Review of Geotechnical and Archaeological Conditions at the Money Pit (1967 - 2005)
Oak Island, Nova Scotia

Presentation By
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August 13, 2005
Outline of Presentation

1. Purpose of Review
2. Geotechnical Investigations and Results
3. Boulders in Glacial Till at Oak Island
4. Selected Archaeological Findings at Money Pit Prior to 1967
5. Archaeological Findings at Money Pit 1967 to 2005
6. Options for Future Exploration
7. Conclusions and Acknowledgements
1. Purpose of Review

1. Provide a summary of the geotechnical conditions at the Money Pit as they affect conceptual studies for a deep shaft.
2. Evaluate the archaeological findings at the Money Pit.
3. Discuss possible options for future exploration.
4. Share information and ideas with the ultimate objective of solving the Oak Island Mystery by the cooperative effort of researchers and interested parties.
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2. Geotechnical Investigations and Results

1. Geological setting
2. Geotechnical programs
3. Geotechnical sections
4. Tidal hydrogeology, anhydrite solubility, flow system in anhydrite
Geological Section of Oak Island

Geotechnical and Archaeological Conditions at Money Pit
Geotechnical Programs

1. Based on the important archaeological findings in the Becker holes in 1967 (to be presented later), geotechnical and archaeological holes were drilled in the area of the Money Pit in 1969 and 1970.

2. In 1969 Warnock Hersey put down 3 geotechnical holes in the Money Pit area and a number of archaeological holes.


4. Archaeological holes were intended to investigate original workings and also provided geotechnical data.

5. Borehole depths at the Money Pit will be with reference to existing ground surface which is about 10 feet lower than original ground surface.
Plan of Geotechnical Boreholes

Geotechnical and Archaeological Conditions at Money Pit
Geotechnical and Archaeological Conditions at Money Pit and 10X

Geotechnical Section A-A at Money Pit and 10X

LEGEND FOR GEOTECHNICAL STRATIGRAPHY

1. REWORKED SOIL
2. HARD BROWN TO GREY CLAYEY TILL WITH BOULDERS
3. HARD GREY, GREY BROWN AND BROWN STRATIFIED CLAYEY SILT AND SANDY SILT (TILL)
4. DENSE BROWN AND GREY SANDY TILL WITH BOULDERS
5. BROKEN ANHYDRITE WITH GYPSUM AND LIMESTONE LAYERS AND WITH OPEN OR SOIL FILLED CAVITIES
6. OPEN CAVITY OR VERY LOOSE SOIL IN BROKEN ANHYDRITE
7. SOIL LAYER IN BROKEN ANHYDRITE
8. COMPETENT ANHYDRITE BEDROCK
9. BEDROCK AT BOTTOM OF CHAPPLE SHAFT EXPOSED BY HAMILTON AT 157 FEET IN 1941
10. DRILLING IN HIDDEN SHAFT FROM 160 TO 180 FEET BY HAMILTON IN 1940 INDICATED GRAVEL AND SOFT MATERIAL

SECTION A-A
(SEE FIGURE 3 FOR LOCATION)

Note
Historical shafts, tunnels and drill holes are not shown

FIGURE 4A
GEOTECHNICAL SECTION A-A TROUGH MONEY PIT AND 10X
Geotechnical and Archaeological Conditions at Money Pit and Dunfield Excavation

Note: Historical shafts, tunnels and drill holes are not shown.

Dunfield Excavation 1965/66
The salinity of the groundwater in the anhydrite is about 50 to 75% that of sea water.
Water Level Variation in 10X from Tidal Variation in Mahone Bay

Time Lag 1 Hour (Between Peaks)
Ratio of Amplitudes = 0.43 (0.65/1.5)

Ref:
Woods Hole Oceanographic Institution
Measurements made in July 1995
Water Level Variation in Coarse Rockfill Dump from Tidal Variation in Rupert Inlet

Flow reversals occur in the rock dump in phase with the tide

Ref: BHP Billiton
Water Level Variation in Coarse Rockfill Dump from Tidal Variation in Rupert Inlet

Time Lag 1 Hour (Between Peaks)
Ratio of Amplitudes = 0.68 (2.3/3.4)

Ref:
BHP Billiton
Lab Scale Testing of Anhydrite Solubility

36 mm Diameter (1.4 in)

Distilled water flow at 56 ml/day (2 fluid oz/day) for 44 days

Ref: James 1978

2.5 mm Diameter Before Test

Sketch to Scale

6 mm Diameter After Test

Geotechnical and Archaeological Conditions at Money Pit
Example Flow System through Anhydrite from Mahone Bay to Money Pit and 10X

The flow system through anhydrite is activated by pumping at the Money Pit or 10X.

When there is no pumping the groundwater in the anhydrite is subject to flow reversals in phase with tidal variations.

Both of these water movement systems result in dissolution of anhydrite and increasing permeability with time.
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3. Boulders in Glacial Till at Oak Island

1. Ron Aston from North Carolina 1999 and 2001

2. Petter Amundsen from Norway 2003

3. Drilled Boulder at Money Pit
Plan of Ron Aston Search Area
Ron Aston and Others 2001

Murray MacPhie                Jim Harvey                David Tobias                Ron Aston

David Tobias
Ron Aston Drilling Program August 2001
Boulder in Glacial Till Exposed by Aston 2001
Large Boulder at Shore
Plan of Petter Amundsen Search Area 2003
Happy Norwegians May 2003

Eric Hauan
Petter Amundsen
Tony Ronning
Sigbjorn Larsen
Boulder 282 Feet South of Cross
Boulders at Shore
Boulder 141 Feet South of Cross
Drilled Boulder at Money Pit
Summary of Geological, Geotechnical and Other Issues for Deep Excavation at Money Pit

1. Boulders in glacial till
2. Open and soil filled cavities in broken anhydrite
3. Saline groundwater in anhydrite
4. Cyclic groundwater movement in anhydrite due to tides
5. Reworked soil zones resulting from events such as collapse of the Money Pit in 1861 and the Dunfield excavation of 1965/66
6. The presence of timbers and debris from numerous previous shafts and tunnels in the area of the Money Pit
7. Steel casings and pipes from previous drilling operations
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4. Selected Archaeological Findings at Money Pit prior to 1967

1. Parchment in Oak Island Treasure Company Shaft 1897

2. Poll Pick, Felling Axe and Anchor Fluke in Chappell Shaft 1937
Plan of Shafts at Money Pit
Parchment Location from Drilling in Oak Island Treasure Company Shaft 1897

Geotechnical and Archaeological Conditions at Money Pit
Photo of Parchment from Oak Island Treasure Company Shaft 1897

Parchment is $\frac{5}{16}$ inches long

Photo from Triton Alliance
Location of Pick, Axe and Anchor Fluke in Chappell Shaft 1931
Pick, Axe and Anchor Fluke
Chappell Shaft 1931

Photo from Triton Alliance
Poll Pick Chappell Shaft 1931

Photos from Triton Alliance
Anglo American Felling Axe Chappell Shaft 1931

Photos from Triton Alliance
Anglo American Axes (1725 - 1800)

Photos from Ancient Carpenters’ Tools by Mercer
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5. Archaeological Findings at Money Pit 1967 to 2005

1. Becker Drilling Program 1967

2. Pollen count results from Golder Holes 1970

3. Five deep holes for detection program in 1993 provide lateral drift data

4. Archaeological plan and sections
Becker Drill Setup 1967

Drive Pipe 5.5” o. d.

Inside Pipe 3” i. d.

Geotechnical and Archaeological Conditions at Money Pit
Becker Drilling Program in 1967

- The objective of the Becker drilling program was to drill through overburden to bedrock surface in search of the presumed treasure chests at 100 and 150 feet.
- The first 10 holes extended to bedrock surface at depths of 145 to 165 feet.
- The 11th hole (B11) extended to a depth of 200 feet before bedrock was encountered. Puddled clay was found from 184 to 200 feet and two oak buds were found embedded in the puddled clay at 196 feet.
- This singular finding initiated the extension of all holes to 200 feet with the use of tricone drilling in bedrock.
- 40 holes were drilled at the Money Pit from January to June 1967.
- The drilling resulted in the major milestone of finding man made cavities in the bedrock at 200 feet and this was completely unexpected.
Plan of First 11 Becker Holes at Money Pit

11th Hole
Deep Rock
200 Feet and
Oak Buds

First 10 Holes
Shallow Rock
145 to 165 Feet
Plan of Deep Rock Area at Money Pit

**Legend**
- Vertical Hole with Deep Rock (generally 201 to 208 feet) Depth to Rock (Note 2)
- Vertical Hole with Shallow Rock (generally 143 to 155 feet) Depth to Rock (Note 2)
- Inclined Hole with Deep Rock Depth to Rock (Note 2)
- Inclined Hole with Shallow Rock Depth to Rock (Note 2)
- Detection Hole with Shallow Rock and Measured Path of Lateral Drift Depth to Rock (Note 3)

**Notes**
1. See legend on Figure 7 for identification of hole numbering system.
2. Lateral drift was measured only in hole W8 and detection holes 93-01 to 93-05. In the remaining holes, the plotted locations at bedrock surface may vary significantly due to lateral drift during drilling.
3. The depth to rock for holes 93-03 and 93-05 is shown along the measured path of lateral drift at the actual plan location where rock was encountered. In hole 93-06, rock was not encountered to the depth of 203.5 feet at which the hole was terminated.
4. The depth to rock is with respect to existing ground surface which is about 10 feet lower than original ground surface in the area of the Money Pit.
5. Holes W2 and W9 may be inclined to the north toward the deep rock area since they are surrounded by holes with shallow depth to rock.

**Figure 10a**
Plan of Holes Showing Depth to Rock at Money Pit
Plan of Pollen Count Holes 1970

Holes with Pollen Count
Dalhousie University
1970

Geotechnical and Archaeological Conditions at Money Pit
Pollen Count Samples from G102 and G103

G102 Samples 36 and 37 Ancient Soil

G103 Samples 27 and 30 Recent Soil
Lateral Drift in Five Deep Detection Holes 1993

- Five deep holes to about 250 feet were put down in 1993 for a geophysical detection program.

- Lateral drift was measured in the 5 detection holes and in Hole W8.

- This provided an understanding of the importance of lateral drift which was not measured in the previous Becker Holes.
Plan of Lateral Drift Measurements

Lateral Drift
17 Feet over 250 Feet Depth

Lateral Drift in 3 holes 3 to 7 feet
Lateral drift in 3 holes 15 to 17 feet

NOTES
1. THE LATERAL EXTENT OF THE INCLINED BECKER HOLES IS BASED ON THE ASSUMPTION THAT THE HOLES FOLLOWED THE STARTING INCLINATION.
2. WARNock HERSEY HOLE W8 WAS PUT DOWN AT THE SAME LOCATION AS BECKER HOLE B24.
3. THE LATERAL DRIFT IN HOLES 93-01 TO 93-05 WAS MEASURED AT SEVERAL DEPTHS WITH THE LAST MEASUREMENT AT A DEPTH OF ABOUT 225 TO 260 FEET. IN HOLE W8 THE LAST MEASUREMENT WAS AT 190 FEET DEPTH.

FIGURE 7A
PLAN OF EXPLORATION HOLES AT MONEY PIT
Geotechnical and Archaeological Conditions at Money Pit

Archeological Section C-C at Money Pit

- **Competent Anhydrite**
- **Broken Anhydrite**
- **Brass Foil**

Legend for Simplified Stratigraphy:
- Glacial Till Overburden and Disturbed Ground
- Rock (mainly Anhydrite)
- Soil Filled Cavity in Rock
- Open Cavity or Very Loose Soil in Rock
- Clay (puddled clay)
- Intact Sample Tested for Pollen Count
Archaeological Section D-D at Money Pit
Summary of Archaeological Features at Money Pit

Holes with Archaeological Features (Note 2)

<table>
<thead>
<tr>
<th>HOLE</th>
<th>FEATURES</th>
<th>DEPTH</th>
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<tbody>
<tr>
<td>B11</td>
<td>PUDDLED CLAY, OAK BUDS</td>
<td>184-200</td>
</tr>
<tr>
<td>B13</td>
<td>PUDDLED CLAY</td>
<td>184-200</td>
</tr>
<tr>
<td>B17</td>
<td>PUDDLED CLAY</td>
<td>176-186</td>
</tr>
<tr>
<td>B21</td>
<td>BRASS FOIL, PUDDLED CLAY, STAGNANT WATER</td>
<td>176-205</td>
</tr>
<tr>
<td>B24</td>
<td>INFERRED CHAMBER, CHINA FRAGMENT, WOOD</td>
<td>192-199</td>
</tr>
<tr>
<td>B25</td>
<td>INFERRED CHAMBER, IRON PLATE</td>
<td>191-198</td>
</tr>
<tr>
<td>B33</td>
<td>INFERRED CHAMBER, WOOD, LIME MORTAR</td>
<td>190-196</td>
</tr>
<tr>
<td>B35</td>
<td>WOOD, CHARCOAL, CLINKER</td>
<td>178-190</td>
</tr>
<tr>
<td>B40</td>
<td>PUDDLED CLAY</td>
<td>175-185</td>
</tr>
<tr>
<td>W9</td>
<td>WOOD, STAGNANT WATER</td>
<td>192-206</td>
</tr>
<tr>
<td>G103</td>
<td>REWORKED RECENT SOIL, (INFERRED CHAMBER)</td>
<td>191-198</td>
</tr>
</tbody>
</table>

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6. Options for Future Exploration

1. **Option 1**
   Exploration boreholes with lateral drift measurements and downhole camera inspection to define the nature of man made workings and possibly to verify the presence of treasure and artifacts. If successful, this could lead to specific targets which could be accessed by a small diameter shaft.

2. **Option 2**
   Excavation of a deep shaft of sufficient diameter to enclose the zone of man made workings at 200 feet depth.

3. Other options could be considered but it is noted that geophysics, including ground penetrating radar, have not been successful.

4. Today we will discuss only Option 2, the large diameter shaft.
Archaeological Criteria for Shaft

1. Construction procedures should allow archaeological investigation as the shaft excavation proceeds.
2. The shaft diameter at bedrock surface should be of sufficient size to include the possible range of locations where the original Money Pit excavation extended below bedrock surface.
3. The shaft diameter at 200 feet depth should enclose a reasonable estimate of the lateral extent of the man-made chambers in bedrock.
4. Construction procedures should be available to allow excavation beyond the limits of the shaft so that possible tunnels can be explored.
Limit of Archaeological Features in Bedrock

Speculated Limit of Features in Rock 70 Ft Diameter

Geotechnical and Archaeological Conditions at Money Pit

<table>
<thead>
<tr>
<th>HOLES WITH ARCHAEOLOGICAL FEATURES (NOTE 2)</th>
</tr>
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<tbody>
<tr>
<td>HOLES</td>
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<tr>
<td>-------</td>
</tr>
<tr>
<td>B11</td>
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<td>W9</td>
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<td>G103</td>
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</table>
Location and Diameter of Shaft

Suggested Shaft Diameter 70 feet
Schematic Section of Shaft

Money Pit

Original Ground Surface

Becker Hole 25

Becker Hole 24

Ground Surface in 1967 about 11 ft below original ground surface

Mean Sea Level

Suggested Shaft Diameter 70 feet

Original wall of Money Pit in hard clay (13 ft diameter)

Original Platforms in Money Pit shown for reference (Collapsed in 1831)

Disturbed ground in and around Money Pit

Approx. outline of pit by Dunfield in 1866 (Projected)

Flood Tunnel from Smith's Cove shown for reference

Assumed Cement Vault from 1897 drilling shown for reference

Chappell Shaft was extended to bedrock at 167 ft and therefore must have been offset from depression in rock at Money Pit

Bedrock Surface at about 167 ft

Drilling revealed a clay filled depression in bedrock; Brass, Oak Buds, Charcoal and Cement were found embedded in the clay

Wood/Clay/Wood at 203 ft in Becker Hole 24 (See Detail)

Possible natural cavity in bedrock with complete or partial soil infilling

Anhydrite Bedrock

Anhydrite Bedrock

Wood/Clay/China

6 to 8 foot Cavity in Bedrock (Vold and/or loose soil infilling)

Drilled through 1/8 inch thick iron Plate at base of 7 ft cavity in Becker Hole 25, hole could not be extended below the plate

Note: All depths are with respect to original ground surface.

Scale - Feet

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7. Conclusions

1. The geotechnical conditions have been defined to the extent required for conceptual studies of a shaft extending to 200 feet depth.
2. The archaeological evidence indicates that man made chambers exist in the bedrock at the Money Pit.
3. There is no physical evidence to indicate the nature of artifacts or treasure (if any) which may be contained in the man made chambers.
4. An investigation phase of borehole and downhole camera work may be considered to possibly verify the nature of the underground workings, to possibly define what is contained therein and to better define the location and diameter of a proposed shaft.
5. A shaft excavation to bedrock surface is expected to resolve the nature of the presumed chests with coins drilled at 100 feet in 1849 and 150 feet in 1897, and the parchment may be recovered.
6. A shaft excavation to 200 feet is expected to recover significant evidence (and possibly artifacts and treasure) which will result in:
   1. An obvious solution to the mystery (possibly by recovery of the parchment)
   2. A solution determined in conjunction with related historical and archaeological studies or verification
   3. The Oak Island mystery is not resolved (very unlikely outcome)
7. Acknowledgements

The permission of David Tobias and Dan Blankenship to present this information is gratefully acknowledged.

Oak Island Group
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Dan Blankenship
Mrs. Sobey
Bill Ulrich
Bill Parkin
????
Bill Sobey
Oak Island 1986