Geoarchaeological Investigation at Hickory Bluff: Site Formation and Preservation within a Changing Holocene Landscape

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TITLE SLIDE

When I was a beginning student in geology, it was continually drummed into me that a good field geologist must always know where he=s at Ageographically and stratigraphically.@ I have carried this philosophy with me throughout my career and, as I became more involved in with archaeology, have come to understand providing just such an overall sense of Atime and place@ is the most basic and important perspective that geoarchaeologists can provide.

AREAL OVERVIEW OF SITE SLIDE (LOOKING SOUTH)

Sadly, the ABig Picture@ overview, which places a site within the broad sweep of the gradual, often millennium-long, fluctuations in Holocene environment, is often lacking. Happily, Parsons and DelDot understood that such a Big Picture, which can only be derived from interdisciplinary contributions, is required to truly understand human settlement systems. Along these lines, we are investigating a whole raft of issues at Hickory Bluff. These range from site pedology and geochemistry to sedimentology and depositional history. While much of this work is in progress, we'd like to present several pertinent ideas concerning site location and formation within a framework of constantly changing environmental conditions.

MAIN POINTS SLIDE

During the next 10 minutes we will concentrate on several issues. Firstly, we will look at where Hickory Bluff fits into Holocene history. We=ll offer some insights about the significance of the site locale as well as suggest why it was occupied when it was -- the where, when, and why of Hickory Bluff. We propose that people came to Hickory Bluff primarily to take advantage of resources provided by the river, which may strike you as an overstatement of the obvious. However, we hope to demonstrate how the availability of certain resources may have changed through time in response to rising sea level during the Holocene transgression of Delaware Bay. Consequently, the behavior and character of the riverine environment changed, as well as the resources it

provided, ranging from gravel availability to plant and animal resources.

Additionally, we will describe how soil weathering has destroyed much of the direct subsistance information needed to understand site structure and use. We will, however, also show you how soil characteristics of both texture and chemistry may provide ways of recovering at least part of that lost information.

Finally, we hope to provide some insights into the identification and characteristics of the range of features identified across the site.

Now, let=s look at the site from an earth science perspective -- that is to say geographically and stratigraphically.

SITE OVERVIEW FROM OBLIQUE ANGLE, AERIAL VIEW

Geographically, the Hickory bluff site is located just south of Dover. It lies along the St. Jones River about 10 km upstream from Delaware Bay. The surrounding area, as is true for most of Delaware, is underlain by the sandy Columbia Formation, which although these days goes under a variety of names, still represents late Pleistocene fluvial and shoreline deposits in the Delmarva. In the vicinity of Hickory bluff the Columbia is 10-20 m thick and is particularly gravel-rich B an archaeologically important factor.

Surface exposures of the Columbia weather into friable, acidic soils, especially under the influence of a deciduous forest cover. Subsequent erosion of surface sediments—particularly by eolian processes—is evident on a regional scale through the identification of surface features such as blowouts and low dunes within the vicinity of the site. On a smaller, site-specific scale, identification of similar processes is less obvious and somewhat masked by subsequent soil weathering and the land-modification practices of the recent past, particularly those related to agriculture.

The St. Jones River and all of its tributaries are entrenched within this landscape, channeling drainage and eroded sediment along a relatively—and progressively--short journey to the sea. Factors of climate, vegetation, relative sea level and transported sediment (bed load) all impart important influences in river behavior over time. As viewed in this slide, the river constituted a wide arcuate bend at this location, prior to channelization efforts that took place earlier this century. The area is presently a tidal backwater. As we hope to point out, factors that carved this wide bend into the Columbia Formation—although not attributable to the recent past—did influence archaeological site formation.

SITE OVERVIEW FROM ORTHOPHOTO COMPOSITE SLIDE

The site=s position on the landscape, and it=s situation in the St. Jones Valley, is critical. It presently lies at the approximate upstream limit of tidal influences in the valley, which is obvious in this slide. Note how broad the valley is below Hickory Bluff compared with above. Downstream from Hickory, the St. Jones meanders to Delaware Bay through a broad up-to-1-km-wide tidal marsh. Its channel is essentially drowned. This configuration, however, is recent. Prior to about 2-3000 BP the St. Jones valley was vastly different. In fact, the timing of these changes is stratigraphically significant

and may correlate with changes in site occupation.

AGE OF SITE OCCUPATION (^{14}C GRAPH AND ARCHAEOLOGY)

Based on ^{14}C chronology as well as the abundance of diagnostic ceramic and point types, Hickory bluff was intensively occupied mainly between 4000 and 1500 BP. Culturally this spans the Late Archaic through the early part of the Middle Woodland. Occupation was relatively minimal before and after this time. This begs the question of why? What is it about Hickory Bluff that made it so attractive between 2-4000 years ago? Especially, why was occupation---as reflected by the archaeological record---less intensive during the Late Woodland?

SEA-LEVEL RISE W/ CHARCOAL GRAPH FROM US-1 STUDY

We believe that the answer lies in this diagram. The left side shows the Holocene transgression of Delaware Bay. It indicates that sea level rose to within 5 m of its present level by 4000 BP, just about the time intensive occupation began at Hickory Bluff. By 2000 BP sea level had risen to within about 1 m of today=s level, which is just prior to the time site use changed and probably declined. We don=t believe this timing is merely coincidental but rather reflects the intimate relationship between human occupation and the changing dynamics of the St Jones River during the Holocene transgression -- changes that made Hickory Bluff attractive for settlement.

The right side of the diagram shows the generalized depositional history of the St. Jones Valley. It was derived from cores taken during the large ADelDot Route 1" study 2-3 km downstream from Hickory Bluff. As typically marks such a transgression, the base of the sequence is sandy and organic-rich fluvial deposits. It was dated to about 3500 BP in adjacent cores. These fluvial deposits were buried by over 3 meters of fine-grained organic-rich, tidal-marsh sediment after 2000 BP. In fact, most of the sequence was deposited by 1000 BP, which suggests that more stable conditions were achieved by then. Interestingly, abundant charcoal was also recovered between 2 and 3+ m, with practically none from the upper 1.5 m. (The basal fluvial sediments were not analyzed for charcoal.) Although the original researchers believed this marked a very dry period with extensive forest fires, we believe that it actually reflects just how intensively the Hickory Bluff environs, located just upstream, was occupied during the Late Archaic through early Middle Woodland Periods.

From these data we can see that changes in the Hickory Bluff archaeological record are clearly associated with dynamic shifts in the St. Jones River related to rising sea level. The period of prolific tool production, as well as most intensive occupation, is related to clastic (fluvial) sedimentation when people came to Hickory Bluff to collect the abundant stream cobbles. When cobbles could no longer be easily found due to extensive marsh infilling of the valley, site use, as well as occupational intensity, changed. The next few slides illustrate an informal model of the relationship between gravel abundance, sea level rise, stream dynamics, and human settlement.

MODEL OF GRAVEL BAR EXPOSURE Pre-4000 BP SLIDE

During most of the past 100,000 years Delaware Bay was mainly dry. Consequently, streams draining into the Bay, such as the St. Jones, eroded deep valleys through most of the unconsolidated Columbia Fm. As is true with most down cutting systems, the St. Jones channel was probably straight, with few meanders. As it eroded the Columbia Fm, gravels may have been periodically exposed but were probably not aerially extensive. Additionally, valley walls probably were also soon slumped and vegetated. Consequently, outcrops of gravel in the Columbia Fm were probably hidden under soil and vegetation.

MODEL OF GRAVEL BAR EXPOSURE 4000-2000 BP SLIDE

As sea level rose during the middle Holocene, the St. Jones Valley began to back-flood. By 4000 BP, Delaware Bay was within 5 m of modern levels and probably began to affect the upstream portions of the river near Hickory Bluff. Rising seas, which form base level for the St. Jones, resulted in a lowered channel gradient B a Aflatter@ less inclined channel. This caused the river to begin to meander. Big arcuate bends in the river formed. As these meanders cut into valley walls, they stimulated erosion and exposed fresh outcrops of the Columbia Fm. Some of these were gravel-rich. Additionally, sizable point bars were formed that further winnowed the gravel. Continued transgression amplified the process. Meandering accelerated, as channel gradient became flatter. Within the channel more extensive point bars developed that included reworked older sequences. The valley aggraded with coarse-grained fluvial (channel) deposits. In fact, by 2500 BP, the valley bottom probably looked more like a braided stream sand-plain than a meandering channel flood plain. Indeed, people were attracted to the area both for the extensive, continually replenished, gravel deposits associated with active fluvial channels, as well as outcrop exposures Columbia Fm gravel.

MODEL OF GRAVEL BAR EXPOSURE post-2000 BP SLIDE

After 2000 BP, however, the valley became fully tidal and extensive fine-grained and organic-rich sediments began filling the valley bottom. The St. Jones channel became drowned progressively upstream and could no longer carry coarse sediment. Point bars were buried or not replenished. Valley walls stabilized and vegetation and soil again covered Columbia Fm. outcrops. Gravel availability at this location was reduced. By the Late Woodland, Hickory Bluff was a different type of archaeological backwater (PUN!), perhaps more focused on aquatic resources within the newly formed tidal marsh.

BLOCK DIAGRAM MAP OF THE SITE LOOKING NORTH

The presence of knapable materials, and the prolific distribution of tool manufacturing debris, are important components of Hickory Bluff. However, these components of the site reflect obvious preservation of these types of materials. Other aspects of the site occupation should indicate a wide range of other activities associated with this location. Unfortunately, because of the sandy nature of the

Columbia Fm., a lot of the record for this daily life is absent. Over the past 2-4000 years, the site has been leached and oxidized to such an extent that most of the organic material, including bone, ash, charcoal and shell is gone. Moreover, what little remains is probably skewed toward the more minor, Late Woodland occupation because it was subjected to less weathering.

Thus, one of our tasks was to Arecover@ some of this information. To this end, we analyzed the texture, geochemistry, pedology, and sedimentology of 280 samples collected from profiles, features, and regular grids in excavation blocks (Locus A and I). We looked at sand-grain distribution, texture, and a whole host of sediment characterizations, including 12 elements using ICP-MS. We certainly can=t show you all this data, but will present a couple of the more interesting results concerning feature identification and phosphorus distribution from over 45 samples collected on a 1 m grid block in the Locus A.

Locus A Block Map of Fine-grained distributions

Basin or pit features were often identified in the field by changes in the overall Afeel@ B the texture and consistency B of excavated fill. Little or no differences were noted in color or contrast, two of the more common indicators of potential features. This distribution of fines within the Locus A indicates that several anomalies, which were identified in the field as potential features, actually show up texturally. Excavator=s observations that features appeared to be Asofter@ actually reflect the increased relative sand content of feature fill. The cultural significance of these features is another story.

Locus A Block Map of Phosphorus and Calcined Bone.

Cultural influences can intensify the additions of select organic substances across a site, in discreet areas such as features. The addition of quantities of plant and animal foodstuffs, waste, organic artifacts, and wood ash---as examples—can result in localized additions of distinctive chemical elements. As bone weathers, constitute elements (Ca, Sr, P, etc.) are released. Some of these elements are carried away by groundwater—especially in a sandy, acidic environment such as Hickory Bluff-- while others are adsorbed on mineral grains and oxides. Although eventually these too are leached away, some can remain in the soil for quite awhile as remnant indicators. Such systematics apparently also functioned at Hickory Bluff.

Phosphorous distribution in Locus A, however, is intriguing. Comparison of the concentrations (counts) of calcined bone, about the only bone on the site, to phosphorus abundance is striking. Clearly, relatively high phosphorous is associated with abundant calcined bone. These results are encouraging, but also beg the questions: Do other areas of Ahigh phosphorous@ indicate where non-calcined (or Agreen@) bone one resided? If so, can we also look at, for example, the range of features identified across the site and discern what was once in them?

Soil-Feature Histogram and Feature Type Histogram.

Comparisons of the abundance of phosphorous in all features with other Asoil@

(non-feature) samples from throughout the site (the left side of this diagram) shows that although a great a variability exists, cultural features are generally higher and more variable. This is evident in the means and standard deviations. This variation in the feature data suggests that some differentiation may also exist for various types of features. These data (the right side of the diagram) show that the large basins are particularly high in phosphorous. FCR features are particularly low in phosphorus. Additionally, pedological and sedimentological data show that many of the large basins were excavated and then immediately back-filled B apparently with the excavated soil. Meanwhile, many of the FCR features—in contrast—remained in a highly leached, near-surface context. What implications these data impart concerning feature origin and significance needs to be further investigated in consideration of all archaeological, physical and chemical data.

Summary Slide.

In summary, we believe that resources associated with the St. Jones River changed over time, in relation to stream dynamics associated with the Holocene transgression of Delaware Bay. In particular, the exploitation of stream cobble resources changed. As the St. Jones tidal marsh evolved through the Middle and Late Woodland, site use, occupation intensity, and the archaeological record changed accordingly.

We have also shown that despite harsh preservation conditions, some aspects of site character may be evident in the physical and chemical characteristics of site sediments. While these ideas need to be further tested in consideration of the archaeological data, promising trends appear evident, especially concerning the identification and characterization of site features.