CLAY SOURCE AREAS AND WOODLAND LAND USE IN THE CAROLINA SANDHILLS

by

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and
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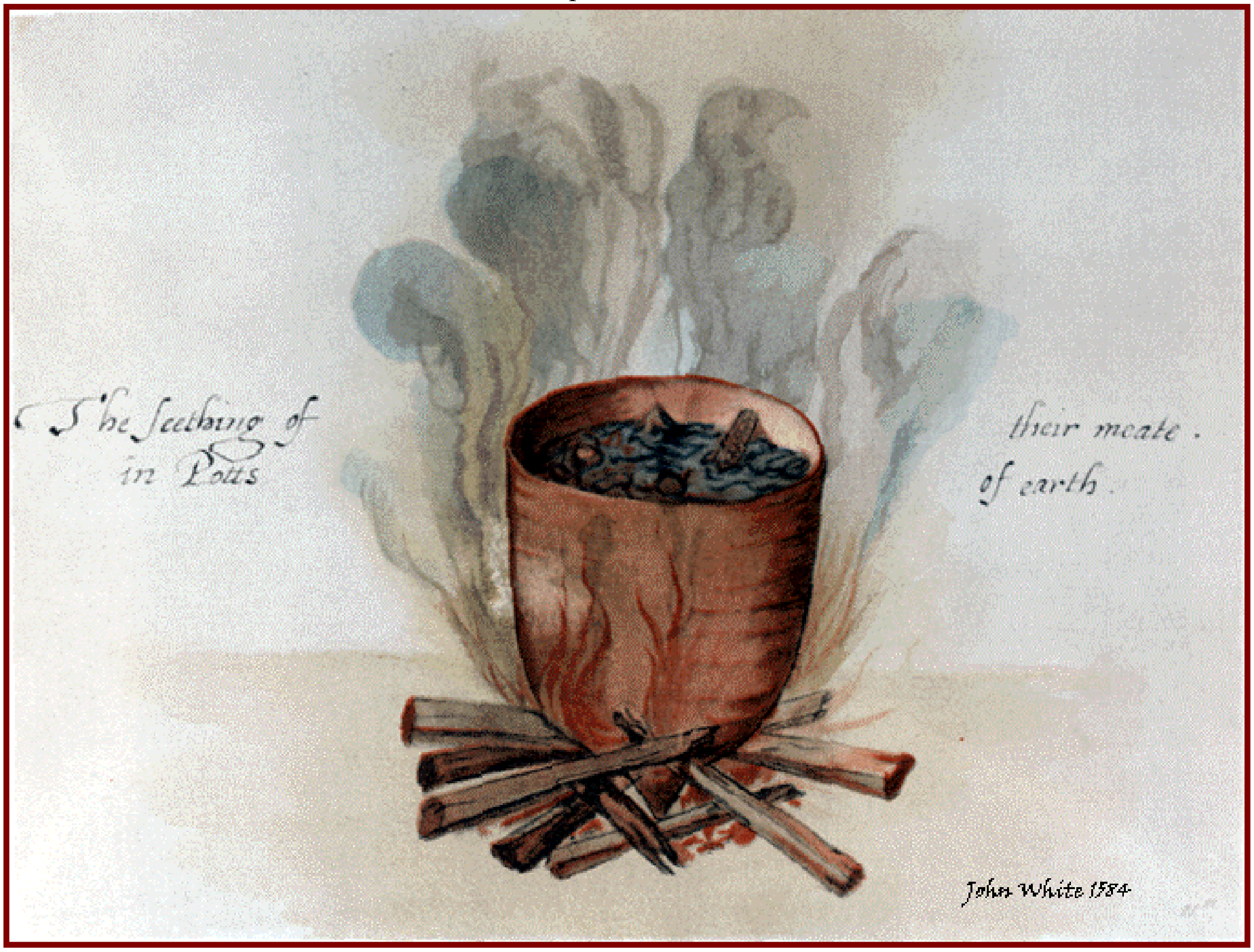

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Abstract. *Pottery from sites in the North Carolina Sandhills is compared to that of adjacent Coastal Plain and Piedmont sites to explore patterns of residential mobility and land use during the Woodland era. Chemical data from neutron activation analyses reveal several distinctive regional clay-source areas. Mineralogical data from petrographic analyses and local geology help to explain the sources of chemical variation. Higher chemical and mineralogical diversity of pottery found on sites in the North Carolina Sandhills suggests that vessels were often transported over substantial distances to the sites where they were last used and abandoned.*

This paper is one of a set of two, presented at the 50th Midwest Archaeological Conference and the 61st Southeastern Archaeological Conference, St. Louis, Missouri, that examine residential Woodland period in the North Carolina Sandhills through the analysis of pottery (Figure 1). Our research attempts to establish if pottery found on Sandhills sites was transported into the area from surrounding regions and, if so, we hope to identify the regions from which it originated. We establish some baseline information about the constituents of pottery and, by logical extension, the clays of the Sandhills and surrounding regions. We begin by comparing the mineral and chemical constituents of pottery from sites in the Sandhills and surrounding regions, and follow in the second paper with an evaluation of the suitability of the clay found near the sites from which our pottery samples are drawn. In short, our study consists of an effort to narrow the range of possible clay source areas for pottery found in the North Carolina Sandhills.

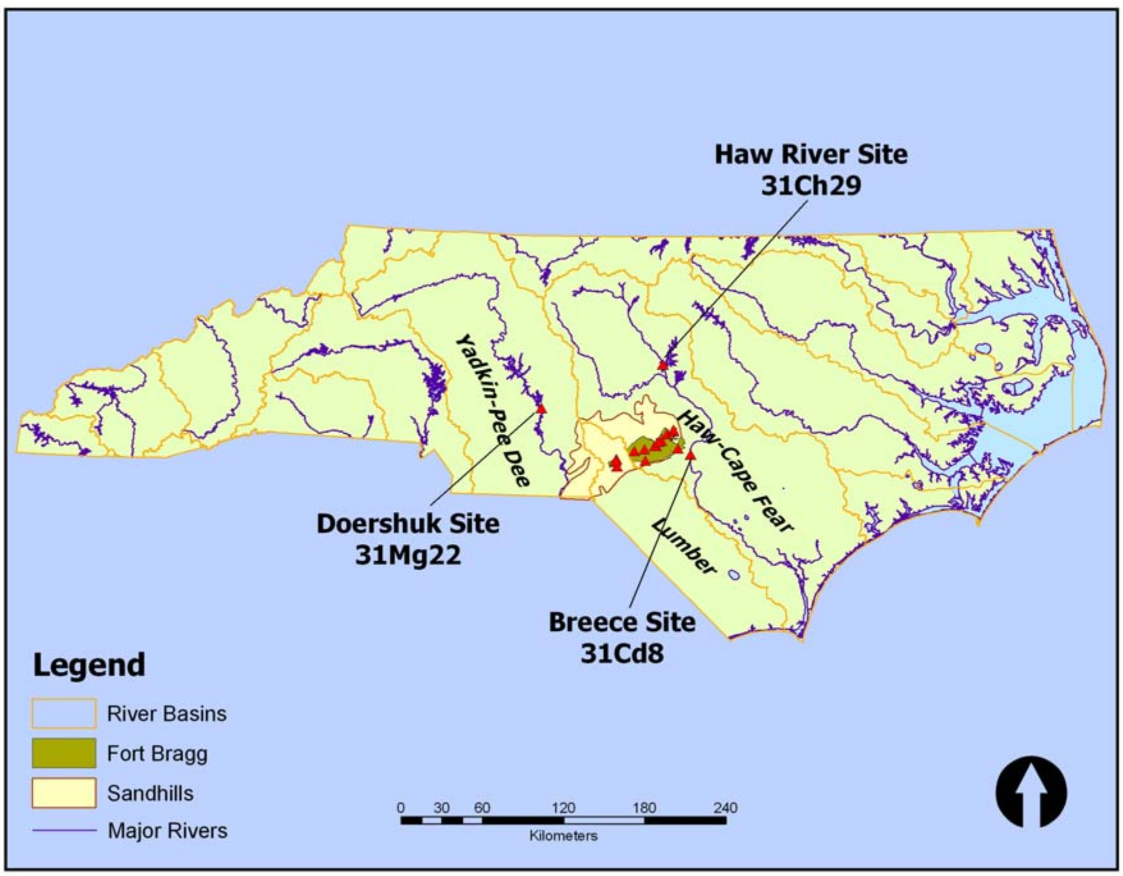
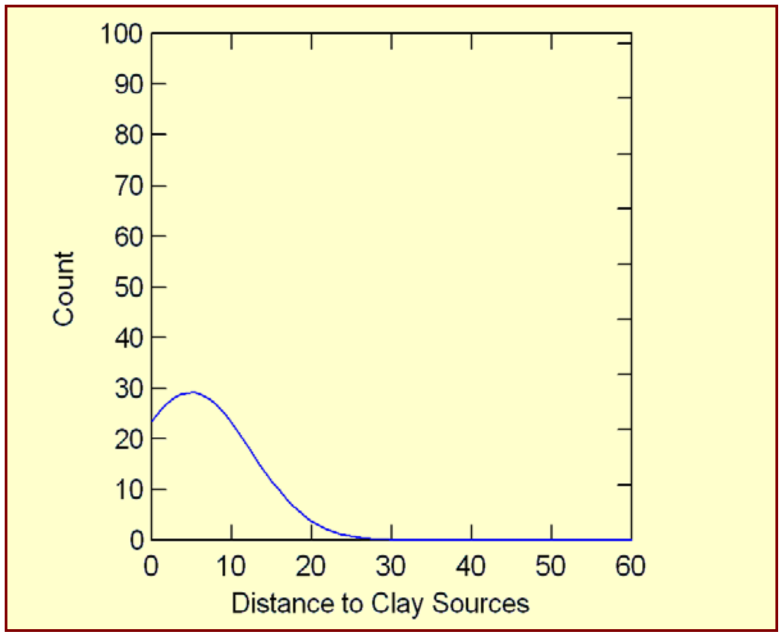


Figure 1. Study area showing the site locations within three river basins in and around Fort Bragg and the North Carolina Sandhills.

The design, testing, and interpretation of research questions regarding hunter-gatherer resource utilization, are shaped by several assumptions derived from relevant ethnohistoric, ethnographic, and archaeological information. On the basis of ethnohistoric evidence, we assume that our sherds are fragments of vessels that were produced at the household level probably by women who procured clay locally (Arnold 1985:101-103; Hudson 1976:264; Skibo and Schiffer 1995). We assume that the production sequence consisted of (1) obtaining and preparing clay and temper, (2) constructing, (3) drying, and (4) firing the vessel (Rice 1987; Rye 1981) — a process typically requiring several days to complete. Based on information from modern potters (Zug 1986:145), we assume the ratio of container capacity to raw clay weight is roughly one-pint capacity per pound of clay. Judging from this, a cook pot of one-gallon capacity would require about eight pounds of clay to produce. Using data from a sample of 108 ethnographies of potters worldwide (Arnold 1985), we find the average distance from clay sources to potters' households is typically less than 5 km (Figure 2). If these observations are applicable to the prehistoric hunter-gatherers, and a least-cost economic argument is appropriate, then we can assume that pots were very likely made at sites located near sources of suitable clay. Although there seems to be no reason to doubt that vessels were conveyed from manufacturing locations to distant sites where they were used and discarded, in general, the pottery found in a given region will tend to reflect the resources of that region.



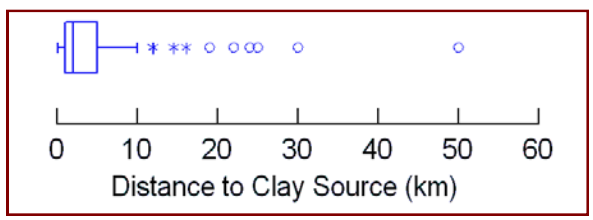


Figure 2. Line graph and box plot showing the distances (km) of ethnographic potteries to their respective clay source locations. Total number of ethnographic cases is 108 (data from Arnold 1985).

Our understanding of the Sandhills as a marginal resource region also influences models of prehistoric human ecology. Located in the upper Coastal Plain, the Sandhills have been referred to as the "Pine Barrens," "Pine Plains," or even the "Sahara of the Carolinas." The sedimentary Cretaceous terraces composing the Sandhills lie east of the Orangeburg scarp, and consist primarily of deeply weathered, acidic sands, dissected by gently sloping streams and narrow wetlands (Figure 3). Pine-savannah, and pine-scrub oak communities are the most common vegetation on the interfluves (Russo et al. 1993; Schafale and Weakley 1990) (Figure 4). Mixed hardwoods, and small stream swamps characterize the bottomlands (Figure 5). We can conclude that subsistence resources available to hunter-gatherers in the Sandhills were probably patchy, dispersed, and focused in the wetlands.

episodes of occupation and the small size of procurement parties suggests foraging strategies characterized by high residential mobility over a broad geographic range. We know from ethnographic and archaeological studies that the foraging ranges of hunter-gatherers inhabiting regions with higher resource density than that 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 (Irwin and Culpepper 2000). The majority of projectile points from any period are made of non-local materials, most often metavolcanic rock from Piedmont quarries 30 or more miles away.

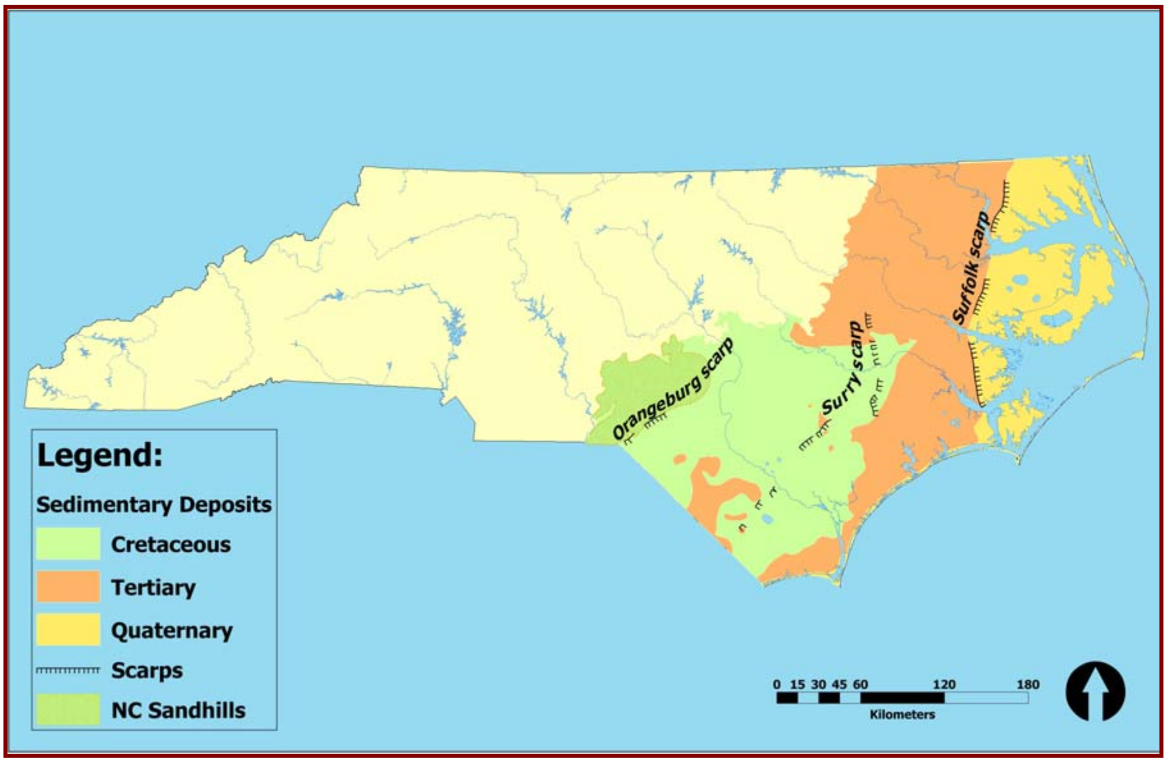


Figure 3. Sedimentary deposits of the North Carolina Coastal Plain illustrating the location of scarps that demarcate the inland extents of deposits of various ages.

Archaeological sites on Fort Bragg typically consist of a small number of artifacts exhibiting low typological diversity that suggests short-term site occupation and limited activities. The apparent shortness of

So, we assume that (1) pots were made near clay sources, and that (2) hunter-gatherer residential mobility was high. We would now like to turn to the ceramic study itself.

Figure 4. Pine-savannah and pine-scrub oak communities are the most common vegetation on Sandhills interfluves.

Figure 5. Mixed hardwoods and small stream swamps characterize the Sanhills bottomlands.

Sampling Strategy and Methods

The ceramic sample used in this project consisted of 50 archaeological potsherds drawn from 19 sites situated in three different major river drainages, the Haw-Cape Fear, the Lumber, and the Yadkin-Pee Dee basins encompassing both Piedmont and Coastal Plain provinces (Figure 6). Ten potsherds were drawn from the Haw River site (31Ch29) to represent the eastern Piedmont source area of the lower Haw River 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. This sample represents a clay source area in the middle Cape Fear basin on the upper Coastal Plain. 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. This sample represents the eastern Piedmont source area of the lower Yadkin River. In addition, 12 sherds were drawn from ten sites on Fort Bragg in the Lower Little River basin in Cumberland, Hoke and Harnett Counties. These samples represent the Sandhills area of the upper Coastal Plain. Eight sherds were also drawn from six sites on Camp Mackall in the Drowning Creek basin of Moore and Scotland Counties. This sample is also from the Sandhills area of the upper Coastal Plain, although only that portion within the upper reaches of the Lumber River basin.

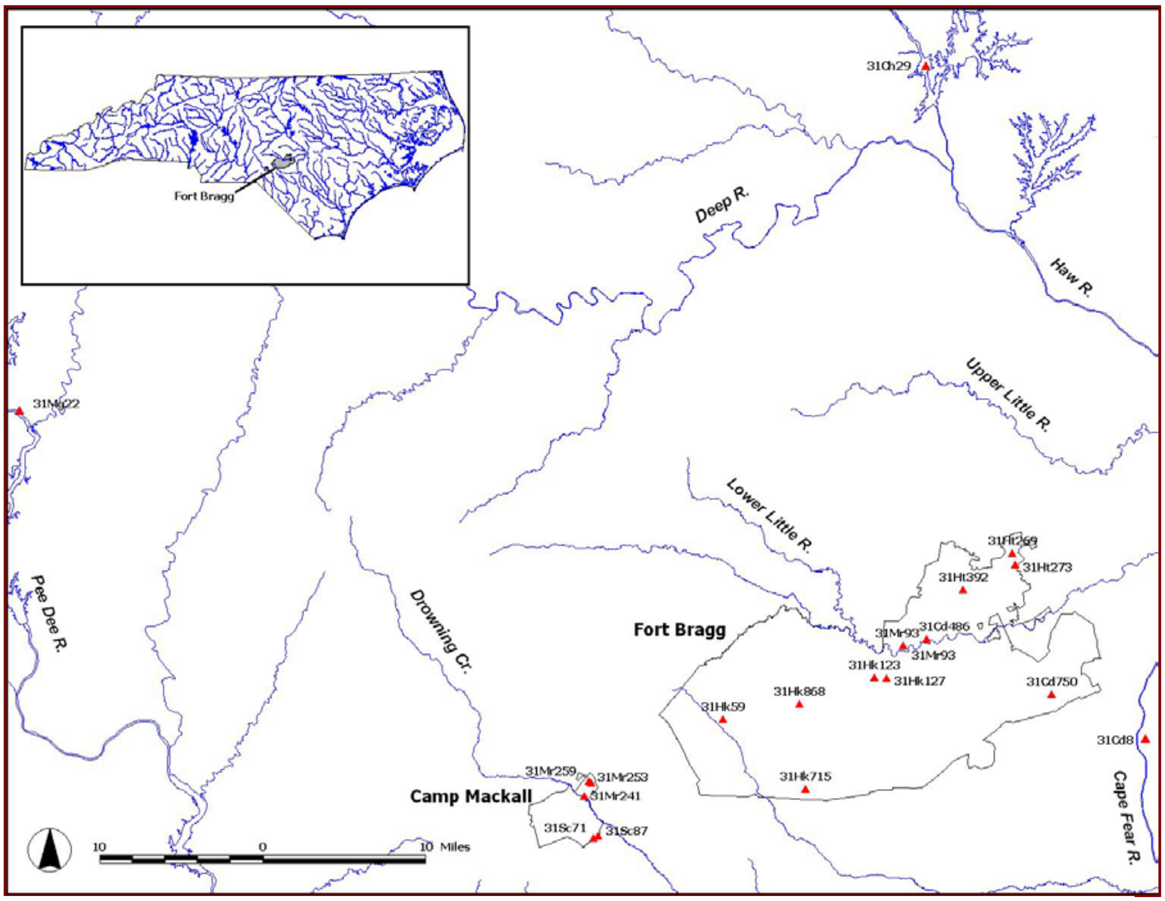


Figure 6. Locations of 19 sites from which the sample of 50 archaeological potsherds was drawn.

Together, samples represent the clay resources in five regions including three different river valleys. They also reflect the differences that 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. 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 in-situ marine sediments deposited on the upper Coastal Plain in the Cretaceous.

Results of the Instrumental Neutron Activation Analysis

As a first step in characterizing the clay resources in each study region, neutron activation analysis was conducted on the 50-sherd sample. As none of the sherds were tempered with shell or limestone, it was not necessary to apply corrective measures to account for variability in calcium and strontium. Likewise, although varying amounts of quartz sand added as temper does introduce the problem of dilution, the results of previous studies indicate that distortions caused by quartz temper are generally not great enough to obscure broad geographic patterns (Steponaitis et al. 1996:559).

The chemical analysis produced elemental concentration values for 32 or 33 elements in most samples (Figure 7). These data were explored by standard procedures to assess the similarity and dissimilarity among the regions sampled (Bieber et al. 1976; Bishop and Neff 1989; Harbottle 1976: 42-60; Neff 2002; Sayre 1975; Speakman and Glascock 2002). Principal components analysis of the 50-specimen data set indicated that there were five recognizable compositional groups. Ten specimens remained unassigned.

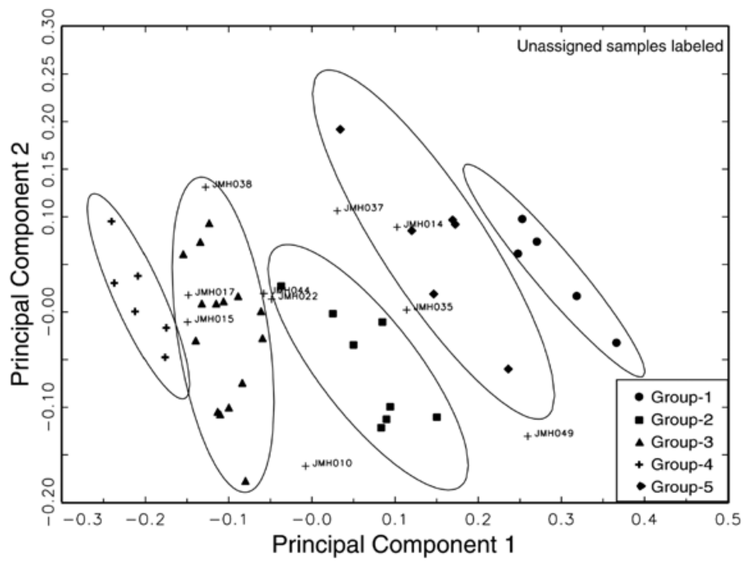


Figure 7. Principal components analysis of elemental concentration values for 32 or 33 elements in the 50-sepcimen data set. Probabilities of compositional-group membership calculated on the first three principal components provides over 77% of the total variation. Five recognizable groups compositional groups emerged, with ten specimens unassigned.

Probabilities of compositional-group membership calculated on the first three principal components provide over 77% of the total variation. It is clear that probabilities were influenced by small sample size; therefore, subjective criteria were used along with the Mahalanobis distance calculations in assigning specimens to a compositional group. The five-group structure in the data set appears on the first two principal components of the dataset variance-covariance matrix (Figure 8). The groups separate primarily along Principal Component 2, which expresses a large share of the variation in calcium concentrations in the data. Groups 3 and 4 are low in calcium, while Groups 1, 2, and 5 are high in calcium.

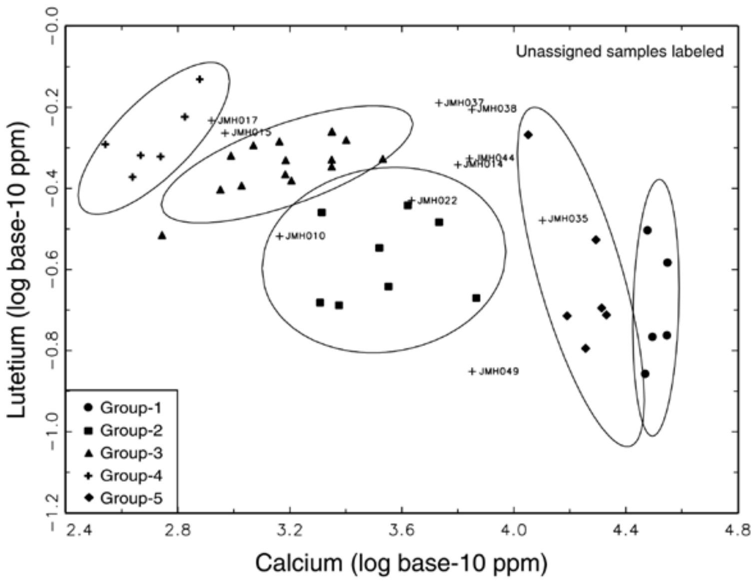


Figure 8. The five-group structure, appearing on the first two principal components of the dataset variance-covariance matrix, expresses a large share of the variation in calcium concentrations.

Approximately seventy-five percent of the samples from the Doershuk and Haw River sites have membership in Groups 1,2, or 5 (Figure 9). The five remaining samples from these sites are unassigned but also have high calcium, sodium, and manganese concentrations. It would appear that the distance between these sites (about 60 miles) argues against vessel exchange between occupants of the two sites. The similarity of group-composition profiles appears to represent the influence of calcium-rich materials derived from Piedmont resources. As will be described below, the mineralogical data indicate that the source of the calcium is not calcareous clay, but is in fact calcium- and potassium-rich rock inclusions, probably added to the clay as temper. Nevertheless, it is clear that the chemical signatures of our ceramic samples from Piedmont sites are distinctive when compared to those from sherds recovered on Sandhills or Coastal Plain sites.

The geographic distribution of chemical groups among samples shows that the Coastal Plain sample of 10 sherds is very homogeneous; all nine assignable samples are members of Group 3. Seventy-five percent of the samples found on Fort Bragg sites are assigned to low-calcium groups Groups 3 and 4. Eight percent of the Fort Bragg sample is assigned to high-calcium Groups 1 or 2. So, the chemical data suggest that either the clay sources in the North Carolina Sandhills are quite variable, or pots are moving into the Sandhills from both Piedmont and Coastal Plain sources.

Results of the Mineralogical Petrographic Analysis

Thin sections were made from each of the 50 pottery samples used in the neutron activation chemical analysis and were examined using standard petrographic practices (Smith 2003) (Figure 10). On the basis of mineralogical data, the samples were separated into three categories: (1) sherds including mostly of pyroxene and plagioclase derived from igneous rock, (2) sherds including quartz, feldspar, biotite, muscovite, amphibole, and opaque minerals and felsic igneous rock fragments where the variation among sherds is controlled by the amount of mafic and opaque minerals; and (3) sherds that contain-muscovite mica and monocrystalline quartz minerals with 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 containing pyroxene and

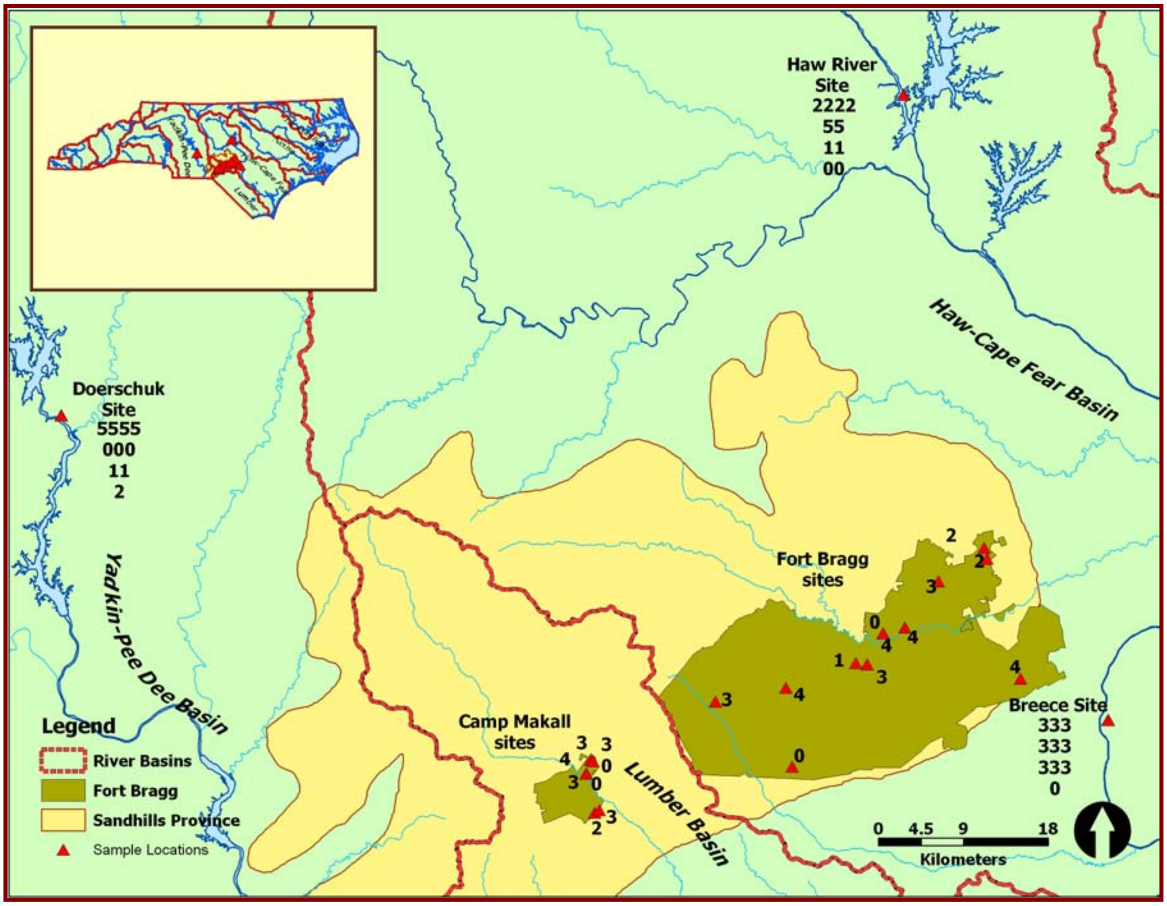
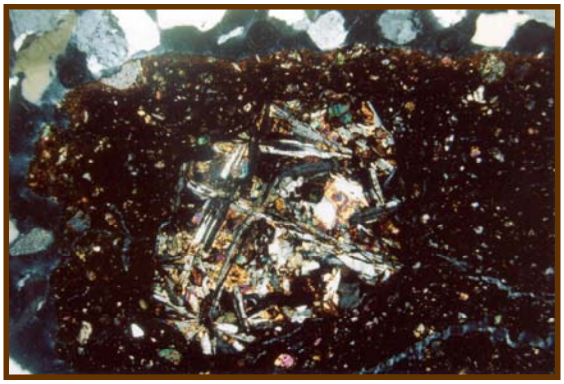


Figure 9. Distribution of chemical group members among the sites sampled shows that Piedmont sites (Haw River and Doerschuk) represent specimens with calcium-rich inclusions. Samples from the Coastal Plain (Breece) and Sandhills comprise mostly low-calcium and low-sodium constituents. Notably, a few high-calcium samples, possibly originating in the Piedmont, were found in the Sandhills.

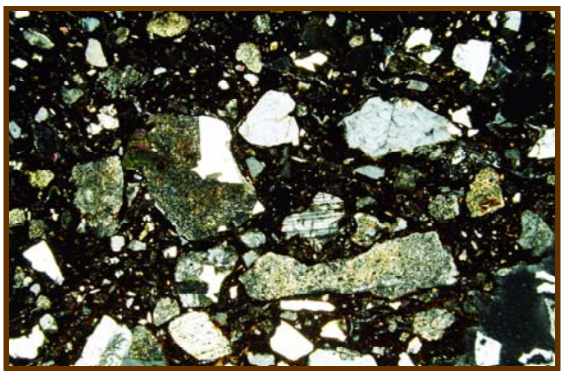
plagioclase minerals, as well as individual mineral grains of pyroxene and plagioclase. These minerals and rock fragments were probably derived from the Jurassic-age diabase dikes that crosscut eastern and central Piedmont North Carolina. The ceramic matrices of these sherds consist of about 30% diabase rock fragments, some of which are in nearly pristine condition suggesting a source close to an exposure of the diabase, while other samples exhibit diabase fragments that appear to be more highly weathered (Smith 2003:6). Almost certainly, the single Group-I sherd found on Fort Bragg was derived from a vessel made in the eastern Piedmont.

Group II is subdivided into two subgroups based primarily on mineral composition, especially variation in the amount of amphibole, muscovite, biotite and opaque minerals. The first subgroup includes three sherds from the Doerschuk site. The matrixes of these sherds include fragments of either polygranular quartz rock, or igneous rock composed of quartz, microline, plagioclase, amphibole, muscovite, and biotite minerals. The second subgroup consists of fourteen sherds predominantly from the Haw River and Doershuk sites. The major aplastic components of this group are quartz,

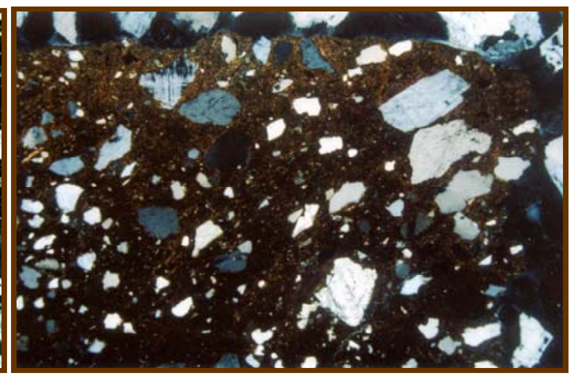


<u>Group I</u> (2.5 X, cross-polarized): Note large diabase rock fragment added to clay as a tempering agent.

<u>Group IIa</u> (2.5X, cross-polarized): Note igneous rock fragment (right), quartz, palgioclase, muscovite and biotite mica.



<u>Group IIb</u> (2.5X, cross-polarized): Weathered igneous rock fragments with less mafic minerals and more quartz, plagioclase and potassium feldspar.



<u>Group III</u> (2.5X, cross-polarized): Most angular grains are monocrystalline quartz, but a few are polygranular quartz grains, feldspar, and microcline.

Figure 10. Fifty-specimen sample was separated into three categories bsed on mineralogical data.

feldspar, biotite, amphibole, and opaque minerals as well as both igneous and polygranular quartz rock fragments. The primary petrographic distinction between this subgroup and the first is that the majority of the igneous rock fragments have little or no mafic minerals and their quartz and feldspar rock and mineral fragments are often heavily altered, suggesting that they were derived from a felsic, plutonic source.

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

The geographic distribution of mineral groups among the sherd-sample sites generally replicates the pattern illustrated by the chemical data (Figure 11). Group I is represented by four Middle Woodland Yadkin series sherds tempered with crushed diabase rock fragments. Two of the Group I sherds are from the Haw River site, one from Doerschuk, and one from Fort Bragg. Group IIa is represented by three sherds from the Doerschuk site.

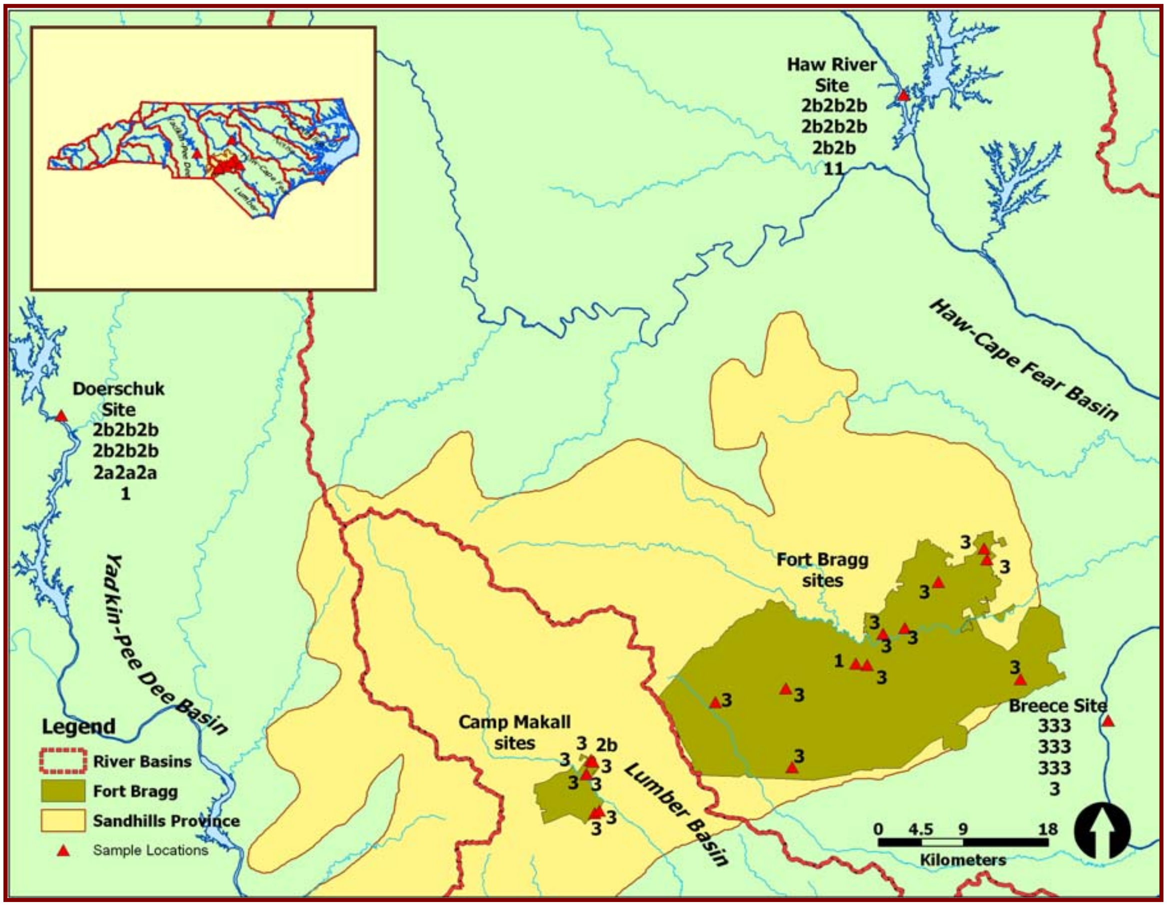


Figure 11. The geographic distribution of mineral groups among the 50-sherd sample generally supports the pattern discovered in the chemical data.

One is Contact period Genrette Plain, one Late Woodland Dan River Simple Stamped and one Middle Woodland Yadkin Fabric Impressed. Mineral Group IIb are almost exclusively represented among the sherds from the Doershuk and Haw River sites. All of the Breece site sherds sampled are Middle Woodland Hanover series, and classified as mineral Group III.

The mineralogical and chemical data also differ only 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. As a result, 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.

Nevertheless, although the petrographic data explain the source of variation in chemical composition among the 50 sherds, the basic pattern of differentiation identified in the neutron activation study was little altered by the mineralogical data (Table 1). 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 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 tentatively classified as Yadkin series. The typological definition for the Yadkin series specifies crushed rock temper — in this case, crushed igneous rock composed of high-calcium minerals (for example, plagioclase). Sherds tempered primarily with sand and grit or sand and grog are mostly found in mineral Group III.

Table 1. Crosstabulation of Chemical and Mineral 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

Summary and Conclusions

In summary, these facts and conclusions have emerged from this phase of the study.

•All pottery samples from the two Piedmont sites were calcium/sodium rich as a result of igneous rock inclusions, and all pottery from the Coastal Plain site, lacking igneous rock inclusions, were calcium/sodium poor.

• A few of the 20 sherds sampled from Sandhills sites exhibited high calcium/sodium values, but most exhibited low calcium/sodium values.

• The igneous rock fragments in Group I sherds are identifiable as diabase that crops out in very restricted locations, whereas Group II and III sherds include mostly granitic rock fragments, common throughout the Piedmont.

• Pots made in the Piedmont were being conveyed to sites in the Sandhills.

• Pots made in the Coastal Plain may have been conveyed into the Sandhills, but pots made in the Sandhills or Coastal Plain were not moving into the Piedmont.

• Pots tempered with diabase were being conveyed east and west within the Piedmont and south into the Sandhills.

Thus, recalling our original hypotheses that pots were made near the sources of clay, and that Sandhills hunter-gatherer groups employed a strategy of high residential mobility, we can add that they seem often to have traveled with ceramic vessels. The diversity of chemical and mineral constituents in pottery from the Sandhills indicates that although some vessels likely originated in the Piedmont, it may also be that clay resources in the Sandhills are more diverse. The fact that the chemical and mineral compositions of Sandhills sherds are quite similar to those from the Coastal Plain limits our ability to determine if in fact pots were also moving into the Sandhills from the Coastal Plain. One way of discriminating variation in clay resources, as opposed to variation in cultural practices regarding vessel conveyance, is to subject representative clay samples to the same analytical procedures as the potsherds, and this is, in fact, what we have planned for the near future. Meanwhile, the question of why particular clays were selected — the anthropological question of interest — requires that we understand more about the way specific clay resources perform technologically. We would like to refer you to the paper on this topic by Theresa McReynolds and Joseph M. Herbert, entitled *An Evaluation of the Utility of Carolina Clays for Woodland Potters,* also available on the Fort Bragg Cultural Resources Program web page.

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