The Geomorphology of the Pig Point Site (18AN50) Landform Development, Climate Change, and Long-Term Human Occupation

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Site Background

Promontory Bluff
Above 500 Year Floodplain

Jug Bay

Western Shore Uplands

Source: Dr. Al Luckenbach – Anne Arundel County Lost Towns Project

Patuxent River, Maryland
Site Background

• Site initially recognized in 2008, with field excavations 2009 to 2015

• 149 5-ft square units documented 365 features, 630,000 artifacts, 30 c-14 dates which spanned nearly 10,000 years

• Three distinct areas excavated:
  • Lower Block
  • Upper Block
  • North Block
Site Background

• Lower Block – “Feasting Area”
  • Contained Woodland period midden
  • Stratified in situ Early, Middle, and Late Archaic cultural deposits
  • Cultural deposits extended to over 6 ft (2 m) below grade

• Upper Block – “Habitation Area”
  • Intact stratigraphy from Late Woodland to Early Archaic
  • Thousands post-holes marking outlines of “wigwams”

• North Block – “Ritual Area”
  • Rare Adena-influenced mortuary pits
Projectile Points – Over 500 Complete

No Major Data Gaps
Lower Block – Depth (over 6 ft of Cultural Deposits) – Why?

Source: Dr. Al Luckenbach - AA County Lost Towns Project

Need for Additional Scientific Disciplines in Geology and Geomorphology
Geomorphological Investigation
Development of a Site Conceptual Model

- Desktop Study (Previous Research)
- Developed Draft Geologic X-Sections
- Visual Observations via Site Visits of Open Excavations
- Hand Auger Soil Sampling (Multiple)
- Digital Photography of Sediments
- 3D Stratigraphic Modeling
- Soil Survey and Soil Profile Analysis
- ESRI GIS Mapping (LIDAR)
- Coulter-Counter Grain Size Analysis

Multiple Lines of Evidence
Geology

- Patuxent River Valley Terrace Deposits
  - Mapped as Pleistocene
  - Interbedded sand and gravel
  - Lesser amounts of Silt/Clay
  - Quartzose gravel typically concentrated in lower portion
  - Cobbles and boulders of mafic rock
  - Limonite conglomerate
  - Glauconitic Sands

Source: MGS – Anne Arundel County Geologic Map
Synthesis on Quaternary aeolian research in the unglaciated eastern United States

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Site Location

Source: Synthesis on Quaternary aeolian research (2015)
Markewich, Litwin, Wysocki, Pavich

Dune Fields
- Infilled parabolic
- Medium Sands (0.25-0.50 mm)
- NW to SE Trending Ridge lines
LIDAR maps confirmed presence of parabolic topographic relief and NW to SE ridge lines.
Aeolian Sand Soils in Pig Point and DORR Archeological Areas (NRCS)

Relic Aeolian Conditions Determined by Soil Survey Data

In Field - Data Collection

Data collection:
• Soil sampling from open excavations
• Hand auger sampling at bottom of archeological units and in near-by strategic areas
Increased Variability of Gravel within Lower Block (Adjacent to Swale/Stream Bank)

3D Model of Gravel/Non Gravel Interface
Potential Climate Change Events?
Document multiple climate-driven erosional and depositional cycles

Soil Profile Analysis
Multiple A horizons, A/E transition, series BC horizons, C1/C2 fluvial gravel
Table 2 - Particle Size Analysis Summary (Coulter Counter < 2mm)

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Depth (ft)</th>
<th>N</th>
<th>Clay</th>
<th>Silt</th>
<th>Sand</th>
<th>vfs</th>
<th>fs</th>
<th>ms</th>
<th>cos</th>
<th>vcoc</th>
<th>Mean</th>
<th>Sorting</th>
<th>Skewness</th>
<th>Kurtosis</th>
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</thead>
<tbody>
<tr>
<td>Lower Block - Above Gravel</td>
<td>1 to 5.5 ft BGS</td>
<td>10</td>
<td>3.7%</td>
<td>13.3%</td>
<td>83.0%</td>
<td>6.6%</td>
<td>15.3%</td>
<td>37.3%</td>
<td>20.3%</td>
<td>5.4%</td>
<td>2.2</td>
<td>2.1</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Lower Block - Transitional</td>
<td>6.0 to 6.5 ft BGS</td>
<td>2</td>
<td>2.9%</td>
<td>12.7%</td>
<td>84.4%</td>
<td>5.7%</td>
<td>12.0%</td>
<td>33.3%</td>
<td>23.0%</td>
<td>10.3%</td>
<td>1.9</td>
<td>2.1</td>
<td>0.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Lower Block - With Gravel</td>
<td>7.0 to 8.5 BGS</td>
<td>4</td>
<td>3.7%</td>
<td>14.7%</td>
<td>81.6%</td>
<td>5.9%</td>
<td>12.2%</td>
<td>32.8%</td>
<td>24.0%</td>
<td>8.8%</td>
<td>2.2</td>
<td>2.3</td>
<td>0.5</td>
<td>1.7</td>
</tr>
<tr>
<td>North Block - Above Gravel</td>
<td>0.2 to 5 ft BGS</td>
<td>18</td>
<td>4.1%</td>
<td>14.5%</td>
<td>81.4%</td>
<td>6.7%</td>
<td>15.7%</td>
<td>40.0%</td>
<td>17.2%</td>
<td>1.8%</td>
<td>2.4</td>
<td>2.1</td>
<td>0.6</td>
<td>1.7</td>
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<tr>
<td>North Block - With Gravel</td>
<td>7 to 13 ft BGS</td>
<td>6</td>
<td>1.6%</td>
<td>4.6%</td>
<td>93.8%</td>
<td>2.2%</td>
<td>7.3%</td>
<td>33.6%</td>
<td>33.9%</td>
<td>16.8%</td>
<td>1.0</td>
<td>1.3</td>
<td>0.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Upper Block - Above Gravel</td>
<td>1 to 1.5 BGS</td>
<td>2</td>
<td>4.5%</td>
<td>16.2%</td>
<td>79.2%</td>
<td>5.8%</td>
<td>12.1%</td>
<td>37.4%</td>
<td>20.8%</td>
<td>3.1%</td>
<td>2.5</td>
<td>2.4</td>
<td>0.6</td>
<td>1.8</td>
</tr>
</tbody>
</table>

- **Highest % in Medium Sand Fractions**
  - Folk and Ward Method (Phi):
  - $(M_2)$: $(\sigma_f)$: $(Sk_f)$: $(K\sigma)$:

- **higher % of VF and F Sand**
- **Higher % of C and VC Sands**
Coulter Counter Testing Results
Mean Grain Size (Folk and Ward Method) in mm

- Mean Grain Size calculated from <2 mm truncated sample set
- Gravel in Sample Bag
- Possible changes during Scandic Time Period
- Evidence of Change in Geomorphological Conditions at Pleistocene/Holocene Contact (Younger Dryas?)
- Evidence of Hypsithermal Sediment Accumulation Changes?

Trends and observations:
- Relic Late Pleistocene Aeolian Sediments
- Pleistocene Terrace Deposit Sediments

Coulter-Counter Grain Size Analysis – Relic Aeolian vs Fluvial Coarse Gravel
Increased Mass-Wasting during Pacific/Little Ice Age, Late Woodland, and Historic Periods

Development of Anthropogenic “Midden” during Stable Sub-Atlantic/Scandic/Neo-Atlantic Early and Middle Woodland Periods

Colluvial Over-Printing and Mass Wasting During Hypsithermal (5-7 ka)

Early Holocene Landform Stabilization

Sediment Accumulation Rates and Climate Change
Sediment Accumulation Rates and Climate Change

**Hypsithermal (5-7Ka)**
- Warmer and Dryer (decrease in vegetation allowing more erosion during rain events)

**Scandic Disconformity** (increased flood frequency and magnitude)
- Possible Erosional Sequence Along Lower Slope of Swale

**Chesapeake Bay Stabilizes**
- Possible erosional sequence along lower slope of swale

**Relationship between Upslope vs Downslope (Lower Block)**
- All Artifacts Normalized per Unit
- Total Count (Normalized per Unit) (Areas 1, 5, 15, 18) Upslope - All Artifacts
- Total Count (Normalized per Unit) (Areas 6, 7, 11, 15) Downslope - All Artifacts
- C-14 (Avg 2-sigmas YBP)
Climate Change and Long Term Human Occupation

Human Occupation of Pig Point

- Hypsithermal (5-7Ka)
- Chesapeake Bay Stabilizes

OCCUPATION RANK

- Heavy
- Moderate
- Light

YEARS B.P.

- Colonial/Historic
- Late Woodland
- Middle Woodland
- Early Woodland
- Late Archaic
- Middle Archaic
- Early Archaic
- Younger Dryas
- Paleo

Other sites and features:
- Choptank
- Potomac
- Tewanna
- Jacks Reef
- Salby Bay
- Rosspville
- Picotaway
- Adkins, Madison
- Calvert, Bare Island ACK ceramics
- Meadowood, ACK ceramics
- Savannah River
- Snook Kill
- Lomako, Breezeway
- Vernon
- Outer Creek
- Guilford
- Morrow M.
- Stanly
- Kirk
- Palmer

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(a) Alluvial deposition of basal Pleistocene terrace sand and gravel deposits and Late Pleistocene deposition of active source-bordering aeolian dunes from braid-plain river sediments
(b) Terrace scarp erosion during the warm, wet interstadial culminating in the cool and dry Younger Dryas
(c) Increased erosion and colluvial over-printing (increased mass wasting) of up-gradient aeolian sands with enhanced activity in the Middle Archaic “hypsithermal”
Geomorphic Landform Development of Pig Point
(Late Holocene to Present)

(d) Landform stability and development of a cumulic A horizon with anthropogenic enrichment during the stable Sub Atlantic through Neo Atlantic (Early and Middle Woodland periods) and additional colluvial over-printing by accelerated mass wasting from the Little Ice Age through historic deforestation (Late Woodland and Historic periods)

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