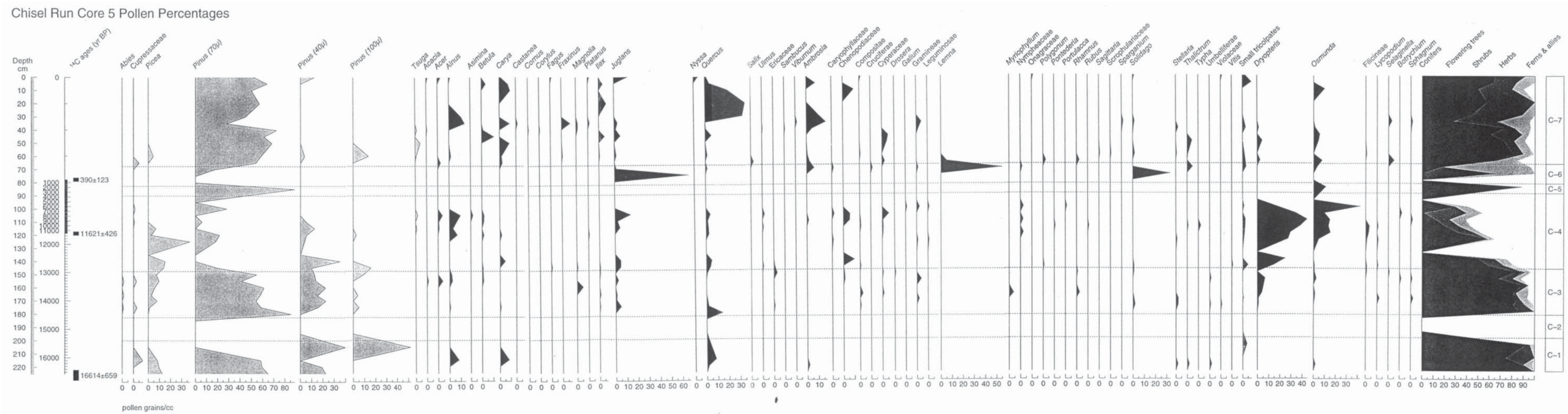

Figure 34. Site 44JC127, Core 5 pollen profile.

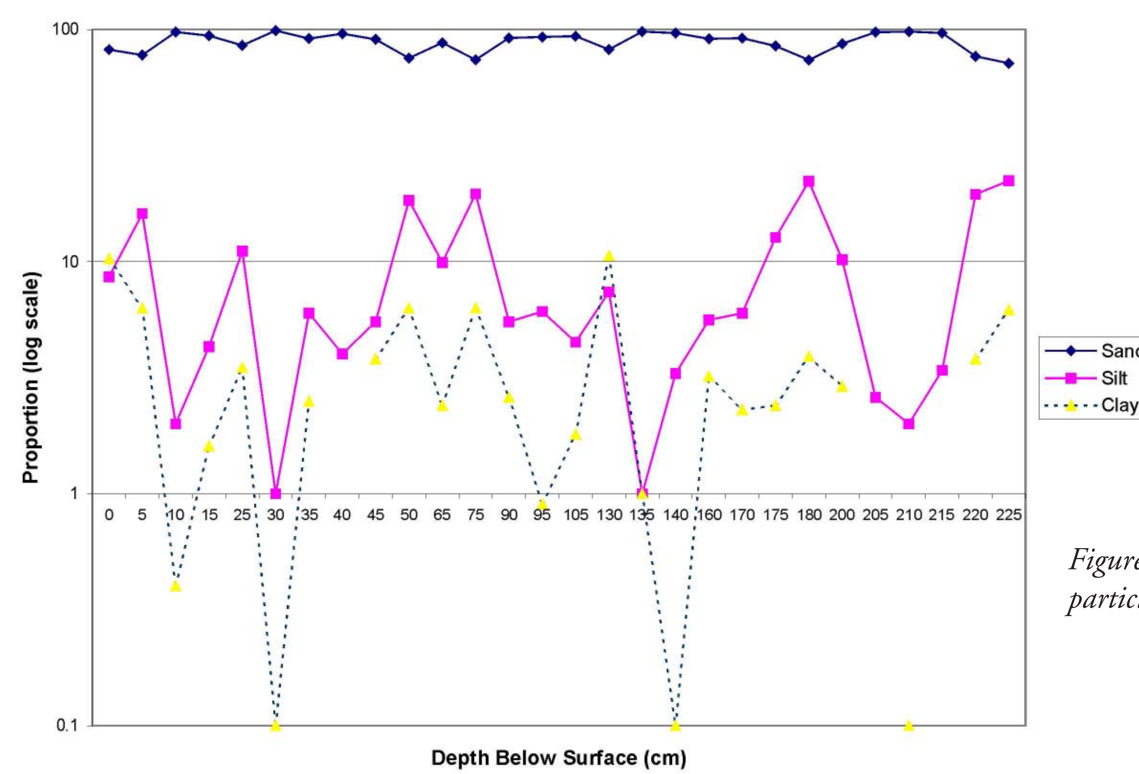

Figure 35. Site 44JC127, Core 5 particle size summary.

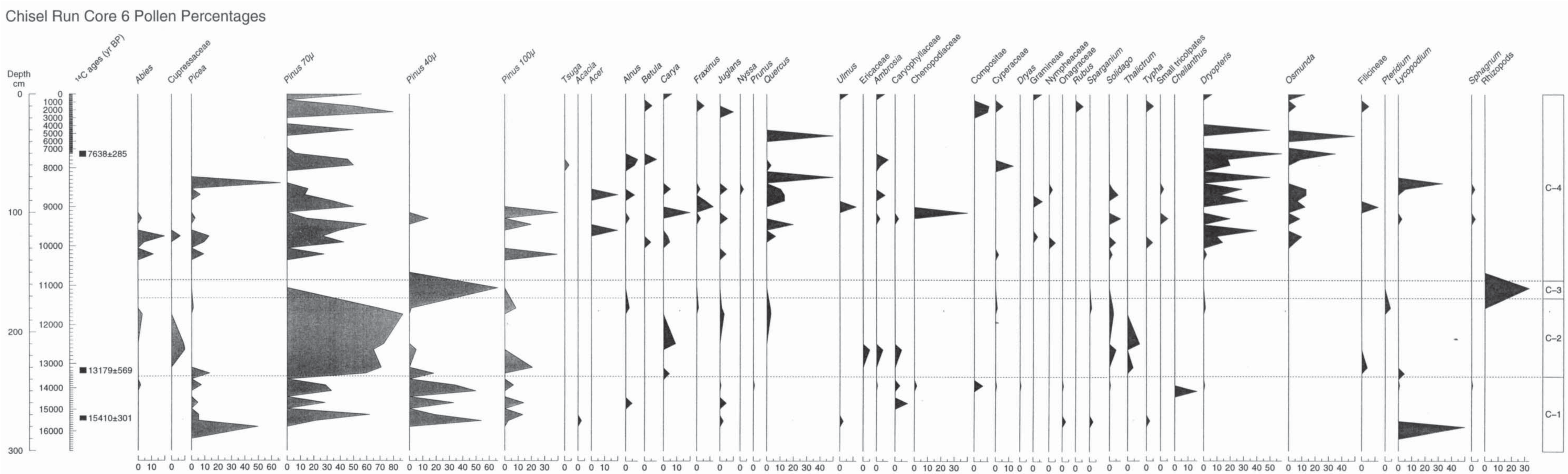

Figure 36. Site 44JC848, Core 6 pollen profile.

were contained in Core 6 (see Figure 33), ranging in color and texture like those in Core 5. Detailed, qualitative description of each stratum is provided in Table 17.

The five radiocarbon dates from this core all predate the mid-Holocene, with the latest assay measured at 7200±160 BP. They were chosen from the length of the column to provide temporal control over other results. The unexpectedly early 7200 BP date from only 50 cm deep, and the alternating earlier and later ages from the lower portion, indicate that some level of mixing has occurred in the deposits.

Depositional and Environmental History. Even taking into account the suspect sequence of dates, the lower half of this core also appears to represent the late Pleistocene period and the pollen profile supports this view (Figure 36). The upper portion is less distinctive and consists of fewer visible strata, but still generally is consistent with Holocene-era conditions.

Pleistocene-age radiocarbon dates were obtained from distinct strata between 150 cm and 275 cm deep, thus indicating that strata below about 140 cm are probably pre-Holocene in origin. The occurrence of pollen that is ordinarily associated with a Pleistocene-age deposits in even higher levels may be explained in part by disturbances. As noted, there is the potential that some mixing has occurred even in these lowest strata, indicated by a sequence of four radiocarbon dates that alternate rather than follow a logical sequence. Within the lower 170 cm, no less than 13 visible strata are represented (see Figure 33). The fairly regular, alternating sequence of coarse and fine sediments, like the pattern in Core 5, would indicate that discrete depositional packages are present and any mixing that has occurred in the lower depths has been minor.

Pollen grains of spruce, fir, small-grained pines, and birch tend to occur below about 1 m in the core. An exception is the occurrence of some spruce pollen at the higher depth of about 70 cm below surface. Whether this is best explained by disturbance in the deposit or to relict spruce is uncertain. It is possible that Pleistocene deposits survive below about 120 cm below surface, but the significant change at that depth, where the deposits become thoroughly homogenized (from disturbance?), prohibits accurate reconstruction. Regardless, it is safe to say that vegetation through the late Pleistocene-Holocene transition, or until about 10,000 years ago, was essentially a boreal forest of spruce-fir-pines and that the Chisel Run wetland within it consisted of a sedge marsh with some open water from time to time. This is largely consistent with the record in Core 5 although there is some indication of a slightly different wetland regime.

The uppermost 140 cm of the core consists of seven strata. Five of these (Strata III–VII) are compressed into the lower 20 cm of this portion, between 120–140 cm deep. Each consists of relatively fine sandy loams and silt, like the uppermost stratum (VIII) in the lower portion. The consistency in texture between the lowermost strata in the upper portion and the stratum marking the top of the lower portion, which yielded a late Pleistocene date, may indicate that they all date from the Pleistocene-Holocene transition. The greater part of this upper portion consists of only two distinct strata, together representing the uppermost 120 cm of the core. Stratum II, in particular, has the appearance of being thoroughly mixed. This lack of clear and alternating horizonation is not consistent with the pattern in Core 5 and, thus, may indicate significant disturbance in the upper portion.

The presence of boreal-type tree pollen up to about 100 cm below surface indicates that the lower portion of this upper section may also date to the late Pleistocene-Holocene transition. Beginning in the mixed Stratum II deposit, however, the character of the pollen profile changes and records a Holocene age shift to a riparian forest cover. This is especially apparent in the common occurrence of *Osmunda* and *Dryopteris* fern pollen, within a profile dominated by forest tree species like oak, large grain pine species, maple, and alder. Apparently the sedge marsh had closed by this time, after about 7,500 years ago, and the wetland became largely forested.

6: Summary and Interpretation of Results

The leading goal of this report is integration of archaeological survey, evaluation, and data recovery results relevant to Middle Woodland occupation of the James-York peninsula, with emphasis placed on VDOT-sponsored findings from Route 199–related studies. The notable increase in site density in this area coinciding with the Middle Woodland period has been appreciated since at least the late 1970s when cultural resource management work began to systematically identify local sites (Brown and Bragdon 2001). Surveys required for proposed Route 199 alternatives were among the first to document the pattern in the peninsula's interior (Hunter and Higgins 1985). Over the last two decades the body of information has continued to grow to the point James City and surrounding counties have one of the best-documented archaeological records in the region. Until now, synthesis of the accumulated information has been minimal.

In sections to follow, patterns evident in the impressive local record of Middle Woodland occupations will be summarized. An obvious strength of this record is spatial information generated by several large-area, systematic surveys, not to mention an even greater number of smaller ones. Results from tracts representative of the York River side of the peninsula (Higgins et al. 1989; Underwood et al. 2003) and the James River side (Blanton et al. 1999; Opperman and Polk 1989), as well as the interior section (Higgins 1988; Higgins and Gray 1997; Hunter and Higgins 1985; Hunter and Kandle 1986), combine to provide fairly representative coverage. As of 2000, VDHR site records for James City, York, and New Kent counties, and the cities of Newport News and Williamsburg, contain information on 964 sites with Middle Woodland components. These components occur at 26 percent of all recorded prehistoric sites. A good number of the identified Middle Woodland components have been subjected to evaluation-level investigation. Twelve such investigations were part of the Route 199 cultural resource studies (Higgins and Deitrick 1996a, 1996b, 1996c, 1996d; Hunter et al. 1987; Underwood 1999). Colonial Williamsburg Foundation archaeologists have evaluated two small shell middens near Carter's Grove (McFaden 1996), the James River Institute for Archaeology examined a similar occupation nearby (44JC30) (Blanton and Wolf 2001), and more recently eight sites were evaluated at Naval Weapons Station Yorktown (Blanton and Underwood In preparation), among others. Another significant test excavation was sponsored by VDHR at Croaker Landing (44JC70) (Egloff et al. 1988). Only a small number of Middle Woodland components have been the object of intensive, data recovery investigation and most were carried out under VDOT sponsorship during Route 199 preparations. The most thorough of these at 44JC850 and 44JC972 are reported in this report.

That there was a burst of human activity on the peninsula after AD 1 is old news. Exactly why it occurred and the nature of the activity has been less clear. Unresolved have been the reasons settlement density jumped as it did, whether it was purely a local matter or one catalyzed by larger regional trends, and to what extent any of the observed patterns can be accounted for by stress due to population increase or movement, or environmental change. One specific problem under consideration in this work is the local meaning of the so-called Mockley spread, embodied by region-wide adoption of shell tempered over lithic tempered ceramics and an apparent cultural homogenization throughout the Chesapeake basin (Dent 1995; Potter 1993; Stewart 1992). Another is adding depth to our interpretation of the socioeconomic arrangements expressed by the pattern of increased settlement density, including in the interior, and the often confusing mix of ceramic wares on the same small sites. The value of these investigations extends beyond mere improvement of knowledge concerning activity during the Middle Woodland, for it provides a sense of the prelude to more complex developments in the ensuing millennium, culminating in the emergence of a complex chiefdom.

The remainder of this interpretive summary will offer the most recent understanding of these issues based on examination of cumulative Route 199 results within a regional context. Owing to the nature of the information that can be generated, the strengths of the overview lie in synthesis of settlement patterns, both at the level of broad area distribution and intra-site structure, and in comparative analysis of assemblages from intensively investigated sites. Perhaps the newest information is environmental, drawn from deep coring of interior wetlands and from exploratory analyses of on-site paleobotanical evidence.

Environmental Context

It is as much a mistake to believe environmental conditions do not influence human activity as it is to believe they account for all or most of what people do in a given time or place. Confronted with evidence of a relatively abrupt jump in activity in the Middle Woodland as regional archaeologists have been for some time, it should be natural to ask to what degree environmental circumstances either encouraged or accommodated the trend. Thorough analysis of several wetland cores and limited examination of phytolith and other evidence from specific sites helps us to secure a sense of what local conditions were like. Here the main findings of the work are summarized, based on more detail given in Chapters 2, 4, and 5.

Tidewater Virginia owes much of its present physical character to steady expansion of the Chesapeake estuary, and the same process has been a significant factor in forging wetland conditions along major drainages of the James-York peninsula for a few thousand years. By four or five thousand years ago sea level had risen to the point extensive new wetland areas were being created, although much of it was still freshwater wetland in the study area. Sometime between 3000 and 2000 BP the James and York rivers had become significantly brackish well up their trunks so that oysters and other marine shellfish became established, many wetlands became saltwater communities, and even more low-lying area was inundated. The timing of the salt water expansion and Middle Woodland activity on the peninsula are intertwined.

Oyster beds appear to have reached their near-modern ranges in the James and York rivers by 1500 BP judging from the locations of Middle Woodland middens. They were probably present in significant numbers at the lower end of the project area (i.e., eastern York County and Newport News) by at least 2000 BP. Historical, nineteenth century maps depicting the locations of the main oyster grounds indicate that their eventual upstream extent in the James was near Hog Island and in the York River it was approaching West Point, closely matching the upstream limit of prehistoric shell middens. There is no good evidence on the peninsula for even moderately intensive shellfish exploitation prior to the Middle Woodland period, but beginning with this period many shell middens, most of them small, are found up and down the lower reaches of estuarine tributaries (Blanton and Wolf 2001; Egloff et al. 1988; Geier and Barber 1983; McFaden 1996; Reinhart 1978).

While estuarine expansion introduced new food options to the area, it had the negative effect of reducing habitable land area and tainting former freshwater sources. These effects are especially evident in low-lying areas like Jamestown Island which lost much area and fresh water to expanding tidal wetlands (Blanton et al. 1999). There is an apparently related downturn in site frequency at Jamestown with the onset of the Woodland stage. At the same time, the noted expansion to interior uplands was occurring. However, if shellfish grounds were nearby, even low islands like Mulberry Island were occupied at least seasonally (Opperman and Polk 1989).

Coring results in interior wetlands do not document significant alterations that account for increased Middle Woodland settlement. There is indication of marked change from a less to more forested wetland at the end of the Pleistocene, about 10,000 BP, and then the reverse shift around 1000 BP. In other words, for about 9000 years following the end of the Pleistocene the Chisel Run wetlands consisted mainly of riparian forest dominated by oak, hickory, and pine, with an undergrowth of woodland ferns. The drainage seems to have been less subject to sedimentation and impoundment for this extended, early to middle Holocene period. The general implication is that the local setting was quite stable in the many millennia leading up to and extending through the Middle Woodland period. It is not until after AD 1000 that clear signs of human intervention emerge, specifically in the form of increased charcoal counts and resumption of high sedimentation rates.

To summarize, all present evidence indicates that local human populations were responding to a series of very gradual environmental changes linked mainly to ongoing expansion of the Chesapeake estuary. There is no evidence of major alteration of regional climate that meant profound shifts in the character of forests or seasonality. The human responses to these changes are probably best regarded as opportunistic ones, encouraged equally as much by demographic factors as by alteration of the natural environment. Aspects of the expanded estuary were fortuitous perhaps, and colored the direction local populations took for the next millennium. It is these issues that will concern much of the remaining discussion.

Middle Woodland Site Distribution

A series of VDOT-sponsored Route 199 surveys, which began as early as 1979 (MacCord 1979), figured prominently in building a base for assessing settlement patterns on the James-York peninsula during the Middle Woodland. Others sponsored by the National Park Service, The Colonial Williamsburg Foundation, and the U.S. Navy now combine to create an unusually representative data set for examining these patterns. As part of this analysis locational data for all prehistoric sites (n=964) recorded through 2000 at the VDHR for New Kent County, James City County/Williamsburg, York County, and Newport News were compiled for GIS-based study. The information quality is very uneven but basic patterns of site distribution can be discerned. In our estimation the two leading issues to be considered are evidence of the marked site density increase itself, and the apparent new emphasis on interior locations for small encampments.

Working with raw counts, Middle Woodland components comprise 48 percent (n=249) of all identifiable prehistoric components recorded on the James-York peninsula through 2000 (n=1,162) (Figure 37). (If all prehistoric components are considered, including those only listed in VDHR site files as "unidentifiable" (n=415), Middle Woodland components still represent the next most common category at 21%). The Middle Woodland components represent nearly a five-fold increase in frequency over Late Archaic components which are the most commonly identified component predating the Middle Woodland period. There are more than six times as many Middle Woodland components as Early Woodland. Middle Woodland components are also more common than Late Woodland occupations at a proportion of about 1.8 to 1.

More meaningful trends are evident if identifiable component frequency is graphed as number per century (Figure 38). A modest but very steady increase in component numbers is observable through the Early Woodland period. Such a pattern of gradual change is what might be anticipated for the entire prehistoric era, but the figure shows a dramatic upturn in component frequency beginning with the Middle Woodland. The change is measurable as a more than three-fold increase in the number of components created per century on the James-York peninsula. The distinctiveness of the Middle Woodland peak is reinforced by the fact that the incidence of Late Woodland components declines somewhat.

The next question to consider is how different Middle Woodland settlement distributions are relative to what came before and after. The present working sense of Middle Woodland settlement on the peninsula is a stronger interior orientation. To examine this issue using the large sample from VDHR site records, the distances of sites to the rivers defining the study area (i.e., the James, York, and Chickahominy) were computed for all components. Middle Woodland settlements do, indeed,

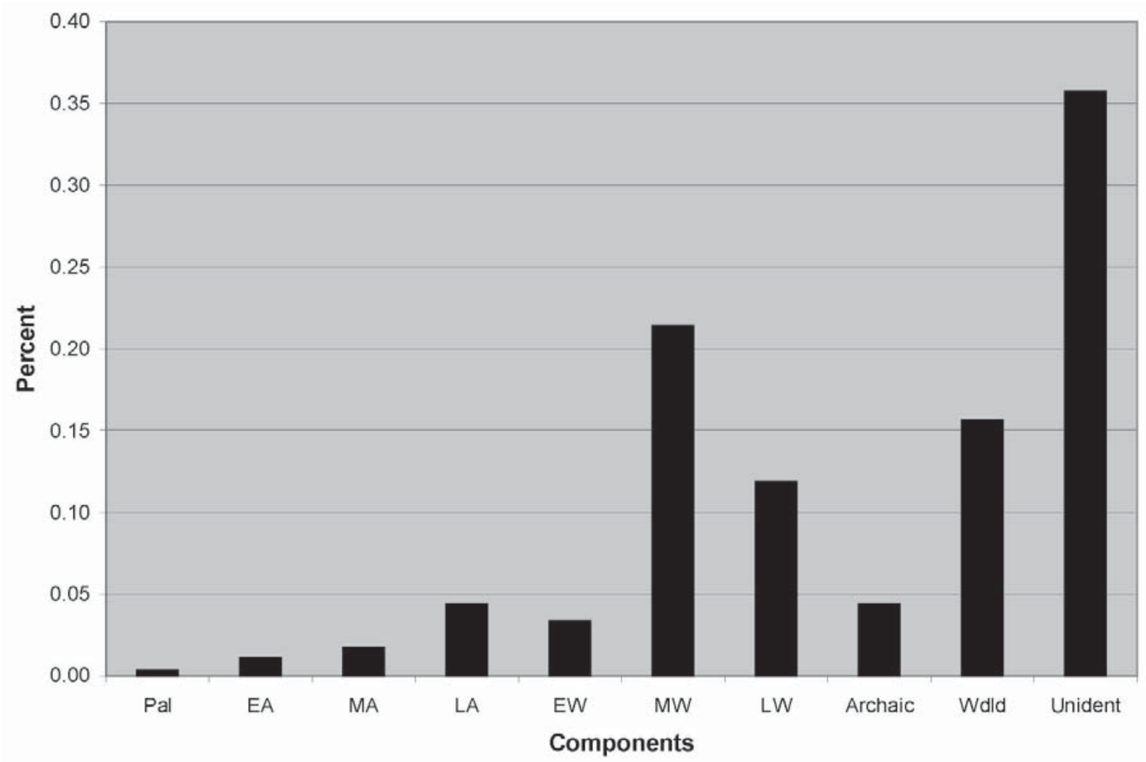

Figure 37. Prehistoric component frequency documented on the James-York peninsula as of 2000.

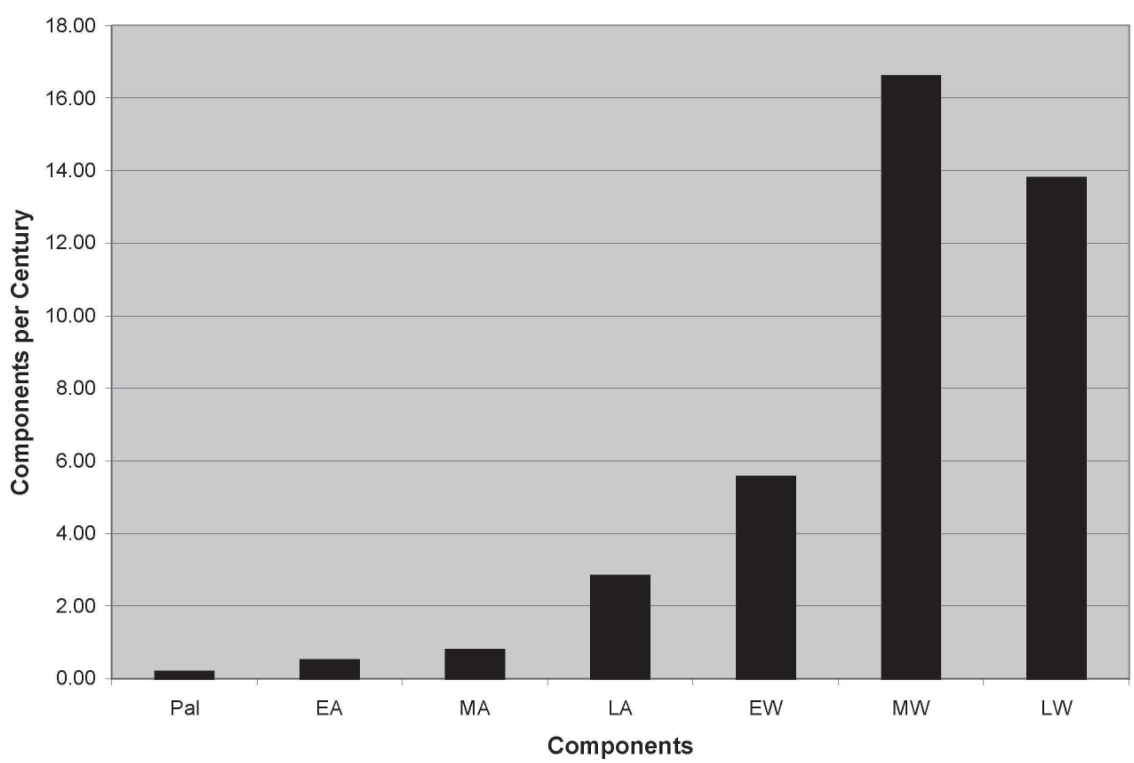

Figure 38. Frequency per century of identifiable prehistoric components on the James-York peninsula.

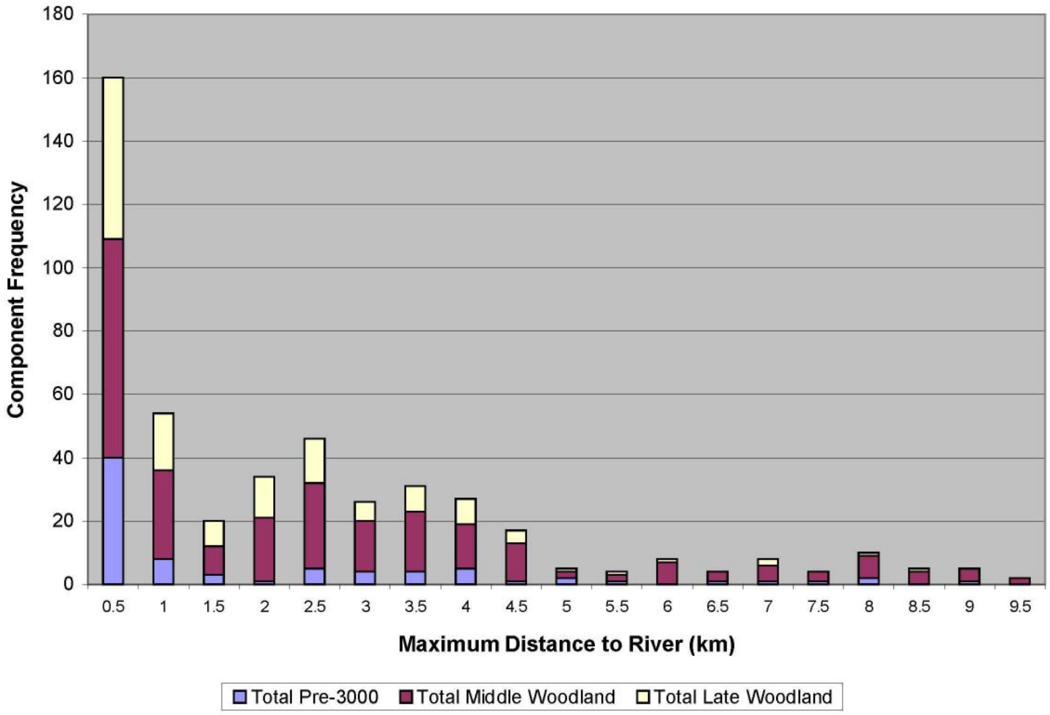

Figure 39. Frequency of prehistoric components on the James-York peninsula by distance to rivers.

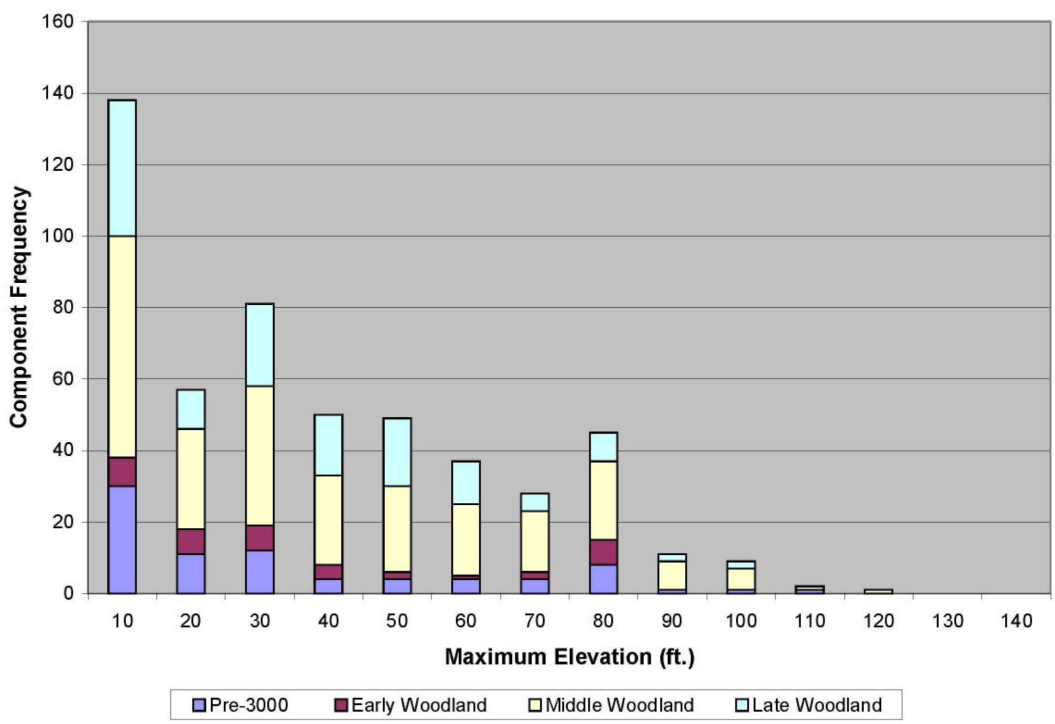

Figure 40. Frequency of prehistoric components on the James-York peninsula by elevation.

tend to occur in higher proportions in interior settings (Figure 39). In terms of the intervals created for this analysis, they begin to become the most common component at distances above 1.5 kilometers from the bounding rivers, and the pattern becomes especially marked beyond 4.5 km.

Looking at site distribution on the peninsula relative to absolute elevation helps to clarify the spatial patterns (Figure 40). Higher elevations can generally be equated with the most interior of settings, along the peninsular drainage divide even though York River frontage tends to be relatively high in elevation compared to many locations along the James and Chickahominy. Component distribution by elevation reinforces the pattern expressed in the distance-to-river data. Middle Woodland occupations become more prominent at elevations above 50 ft. amsl. At this elevation they outstrip the proportion of Late Woodland sites, for instance, which are more prevalent below 50 ft. amsl, and particularly so above 80 ft. amsl.

These general observations must be treated as measures of basic tendencies. Site file records from which these data are derived are by nature quite general. Aspects of site function are difficult if not impossible to obtain, and chronological resolution is not high. The main purpose is to offer a more secure measure of the informal sense that has emerged of where sites of different ages tend to occur. Locations near local rivers and at the lowest elevations always support higher proportions of sites regardless of age. Peninsula topography is variable enough to make it ultimately worthwhile to examine localized patterns, comparing James versus York river drainages for instance. The aggregate evidence serves to indicate that the Middle Woodland settlement range was less constrained, or certainly no more limited, than it was during any other period. Middle Woodland components are more prevalent than any others regardless of distance from major streams or elevation. The most notable contrast is the higher numbers of Middle Woodland components in the upland, interior areas. This is not unexpected relative to settlements postdating AD 1000, after which time there was a general contraction to riverine settings at relatively lower elevations. And as noted before the lower frequency of these later sites should not be taken to represent population decline, but rather the nucleation of area inhabitants into fewer but larger communities.

The broad perspective taken here allows some refinement of the general pattern. On the whole, available distributional data for the James-York peninsula leads to portrayal of Middle Woodland economic patterns as generalized, reflecting more tendencies toward foraging than collecting. Such has been the working view of the period for some time, in fact. Viewed simply as a single block of time, we can say with some confidence that Middle Woodland sites can be anticipated virtually anywhere on the peninsula, a pattern not true of all periods and especially not of those to follow. There are indications of greater selectivity in choosing settlement locations during periods both preceding and following the Middle Woodland.

Middle Woodland sites meet generalist expectations first in their wide distribution, seemingly ubiquitously across elevation, drainage, and soil category ranges. Working from the level of specificity at hand, the distribution of Middle Woodland sites exhibits no strong associations to specific locational criteria beyond the tendency common to all prehistoric sites to occur often in relative proximity to major streams. Neither do local Middle Woodland occupations break down neatly into subsets of distinctly smaller or larger sites. Regardless of location, most tend to be relatively limited in areal extent. Where extensive scatters are recorded the evidence is best explained as the outcome of repeated, brief occupations. Truly larger, intensively occupied sites are known from the region but to date they do not fall within the present study area.

The Nature of Middle Woodland Occupations

It would be easy to assume that every small Middle Woodland site on the peninsula is essentially like another. A central goal of the intensive investigations of interior sites within the Route 199 corridor has been to address just that question. In the end we do discover considerable consistency across these sites, but broader comparisons across the James-York peninsula expose important differences, too. This section is concerned with describing the similarities and differences that we can document, and also with accounting for them in social and economic terms.

Although a great many sites with Middle Woodland components have been recorded on the peninsula, investigation sufficient to document details of internal patterning and assemblage composition has occurred at only a few. Most of the best-documented sites were investigated within the Route 199 corridor and these will be the basis of much to follow. Recent work at Naval Weapons Station Yorktown and testing at a few area middens helps to expand the sample.

Temporal Patterns

A natural first question is to ask how uniform local cultural patterns may have been within the span of the Middle Woodland, defined here as the interval between 200 BC and AD 900. Archaeologists have tended to treat change linearly, especially when evidence is still meager. Heretofore, any sense of local change has come mainly from ceramic sherds found on the profusion of sites. The received wisdom from ceramic analysis, supported by an increasing number of dated assemblages in the region, is that there was a fairly rapid progression from lithic- to shell-tempered wares around AD 200. This trend is often presented as evidence of genuine cultural change as well, mainly the material evidence of a so-called "Mockley spread" (Custer 1989:276–277; Stewart 1992). There has been a growing sense that this evidence signals new migration into the Chesapeake area (Potter 1993:2–3). How this notion plays out on the James-York peninsula can be examined.

Information from local sites can support the lithic-to-shell temper trend, but only as a very gradual change with little evidence of population replacement or rapid cultural change. Thirty-eight radiocarbon dates from Tidewater Virginia sites fall within the Middle Woodland range (VDHR n.d.). Plotted chronologically the earlier dates, before 2200 BP, are almost all in association with lithic-tempered wares, and those that fall after 1200 BP are always associated with shell-tempered Mockley sherds (Figure 41). This leaves a millennium long span in the middle during which lithic- and shell-tempered ceramics occur about evenly in the dated samples. There is very consistent overlap in the two-sigma ranges of these mixed-assemblage dates between 1800–1400 BP.

Twenty-four ceramic assemblages from Middle Woodland sites on the peninsula that have been derived from evaluation or data recovery level investigations are summarized in Table 18. They represent a range of locations, including York and James river basins, and streamside shell middens and non-midden interior sites. Very few of the assemblages have exclusively lithic- or shell-tempered ceramics, although in most there is a very strong dominance of one over the other. Probably the strongest pattern observed among the assemblages is a distinct correlation between shell-tempered sherds and shell midden sites, and a like relationship between lithic-tempered ceramics and non-midden sites. Eight of 13 sites (62%) with strong Mockley components (>25% Mockley sherds) are at shell middens, and 10 of the 14 sites where the majority of sherds are simply shell-tempered are midden sites (Figure 42). (This latter fact also represents the same strength of midden association among significant Late Woodland, Townsend components [63%].) By contrast, strong early Middle Woodland components identified by lithic tempered ceramics (>25% Pope's Creek, Varina, or Prince George sherds) occur at interior, non-midden sites 82% of the time. This perspective suggests that location can be as strong a factor in determining ceramic assemblage composition as time.

Stratified deposits are a traditional basis for establishing cultural sequences but few such contexts from the study area are documented that offer clarity. Among the best is the sequence from Croaker Landing (44JC70) even though the stratigraphy was described as "complex" and "difficult to interpret" by the reporters (Egloff et al. 1988:7, 13). Even conservatively considered, one does not find neat separation between lithic- and shell-tempered Middle Woodland ceramics. From bottom to top the shell-tempered sherds eventually gain prominence but the process appears to have been a gradual one.

Temporal control can often derived from dated feature contexts, but like clear stratigraphic sequences reliably dated feature assemblages are the exception rather than the rule on the peninsula.

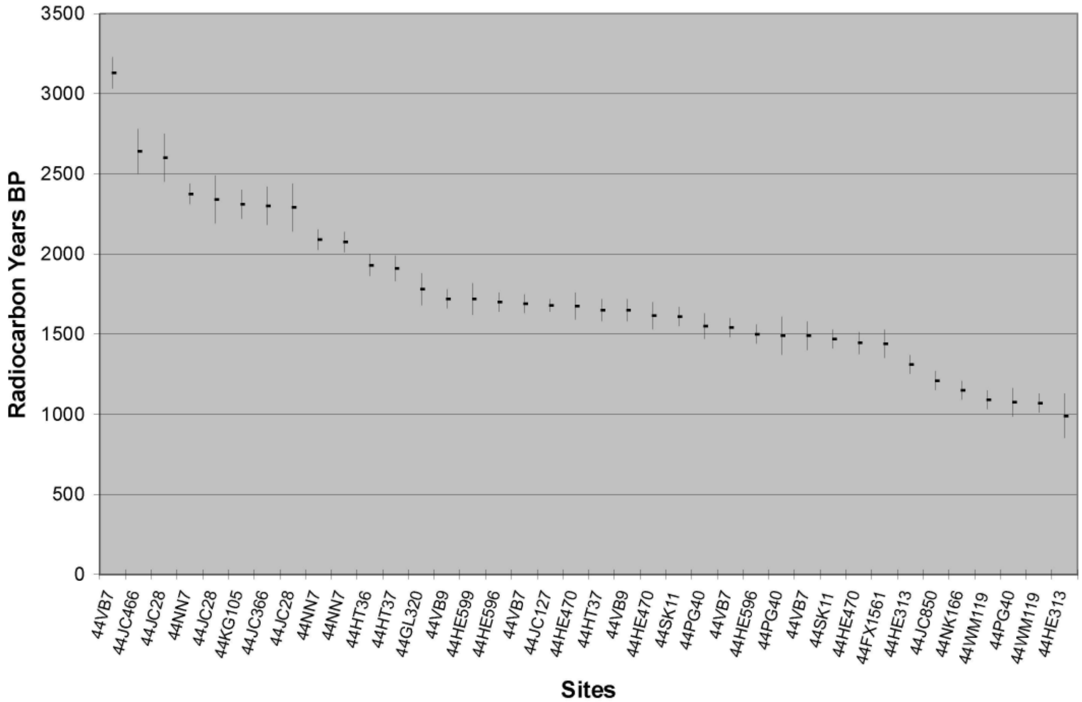

Figure 41. Summary of radiocarbon dates for Middle Woodland components in the Virginia Coastal Plain.

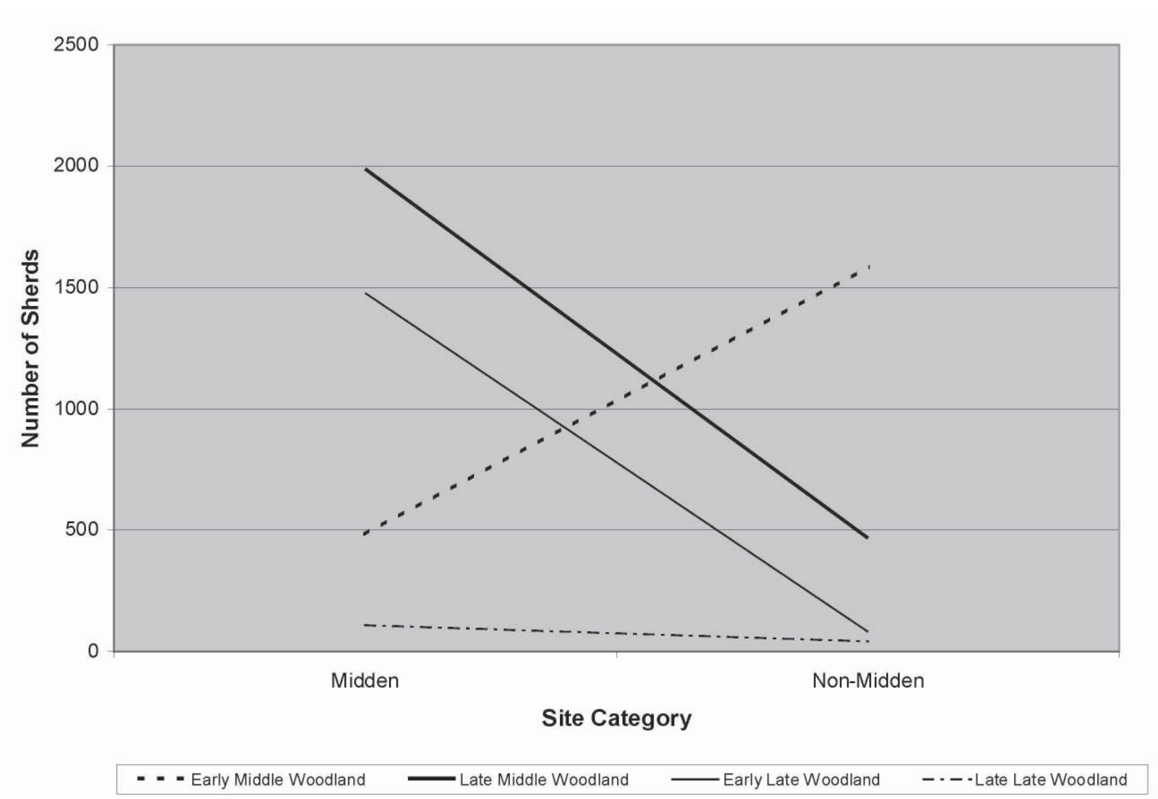

Figure 42. Frequency of ceramics by period at midden and non-midden sites.

Site	Site Type	EW	EMW	LMW	ELW	LLW
Carters Grove	Midden	0	0	67	18	0
College Creek	Midden	0	57	349	1204	0
44JC30	Midden	0	0	158	4	16
44JC659	Midden	0	6	71	3	0
44JC70	Midden	0	152	141	12	4
44NN7	Midden	0	176	846	0	0
44YO2	Midden	0	16	111	74	22
44YO324	Midden	0	0	17	107	2
44YO693	Midden	0	19	15	8	31
44YO800	Midden	0	55	213	14	0
44YO801	Midden	0	8	50	0	0
44JC359	Interior	1	369	5	4	0
44JC363	Interior	6	222	42	0	0
44JC366A	Interior	0	109	15	2	0
44JC366B	Interior	0	41	154	20	33
44JC367	Interior	0	109	50	9	0
44JC369	Interior	0	103	2	0	0
44JC466	Interior	0	76	30	0	4
44JC850	Interior	0	365	1	11	0
44JC972	Interior	0	117	4	2	0
LKPOWA	Interior	0	59	13	9	4
44YO802	Interior	0	9	32	21	0
44YO798	Interior	0	1	21	36	33
44YO799	Interior	0	0	48	0	0

EW = Early Woodland; EMW = lithic-tempered Early Middle Woodland; LMW = shell-tempered late Middle Woodland (Mockley); ELW = shell-tempered early Late Woodland (Townsend); LLW = late Late Woodland simple-stamped

Table 18. Summary of Middle Woodland ceramic assemblages from excavated sites on the James-York peninsula.

Most often ceramics from local Middle Woodland sites are recovered from thin deposits within which concentrations or clusters of artifacts are the closest context to a formal pit feature. In fact, there is not a single formal pit feature dated to the Middle Woodland known from the many sites investigated in the project area. Shallow basins, sometimes best called depositional lenses, and relatively deep but irregularly shaped pits do occur on a few sites. The latter most closely resemble midden-filled tree-throw cavities rather than true purpose-dug silos or other such facilities (Blanton and Wolf 2001; Geier and Barber 1983). Further, these rude pits are only known to date from riverside midden sites; none occur at upland, interior sites. The observed association between midden-filled cavities and riverside middens is viewed here as a natural function of the relationship—existing midden collapses into holes created by tree throws, as opposed to a cultural pattern.

In spite of these limitations, it is necessary to explore whether these "feature" assemblages can help to resolve lithic- and shell-tempered ceramic relationships. Table 19 summarizes Middle Woodland

Site	Feature	Feature Type	Lithic-tempered	Shell-tempered
44JC30	2	Basin	0	58
44JC30	4	Basin	1	44
44JC30	6	Basin	9	4
44JC30	8	Basin	0	5
44VB7	165	Basin	0	1
44VB7	166	Cylindrical	0	13
44VB7	195	Basin	1	0
44VB7	106AB	Cylindrical	0	229
44VB7	106AB3		0	9
44VB7	106AC	Basin	0	2
44VB7	106AE	Cylindrical	3	179
44VB7	106AF	Basin	0	10
44VB7	106AP	Cylindrical	0	32
44VB7	106C	Cylindrical	0	294
44VB7	106D	Basin	0	28
44VB7	155B	Basin	0	6
44VB7	158B	Basin	0	3

Table 19. Summary of ceramic assemblages from Middle Woodland features on the James-York peninsula and 44VB7.

ceramic occurrences, separating them by temper, from 17 locally documented Middle Woodland features. In only two features, one each from 44JC30 and 44VB7, do lithic tempered Middle Woodland sherds outnumber shell-tempered, Mockley sherds. The foremost implication is that pit-like features of any description do not appear in the record in appreciable numbers prior to the appearance of Mockley components at the end of the Middle Woodland period. Further, once the Mockley features begin appearing there is only the lowest incidence of lithic tempered wares in their fill. This is all to say that pit features, however simple in form, are clearly a product of Mockley activities rather than earlier Middle Woodland activities and there is little indication from their contents of interaction between lithic and shell tempered ceramic users.

Mockley-type ceramics, as noted earlier, do occur on non-midden sites, albeit in low numbers, and these include a number of sites like the Route 199 group that are in distinctly interior settings. In the sample of 24 well-studied sites cited earlier, for example, there is only one site without at least a trace of Mockley sherds (see Table 18). The prevailing assumption in these cases has been that the occurrence of both lithic and shell-tempered ceramics on the same small, interior site was the product of multiple occupations by groups of different cultural traditions. The Route 199 large-area excavation of such sites is beginning to indicate another explanation. Area excavation at sites 44JC366B, 44JC367, and 44JC466 exposed Middle Woodland activity areas more or less centered around hearths of fire-cracked rock and "bog iron" (Figure 43). Shell- and lithic-tempered ceramics were found in each of the excavations. Overlapping distributions of both ceramic types in the same relationship to the hearths indicates very strongly that the sherds are all from the same episode of occupation. The relative proportions of lithic- and shell-tempered sherds at these sites are summarized in Table 20. At only one of the nine sites do Middle Woodland shell-tempered ceramics dominate (44JC366B) (59%), where otherwise they represent only 0–35% of the assemblages; the average representation is 17%.

Figure 43. Comparison of artifact distribution patterns around hearths at excavated Route 199 Middle Woodland sites.

Site	Croaker Landing	Varina	Prince George	Mockley	Townsend	Simple-Stamped	Unident.
JC359	1	344	25	5	4	0	8
JC363	6	151	73	49	0	0	0
JC366A	0	0	112	15	0	0	2
JC366B	0	0	72	154	0	33	17
JC367	0	23	126	80	0	0	7
JC369	0	104	0	2	0	0	0
JC466	0	37	43	30	0	4	9
JC850	0	376	0	1	0	0	143
JC972	0	184	32	5	0	0	31

Table 20. Summary of ceramic assemblages from excavated Route 199 Middle Woodland sites.

Results of Ceramic Sourcing Study

As described in Chapter 2, a sample of prehistoric ceramic sherds and modern fabricated tiles was examined for the purpose of discerning potential patterning in the types of clays chosen for ceramic production. One specific goal was to measure the level of variability in clay sources utilized within and across time periods, and another was to determine the feasibility of identifying specific sources of potting clay utilized by local prehistoric populations. Observed patterns could inform on group ranges and technological constraints.

The method employed for this analysis is known as acid extraction (Burton and Simon 1993). Pulverized samples of fired clay are soaked in dilute acid to produce a solution that can be analyzed spectrographically to measure the relative abundance of selected chemical elements. The procedure was carried out for the present project by Dr. Gary Rice in the Chemistry Department at the College of William and Mary. Twenty-nine prehistoric ceramic sherds from 12 different area sites were selected for the study sample. The majority of the sherds represent Middle Woodland types most relevant to the interior James-York peninsula sites investigated as part of the Route 199 project, but other types were also included to provide a broader diachronic perspective (Table 21). Tiles made from 10 potential clay sources in the area also were tested (see Table 21). The tiles were low-fired (<800° C) in an electric kiln before they were analyzed. Clay for the tiles was chosen to represent high (>50 ft. amsl) and low (<50 ft. amsl) terrace, as well as tidal marsh sources. Material for the acid extraction process was obtained from the tiles and sherds by drilling into them and collecting the residue. Relative proportions of seven chemical elements present in the prehistoric and modern samples were then measured. The tabulated results were explored in Excel and with SPSS to identify meaningful patterns.

A matrix of bivariate scatterplots was generated as a means of exposing obvious patterning in the chemical data (Figure 44). Distinct clustering of points on the plots was not evident, but plots for some pairs of elements did show suggestions of separation (see, for example, Fe-K, K-Ti, and K-Mg). Closer examination of individual scatterplots revealed a tendency for general separation of shell- versus lithic-tempered sherds. Shell-tempered sherds often tended to have moderate to high concentrations of iron (Fe) and higher concentrations of potassium (K) (Figure 45). The tiles of potential source clays almost all contained low levels of potassium which generally located them on the plot space with lithic-tempered sherds (Figure 46). Another result of the clay tile analysis is documentation of a high degree of consistency in the chemical composition of potential clay sources in the Powhatan Creek environs, whether from high or low terrace settings or even marsh sediments. One can observe that the clay tile samples tend to cluster closely together in the scatterplots (Figure 47; see Figures 45 and 46).

These scatterplot patterns exhibited by prehistoric sherds may have two possible explanations. One is that the clay sources generally used for lithic- versus shell-tempered sherds were different. The data also may be indicating that the sources chosen for clay tiles are more consistent with those used by earlier ceramic making groups utilizing lithic tempering. A second explanation could be the effect of the tempering agents themselves on the sample solutions. It is possible, in other words, that shell inclusions are skewing the chemical signatures in a way that separates the shell-tempered sherds from those with lithic inclusions. Such an effect may account for the separation of the tempers along the scale of potassium concentrations, for instance. Resolution of this issue will only be achieved by more careful sample preparation that excludes temper particles and precisely measures clay chemistry alone.

Cluster analysis was performed to further evaluate the patterns observed in scatterplots. The method of analysis utilized is known as Ward's method using squared Euclidean distances (Shennan 1997). Either with or without z-score standardization of the data values, the consistent result was separation of two clusters, and they ultimately corroborate observations made from scatterplots (Figure 48). The larger cluster of samples consists exclusively of Middle Woodland sherds, all but one of which are lithic-tempered, and of eight of the ten possible sources represented by clay tiles. The second cluster contains samples representing a much wider range of time periods and tempering agents.

Site	Type	Sample	Period	Chemical Elements (ppm)						
				Cu	Fe	K	Mg	Mn	Ti	Zn
Prehistoric Sherds										
44JC850	Varina	JC850-1	EMW	28	20767	2628	937	180	409	133
44JC850	Popes	JC850-2	EMW	35	10778	468	591	86	413	147
44JC850	Mockley	JC850-3	LMW	13	37768	6126	3977	224	906	181
44JC850	Varina	JC850-4	EMW	11	22571	2749	882	214	679	117
44JC850	Popes	JC850-5	EMW	347	15126	774	464	107	914	134
44JC850	Popes	JC850-6	EMW	650	10328	2029	331	169	694	217
44JC850	Popes	JC850-7	EMW	22	13475	4252	249	109	517	130
44JC850	Popes	JC850-8	EMW	9	22605	2988	414	48	854	110
44JC850	Popes	JC850-9	EMW	359	11227	1389	404	69	726	146
44JC850	Popes	JC850-10	EMW	208	12883	1433	857	164	922	162
44JC850	Popes	JC850-11	EMW	225	8197	3062	356	109	816	174
44JC850	Popes	JC850-12	EMW	12	10269	2687	413	159	613	138
44JC850	Popes	JC850-13	EMW	92	7854	1439	393	90	443	155
JC127	Varina	JC127-1	EMW	22	28648	2811	1164	419	513	148
JC127	Roanoke	JC127-2	LLW	10	21934	8691	2232	259	322	152
JC359	Varina	JC359-1	EMW	478	29196	3394	2153	136	361	325
JC359	Varina	JC359-2	EMW	43	36350	5256	913	107	862	151
JC367	Pr. Geo.	JC367-1	EMW	95	37391	6067	981	82	434	177
JC366	Roanoke	JC366-1	LLW	22	25746	1835	1220	353	143	177
JC472	Mockley	JC472-1	LMW	328	20095	7998	1460	165	1219	481
JC363	Varina	JC363-1	EMW	29	18760	1985	290	101	345	135
JC466	Varina	JC466-1	EMW	28	25689	1972	191	117	535	115
JC369	Varina	JC369-1	EMW	73	20165	2630	458	111	508	137
JC369	Colono	JC369-2	HIST	38	40694	8366	2124	254	564	137
A2	Pr. Geo.	A2-1	EMW	190	21725	10507	2184	173	424	252
A9	Towns.	A9-1	ELW	60	40663	587	1759	121	341	158
A9	Elk Isl.	A9-2	EW	19	45292	2089	623	115	613	131
A9	Roanoke	A9-3	LLW	18	41040	7206	1152	92	1051	154
D1	Towns.	D1-1	ELW	21	47312	8340	1937	124	1011	162
Clay Tiles										
York R.	High Ter	JC-3		166	38745	2723	1847	64	264	170
Thorofare	Low Ter	CS3		176	19317	2313	1586	182	263	188
Thorofare	Marsh	CS4		28	8549	1597	1695	87	130	142
St. Geor.	Low Ter	CS5		68	20560	2208	1008	131	224	167
Rt. 613	High Ter	CS7		73	19320	1156	1132	52	257	123
Rt. 613	Low Ter	CS8		31	21387	1525	1170	80	161	138
Rt. 658	High Ter	CS9		50	20080	1699	869	57	149	138
44JC848	Low Ter	CS12		83	23704	1672	1393	51	121	144
44JC365	Low Ter	CS13		214	37036	1883	1678	132	186	191
44JC850	High Ter	CS14		87	19700	1524	874	34	138	108

Table 21. Chemical composition of sherd and clay samples used in ceramic sourcing study.

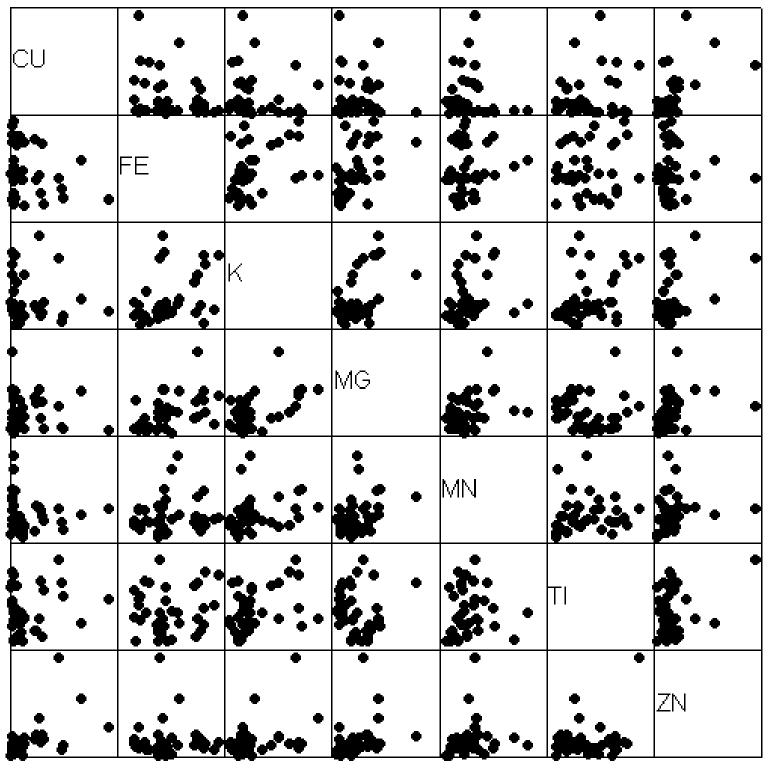

Figure 44. Scatterplot matrix of all chemical elements

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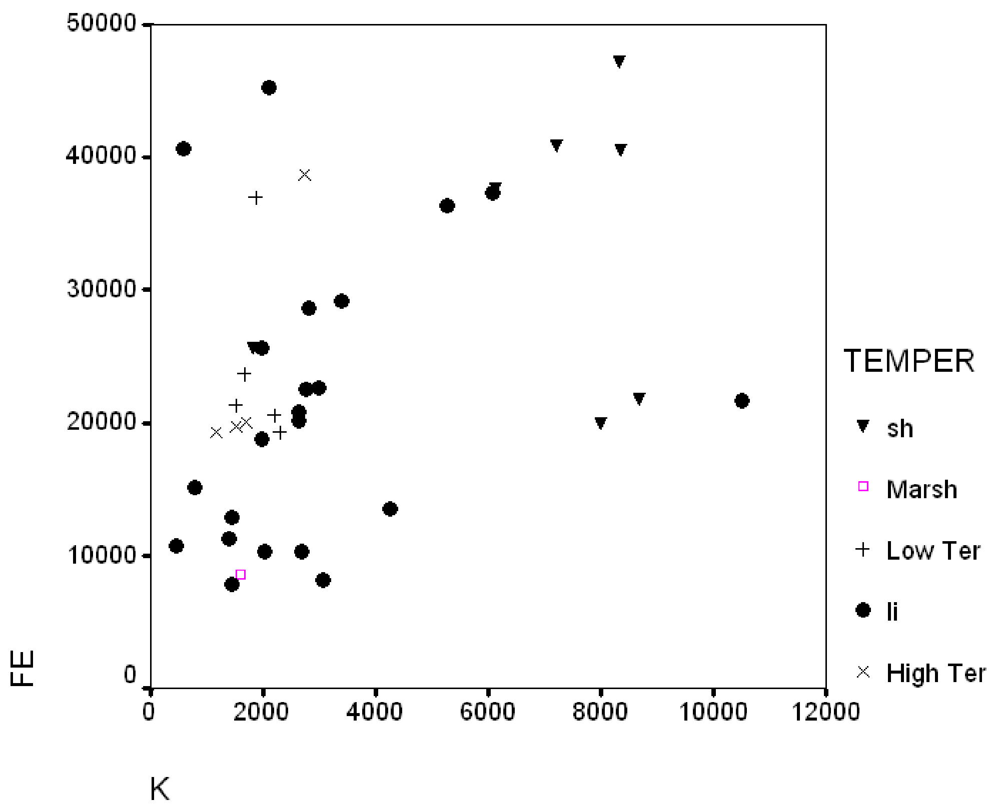

Figure 45. Scatterplot for Fe and K (parts per million).

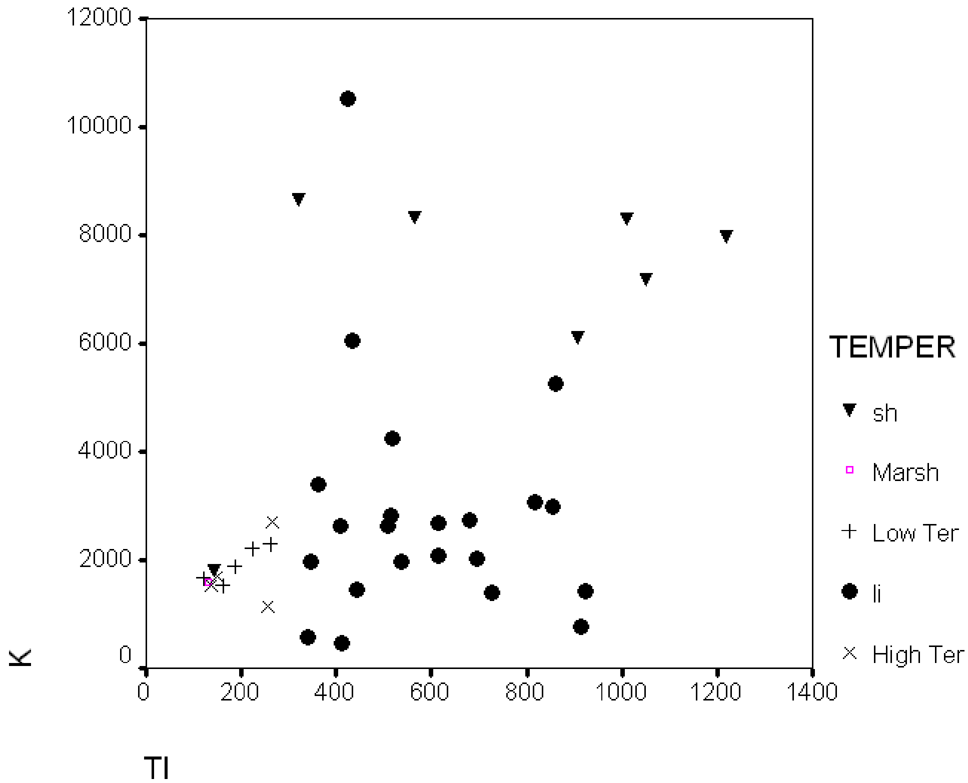

Figure 46. Scatterplot for K and Ti (parts per million).

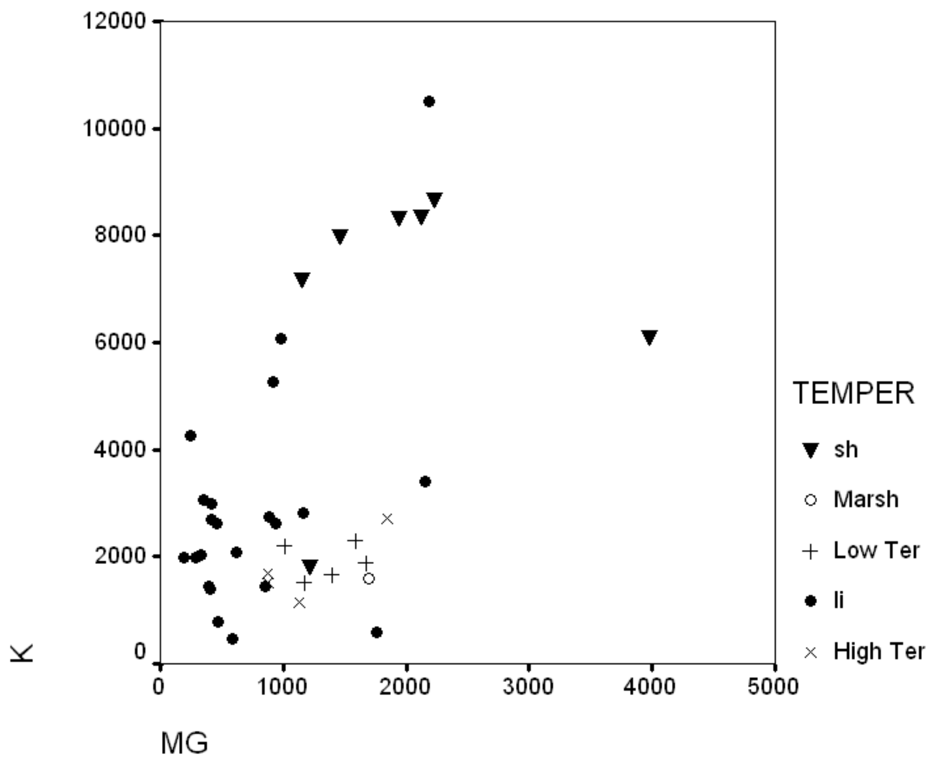

Figure 47. Scatterplot for K and Mg (parts per million).

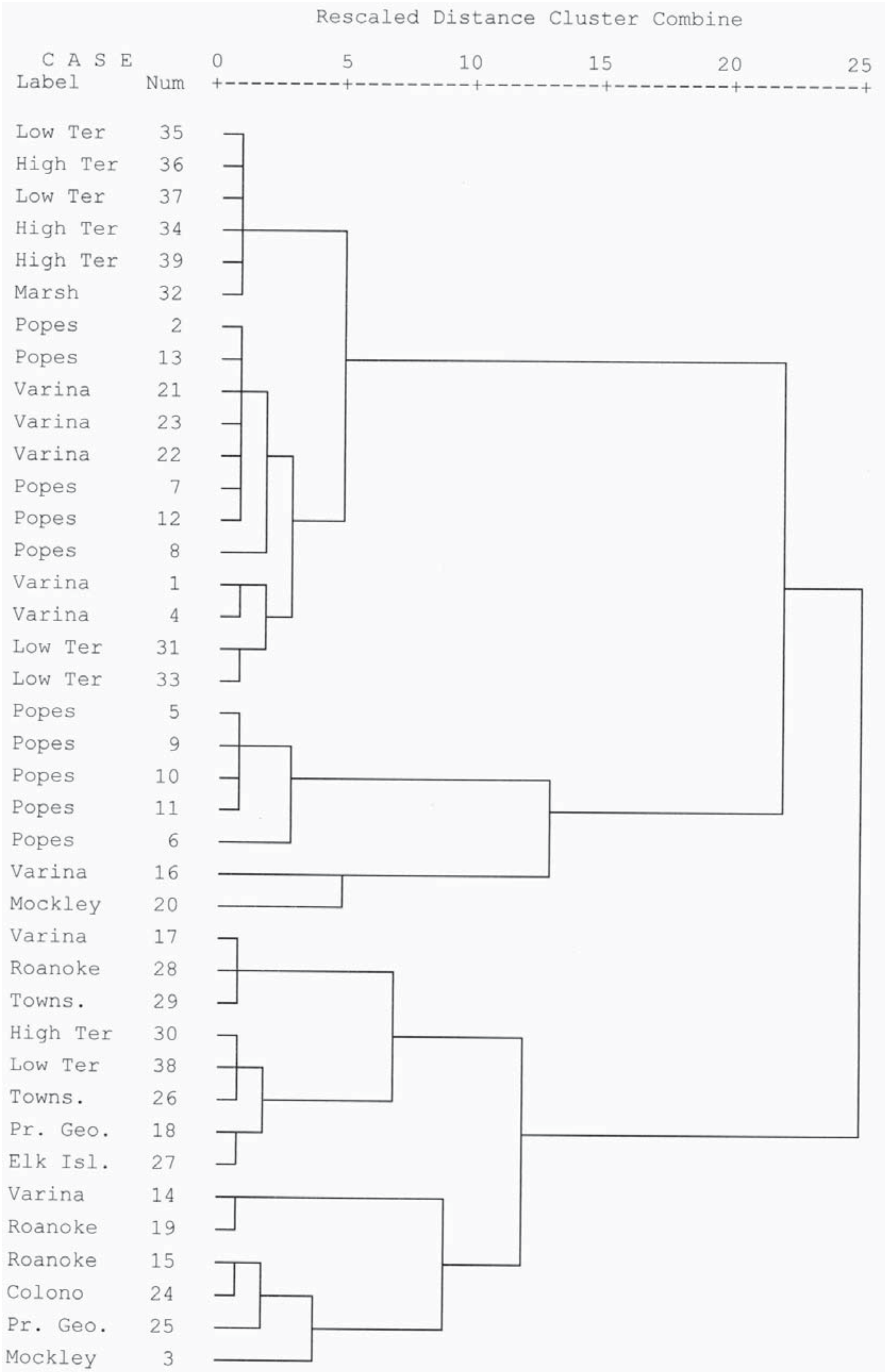

Figure 48. Dendrogram (using Ward method) of cluster analysis.

Site	Area (m²)	Quantity				Average Density (m²)				Hearths
		Lithic-Tempered Sherds	Shell-Tempered Sherds	Lithics	FCR	All Types	Sherds	Lithics	FCR	
Total Site										
44JC366B	40	96	318	583	125	28.05	10.35	14.58	3.13	1
44JC367	112	334	236	374	234	10.52	5.09	3.34	2.09	1
44JC466	121	193	179	418	114	7.47	3.07	3.45	0.94	1
44JC850	160	500	8	390	492	8.69	3.18	2.44	3.08	1
44JC972	140	243	10	770	464	10.62	1.81	5.50	3.31	3
Average	114.6	273.2	150.2	507	285.8	13.07	4.70	5.86	2.51	1.40
Core of Site										
44JC366B	40	96	318	583	125	28.05	10.35	14.58	3.13	1
44JC367	25	179	97	173	33	19.28	11.04	6.92	1.32	0
44JC466	18	96	72	339	25	29.56	9.33	18.83	1.39	1
44JC850	88	443	4	291	488	13.93	5.08	3.31	5.55	1
44JC972	108	227	4	705	408	12.44	2.14	6.53	3.78	3
Average	55.8	208.20	99.00	418.20	215.80	20.65	7.59	10.03	3.03	1.20

Table 22. Attributes of excavated Route 199 Middle Woodland sites.

The latter group contains, among other varieties, all but one of the shell-tempered sherds in the sample. Here again the results of analysis have separated the two general temper categories and, thus, types of sherds on either side of the approximately AD 1000 calendar date. All of the earlier-dating, lithic-tempered Prince George ceramics in the sample, plus two Varina sherds, also fall into this second cluster, however.

What are the possible cultural implications of these results, assuming the chemical data are reflective of source clays without significant effect from tempering agents? The most obvious implication is that there was a significant change in the clay sources utilized before and after shell was introduced as a tempering agent (or before and after about AD 1000). Judging from comparison of clay tile and sherd chemistry, it would appear that a wide range of local sources largely confined to the Powhatan Creek drainage, especially those on both upper and lower terraces, were utilized by early Middle Woodland groups (Popes Creek and Varina). It is worth noting further that Pope's Creek sherds (especially the large number from 44JC850) have a relatively low iron content and that this conforms most closely with the marsh clay sample tile. Other clay sources were apparently favored after shell-tempered Mockley ceramics appeared, although Prince George ceramics from the preceding early Middle Woodland fall into the same cluster. Overall the types comprising the eclectic second cluster include Mockley, Townsend, Roanoke, Colonoware, Varina, Prince George, and Elk Island.

Projectile Points

Projectile points associated with the interior Middle Woodland sites tend to be of the Potts type (McCary 1953; Potter 1993:68). This is regardless of whether the principal ceramic type is shell- or lithic-tempered. The second hafted biface type which occurs with about half the frequency of Potts points are Rossville points. Thus, there is no obvious association between the Rossville form and a particular ceramic ware. It is abundantly clear at least that the Potts type is not exclusive to the generally later

Mockley components as some have suggested. The average number of projectile points with any of these occupations is about two, and the range is from none up to five.

Subsistence Patterns

Our knowledge of subsistence activity associated with the interior sites remains very poor owing to conditions of negligible organic preservation. Interpretation must rely largely on indirect, circumstantial evidence. The most concrete evidence of subsistence activity is common pieces of burned hickory nutshell in the general matrix of the sites. Nutshell is observed at all sites but systematic flotation recovery has not been thorough enough to provide a basis for comparative analyses. Nonetheless, the regular occurrence of this material very strongly indicates that hickory nuts in particular were a dietary staple. Occasional traces of burned animal bone are recovered but they are too scarce and fragmentary to be informative beyond confirming that large- and medium-sized mammals were taken and processed on the sites. It is important to repeat that no traces of estuarine resources like shellfish are present on these sites, underscoring other indications of a dedicated pattern of upland, interior settlement and subsistence.

A unique contribution of this project designed to extract better subsistence information was a pilot analysis of phytolith remains at 44JC850 (see Appendix D). Only five soil samples were examined but the study both confirms the presence of significant quantities of these siliceous plant remains and reveals some potentially very important aspects of the local Middle Woodland subsistence regime. Undoubtedly the most significant contribution is the recovery of "a small quantity of probably Cucurbitaceae phytoliths", such as from gourds or squash, from both Units 9 and 11. Direct evidence of Middle Woodland horticultural activity and domesticated plants is extremely sparse in the Tidewater area, so low in fact that there is no consensus that it was even practiced. The apparent cucurbit phytoliths at 44JC850 give some credibility to views of at least low-level horticultural activity between AD 1–600, but duplication of the findings at other sites will be necessary to secure the interpretation.

We are left to surmise that subsistence activity at small, interior Middle Woodland sites on the James-York peninsula involved fairly generalized collection of interior plant and animal foods, perhaps augmented at low levels by domesticated plant foods such as squash. Intensive collection of mast resources like hickory nuts appears to have been an important activity. The small size of the sites and evidence of short-term occupation indicates that relatively autonomous family/extended family foraging groups were ranging widely in the interior uplands to collect locally available foods. There is no reason to believe that these sites are the product of specialized collecting parties ranging outward from larger "base camps."

Site Structure

In Figure 43 generalized artifact distributions relative to hearth features are shown for local Middle Woodland sites for which such information is available. All of these, incidentally, were investigated as part of Route 199 studies and reflect the quality of information that can be generated by painstaking documentation. The plans are drawn to the same scale and each depicts Middle Woodland lithic- and shell-tempered ceramic distributions, flaked stone concentrations, and high densities of thermally altered rock. Only the most recent data recovery block investigations at 44JC850 and 44JC972 capture the greater part of a Middle Woodland occupational locus, but the others are sufficiently centered on similar loci to give a sense of internal "structure".

From one to three hearth features were documented at each site, around which are arrayed intersecting clusters of artifacts in different categories. To the extent these excavated exposures allow us to detect patterns, artifacts in every category are concentrated near the hearths. It would be inaccurate to say the distributions are literally hearth-centered, but at the same time it is obvious the hearths are a focal point in the patterns. Returning to the question of the temporal relationship of shell- and lithic-tempered ceramics, the literal overlap of each ceramic temper category together with lithic debris around a single hearth is difficult to dismiss as anything other than evidence of simultaneous use. The co-occurrence of shell- and lithic-tempered wares around a single hearth is especially clear at 44JC366B and 44JC367, and nearly as strong at 44JC466. At 44JC850 and 44JC972 lithic-tempered wares occur almost exclusively, but even there a very few shell-tempered Mockley sherds were recovered to reinforce the suggestion the two types may have been in use at the same time.

Beyond the ceramic issue, distributional patterns in the large-area exposures raise interesting questions about organization of activities, group size, and duration of occupation. Perhaps the most significant revelation is the prospect that these hearth-based concentrations coincide with structure locations and, in turn, permit some consideration of activities in and around temporary dwellings. Aside from the evidence already described, there are no traces of buildings like post holes or obvious floor accumulations. It is probably more reasonable to expect that such evidence would not be present at these sites, owing both to the nature of the native soils, shallowness of the deposits, and the brevity of the occupations.

Only short-term occupation is indicated by evidence from small interior sites. Artifact density is moderate to low in every case with an average of about 13 artifacts per square meter overall, or just over 20 artifacts per square meter in the core loci (Table 21). There is no trace of midden accumulation, and no direct evidence of facilities beyond creation of simple surface hearths. Shellfish remains do not occur on these sites, indicating a range of activities distinct from but complementary to those occurring at sites on estuarine streams. Most of the sites were occupied only one or a very few times, usually leaving evidence for only a single, discrete occupation locus free of clutter from prior or later activity. These loci average about 56 square meters in extent, with a general range from 18 to 108 square meters (see Table 21). A 4-m radius around any of the hearths at these sites would capture the greater part of the associated artifact concentration. The lack of structural evidence prohibits greater precision, but it is not unreasonable to imagine a temporary shelter at these sites with a footprint encompassing something near 50 square meters. An apparent Early Woodland structure from 44WR329 reported by McLearen (1991) encompassed about 46 square meters and typical Late Woodland structures in the area routinely have floor areas between 40 and 50 square meters (Dent 1995:249, 252). Even a 3-m radius would embrace much of the artifact scatter on these sites, leaving exterior space for other activities. A potential Middle Woodland shelter outline from the western part of the state (44RU61) described as measuring 6 by 3.3 meters (20 square meters) gives a sense of the lower end of the range (McLearen 1990). Certainly activity-related residue ranging from vessel fragments to lithic debitage to food scraps would have been lost and purposely discarded both within and without the shelters. Exactly what a local Middle Woodland structure would look like is uncertain but a basic frame of hole-set posts forming a circular or elliptical plan can be envisioned. The variable distribution of arboreal and grass phytoliths at 44JC850 could be taken as more evidence of both activity and structure locations. The relative concentrations of arboreal and grass phytoliths could conceivably be indicative of shelters, specifically where bedding was placed or where roof coverings eventually collapsed.

The weight of available evidence suggests that groups occupying the small interior sites were family-size units, perhaps extended family groups. Evidence from most interior Middle Woodland sites would allow for only a single shelter per episode of occupation. This, again, is inferred from the limited areal extent of the loci and presence in most cases of only a single hearth. At a few sites there are multiple hearths in evidence that may be taken to indicate multiple structures during a single occupation, or alternatively multiple occupations with one shelter. The best evidence for multiple hearths comes from sites 44JC367 and 44JC972 (see Figure 42). Another alternative is that hearths were used both inside and outside the shelters.

Comments on Longer-Term and Larger Area Patterns

This final interpretive section seeks to link the new evidence from the James-York peninsula with longer term trends cited for the Middle Woodland record across the Chesapeake region. The underlying message from the perspective of the James-York peninsula is that pan-Chesapeake models may be applied but the local details reflect the particular cultural and geographical circumstances of the local populations. In effect, the models we tend to apply are one-size-fits-all only up to a point, beyond which improved explanation hinges deciphering the unique and sometimes contrary local expression of larger, regional trends.

Culture Historical Issues

The results presented here help improve on the traditional, linear culture history of the lower James River basin wherein a relatively neat succession of cultural phases was constructed, guided in large measure by larger regional understandings of prehistoric chronology. Specifically, the evidence at hand forces us to acknowledge a more dynamic culture history wherein changes either in technology, economy, or social organization occurred at different rates at different times, and in response to a host of stimuli. Locally, there is no evidence for a relatively abrupt "Mockley spread" around AD 200, but instead there was a gradual shift that may have initially been as much a practical, technological one as it was a fundamental cultural one. Eventually these modest, local Middle Woodland changes created a setting for more abrupt and deep change after AD 1000.

Nearly 15 years ago Doug McLearen and Dan Mouer (1989) chose to characterize essentially the same observation as evidence for a pattern of "localization" around AD 200 – 400. Local ceramic diversity – expressed in the apparent co-occurrence of lithic- and shell-tempered wares – was taken to indicate "the [concurrent] development of local styles or types within smaller areas than in previous times", such that "Mockley coexists, at least for a time, alongside a series of highly localized wares" (McLearen and Mouer 1989:22). Spatial factors they noted, too, account for the relative frequency of Mockley sherds in Coastal Plain assemblages. Namely, Mockley proportions decline with distance from the coastal zone (generally from east to west) and in the Inner Coastal Plain they are extremely low beyond riverine margins.

Mary Ellen Hodges' (1998) thoughtful summary of Middle Woodland occupation in the Outer Coastal Plain also rests on the conclusion that shell- and lithic-tempered (non-shell) Middle Woodland ceramics were in circulation at the same time. During the common period of usage she suggests that the distinctions are ultimately cultural ones and the distinctive wares represent groups carrying different ceramic "traditions" (Hodges 1998:190). She does not argue for stylistic localization in the same way McLearen and Mouer (1989) did for the Middle and Inner Coastal Plain, but simply proposes that groups representing two populations were moving within overlapping territories and occasionally occupied the same sites and exchanged vessels from time to time (McLearen and Mouer 1989:192).

All of the archaeological evidence from the James-York peninsula compiled by this study is supportive of the suggestion that a Mockley-using population emerged, coexisted for a time with already present Varina/Prince George ceramic users, and then effectively replaced the latter population. At present the process of replacement appears to have been a relatively gradual one. This is most strongly supported by the lengthy period of overlap between AD 200–500 as shown by radiocarbon-dated components. Prior to this span lithic-tempered types were in more or less exclusive use, just as shell tempered wares were after about AD 600. The rate of change may have been moderated by the general spatial segregation of the two groups that is increasingly apparent. In other words, eventual replacement of indigenous groups by the Mockley population could have been deterred for some time as a function of the Mockley focus on the estuarine zone and the Varina/Prince George focus on the interior setting. More direct competition could arguably have meant more rapid assimilation of one group by another.

Settlement-Subsistence Issues

The James-York Middle Woodland record is reflective of a fairly conservative settlement-subsistence system based mainly on an annual foraging round. The profusion of small to moderate sized sites both in the interior and along the estuaries through virtually the entire 1,000-year span supports this notion. There is no obvious dichotomy of sites based on size. The visual impact of shell in even thin middens can provoke thoughts of functional distinctions, but the evidence does not support such contrasts locally. Elsewhere along the lower James River, closer to the fall zone and nearer the coast, a real distinction can be drawn between apparent semi-sedentary "macroband base camps" or aggregation sites, and smaller extractive sites used only briefly.

Viewed from the perspective of the entire Coastal Plain segment of the James River basin then, the rather homogenous collection of modest James-York peninsula sites lies between two areas where numerous short-term habitations surround a few large, intensively occupied sites. Typically, the intensively occupied sites are dominated by Mockley rather than lithic-tempered ware. On the outer Coastal Plain, good examples of large, semi-sedentary Mockley occupations are those at Great Neck (44VB7 and 44VB9) (Geier et al. 1986; Hodges 1998), and the best inland example is the Maycock's Point Site (44PG40) with a large freshwater mussel midden (Barber 1981; Opperman 1980). On the peninsula-proper the nearest documented site approaching this sort is at Hampton University (44HT36 and 44HT37) at the edge of the bay (Edwards et al. 1989). Everywhere small sites occur that contain some proportion of lithic-tempered wares.

The key features of most of the larger, more permanent aggregation sites aside from greater areal extent are a predominance of Mockley pottery, substantial shell midden, true pit features for below ground storage, and a direct estuarine or riverine setting. Substantial shell midden is least firm among the characteristics, as indicated by the Hampton University sites. Smaller sites, by contrast, occur widely in both upland and estuarine/riverine settings, seldom if ever do they have substantial pit features, and while lithic-tempered ceramics most commonly predominate in some cases Mockley sherds can be most abundant. Related patterns distinguish distributions of shell- and lithic-tempered components. The latter diminish in number upstream toward the fall line, and also as the fall line is approached Mockley sherds seldom occur on sites away from the river. The distribution of Mockley components assumes in effect a wedge-like form, with a pattern of relatively widespread settlements toward the coast becoming more narrowly confined to major stream margins closer to the fall line.

Fundamentally, the most novel feature of Mockley components is their obvious link to estuarine settings including productive riparian habitats, whether directly in the form of shell middens or indirectly as shell temper in ceramic paste. The unique feature of uniform and widespread adoption of shell as a tempering agent figured prominently in the original definition of this cultural phase. Over and again regional archaeologists note the connection between Mockley sites and the Chesapeake and other regional estuaries (Blanton 1992; Dent 1995; McLearen 1992; Potter 1993; Stewart 1992), having observed that Mockley site density is invariably greater below the salt-freshwater transition zone in major tributaries. Both large and small Mockley sites occur upstream of the transition but they tend to hug the rivers. Literally at the same time, at least for a while, components dominated by lithic-tempered ceramics are widespread, occurring more uniformly over the entire Coastal Plain. Most are relatively small and in much fewer instances are they dominant at substantial shell middens.

Culture Process

The ultimate questions provoked by the evidence presented here concern the process under which one population would come to replace another, and the nature of the interaction between two competing societies. At the very least this closing section will make some working suggestions to begin to provide some answers.

It has been suggested that indigenous Middle Woodland groups, using lithic-tempered ceramic wares, were gradually replaced by Mockley ceramic users. Also, there is good evidence that the rate of replacement was rather slow. The general consensus in the region is that the Mockley emergence marks a significant transition, perhaps associated with migration into the area by a different population (Potter 1993; Stewart 1992). Whether the transition is tied to population movement or local initiatives is yet to be determined, but it is probably safe to suggest that the principal Mockley advantage was a different economic focus, specifically on local estuarine resources. This new focus seems to have carried certain competitive advantages over a strategy focused on upland, interior resources.

There is evidence to suggest that increased exploitation of aquatic resources is often the product of a reduction in group range due to population increase (Binford 2001:369, 385; Kelly 1995:130). Binford (2001:383) is very specific in saying that hunting will be a viable subsistence option only when population density remains below 9.1 persons/100 square kilometers. Above that *density* ("packing") threshold, the primary food source must shift to either terrestrial plants or aquatic resources or resultant stress will mean population reductions (Binford 2001:385). Experimentation with aquatic resources could reduce mobility costs in low-yield terrestrial habitats (Kelly 1995:125). Binford (2001:386) states that also among groups heavily dependent upon terrestrial plants, population packing drives intensification of subsistence activities. The most viable options are to (1) increase net returns from plants per unit area of territory or (2) expand niche breadth by increasing exploitation of aquatic resources, if possible. Another common option for achieving dietary balance is some form of "mutualistic" exchange arrangement with neighboring inland/mainland groups (Binford 2001:386; Voorhies 1978:18; Yesner 1980:733). Mutualism is an important means of accessing plant foods so as to avoid the "calorie crunch" plaguing intensively, aquatically oriented groups (Stark and Voorhies 1978:281; Yesner 1980:733).

As a rule, aquatic resources are extremely concentrated and this condition will influence the way they are exploited (Binford 2001:368; Kelly 1995:151). Where food is reliable and constant, as it can be in a coastal setting, the need for residential mobility is limited. It is very common, then, for groups with coastal economies to rely on a logistical resource procurement strategy, often with the aid of watercraft (Kelly 1995:132; Yesner 1980:730). An arrangement of this kind amounts to a central place foraging strategy designed to return resources to people, rather than to move entire groups to resource collection sites. Given the usually linear distribution of aquatic-dependent groups, population "packing" is as much a function of the spatial structure of the resources as it is a product of simple population growth (Binford 2001:384).

The costs associated with aquatic resource dependence, measured in terms of either energy:labor return rate or risk, define thresholds above and below which aquatic resources will be sporadically or routinely exploited. Regular dependence on aquatic resources, and especially transformative economic shifts toward them, can be expected in direct association with conditions of overall environmental productivity and population packing. Coastal resources will, therefore, predictably become significant dietary/economic staples only under particular, often stressful, conditions.

Factors determining the social organization of groups with aquatic-dependent economies are the abundance and distribution of the resources (Binford 2001:385). Levels of competition and associated restrictions on general access to resources, usually when population densities are high, will be especially influential. With demographic packing, expansion of diet and niche breadth through the use of aquatic resources will regularly result in organized and institutionalized stewardship and ownership of key locations (Binford 2001:369). Thus, high population density relative to the food base is a probable precursor to competitive behavior like territoriality and boundary defense (Kelly 1995:310; Palsson 1991:34; Yesner 1980:731). These changes effectively engender notions of "property." Any reduction in mobility leading to a largely sedentary pattern can be a significant "kick" setting dramatic sociopolitical changes in motion (Kelly 1995:310). There is, as noted, a strong association between non-egalitarian hunter-gatherers and aquatic resources. Significant investments of labor in implements and facilities used to extract aquatic resources will often call for more stringent limitations on resource access, with open access granted more to those responsible for the labor (Binford 2001:369). Strategies for mass capture and subsequent storage of food in so-called delayed return systems will also require coordination of labor (Kelly 1995:312).

These tendencies are the basis for a common scenario characterizing the path toward increasing aquatic resource dependence (Kelly 1995:259), which may be applicable to the case of Mockley spread. Hunter-gatherer societies can become caught in an upwardly spiraling trend of increasing population density as they become more sedentary due to restrictions on mobility. These conditions may reward subsistence intensification and, if possible, arrangements for food storage. Further population growth is the consequence, which will mean even higher density and place even more severe costs on residential mobility. In the most advanced situations, "quantum leap", qualitative transformations can occur that result in large and complex (chiefdom-level) hunter-gatherer societies (Arnold 1993; Palsson 1991:34). Some classic examples are found on the Northwest Coast of North America, among the Ainu in northern Japan, and in southern Florida with the Calusa (Kelly 1995:294, 302, 321). These few examples do, indeed, seem to represent exceptional cases. One should anticipate less elaboration among most aquatically oriented societies, theoretically because their demographic and environmental contexts are less constraining. Such divergent contexts are what accounts for most of the observed variability in these systems.

During the period the two James-York Middle Woodland populations were in coexistence, there was clearly some level of interaction. The nature of their relationship is far from certain but there is no reason to believe that both resource and mate exchanges were not aspects of it. The occurrence of occasional Mockley vessels in interior site assemblages could be the product of either process. The common presence of deer bone in shell middens at the estuary fringe could, in part, be evidence of resource exchanges between the groups. A term referred to earlier for this kind of relationship is "mutualism". Ethnographically there is ample evidence of precisely this kind of interaction among neighboring hunter-gatherer societies (Kelly 1995). Ideally, these kinds of questions will be the focus of investigations that build on the work reported here.

Management Statement

This archaeological data recovery project has resulted in the documentation of significant information from two NRHP-eligible cultural resources, Sites 44JC127 and 44JC850, within the Route 199 corridor. Completion of this report satisfies requirements for cultural resource management activity at these sites. A strength of the project has been explicit development of detailed cultural and environmental contexts that allow for more comprehensive interpretations of the findings at these and other area prehistoric sites. The results are particularly important for understanding Middle Woodland period societies in the lower Chesapeake region.

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Appendix B:
Radiocarbon Calibration Results

BETA ANALYTIC INC.

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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: Auth. Aug. 26, 1996
DATE REPORTED: September 17, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-95745	101.9 +/- 1.1 % modern	-27.5 o/oo	102.4 +/- 1.1 % modern

SAMPLE #: Core 3/38-42
ANALYSIS: radiometric-standard
MATERIAL/PRETREATMENT:(wood): acid/alkali/acid
COMMENT: the small sample was given extended counting time
COMMENT: reported result indicates an age of post 0 BP and has been reported as a % of the modern reference standard

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-95746	830 +/- 80 BP	-28.8 o/oo	770 +/- 80 BP

SAMPLE #: Core 5/76-79
ANALYSIS: radiometric-standard
MATERIAL/PRETREATMENT:(wood): acid/alkali/acid

NOTE: It is important to read the calendar calibration information and to use the calendar calibrated results (reported separately) when interpreting these results in AD/BC terms.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.8:lab. mult=1)

Laboratory Number: Beta-95746 Core 5, 76-79 cm

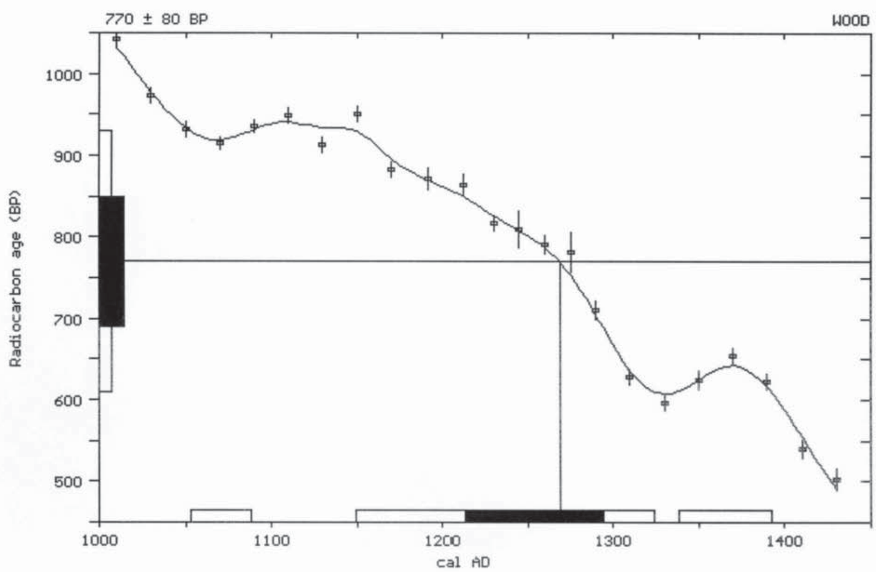
Conventional radiocarbon age: **770 ± 80 BP**

Calibrated results:
(2 sigma, 95% probability)
cal AD 1055 to 1090 and
cal AD 1150 to 1325 and
cal AD 1340 to 1390

Intercept data:

Intercept of radiocarbon age with calibration curve: cal AD 1270

1 sigma calibrated results: (68% probability) cal AD 1215 to 1295



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Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: October 30, 1996
DATE REPORTED: December 11, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-098694	10440 +/- 80 BP	-28.6 o/oo	10380 +/- 80 BP

SAMPLE #: Core 5/117-120
ANALYSIS: radiometric-standard
MATERIAL/PRETREATMENT:(organic sediment): acid washes

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-98695	14280 +/- 260 BP	-28.8 o/oo	14220 +/- 260 BP

SAMPLE #: Core 5/222-230
ANALYSIS: radiometric-standard
MATERIAL/PRETREATMENT:(organic sediment): acid washes

NOTE: It is important to read the calendar calibration information and to use the calendar calibrated results (reported separately) when interpreting these results in AD/BC terms.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: Auth. Oct. 28, 1996
DATE REPORTED: November 5, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-98182	7260 +/- 170 BP	-28.8 o/oo	7200 +/- 160 BP
Beta-98183	13910 +/- 330 BP	-28.7 o/oo	13860 +/- 330 BP

Beta-98182

SAMPLE #: Core 6/48-53
ANALYSIS: radiometric-standard
MATERIAL/PRETREATMENT:(organic sediment): acid washes

Beta-98183

SAMPLE #: Core 6/180-187
ANALYSIS: radiometric-PRIORITY
MATERIAL/PRETREATMENT:(organic sediment): acid washes

NOTE: It is important to read the calendar calibration information and to use the calendar calibrated results (reported separately) when interpreting these results in AD/BC terms.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.8:lab. mult=1)

Laboratory Number: Beta-98182

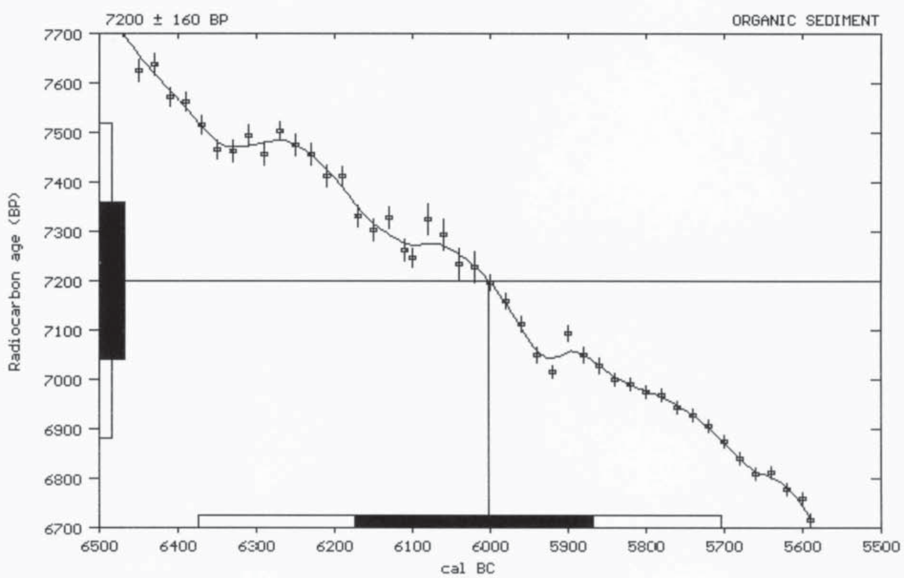
Conventional radiocarbon age: **7200 ± 160 BP**

Calibrated results: **cal BC 6375 to 5705**
(2 sigma, 95% probability)

Intercept data:

Intercept of radiocarbon age with calibration curve: cal BC 6000

1 sigma calibrated results: cal BC 6175 to 5870
(68% probability)



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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: Auth. Aug. 26, 1996
DATE REPORTED: October 3, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-95747	29190 +/- 290 BP	-24.1 o/oo	29210 +/- 290 BP

SAMPLE #: Core6/146-150
ANALYSIS: AMS(ETH)
MATERIAL/PRETREATMENT:(wood): acid/alkali/acid

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: October 15, 1996
DATE REPORTED: October 22, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-98184	11630 +/- 270 BP	-26.8 o/oo	11600 +/- 270 BP

SAMPLE #: Core 6/ 230-235
ANALYSIS: radiometric-PRIORITY
MATERIAL/PRETREATMENT:(peat): acid washes
COMMENT: the small sample was given extended counting time

NOTE: Samples Core 6/ 48-53 and 182-187 were submitted but not analyzed.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

FOR: Mr. Dennis Blanton
The College of William and Mary

DATE RECEIVED: Auth. Aug. 2, 1996
DATE REPORTED: September 10, 1996

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-95748	13460 +/- 50 BP	-29.1 o/oo	13400 +/- 50 BP

SAMPLE #: Core 6/271-275
ANALYSIS: ADVANCE AMS (LLNL)
MATERIAL/PRETREATMENT:(wood): acid/alkali/acid

NOTE: Three additional samples from this set are currently being analyzed and will be reported separately.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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QUATERNARY ISOTOPE LAB
RADIOCARBON CALIBRATION PROGRAM REV 3.0.3
Stuiver, M. and Reimer, P.J., 1993, Radiocarbon, 35, p. 215-230.

Calibration file(s): INTCAL93.14C
Listing file: C14FIL.TXT

Beta 95748Core 6/271

Radiocarbon Age BP 13400 ± 50 | Reference(s)
Calibrated age(s) cal BC 14078 | (Bard et al, 1993)

cal AD/BC age ranges obtained from intercepts (Method A):
one Sigma** cal BC 14196 - 13957
two Sigma** cal BC 14312 - 13834

Summary of above:

minimum of cal age ranges (cal ages) maximum of cal age ranges:
1σ cal BC 14196 (14078) 13957
2σ cal BC 14312 (14078) 13834

References for datasets used:
Bard, E, Arnold, M, Fairbanks, RG, and Hamelin, B, 1993,
Radiocarbon, 35, 191-199.

Comments:
†This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^{2}+ curve std. dev.^{2})
2 sigma = 2 x square root of (sample std. dev.^{2}+ curve std. dev.^{2})
[ ] = calibrated with linear extension to calibration curve
0* represents a "negative" age BP
1955* denotes influence of bomb C-14
For cal yrs between 5500-5190 BC an offset of 25 years is possible.
NOTE: Cal ages and ranges are rounded to the nearest year which may be too precise in many instances. Users are advised to round results to the nearest 10 yr for samples with standard deviation in the radiocarbon age greater than 50 yr.

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QUATERNARY ISOTOPE LAB
RADIOCARBON CALIBRATION PROGRAM REV 3.0.3
Stuiver, M. and Reimer, P.J., 1993, Radiocarbon, 35, p. 215-230.

Calibration file(s): INTCAL93.14C
Listing file: C14FIL.TXT

References for datasets used:

Comments:
†This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^{2}+ curve std. dev.^{2})
2 sigma = 2 x square root of (sample std. dev.^{2}+ curve std. dev.^{2})

Beta-95748 13460 +/- 50 BP -29.1 o/oo 13400 +/- 50 BP

SAMPLE #: Core 6/271-275
ANALYSIS: ADVANCE AMS (LLNL)
MATERIAL/PRETREATMENT:(wood): acid/alkali/acid

NOTE: Three additional samples from this set are currently being analyzed and will be reported separately.

Dates are reported as RCYBP (radiocarbon years before present, "present"= 1950A.D.). By international convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards. Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 Age.

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Appendix C: Pollen, Seed, and Charcoal Study of Sediment Cores

Dr. Grace Brush
William Hilgartner

Two sediment cores, Core 5 and Core 6, collected along Chisel Run in upland Virginia were analyzed for pollen, seeds and charcoal in order to reconstruct the regional and local environmental history. Thirty-eight samples were analyzed from Core 5 and 49 from Core 6. Pollen provides a history of regional climate, whereas seeds provide a history of the local environment. Charcoal in sediment cores is a surrogate of fire.

Methods

Pollen Grain Extractions. A measured volume of sediment was washed in hydrochloric acid and hydrofluoric acid, and acetylyzed using a mixture of nitric acid and acetic anhydride to remove carbonates, silicates, and organic material. The residue was washed in glacial acetic acid, distilled water and alcohol, then stored in a measured amount of tertiary butyl alcohol. Aliquots were mounted in silicone oil on microscope slides, and all pollen in an aliquot identified and counted. Counts were converted to percentages based on the total pollen count.

Seed Extractions. A measured volume of sediment was submersed in HNO_3, and washed through 20 and 60 mesh sieves. The 20 mesh has 250µ openings and the 60 mesh has 833µ openings All seeds were identified, counted, and stored in vials of dilute formalin. Concentrations of seeds per 100 ml were calculated.

Charcoal Extractions. Charcoal particles collected in the 20 and 60 mesh sieve while separating seeds from the sediment were counted and converted to area, expressed as mm^2 per 100 ml of sediment.

Analyses and Graphical Representation of Data. Pollen percentages and seed and charcoal concentrations are plotted against depth and time (Figures C-1 and C-2) using the “psimpoll” program (Bennett 1994). A list of all taxa identified in the cores is presented in Table C-1.

Dating of Cores. Radiocarbon dates show that the cores have a history dating from late glacial time and extending to the present (Table C-2). Sedimentation rates vary a great deal, so that some time intervals are represented better than others.

Results

Core 5

The pollen profile, which spans over 16,000 years is divided into seven zones (see Figure C-1). Sedimentation rates are extremely low from 11,000 to 400 years ago, and increase from 4 to 5 times after 400 years ago. Spruce is an important part of the pollen assemblage until 11,000 years ago, accompanied by small amounts of fir from 14,500 to about 13,000 years ago. During this time, there are three sizes of pine pollen, 100µ, 70µ and 40µ, indicating that northern pines (the smaller type, possibly jack pine) were present along with southern species, represented by the largest pollen. The medium-size grains probably represent pitch pine and virginia pine common in the area today. From 13,000 to about 3,000 years ago, wood fern and cinnamon fern were abundant, designating a wet woodland forest For about 1000 years from 3000 to 2000 years ago, the medium size pine pollen is the only pollen type in the sediment. There is a spike in walnut and duckweed from 2000 years ago to about 350 years ago. Ragweed, an indicator of European land clearance and agriculture becomes dominant in the recent sediments. Oak and hickory are the major tree types along with pine. There is a spike in alder synchronous with a spike in ragweed. The ragweed profile reflects probable small clearings with initial European settlement, followed by more intensive land clearance in the nineteenth century. The large increase in oak in recently deposited sediments reflects a larger source of tree pollen in local depositional areas when the land is largely cleared.

The seed profile is divided into 5 zones. The first zone extends from the bottom of the core to well into European settlement, but the zonation is influenced by the fact that there are no seeds preserved after 12,500 years ago to about 350 years ago. Seeds of sev-

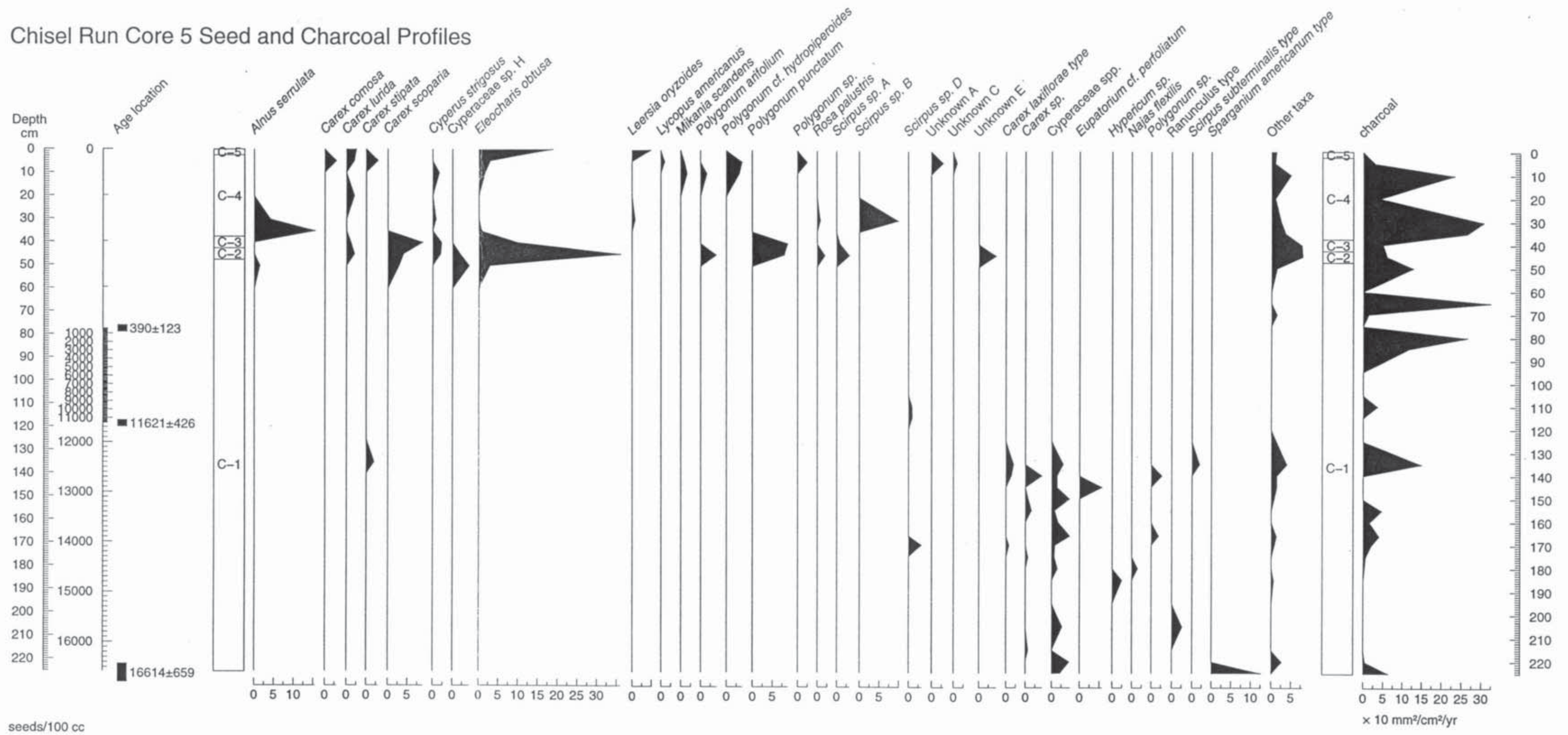

Figure C-1. Core 5 seed and charcoal profiles.

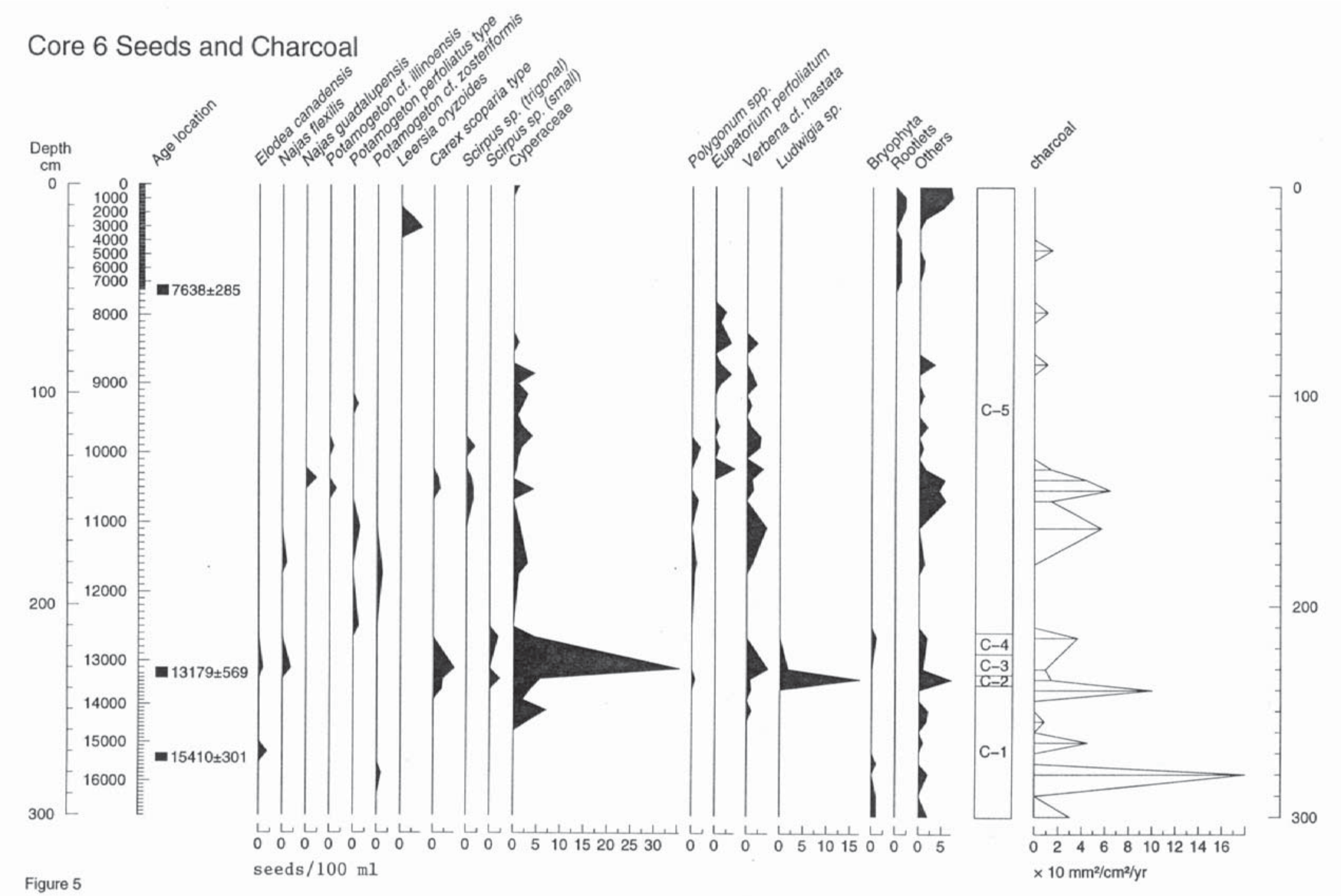

Figure C-2. Core 6 seed and charcoal profiles.

Scientific Name	Common Name
Abies sp.	fir
Acacia	mimosa
Acer	maple
Alnus serrulata	smooth alder
Ambrosia	ragweed
Asimina	pawpaw
Betula	birch
Botrychium	grape fern
Bryophyta	mosses
Carex comosa	sedge
Carex laxiflorae	sedge
Carex lurida	sedge
Carex scoparia	sedge
Carex stipata	sedge
Carya	hickory
Caryophyllaceae	pink family
Castanea	chestnut
Cheilanthus	lip fern
Chenopodiaceae	pigweed family
Compositae	composites
Cornus	dogwood
Corylus	hazelnut
Cruciferae	mustard family
Cupressaceae	red cedar?
Cyperaceae	sedge family
Cyperus strigosus	nut sedge
Drosera	sundew
Dryas	dryas
Dryopteris	wood fern
Eleocharis obtusa	spike rush
Elodea canadensis	water weed
Ericaceae	blueberry heath family
Eupatorium perfoliatum	boneset
Fagus	beech
Filicineae	ferns
Fraxinus	ash
Galium	bedstraw
Gramineae	grass family
Hypericum sp.	St. John's wort
Ilex	holly
Juglans	walnut
Leersia oryzoides	rice cut grass
Leguminosae	bean family
Lemna	duckweed
Ludwigia sp.	loosestrife
Lycopodium	club moss
Lycopus americanus	bugle weed
Magnolia	magnolia
Mikania scandens	climbing hemp weed
Myriophyllum	milfoil
Najas flexilis	naiad
Nympheaceae	water-lily family
Nyssa	blackgum
Onagraceae	evening primrose family
Osmunda	cinnamon fern
Picea	spruce
Pinus 40	jack pine?
Pinus 70	pitch/virginia pine?
Pinus 100	southern pines?
Platanus	sycamore
Polygonum arifolium	arrow leaf tear-thumb
Polygonum cf. hydropiperoides	water smartweed
Polygonum punctatum	dotted smartweed
Pontederium	pickerelweed
Portulacca	purslane
Potamogeton cf. illinoiensis	pondweed
Potamogeton perfoliatus	redhead grass
Potamogeton cf. zosteriformis	pondweed
Prunus	cherry
Pteriduium	bracken fern
Quercus	oak
Ranunulus sp.	buttercup
Rhamnus	buckthorn
Rosa palustris	swamp rose
Rubus	blackberry
Sagittaria	arrowhead
Salix	willow
Sambucus	elderberry
Scirpus subterminalis	sedge
Scrophulariaceae	figwort family
Selaginella	spikemoss
Sparganium americanum	burreed
Solidago	goldenrod
Sphagnum	sphagnum moss
Stellaria	chickweed
Thalictrum	meadow-rue
Tsuga	hemlock
Typha	cattail
Ulmus	elm
Umbelliferae	parsley family
Verbena cf. hastata	blue vervain
Viburnum	viburnum
Violaceae	violet family
Vitis	grape

Table C-1. List of taxa alphabetized by scientific name.

Core 5		Core 6	
Depth (cm)	Years bp	Depth (cm)	years bp
76-79	390±123	48–53	7,638±285
117–120	11,621±426	230–235	13,179±569
222–230	16,614±659	271–275	15,410±301

Table C-2. Corrected carbon-14 dates for Cores 5 and 6.

eral species of marsh plants including mainly sedges are present from 16,614 to about 12,500 years ago. *Eupatorium* (boneset), a wetland composite is present during this time along with several sedges The absence of seeds from 12.500 years ago to about 350 years ago, is consistent with the development of a wet woodland or riparian forest indicated by the pollen profile, when low sedimentation would have precluded seed preservation. Seeds from 350 years ago to the top of the core include an assemblage comprised of different species of sedge as well as alder, suggesting a shrub-sedge marsh. The latter assemblage occurs during the oak-hickory pollen interval, and is entirely different in composition from the marsh which occurred during the early spruce-pine-fir interval.

The charcoal record is highly variable, but shows a large increase in charcoal deposition beginning about 6,000 years ago and continuing to the top of the core.

Core 6

The pollen profile is divided into 4 zones (see Figure C-2). Sedimentation rates are lowest from 7000 years ago to the present at this coring site. Spruce and fir extend from 15,400 years ago to about 8,500 years ago and the 3 sizes of pine pollen are present until about 9,000 years ago. Spruce and fir pollen are not present at all from 12,500 to 11,000 years ago (zone C-3) and then reappear from 11,000 years ago to about 8,500 years ago. The spruce-pine-fir interval is accompanied by sedges and some other herbaceous species. Zone C-3, when spruce and fir are absent, contains alot of small pine grains and rhizopods.

Oak, 70µ pine, and other deciduous trees become important about 9,500 years ago. Wood fern and cinnamon fern are abundant throughout this interval, indicating the establishment of a temperate wet woodland or riparian forest.

The seed profile is divided into five zones. From about 15,000 to 12,500 years ago, a sedge-dominated marsh became established and remained dominant until about 8700 years ago. During this period *Verbena hastata* (blue vervain) and *Ludwigia sp*. (probably *L. palustris*, marsh purslane) are common. Later, *Polygonum spp*. and *Eupatorium perfoliatum* (boneset) become important. Six species of submerged macrophytes are all present at different times during this interval, indicating wetter conditions or an environment where slow open water occurred within the marsh habitat. About 7,500 years ago, the marsh disappeared, and a shrub or open forest habitat became established indicated by woody plant rootlets. An open canopy condition from 4000 to 3000 years ago is indicated by the presence of *Leersia* (rice cut-grass).

Charcoal occurs fairly abundantly in late glacial-early Holocene time. Very little charcoal was deposited at this coring site after 10,000 years ago.

Discussion and Conclusions

The pollen record is a good indicator of the regional environment, representing an area extending several kilometers around the site. It shows a history of a boreal type forest in the region until about 9000 years ago. After 9,000 years, there is a gradual warming and the development of a wet woodland or riparian forest. The seed record provides a record of the local environment, which extends only a few meters from the coring site. At coring site 5, there was a sedge marsh with intermittent open water until about 11,000 years ago, after which a riparian forest became established. The sedge marsh identified in these cores would come under the description"palustrine emergent wetland, seasonally flooded, dominated by *Carex spp., Polygonum and Eleocharis"* (Cowardin et al. 1979). Later around 2000 years ago and concurrent also with

European settlement, a second sedge marsh developed, with a different species composition from the earlier marsh. At coring site 6, the sedge marsh with intermittent open water is present until about 10,000 years ago, and is succeeded by a wetland or riparian forest, which remains in place up to the present. Riparian forests are characterized by abundant *Osmunda* and *Dryopteris,* as found in these cores. The presence of opollen of *Alnus* and rootlets of *Alnus* and *Acer negunda* is also a clear indicator of a riparian forest The spatial and temporal distribution of the marshes is probably related to the behavior of the stream.

The core data are consistent with general climate conditions described from other pollen profiles in the general area (Table C-3). The modern temperate forest at Chisel Run is an oak-pine forest, characteristic of upland forests and interior Coastal Plain forests. The late glacial-early Holocene forest at Chisel Run was a boreal type forest dominated by a mixture of pines, spruce and some fir. A 12,000 year record from a similar floodplain environment around Indian Creek a tributary of the Anacostia River (Yuan 1995) shows a similar sequence of fir, spruce and pine until about 9,000 years ago. This boreal type forest was succeeded by hemlock and pine and later by pine and oak. In the Upper Magothy River, where there is a 4,000 year record, the early forest was predominantly sweet gum and black gum, and was succeeded by oak and pine more recently. (Brush 1986) Farther south in the vicinity of St. Mary's River, a cypress type forest 7000 years ago was succeeded by a sphagnum bog environment 4,500 years ago (Brush, unpublished data). At that site, oak and pine were present throughout accompanied at different times by holly and gum taxa. At none of the sites is there evidence of human activity prior to European settlement.

The general history of the eastern United States indicates that oak-pine and oak-hickory forests developed in some areas and cypress-gum swamps at others (see Table C-3). This mosaic is likely controlled by soil types and water levels. For example, Whitehead (1981) studied a 30,000 year history of vegetation based on pollen analyses of sediment cores collected in Rockyhock Bay, a Carolina bay in northeastern North Carolina. From 30,000 to roughly 21000 years before present, the pollen assemblage is dominated by Cupressaceae, oak and alder. From 21,000 to 10,000 years ago, pine, spruce and quillwort are dominant. Pine grains were all small, and according to Whitehead probably represent jack and/or red pine. The conifers began to decline10,000 years ago and deciduous taxa such as oak along with hemlock and white pine became dominant. The change in sediment type at that location suggests a drop in water table during this time. From 7200 to 5000 ybp, there is a sweetgum golden club zone As the water table dropped the sediment became more peaty and aquatics including Sagittaria, Nymphea and Myriophyllum appeared and were fairly abundant After 5,000 ybp, there was a gradual development of swamp forests. Oak declined, sedges increased and aquatics including Sagittaria, Nymphea and Myriophyllum were also fairly abundant .

A more recent study of pollen and macrofossils was made from borings drilled along the proposed Chesapeake Bay Bridge and Tunnell Parallel Crossing in Virginia (Rogers and Dering 1992). Two of the samples were radiocarbon dated. The dates obtained were 9,290±100 ybp and 8,520±70 ybp (uncorrected). Both samples are dominated by oak and grasses.

This study along with others indicates that the modern temperate forest became established in the southern part of Mid-Atlantic USA as a mosaic of oak-pine and gum forests. The establishment of these forests was in all likelihood controlled by hydrologic conditions of the substrate including ground water levels. There is no clear sign of human activity, prior to 400 years ago. Even the charcoal records show no clear trend. This is not unusual however, because there is little evidence if any from pollen, seed and charcoal records of human activity in sediment cores collected in the mid-Atlantic region. This is not to say that there was no human activity, but rather that human activity did not alter the environment as portrayed in pollen and seed records.

AGE (ybp)	SOUTHERN NEW ENGLAND (Davis 1969)	SHENANDOAH VALLEY VIRGINIA (Craig 1969)	NEW JERSEY (Watts 1979)	MARYLAND COASTAL PLAIN (Yuan 1995)	VIRGINIA COASTAL PLAIN (Whitehead 1973)	NORTH CAROLINA (Whitehead 1981)	SOUTH CAROLINA (Watts 1980)	GEORGIA & NORTHERN FLORIDA (Watts 1971)
1000					CYPRESS-GUM SWAMPS		PINE	
2000		OAK-PINE	OAK - BOG EXPANSION	OAK-HICKORY				
3000	OAK					CYPRESS-GUM SWAMPS		VAST CYPRESS SWAMPS
4000								
5000					HICKORY-SWEET GUM			
6000								
7000		OAK-HEMLOCK	OAK	PINE-HEMLOCK-OAK				OAK-PRAIRIE
8000	PINE-OAK							
9000	SPRUCE-FIR-PINE				BEECH-HEMLOCK-BIRCH		OAK-PINE-GUMS	
10,000				YOUNGER DRYAS		WHITE PINE-HEMLOCK		
11,000	SPRUCE-PINE	SPRUCE-PINE	SPRUCE-PINE	SPRUCE-FIR-PINE	SPRUCE-PINE		HICKORY-BEECH	
12,000								

Table C-3. Summary of postglacial pollen stratigraphy in eastern United States.

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Appendix D:
Phytolith Analysis

Dr. Lisa Kealhofer

Introduction

Soil samples from five features at the 44JC850 Middle Woodland (500 B.C. – A.D. 900) were analyzed for phytotiths to explore the viability of phytolith analysis for this context. The initial goal was merely to determine if phytolittis were present in the prehistoric period soil sample 8. If phytouths were present, and well-preserved, secondary goals Included the identification of feature differences within the site and, if possible, an assessment of the plants associated with those features. Since the goals for this project were limited in scope and the number of samples was very small, the amount of information they reveal is limited. Further sampling, against the background of a longer term environmental sequence, will provide a much greater understanding of the archaeological features.

Background

Phytolith Analysis and Soils

Phytoliths consist of one of the most ubiquitous minerals on earth: silica. They are formed when plants absorb, through transpiration, hydrated silica from the soils in which they grow. The silica is then deposited in and between cells in the plant. Plants vary a good deal in the extent to which they deposit silica. Some plants do not deposit SiliCa, and therefore create no phytoliths (e.g., most water plants), wtiile others rely upon silica as the backbone of their structure (e.g., rice and other grasses).

Silica deposition in plants tends to follow taxonomic relationships. For example, most of the species in the Moraceae family (in which figs occur) make extremely diagnostic phytolitha, while most of the species ifl the Rosaceee family (apples, pears, etc.) do not. in addition, forms made by related species are similar, This aids in the identification of unknown forms. Phytoliths can be diagnostic to the species, genus, tribe, or family level. What makes them diagnostic Is the unique shapes they take on as they fill in or surround plant cells, since the plant cells themselves are often diagnostic of their taxa.

Several other factors are of importance for interpreting soil phytolith assemblages. First, different plants produce different quantities of phytoliths. For example, many grasses produce phytoliths in abundance, as well as more than one type of phytolith. For Monocots (e.g., grasses, sedges), in general, each part of the plant produces a different kind of phytolith, although not all are diagnostic. Dicots (most trees and shrubs) usually produce a narrower range of phytolith types: often only one type from one part of the plant (fruit or nut often). They also do not produce as many phytoliths. This means that almost any soil collected where grasses occur will over-represent grass phytoliths relative to the amount of grass present at the time. Trees and shrubs, producing fewer phytoliths, will be under-represented (this pattern is clearly illustrated in Fig D-1). Over and under-representation of taxa is a problem common to pollen analysis, as well.

Because so little phytolith work has been done in many regions, the distribution of phytoliths (forms and frequencies) for many species is unknown. However, general silica distribution at the family and even subfamily level has been fairly well documented (Kealhofer and Pipemo 1996; Piparno 1988; 1989; 1990). Still, a reference collection of modern plant phytoliths must be compiled for each biotic region in which research is undertaken.

It is also crucial to understand the depositiortal process for phytoliths. in non-depasitional environments (soil deposition), sediments accumulate phytoliths from the plants that grow in them (i.e. A Horizon soils). In low-lying or depositianal contexts, phytoliths may be camed in and deposited through alluvial processes. They are less commonly "blown around" than pollen, and therefore are more representative of the immediate habitat of the soils in which they are found. Sediments by their fundamental nature will include a pelimpsest of biological and mineral materials. Soil is created by the mechanical chemical and biological break down of plant remains, among other things, *in* sediment over a long period. This means that analysis of a soil sample will yield plants present during the full period of the creation of that soil wild plants or intentionally planted species, as well as weeds Soil formation can take a variable amount of time, depending on the climate and the parent sediment; therefore several generations of plant material may have decayed into one soil zone. In addition, sediments in gardens or activity areas are often changed by human activities Many factors can change the assemblage of phytoilths present in the top most soil horizon (A). Sediment samples therefore contain a broad variety of plant species, a "soil assemblage" Interpretation of samples involves attributing the various species present to the different ways in which the plants could have been introduced to that soil location, including both cultural and natural processes

Site Context

The five samples analyzed here were recovered from 5 different units excavated at the site (Test Units 6, 9, 11, 16, 18). All the samples ware taken from the same Level Va. This level included a Middle Woodland living area with a tow density of artifacts, Some concentrations of ceramics, lithics, and fire-cracked rock were found in this level, but no formal features were identified. Occupation seems to have been short term, based on the lack of "installations", the low density of material, and the limited sediment accumulation. Soil samples were taken from areas with both low and high densities of artifacts.

In geological terms Level Va was at the top of a B Horizon matrix. The B Horizon began Ca. 14 cm below surface, consisting of an olive yellow (2.5Y6/6) sandy loam with patches of pale brown sand (10YR8/2). Root disturbance is common throughout the B Horizon. Level Va deposits were ca. 5 cm thick (depth=14–19 cm), and Stratum V totaled 16 cm thick. Underlying Stratum V, ca. 30 cm deep, is a sandy clay stratum (Miocene?). The A Horizon is disturbed by lagging, but the site does not seem to have been plowed.

Methodology

Analysis has proceeded as a "two-pronged" effort, Before the soils could be studied, a reference collection for identifying the phytoliths of the local flora had to be compiled. A list of habitat specific plants for the Williamsburg area was created in consultation with Donna Ware at the Herbarium of the College of William and Mary. Nearly 350 samples have presently been collected. About 200 of these have been analyzed. While this may seem like a large number, it is important to remember that the potential number of species in local environments runs to the thousands. Creating a reference collection is an ongoing process that can take years to complete if, in fact, it can ever be completed. initially plants were collected strategically, focusing on those known to distinguish different habitats, and most importantly, plants known to produce phytoliths. We are, and will be, continuing to build our type collection to improve the identification of phytoliths train soil samples.

The second part of the analysis centered on the sediment samples from Route 199. As noted above, the main task was to test for the presence of phytoliths, and to sea if we could find meaningful plant distributions across the archaeological features tested. Blanton chose five samples from site features to represent a range of contexts identified during excavations. The five samples taken include :

The samples were processed by standardized techniques outlined in Piperno (1988), with a limited number of modifications (chemical substitutions). Laboratory processing required approximately one month. Once the phytoliths were removed from their sediment matrix, they were mounted on microscope slides and viewed at 400x magnification. The phytolith types present were identified when possible, assigned a descriptor If riot, and counted and photographed. In order to get a good representation of the range and distribution of phytoliths present, ca, 200 diagnostic phytoliths were counted per slide.

Results

Of the 5 samples analyzed, four contained abundant phytoliths. Only in the sample from Test Unit 9 were phytoliths rare. Test Unit 9 is included in Figure C-1 because enough phytoliths were found to reveal a pattern, however this sample is undoubtedly biased. Test Unit 9 is either a non-cultural context, contains a mix of natural B Horizon soils, or contains material from plants that do not produce phytoliths. As expected, grasses dominate the assemblage; however, the arboreal component is higher than expected, particularly in Test Unit 6 (see Figure C-1).

Four categories of grasses were identified in these samples: Pooideae, Chloridoideae, Panicoideae, and Other (probably a mix). Pooid grasses are most commonly found in temperate, cool and dry contexts (wheat, barley, rye are all Pooids). Cloridoid grasses indicate warm to hot, dry habitats that are very open. Panicoid grasses, on the other hand, are most often found in subtropical to tropical disturbed contexts, where habitats are warmer and wetter (Twiss 1992). Panicoid taxa include commonly known Panicums, millets (Setaria, Pennisetum), Brachiaria, Digitaria, Zea, Sorghum, etc.

In this region, two sublamules are most common: Panicoideae and Chloridoideae. Cloridoid grasses are locally dominant in marsh and nearshore contexts {e.g. , Spartina, Cynodon). Predictably, Pooid grasses are rare in these site samples, and Panicoid grasses are most common. However, there is some variability in their distribution: Test Units 11, 16, and 18 are very similar in Panicoid taxa frequencies, although slight differences in taxa occur, while Test Unit 6 contains very few Panicoid taxa. The lack of Cloridoid phytoliths seems to confirm that marsh greases (baskets? seeds?) were not carried into the site. The presence of grasses in this context may suggest a couple different interpretations. Either the grasses were part of the habitat or they were brought in by the people stopping there. If they were part of the habitat, then they indicate that this area was open to the sunlight, and likely fairly damp. If they were brought in by people, they could either have been used for making a shelter, or other items, or as food. Most of the phytoliths were from leaves, suggesting they were probably not used for food. Test Unit 6 is the only sample where Pooid inflorescence or seed phytoliths were found. The frequency, however, is so low that little can be confidently drawn from this. It is interesting that no maize phytoliths were found.

The patterning in the arboreal assemblage mimics the grass distribution: Test Unit 6 contains a different distribution and arboreal content than Test Units 11, 16, and 18. Small amounts of oak phytoliths were found in Test Units 6, 9, and 18 (MFP). One particular form "spikey MFP" dominated the Test Unit 6 sample. Unfortunately, this form is as yet unidentified. Most of the arboreal assemblage is not taxonomically diagnostic. Differentiating the various MFP types will eventually contribute significantly more information. Both Test Units 8 and 11 contained very diverse assemblages of dicot and arboreal phytoliths, suggesting that a variety of food or plant refuse remains decayed in these areas.

In Test Units 9 and 11 a small quantity of probable Cucurbitaceae phytoliths were found. They were fragmentary, so further identification would be difficult, but gourds or squash are likely contenders. No sedges were found in the assemblage, which indicates that the site was not very to the marsh or water source.

In order to resolve the assemblage patterns into more easily "readable" differences between samples, a graph was made of the correspondence analysis of the phytolith assemblages from each sample. Clustering on the graph indicates sample similarity, just as distance indicates sample dissimilarity. Two different analyses were run, one that included the low count sample from Test Unit 9, and one that did not. Figure C-2 shows the similarity between Test Units 11, 16, and 18 discussed above, and the uniqueness of Test Units 6 and 9. In Figure C-3 the phytoliths that cause the sample distribution are graphed. Also as discussed above, the phytoliths that contribute to making TU 11, 16, and 18 look similar include both Panicoid grass and arboreal phytoliths. While Test Unit 6 is distinguished by a variety of dicot and arboreal forms, Test Unit 9 contains a distinct set of dicot and arboreal forms.

In Figure C-4, the four phytolith samples with significant numbers of phytoliths are graphed. This graph reveals the more subtle differences between the samples. While Test Unit 6 still stands out as a unique sample (note X axis values), Test Unit 11 is shown to be substantially different from Test Units 16 and 18. The presence of several unidentified dicot types ac-

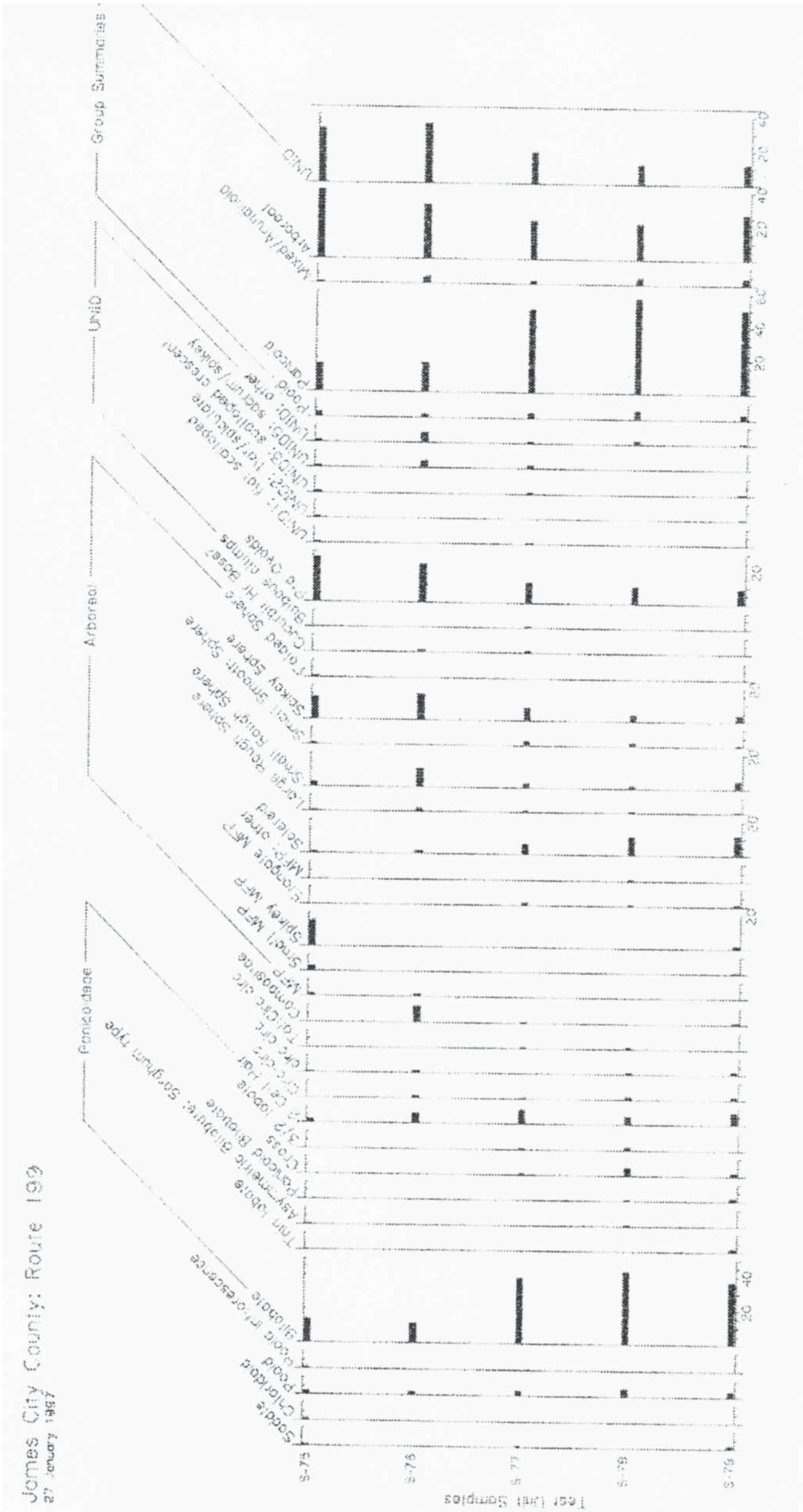

James City County: Route 199
Test Unit Samples
Arboreal
UnID
Group Summaries

Figure C-1.

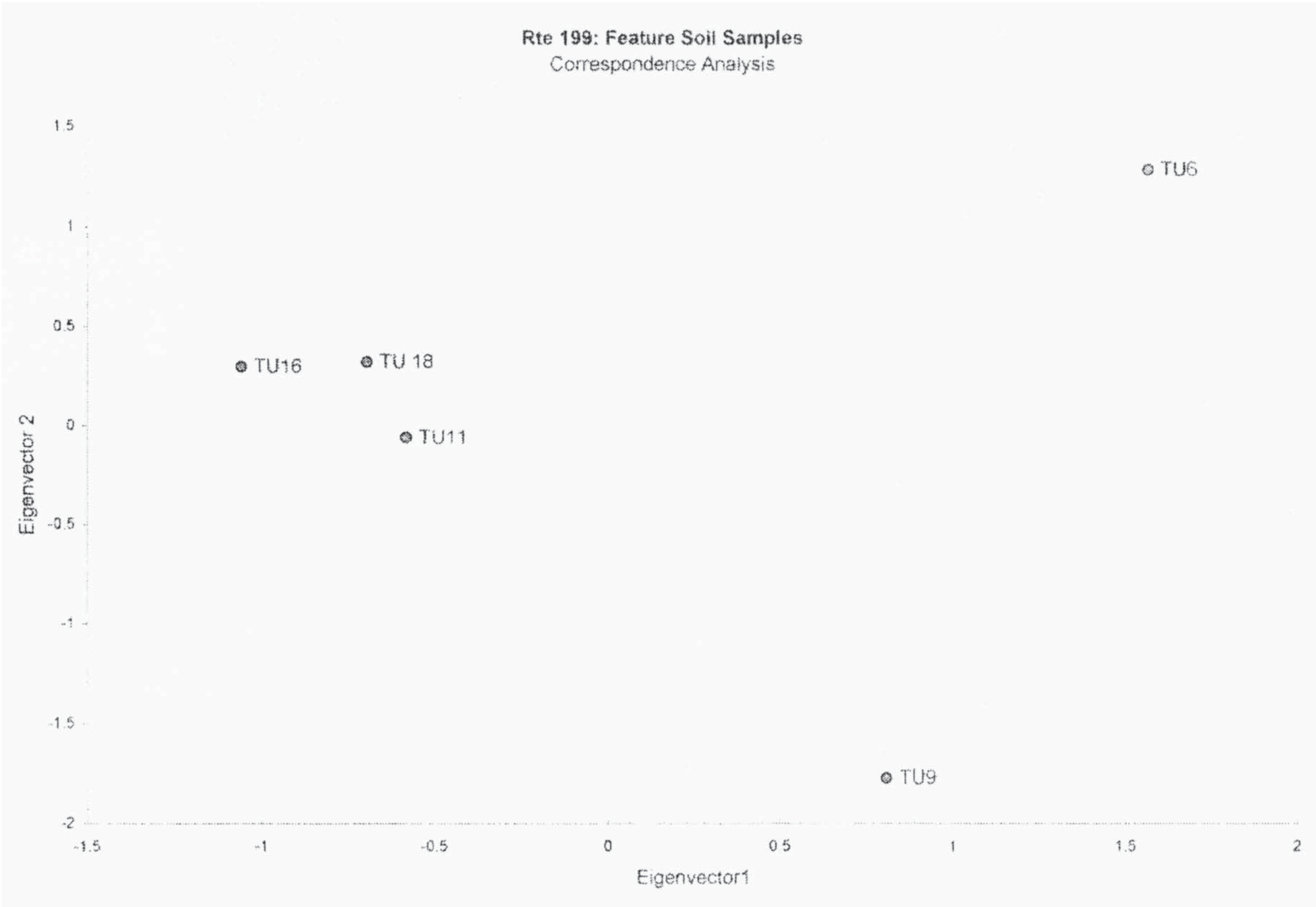

Rte 199: Feature Soil Samples
Correspondence Analysis
Eigenvector 2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Eigenvector1
TU6
TU16
TU 18
TU11
TU9

Figure C-2.

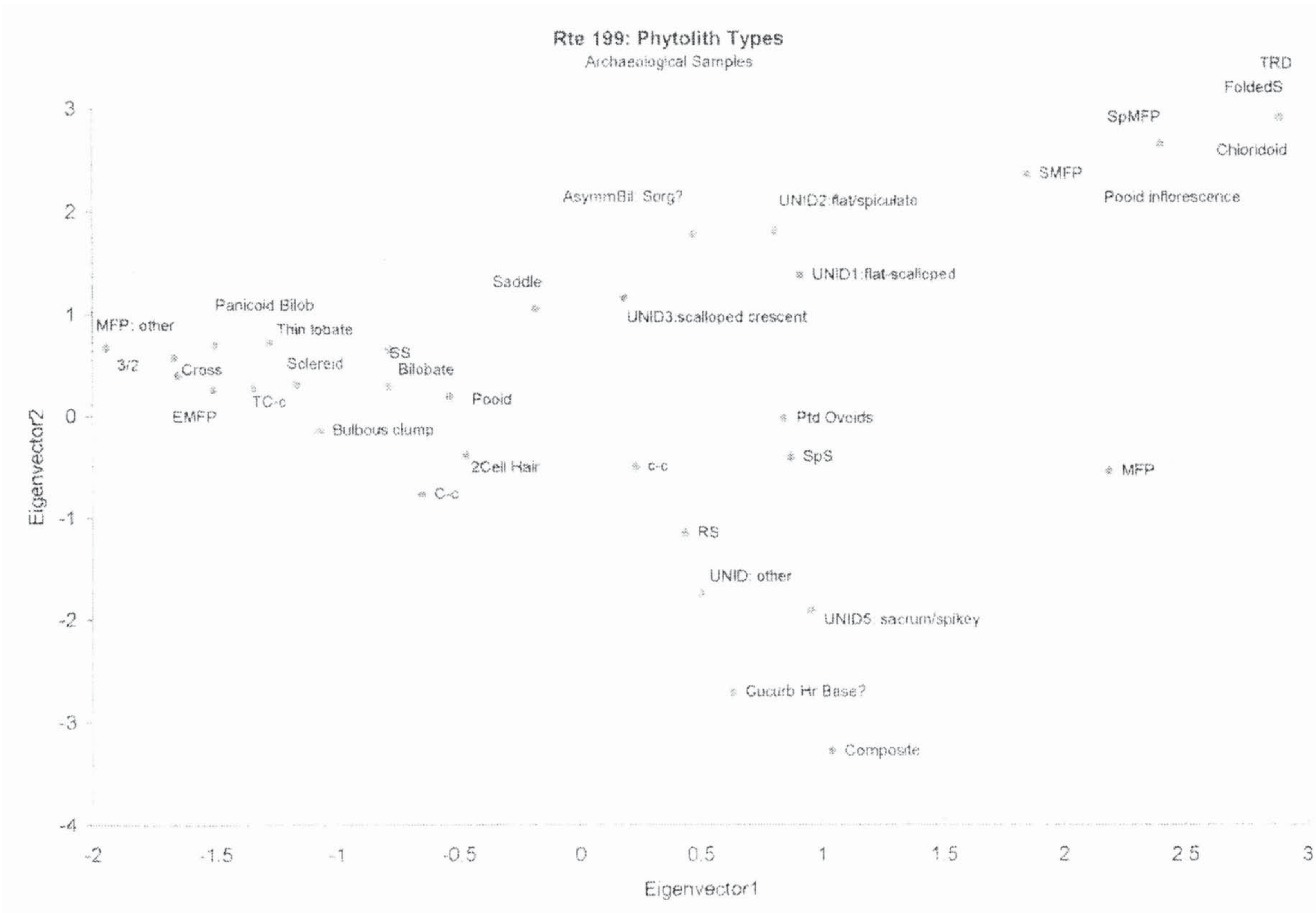

Rte 199: Phytolith Types
Archaeological Samples
TRD
FoldedS
SpMFP
Chloridoid
SMFP
Pooid inflorescence
AsymmBil: Sorg?
UNID2:flat/spiculate
UNID1:flat-scalloped
Saddle
UNID3.scalloped crescent
Panicoid Bilob
MFP: other
Thin lobate
SS
3/2
Cross
Sclereid
Bilobate
TC-c
Pooid
EMFP
Ptd Ovoids
Bulbous clump
SpS
2Cell Hair
c-c
MFP
C-c
RS
UNID: other
UNID5: sacrum/spikey
Cucurb Hr Base?
Composite
Eigenvector2
Eigenvector1
3
2
1
0
-1
-2
-3
-4
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3

Figure C-3.

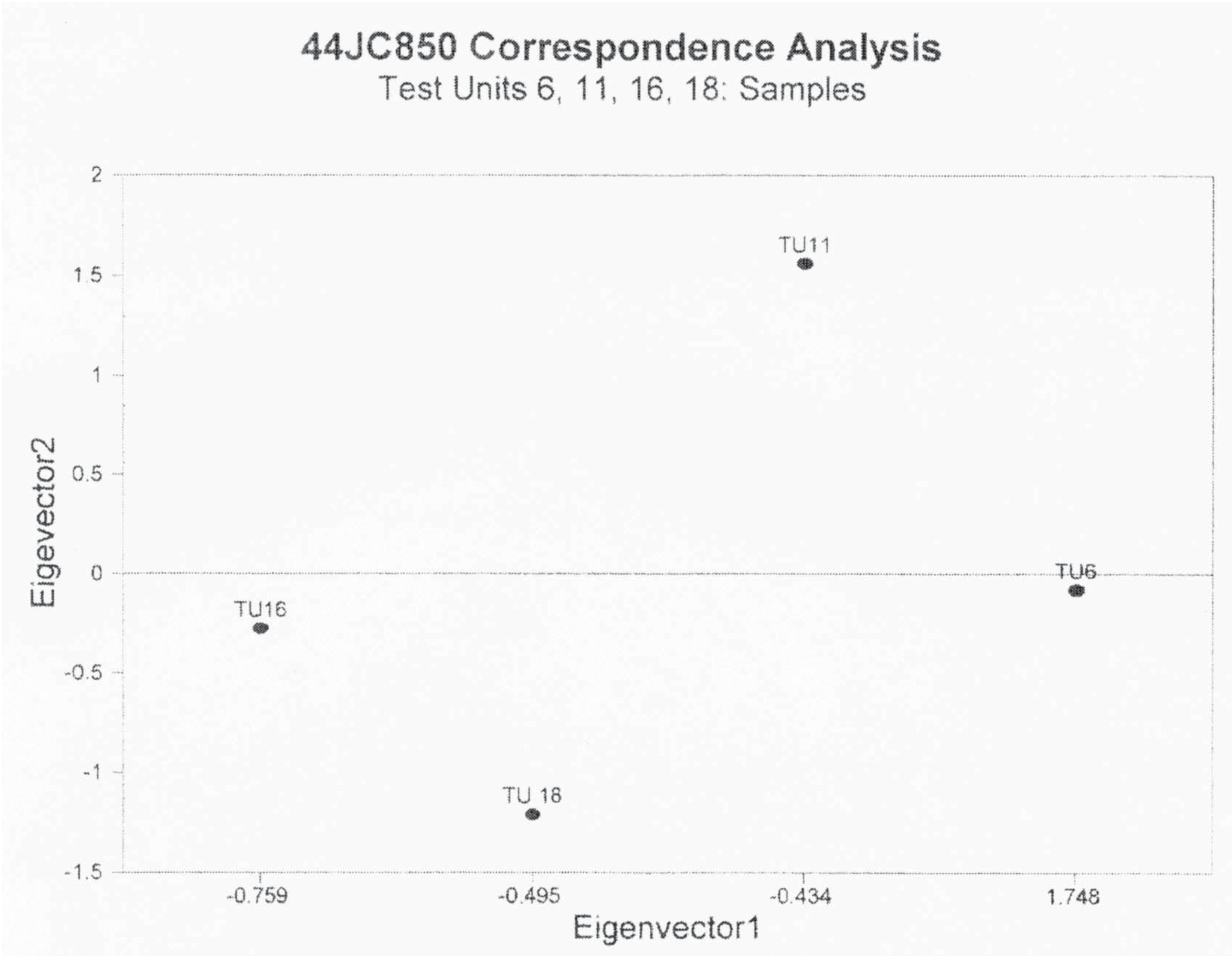
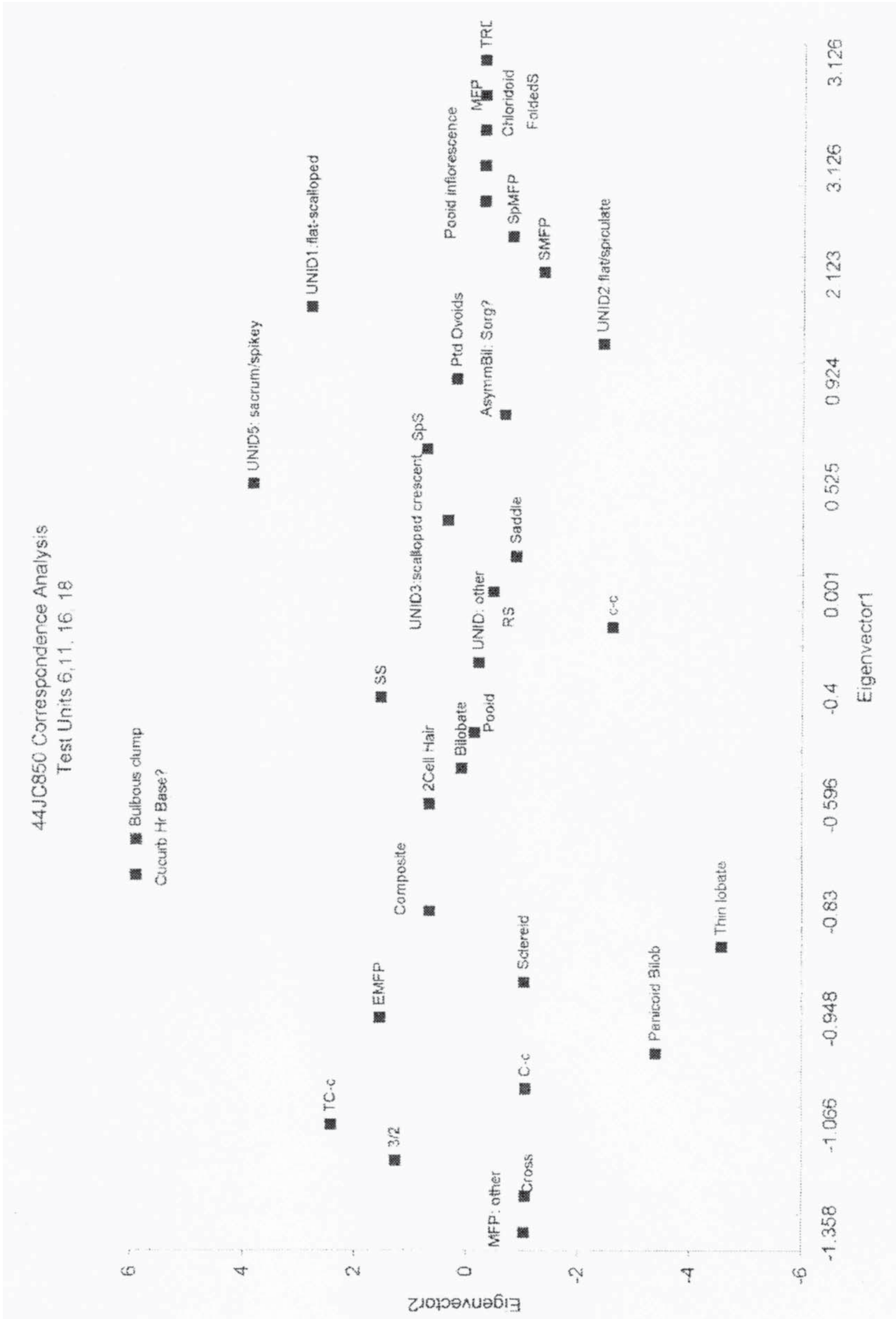

44JC850 Correspondence Analysis
Test Units 6, 11, 16, 18: Samples
Eigevector2
2
1.5
1
0.5
0
-0.5
-1
-1.5
TU11
TU6
TU16
TU 18
-0.759
-0.495
-0.434
1.748
Eigenvector1

Figure C-4.



44JC850 Correspondence Analysis
Test Units 6,11, 16, 18
Eigenvector2
Eigenvector1
6
4
2
0
-2
-4
-6
-1.358
-1.066
-0.948
-0.83
-0.596
-0.4
0.001
0.525
0.924
2.123
3.126
3.126
MFP: other
Cross
3/2
TC-c
C-c
Panicoid Bilob
EMFP
Sclereid
Thin lobate
Composite
Cucurb Hr Base?
Bulbous clump
2Cell Hair
Bilobate
Pooid
SS
UNID: other
RS
c-c
Saddle
UNID3:scalloped crescent
SpS
UNID5: sacrum/spikey
AsymmBil: Sorg?
Ptd Ovoids
UNID2 flat/spiculate
UNID1 flat-scalloped
SMFP
SpMFP
Pooid inflorescence
Chloridoid
FoldedS
MFP
TRE

Figure C-5.

count for this difference, as well as the probable presence of Cucurbitaceae in Test Unit 11.

In sum, of the four samples with more than 200 phytoliths, Test Unit 6 stands out as the most unique. Its assemblage suggests an arboreal concentration, with very few grasses present. Test Units 9, 16, and 18 are more similar in their distribution of grasses, but reveal distinct dicot and arboreal taxa. Test Unit 9 has the most diverse assemblage of any of the samples, suggesting a richer concentration of plant remains than any other locale. Test Units l6 and 18 are very similar, both in their grass and dicot and arboreal distributions, suggesting a similarity in function of these two locales.

Conclusion

This preliminary phytolith analysis of five salt samples from a Middle Woodland site has proven to be successful, Not only were phytoliths present, they were abundant in all but one sample and distributed in meaningful patterns across the site Differences between sample are likely related to variability in activity areas: between Test Unit 6, as the most unique, and Test Units 11, 16, and 18, as variable but more similar to each other.

Further assessment of intrasite variability is needed before confident interpretations can be made. A sample from non-cultural contexts would also highlight the cultural components of these sample assemblages. Specifically, an assessment of grasses from non-cultural contexts would reveal the extent to which their presence is cultural. As noted, one possible explanation for their presence here is for use in a temporary structure. Ongoing expansion of the phytolith type collection will add significant detail to the interpretation of the specific unidentifiable taxa present in the site.