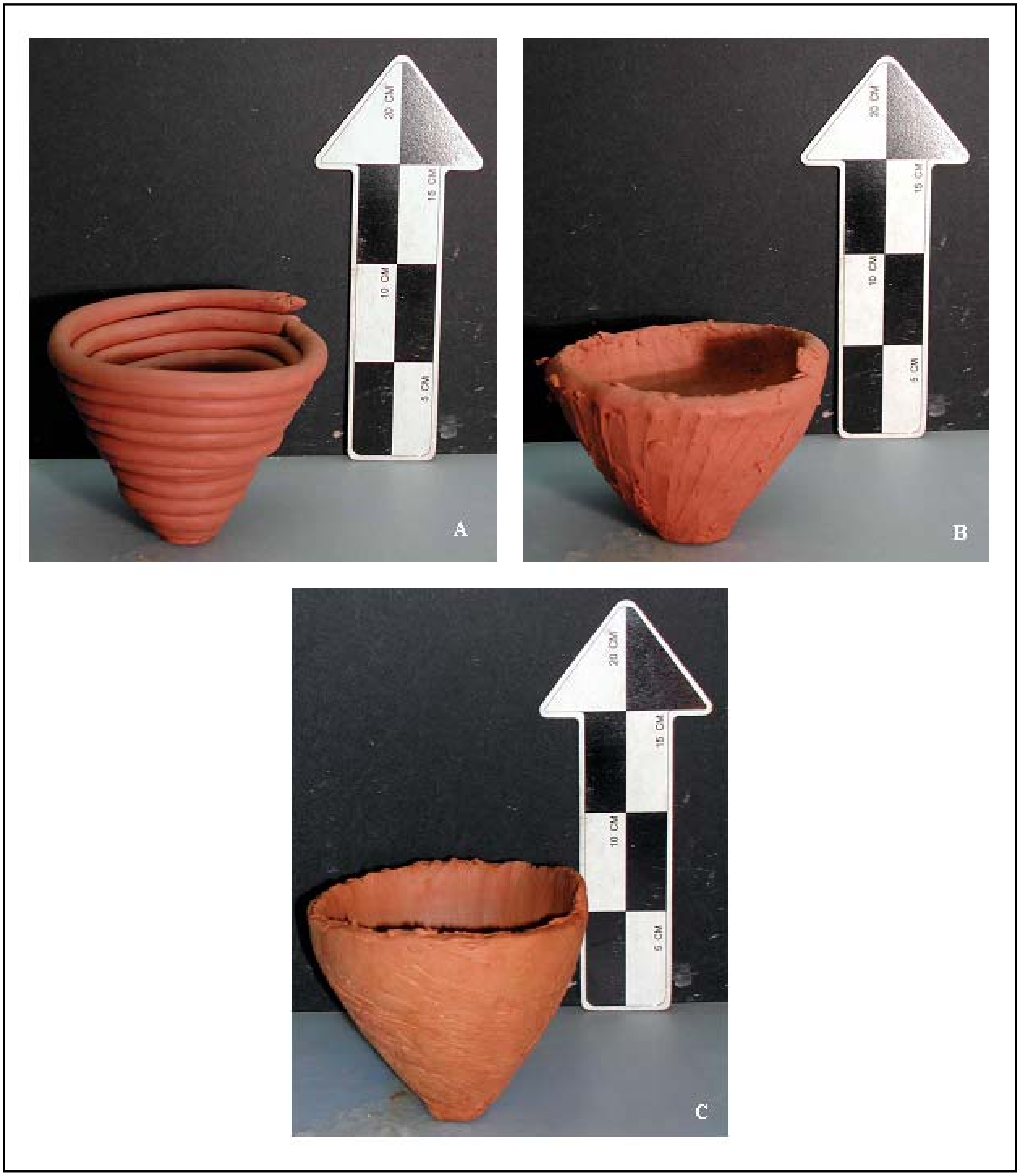

Figure 11. Process of building a vessel from clay collected in the vicinity of the Haw River site: (A) addition of coils to build up vessel walls, (B) smoothing of vessel walls, and (C) monitoring vessel for slumping. Note that the clay retains its shape perfectly during the building process.

Figure 12. Process of building a vessel from a "fat" clay collected in an alluvial setting: (A) addition of coils to build up vessel walls, (B) smoothing of vessel walls accompanied by noticeable slumping, and (C) complete collapse of vessel under its own weight.

Figure 13. Process of building a vessel from clay collected in a non-alluvial setting: (A) addition of coils to build up vessel walls, (B) smoothing of vessel walls accompanied by cracking, and (C) walls coming apart with large, vertical cracks.

Adding temper (e.g., sand, crushed rock, or grog) does not appreciably improve the workability of the clay samples, although it does affect shrinkage and thus the ultimate success of drying and firing vessels. Overall, our efforts lead us to conclude that while it might be possible to coax vessels out of clays that are too fat or too lean, the process would be aggravating and the end results would be poor substitutes for vessels made of good clays.

The results of four stages of experimentation can therefore be summed up as follows:

1) Clay that passes initial workability tests can be readily found in the immediate vicinities of the Haw River site in the Piedmont and the Breece and Kolb sites in the Coastal Plain, but not near the pottery-source sites in the Sandhills or the Doerschuk site in the lower Yadkin River basin.
2) Clay that passes initial workability tests also makes successful test tiles.
3) Nevertheless, clay that is suitable for making actual *pots* is exceedingly difficult to find.

Conclusions and Implications

Chemical and mineralogical evidence obtained in Phase I suggests that pottery at the Doerschuk, Haw River, and Breece sites was fashioned from the same ceramic resources more consistently than was pottery found in the Sandhills. Smith and Herbert (2004) propose that the greater chemical and mineralogical variability observed for the Sandhills samples indicates that either (a) pottery recovered from Fort Bragg sites was imported into the Sandhills, presumably from the Piedmont but possibly from Coastal Plain areas as well, or (b) clay and temper resources in the Fort Bragg region of the Sandhills are more chemically and mineralogically variable than their Piedmont and Coastal Plain counterparts.

The results of the Phase II ceramic raw materials survey suggest that regardless of the chemical and mineralogical variation that may characterize Sandhills clays, it is highly unlikely that local clays were used to fashion the pottery found at Woodland sites on Fort Bragg. Clays in general, but especially clays suitable for making low-fired earthenwares, do not appear to be locally abundant in the Fort Bragg region of the Sandhills. However, higher quality clays are available to the north in the lower Haw River basin and to the west and south in the middle Cape Fear and Coastal Plain Pee Dee basins.

Furthermore, our personal experiences demonstrate that finding a suitable potting clay source in an unfamiliar landscape would have been very costly in terms of time and energy. We therefore submit that the value of pots to Woodland people occupying the Sandhills was probably much greater than we assumed prior to this study. We also suggest that once a suitable clay source was discovered, it would have become a valuable, perhaps even guarded, resource, the extraction of which would likely have been scheduled into seasonal activities. Alternatively or additionally, ceramic vessels may have become important commodities of exchange between Sandhills groups and their Piedmont and Coastal Plain neighbors.

Of course, we have yet to conclusively demonstrate the exact region of the source area or areas from which raw clay was obtained for making Sandhills pots. We remain optimistic that planned chemical and petrographic analyses of our fired test tiles and additional sherd samples will provide new information pertaining to this still unresolved question of ultimate provenience. Nonetheless, recognizing why locally available clays were not exploited in the Sandhills represents a significant step toward understanding the decisions that shaped Woodland period pottery-making practices in this region.

References Cited

Arnold, Dean E.
1985 *Ceramic Theory and Cultural Process*. Cambridge University Press, Cambridge.

Bieber, A. M. Jr., D. W. Brooks, G. Harbottle, and E. V. Sayre
1976 Application of multivariate techniques to analytical data on Aegean ceramics. *Archaeometry* 18:59–74.

Binns, Charles F.
1947 *The Potter's Craft*. Third Edition. D. Van Nostrand Company, Inc., New York.

Bishop, R. L. and H. Neff
1989 Compositional data analysis in archaeology. In *Archaeological Chemistry IV*, edited by R. O. Allen, pp. 576–586. Advances in Chemistry Series 220, American Chemical Society, Washington, D.C.

Bjørn, Arne
1969 *Exploring Fire and Clay: Man, Fire, and Clay Through the Ages*. Van Nostrand Reinhold Company, New York.

Gunn, Joel D.
2002 Steep Shore, Deadly Environment: A Case for a Cultural Anvil Along the Unembayed Atlantic Coast. *North Carolina Archaeology* 51:1–33.

Harbottle, G.
1976 Activation analysis in archaeology. *Radiochemistry* 3:33–72. The Chemical Society, London.

Hathaway, J. C.
1972 Regional Clay Mineral Facies in Estuaries and Continental Margin of the United States East Coast. Memoir 133. In *Environmental Framework of Coastal Plain Estuaries*, edited by B. W. Nelson, pp. 293–316. Geological Society of America, Boulder, CO.

Herbert, Joseph M. and Jeffrey D. Irwin
2003 *Compositional Variability in Prehistoric Native American Pottery from the North Carolina Sandhills: Research Design*. Report submitted to ERDC-CERL, Champaign, Illinois.

Irwin, Jeffrey D. and William S. Culpepper
2000 Prehistoric Land Use in the North Carolina Sandhills. Paper presented at the 57th Annual Meeting of the Southeastern Archaeological Conference, Macon, Georgia.

Jones, George T., Charlotte Beck, Eric E. Jones, and Richard E. Hughes
2003 Lithic Source Use and Paleoarchaic Foraging Territories in the Great Basin. *American Antiquity* 68:5-38.

Kelly, Robert L.
1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington.

Neff, Hector
2002 Quantitative techniques for analyzing ceramic compositional data. In *Ceramic Production and Circulation in the Greater Southwest: Source Determination by INAA and Complementary Mineralogical Investigations*, edited by D.M. Glowacki & H. Neff, pp. 15-36. Monograph 44, Cotsen Institute of Archaeology, UCLA.

Neff, Hector, Frederick J. Bove, Brenda L. Lou P., and Michael F. Piechowski
1992 Ceramic Raw Materials Survey in Pacific Coastal Guatemala. In *Chemical Characterization of Ceramic Pastes in Archaeology*, edited by Hector Neff, pp. 59-84. Prehistory Press, Madison, Wisconsin.

Neiheisel, J., and C. E. Weaver
1967 Transport and Deposition of Clay Minerals, Southeastern United States. *Journal of Sedimentary Petrology* 37:1084-1116.

Olive, W. W., A. F. Chleborad, C. W. Frahme, J. Shlocker, R.R. Schneider, and R. L. Schuster
1989 *Swelling Clays Map of the Coterminous United States*. 1 sheet, 1:7,5000,000. Miscellaneous Investigations Series Map I-1940. U.S. Geological Survey, Reston, Virginia.

Pevear, D. R.
1972 Source of Recent Nearshore Marine Clays, Southeastern United States. Memoir 133. In *Environmental Framework of Coastal Plain Estuaries*, edited by B. W. Nelson, pp. 317–355. Geological Society of America, Boulder, Colorado.

Rice, Prudence M.
1987 *Pottery Analysis: A Sourcebook*. The University of Chicago Press, Chicago.

Ries, Heinrich
1927 *Clays: Their Occurrence, Properties, and Uses, with Especial Reference to Those of the United States and Canada*. John Wiley and Sons, Inc., New York.

Russo, Mary J., Bruce A. Sorrie, Brian van Eerden, and Tracy. E. Hippensteel
1993 *Rare and Endangered Plant Survey and Natural Area Inventory for Fort Bragg and Camp Mackall Military Reservations, North Carolina*. The Nature Conservancy, Carrboro, and The North Carolina Natural Heritage Program, Raleigh. Submitted to XVIII Airborne and Fort Bragg, Fort Bragg, DoD Contract M67004-91-D-0010. Ms. on file at the XVIII Airborne and Fort Bragg, Cultural Resource Management Office, Fort Bragg.

Sayre, E. V.
1975 *Brookhaven Procedures for Statistical Analyses of Multivariate Archaeometric Data*. Brookhaven National Laboratory Report BNL-23128. New York.

Schafale, M. P., and A. S. Weakley
1990 *Classification of the Natural Communities of North Carolina, Third Approximation*. North Carolina Natural Heritage Program, Raleigh.

Smith, Michael, S.
2003 *Patterns in the Mineral and Chemical Composition of Metavolcanic Stone and Pottery: A Pilot Study for Identifying Raw Material source Areas for Prehistoric Artifacts from Fort Bragg, North Carolina*. Report submitted to TRC Garrow Associates, Inc., Durham, and Fort Bragg Cultural Resources Program, Fort Bragg, North Carolina.

Smith, Michael and Joseph M. Herbert
2004 Clay Source Areas and Woodland Land Use in the Carolina Sandhills. Paper presented at the 2004 joint meeting of the Southeastern Archaeological Conference and the Midwestern Archaeological Conference, St. Louis.

Speakman, Robert J., and Michael D. Glascock
2002 *Instrumental Neutron Activation Analysis of Metavolcanic Rocks from the Vicinity of Fort Bragg, North Carolina*. Report submitted to TRC Garrow Associates, Inc., Durham, and Fort Bragg Cultural Resources Program, Fort Bragg.

Steponaitis, Vincas P., M. James Blackman, and Hector Neff
1996 Large-Scale Patterns in the Chemical Composition of Mississippian Pottery. *American Antiquity* 61(3):555–572.

Windom, H. L., W. J. Neal, and K. C. Beck
1971 Mineralogy of Sediments in Three Georgia Estuaries. *Journal of Sedimentary Petrology* 41(2):497–504.

Zug, Charles G., III
1986 *Turners and Burners: The Folk Potters of North Carolina*. The Fred W. Morrison Series in Southern Studies. University of North Carolina Press, Chapel Hill.

Appendix A. Provenience and Description of Phase I Sherd Samples.

Sample	Site	Drainage	Provenience	Pottery Type	Culture Period	Chemical Group	Mineral Group
JMH001	31Hk868	Lower Little	522n778e	Hanover Fabric Impressed	Middle-Late Woodland	4	3
JMH002	31Ht392	Lower Little	TU 2	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH003	31Ht273	Lower Little	TU 2	Hanover Fabric Impressed	Middle-Late Woodland	2	3
JMH004	31Hk127	Lower Little	surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH005	31Hk59	Lower Little	surface	Hanover Cord Marked	Middle Woodland	3	3
JMH006	31Hk123	Lower Little	surface	Yadkin Fabric Impressed	Middle Woodland	1	1
JMH007	31Cd750	Lower Little	TU 4	Hanover Paddle-edge Overstamped	Middle Woodland	4	3
JMH008	31Ht269	Lower Little	TU 2	Hanover Cord Marked	Middle Woodland	2	3
JMH009	31Cd486	Lower Little	A&C	Cape Fear Cord Marked	Middle Woodland	4	3
JMH010	31Hk715	Lower Little	TU 2	Hanover Fabric Impressed	Middle-Late Woodland	unx	3
JMH011	31Mr241	Drowning Creek	TU 2b	Hanover Cord Marked	Middle Woodland	3	3
JMH012	31Mr259	Drowning Creek	shovel test	Hanover Fabric Impressed	Middle-Late Woodland	4	3
JMH013	31Mr241	Drowning Creek	TU 6	Deptford Linear Check	Middle Woodland	4	3
JMH014	31Mr253	Drowning Creek		Yadkin Fabric Impressed	Early-Middle Woodland	unx	2b

Appendix A, cont.

Sample	Site	Drainage	Provenience	Pottery Type	Culture Period	Chemical Group	Mineral Group
JMH015	31Mr241	Drowning Creek	TU 7	Sand-tempered Plain	Early-Middle Woodland	unx	3b
JMH016	31Sc71	Drowning Creek	Surface	Hanover Paddle-Edge Overstamped	Middle Woodland	2	3
JMH017	31Mr93	Lower Little	TU 2	New River Cord Marked	Early Woodland	unx	3b
JMH018	31Sc87	Drowning Creek	Surface	Deptford Check Stamped	Middle Woodland	3	3
JMH019	31Mr93	Lower Little	TU 2	Hanover Cord Marked	Middle Woodland	4	3
JMH020	31Mr241	Drowning Creek	Surface	Hanover Cord Marked	Early Woodland	3	3
JMH021	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Paddle-Edge Overstamped	Middle Woodland	3	3
JMH022	31Cd8 (Breece)	Haw-Cape Fear	Surface	New River Fabric Impressed	Early Woodland	unx	3b
JMH023	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH024	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH025	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Cord Marked	Middle Woodland	3	3
JMH026	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH027	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH028	31Cd8 (Breece)	Haw-Cape Fear	Surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3

Appendix A, cont.

Sample	Site	Drainage	Provenience	Pottery Type	Culture Period	Chemical Group	Mineral Group
JMH029	31Cd8 (Breece)	Haw-Cape Fear	surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH030	31Cd8 (Breece)	Haw-Cape Fear	surface	Hanover Fabric Impressed	Middle-Late Woodland	3	3
JMH031	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Yadkin Fabric Impressed	Early-Middle Woodland	5	1
JMH032	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Dan River Simple Stamped	Late Woodland	1	2a
JMH033	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Yadkin Fabric Impressed	Early-Middle Woodland	5	2a
JMH034	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Genrette Plain (Bruton?)	Contact period	1	2a
JMH035	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	New River Cord Marked	Early Woodland	unx	2b
JMH036	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	New River Net Impressed	Early Woodland	5	2b
JMH037	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Yadkin Check Stamped	Early-Middle Woodland	unx	2b
JMH038	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	New River Cord Marked	Early Woodland	unx	2b
JMH039	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Dan River Net Impressed	Late Woodland	2	2b
JMH040	31Mg22 (Doerschuk)	Yadkin-Pee Dee	wall slump	Yadkin Net Impressed	Early-Middle Woodland	5	2b
JMH041	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Paddle-edge Stamped	Early-Middle Woodland	2	2b
JMH042	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Cord Marked	Early-Middle Woodland	2	2b

Appendix A, cont.

Sample	Site	Drainage	Provenience	Pottery Type	Culture Period	Chemical Group	Mineral Group
JMH043	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Plain	Early-Middle Woodland	2	2b
JMH044	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Fabric Impressed	Early-Middle Woodland	unx	2b
JMH045	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Plain	Early-Middle Woodland	5	2b
JMH046	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Plain	Early-Middle Woodland	1	1
JMH047	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin eroded	Early-Middle Woodland	1	1
JMH048	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Plain	Early-Middle Woodland	5	2b
JMH049	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin Plain	Early-Middle Woodland	unx	2b
JMH050	31Ch29 (Haw River)	Haw-Cape Fear	plowzone	Yadkin eroded	Early-Middle Woodland	2	2b

Appendix B. Provenience of Phase II Clay Samples.

Sample	Northing	Easting	General Location	Drainage
1	3896570	0688812	Fort Bragg	Lower Little River
2	3887458	0677832	Fort Bragg	Lower Little River
3	3892165	0674316	Fort Bragg	Lower Little River
4	3894404	0674308	Fort Bragg	Lower Little River
5	3896330	0669883	Fort Bragg	Lower Little River
6	3879046	0648897	Fort Bragg	Lumber River
7	3880183	0655285	Fort Bragg	Lower Little River
8	3888792	0662959	Fort Bragg	Lower Little River
9	3892747	0665640	Fort Bragg	Lower Little River
10	3896332	0669869	Fort Bragg	Lower Little River
11	3884406	0695950	Breece site	Haw-Cape Fear
12	3884925	0695785	Breece site	Haw-Cape Fear
13	3885783	0695881	Breece site	Haw-Cape Fear
14	3883886	0694988	Breece site	Haw-Cape Fear
15	3884023	0694950	Breece site	Haw-Cape Fear
16	3885187	0694580	Breece site	Haw-Cape Fear
17	3903843	0681641	Overhills	Lower Little River
18	3903844	0681603	Overhills	Lower Little River
19	3805454	0618115	Kolb site	Yadkin-Pee Dee
20	3805299	0617891	Kolb site	Yadkin-Pee Dee
21	3804557	0617277	Kolb site	Yadkin-Pee Dee

Appendix B, cont.

Sample	Northing	Easting	General Location	Drainage
22	3804963	0620363	Kolb site	Yadkin-Pee Dee
23	3814785	0609741	Kolb site	Yadkin-Pee Dee
24	3805177	0620459	Kolb site	Yadkin-Pee Dee
25	3806036	0620260	Kolb site	Yadkin-Pee Dee
26	3806380	0620093	Kolb site	Yadkin-Pee Dee
27	3804425	0617564	Kolb site	Yadkin-Pee Dee
28	3950457	0672311	Haw River site	Haw-Cape Fear
29	3950470	0672279	Haw River site	Haw-Cape Fear
30	3946847	0673360	Haw River site	Haw-Cape Fear
31	3945995	0673247	Haw River site	Haw-Cape Fear
32	3955697	0671194	Haw River site	Haw-Cape Fear
33	3955697	0671194	Haw River site	Haw-Cape Fear
34	3953162	0676533	Haw River site	Haw-Cape Fear
35	3953225	0676289	Haw River site	Haw-Cape Fear
36	3953225	0676289	Haw River site	Haw-Cape Fear
37	3960071	0677576	Haw River site	Haw-Cape Fear
38	3963409	0678625	Haw River site	Haw-Cape Fear
39	3963491	0679059	Haw River site	Haw-Cape Fear
40	3963491	0679059	Haw River site	Haw-Cape Fear
41	3955654	0679577	Haw River site	Haw-Cape Fear
42	3974555	0677701	Morgan Creek	Haw-Cape Fear

Appendix B, cont.

Sample	Northing	Easting	General Location	Drainage
43	3974619	0677779	Morgan Creek	Haw-Cape Fear
44	3976552	0683043	New Hope Creek	Haw-Cape Fear
45	3976465	0683045	New Hope Creek	Haw-Cape Fear
46	3920259	0588642	Doerschuk site	Yadkin-Pee Dee
47	3919683	0588766	Doerschuk site	Yadkin-Pee Dee
48	3918363	0588424	Doerschuk site	Yadkin-Pee Dee
49	3919007	0589049	Doerschuk site	Yadkin-Pee Dee
50	3918787	0588793	Doerschuk site	Yadkin-Pee Dee
51	3918787	0588793	Doerschuk site	Yadkin-Pee Dee
52	3918739	0588663	Doerschuk site	Yadkin-Pee Dee
53	3916353	0587073	Doerschuk site	Yadkin-Pee Dee
54	3916353	0587073	Doerschuk site	Yadkin-Pee Dee
55	3916289	0586491	Doerschuk site	Yadkin-Pee Dee
56	3915713	0585659	Doerschuk site	Yadkin-Pee Dee
57	3916505	0585337	Doerschuk site	Yadkin-Pee Dee

Appendix C. Performance Characteristics of Phase II Clay Samples.

Sample	General Description	Workability	Coil Test	Loop Test	Ball Test	Test Tile
1	strong brown silty clay	lean	breaking		cracking	No
2	red clayey silt	lean	breaking		deep cracking	No
3	yellowish red sandy and clayey silt	lean	breaking		cracking	No
4	slightly silty and blocky light gray clay with yellowish red and brown mottles	lean	breaking	sagging	cracking	No
5	black silty clay with some fine sand and grit	mod. lean	cracking	retains shape	cracking	No
6	white clay with reddish brown, light reddish brown, and orange mottles	lean	breaking		cracking	No
7	brownish yellow silty clay	lean	breaking	sagging	cracking	No
8	white clay with red and orange mottles	lean	breaking		cracking	No
9	light greenish gray silty clay with a few orange and red mottles	lean	breaking		deep cracking	No
10	gray clayey silt	lean	breaking	sagging	cracking	No
11	grayish brown clay with some orange mottles, sand, and grit	good	no breaking/ cracking	retains shape	no cracking	Yes
12	stiff gray clay with yellowish and gray-brown mottles, some fine sand, and an occasional piece of gravel	good	no breaking/ cracking	retains shape	no cracking	Yes
13	gray clay with yellowish brown mottles, fine sand, and grit	mod. lean	no breaking/ cracking	retains shape	cracking	Yes
14	brown clay with a trace amount of very fine sand	good or fat	no breaking/ cracking	retains shape	no cracking	Yes
15	dark grayish brown clay with dark yellowish brown clay forming on outside	mod. lean	no breaking/ cracking	sagging	cracking	No

Appendix C, cont.

Sample	General Description	Workability	Coil Test	Loop Test	Ball Test	Test Tile
16	light yellowish brown clay with some orange mottles and water soluble argillaceous structures	mod. lean	no breaking/ cracking	sagging	cracking	Yes
17	mottled gray and yellowish brown clay with a little bit of fine sand	good	no breaking/ cracking	retains shape	no cracking	Yes
18	gray silty clay with yellowish brown and red mottles and argillaceous structures	mod. lean	breaking	retains shape	cracking	No
19	gray clay with brownish orange mottles and a very small amount of fine sand and grit	good	no breaking/ cracking	retains shape	no cracking	Yes
20	yellowish brown clay with some gray mottles and a tiny amount of grit	good	no breaking/ cracking	retains shape	no cracking	Yes
21	gray clay with a very small amount of fine sand and organics	good	no breaking/ cracking	retains shape	no cracking	Yes
22	stiff brown clay with gray and yellowish brown mottles and some fine and medium sand and organics	good	no breaking/ cracking	retains shape	cracking	Yes
23	stiff brown clay with gray and yellowish brown mottles and a very small amount of very fine sand	good	no breaking/ cracking	retains shape	no cracking	Yes
24	brown clay with yellowish brown and gray mottles, some fine sand, and argillaceous structures	fat?	no breaking/ cracking	sagging	no cracking	Yes
25	dark grayish brown clay with abundant reddish brown small lumps or grit, some fine sand, and argillaceous structures	fat?	no breaking/ cracking	significant sagging	no cracking	Yes
26	stiff clay with yellowish brown, orange, and gray mottles and fine sand, grit, and organics	mod. lean	Cracking	sagging	cracking	Yes

Appendix C, cont.

Sample	General Description	Workability	Coil Test	Loop Test	Ball Test	Test Tile
27	yellowish brown clay with argillaceous structures and grit	good	no breaking/ cracking	sagging	no cracking	Yes
28	slightly silty clay with gray and reddish brown mottles and yellowish brown hard gravel- and pebble-sized chunks of quartz, feldspar(?), and hematite(?)	mod. lean	no breaking/ cracking	sagging	no cracking	Yes
29	brown silty clay with grit and gravel and pebble-sized inclusions (clay 1); light yellowish brown silty clay with gray and orange mottles and gravel- and pebble-sized inclusions (clay 2)	mod. lean	breaking	significant sagging	cracking	Yes
30	yellowish brown clay with greenish gray and red mottles, grit, a lot of gravel, and pebble-sized aplastic inclusions	mod. lean	breaking	significant sagging	cracking	Yes
31	olive yellow clay with fine sand, gravel- and pebble-sized quartz, and possible argillaceous structures	mod. lean	no breaking/ cracking	significant sagging	cracking	No
32	dark grayish brown silty clay with some grit	mod. lean	no breaking/ cracking	significant sagging	cracking	No
33	grayish silty clay with yellowish brown mottles, some grit, and organics	mod. lean	breaking	significant sagging	no cracking	No
34	brownish yellow clay with a little fine sand, grit, and organics	mod. lean	cracking	retains shape	cracking	Yes
35	very stiff orange clay with yellowish brown and gray mottles and fine sand	good	no breaking/ cracking	retains shape	cracking	Yes
36	yellowish brown very sandy clay with greenish gray mottles	mod. lean	cracking	retains shape	cracking	Yes
37	brown clayey silt with fine sand, grit, and organics	mod. lean	cracking	significant sagging	cracking	Yes

Appendix C, cont.

Sample	General Description	Workability	Coil Test	Loop Test	Ball Test	Test Tile
38	stiff yellowish brown mottled clay with some yellow and gray near bottom and a slight amount of very fine sand	mod. lean	cracking	retains shape	cracking	Yes
39	gray clay with a few yellowish brown and red mottles and a slight amount of very fine sand	good	no breaking/ cracking	retains shape	cracking	Yes
40	olive yellow clay with fine sand	good	no breaking/ cracking	retains shape	no cracking	Yes
41	tannish gray, very sandy clay with yellowish brown mottles	good	no breaking/ cracking	sagging	cracking	Yes
42	greenish gray, very sandy clay with dark yellowish brown mottles	mod. lean	no breaking/ cracking	significant sagging	cracking	Yes
43	brown clay with some orange mottles, fine to medium sand, and organics	mod. lean	cracking	retains shape	deep cracking	Yes
44	gray clay with yellowish brown mottles and some very fine sand	mod. lean	cracking	sagging	cracking	Yes
45	yellowish brown very silty clay with fine sand	mod. lean	no breaking/ cracking	significant sagging	cracking	Yes
46	yellowish brown silty clay with fine and medium sand and organics	mod. lean	cracking	significant sagging	cracking	No
47	brown very silty clay with yellowish brown mottles and some fine sand	lean	cracking	significant sagging	cracking	No
48	greenish gray silty clay with very fine sand and organics	mod. lean	cracking	significant sagging	cracking	Yes
49	gray clay with dark yellowish brown mottles, silt, very fine sand, and organics	mod. lean	no breaking/ cracking	significant sagging	cracking	Yes
50	olive gray very silty clay with some fine sand and a lot of organics	lean	breaking	cannot even make ring	cracking	No

Appendix C, cont.

Sample	General Description	Workability	Coil Test	Loop Test	Ball Test	Test Tile
51	olive gray very silty clay with some fine sand and organics	mod. lean	no breaking/ cracking	significant sagging	cracking	No
52	olive brown silty clay with fine sand and organics	mod. lean	cracking	significant sagging	cracking	No
53	silty clay with yellowish brown and greenish gray mottles and fine sand	mod. lean	cracking	sagging	cracking	No
54	grayish green silty clay with fine sand	mod. lean	cracking	significant sagging	cracking	No
55	gray silty clay with fine sand	mod. lean	cracking	significant sagging	cracking	No
56	gray very silty clay with a lot of fine sand and organics and mixed with some lumpy reddish brown clay	mod. lean	breaking	significant sagging	cracking	No
57	olive gray silty clay with some fine sand and organics	lean	cannot even make coil	cannot even make ring		No

Appendix D. OSA Site Form III : Revisit to Site 31Mg14

PERMANENT SITE NO. 31MG14

ARCHAEOLOGICAL SITE FORM III

Archaeology Branch, N.C. Division of Archives and History
109 E. Jones St., Raleigh, N.C. 27611

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1. Project site:

2. Other site #:

3. Site name:

4. Institution: **101 Fort Bragg**

5. Date recorded: 11-01-04

6. PI/Recorder: Joseph M. Herbert

7. Project name: ARPA Permit 62

8. ER/CH #:

9. County: Montgomery

10. USGS quad: Badin (B79)

11. UTM coordinates (NAD83):
17 Northing: 3915713 Easting: 0585659

12. Directions to site: The site is on the northeastern, inland, tip of the large island on the left bank of the Pee Dee immediately downstream of the confluence of the Uwharrie into the Yadkin River.

13. Describe topography: The island consists of a deltaic alluvial bench that is currently only a foot or two above the water level of the Pee Dee. The topo map shows a thin isthmus connecting what was, at the time the map was made, a peninsula. That isthmus has been cut by river action, and the peninsula is now an island. A not insignificant portion of the site must have been destroyed by this erosion as the artifacts recovered in this study we all found on a submerged shelf along the shoreline of the new channel.

14. Describe vegetation / visibility: Trees on the island are very large mature hardwoods with moderate under-story vegetation.

15. Site description / dimensions: this site was not tested and therefore no information is available regarding its total size. The artifacts recovered along the eroding bank were clustered in what were clearly identifiable feature assemblages. Fire-cracked rock hearths were plainly evident along the eroding shoreline of the new channel spreading over an area of about 30–40 meters.

16. Test excavations? no No., size and placement:

17. List artifacts: (separated by a semi-colon): see attached table

18. Cultural components: Woodland (Yakin phase) and Archaic (Guilford phase) diagnostics were recovered in different locations along the shoreline. The FCR hearths and the metate recovered appear to be associated with the Guilford component.

19. Place artifacts stored: **Office of State Archaeology** 20. Acc. #s 240430

21. Research potential: This site has outstanding research potential. Multiple components appear to be horizontally segregated and the geomorphological setting suggests a very high probability for there to be vertical stratigraphic zonation of buried cultural components.

22. Recommendations for further work: This site should be protected by every measure available to the staff of the Office of State Archaeology and the professional community. It has the potential to be extremely valuable for understanding chronological aspects of the Guilford and Yadkin phases, both of which are very much in need of chronometric data.

23. Describe site condition: Cultural deposits appear to be buried to depths of at least two feet. The overburden of sediment is relatively free of artifacts. A zone of spatially concentrated artifacts about two feet below the surface appears to mark a stratigraphically sealed cultural deposit. The sediment below the cultural stratum is noticeably different than that above, suggesting different environmental conditions before and after the cultural materials were deposited.

24. National Register significance: My recommendation, based on this very minimal amount of information, is that the site has the potential to be eligible for nomination to the NRHP.

25.Owner / tenant / informant: **Based on information presented on the quad map, the island on which the site is located appears NOT to be within the Uwharrie National Forest. It is not known if the land is privately owned.**

ATTACH PHOTOCOPY OF USGS QUAD MAP, SHOWING SITE LOCATION

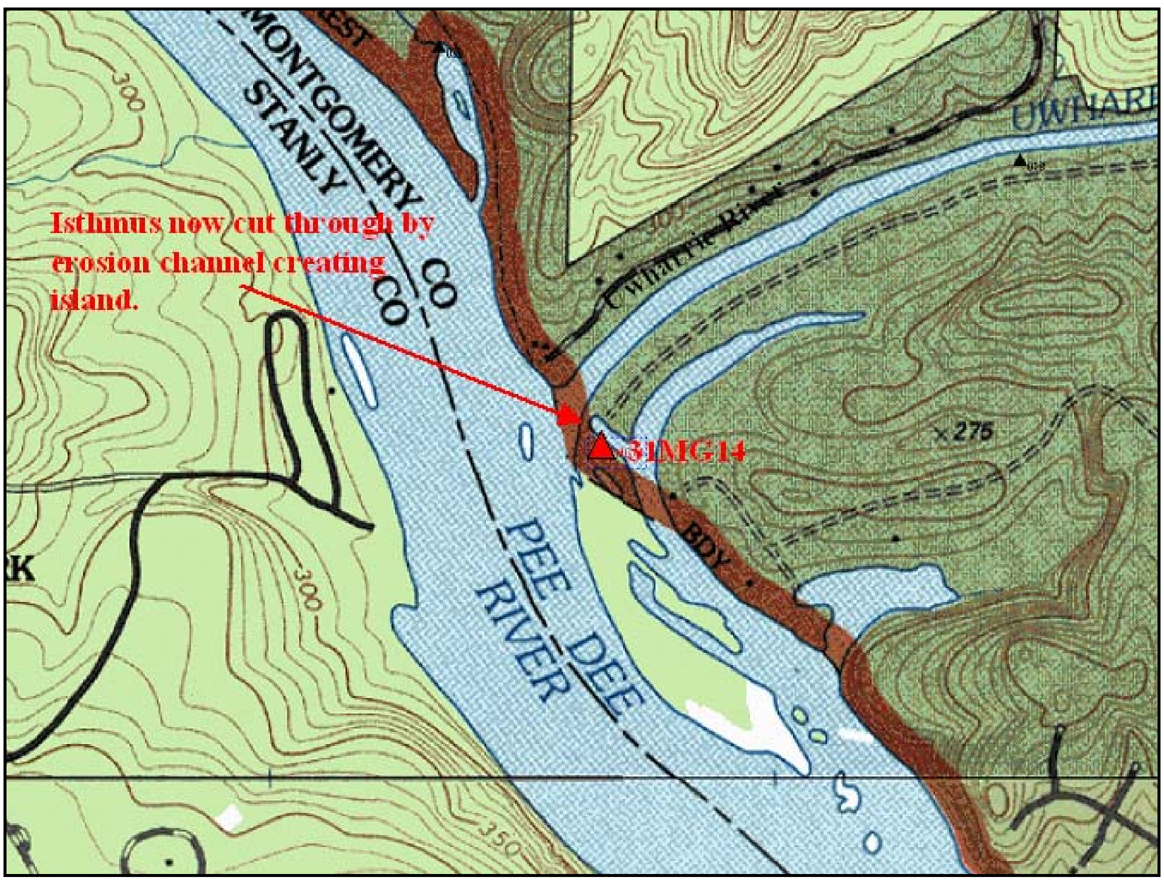

Figure 14. Location of the artifacts recovered along the eroded bank and shoreline of site 31MG14, illustrated on the Badin USGS 7.5' series quadrangle map. Artifact recovery location is shown as a red triangle. UTM coordinates (NAD 83) for artifacts are Zone 17N 3915713N, 585659E.

SPECIMEN CATALOG
OFFICE OF STATE
ARCHAEOLOGY
NORTH CAROLINA
DIVISION OF ARCHIVES
AND HISTORY

Accession No.240430
Site Number:31MG14
Recorder: J. Herbert
Date: 11-01-04

Spec. No.	Location	Number	Description
240430p1	General surface	3	Yadkin Cord Marked
240430m2	General surface	1	Projectile point base, Guilford, metavolcanic
240430m3	General surface	2	Early-stage bifaces, metavolcanic
240430m4	General surface	2	Biface fragments, metavolcanic
240430m5	General surface	1	core, metavolcanic
240430m6	General surface	3	core debris, quartz
240430m7	General surface	2	core debris, metavolcanic
240430m8	General surface	10	Primary reduction flakes, metavolcanic
240430m9	General surface	6	Early reduction flakes, metavolcanic
240430m10	General surface	9	Late reduction flakes, metavolcanic
240430m11	General surface	8	Fire-cracked rock, metavolcanic
240430m12	General surface	4	Fire-cracked rock, quartz
240430m13	General surface	1	Metate, metavolcanic