[PS]Parent Source Material of Calcium Bentonite in Smith County, Mississippi*

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Search and Discovery Article #50828 (2013)**
Posted July 31, 2013

*Adapted from poster presentation given at AAPG 2013 Annual Convention and Exhibition, Pittsburgh, Pennsylvania, May 19-22, 2013

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Abstract

Bentonite deposits of the Glendon and Bucatunna formations (Luper, 1972) of the Oligocene Vicksburg Group located in Smith County, Mississippi were examined to determine the depositional environment, diagenetic history and origin of the bentonite. The Mississippi bentonite deposits consist of calcium montmorillonite, smectite clay with an aluminum silicate and calcium structure. A widely accepted theory is that calcium bentonite deposits formed because of weathering of volcanic ash deposits. The hypothesis tested is that the Glendon and Bucatunna formations bentonite deposits are not a result of weathered volcanic ash, but are a result of weathered marl. Core samples were drilled from the Chisholm bentonite mine near Raleigh in Smith County. Samples studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), and the petrographic microscopy revealed zones of poorly sorted angular quartz grains, glauconite, pyrite, organic matter, marine fossils (coccoliths, echinoderm fragments, benthic and planktonic foraminifera), abundant bacteria, micrite, and evidence of extreme diagenesis resulting in significant microporosity (max 24%). Abundant bacteria (filamentous, coccus and bacillus) along with nanometer-scale organic textures are consistently associated with bentonite, illite, and/or smectite. To date, no evidence of volcanic ash has been found. It appears that the clays in the Glendon and Bucatunna formations of Smith County, Mississippi formed from the weathering, including bacterial activity, of glauconite-bearing marl.

PARENT SOURCE MATERIAL OF CALCIUM BENTONITE IN SMITH COUNTY, MISSISSIPPI

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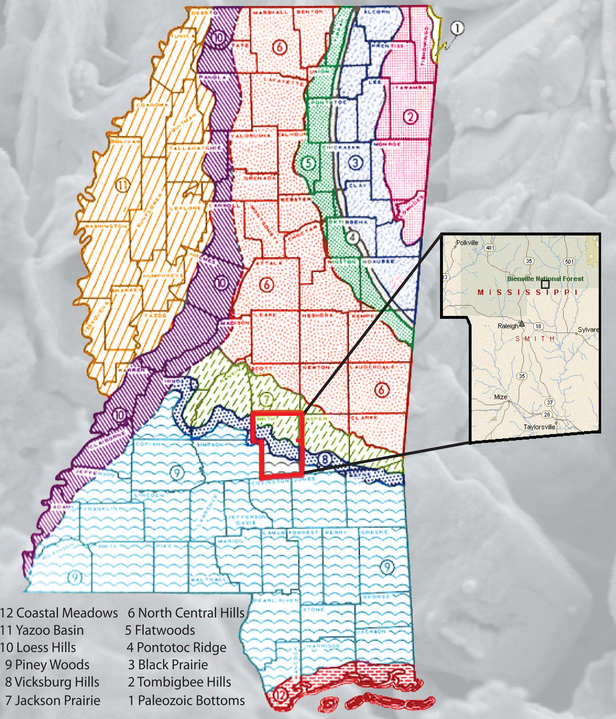
ABSTRACT

Bentonite deposits of the Glendon and Bucatunna formations (Luper, 1972) of the Oligocene Vicksburg Group located in Smith County, Mississippi were examined to determine the depositional environment, diagenetic history and origin of the bentonite. The Mississippi bentonite deposits consist of calcium montmorillonite, a smectite clay with an aluminum silicate and calcium structure. A widely accepted theory is that calcium bentonite deposits formed as a result of weathering of volcanic ash deposits. The hypothesis tested is that the Glendon and Bucatunna formations bentonite deposits are not a result of weathered volcanic ash, but are a result of weathered marl. Core samples were drilled from the Chisholm bentonite mine near Raleigh in Smith County. Samples studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), and the petrographic microscopy revealed zones of poorly sorted angular quartz grains, glauconite, pyrite, organic matter, marine fossils (coccoliths, echinoderm fragments, benthic and planktonic foraminifera), abundant bacteria, micrite, and evidence of extreme diagenesis resulting in significant microporosity (max 24%). Abundant bacteria (filamentous, coccus and bacillus) along with nanometer-scale organic textures are consistently associated with bentonite, illite, and/or smectite. No evidence of volcanic ash has been found. It appears that the clays in the Glendon and Bucatunna formations of Smith County, Mississippi formed from the weathering, including bacterial activity, of glauconite-bearing marl.

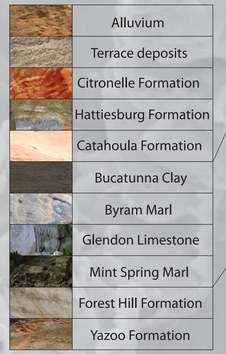
INTRODUCTION

The samples were taken from Chisholm Mine, an abandoned bentonite mine in Smith County, Mississippi.



12 Coastal Meadows
11 Yazoo Basin
10 Loess Hills
9 Piney Woods
8 Vicksburg Hills
7 Jackson Prairie
6 North Central Hills
5 Flatwoods
4 Pontotoc Ridge
3 Black Prairie
2 Tombigbee Hills
1 Paleozoic Bottoms

Regional Stratigraphy



Local Stratigraphy

Descriptions of the Study Area	
Bucatunna Clay	Clay, tan, bentonitic
Byram Marl	Marl, red to dark brown, highly weathered
Glendon Limestone	Limestone, light gray, hard, calcareous, fossiliferous
Mint Springs Marl	Marl, greenish gray, glauconitic, fossiliferous
Forest Hill Formation	Clay, light to dark gray, silty, lignitic

Stratigraphic Units of Sample Locations

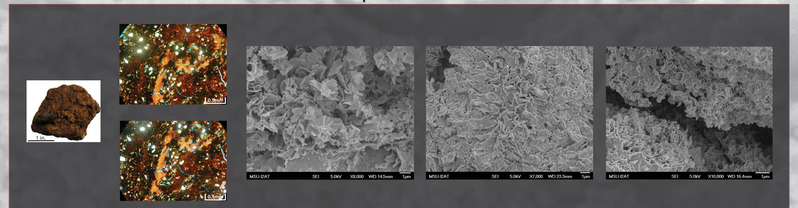
BMB 1

BMB 4

481

BMB 1

Depth: 42 feet



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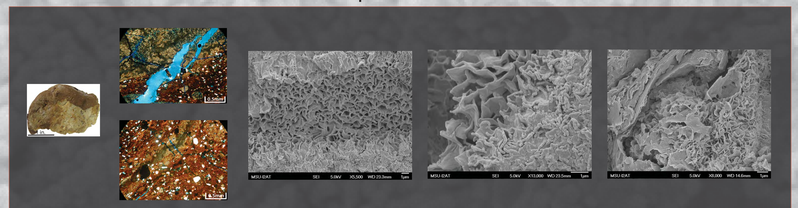

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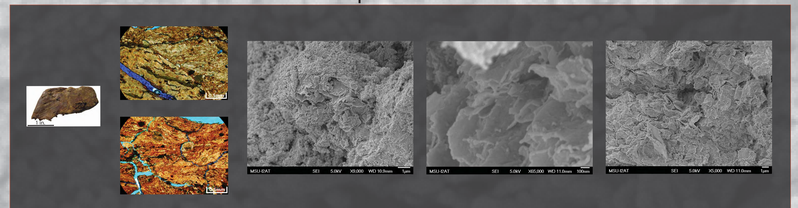

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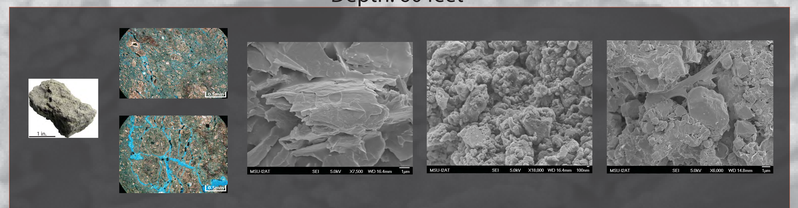
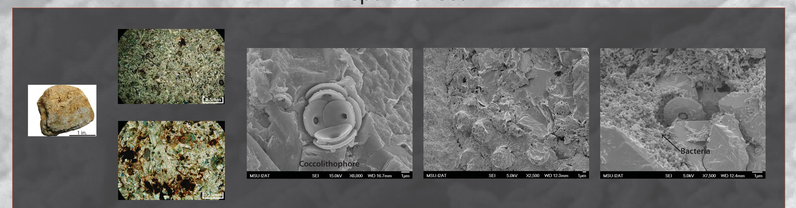


BMB 4

Depth: 9 feet

Depth: 15 feet



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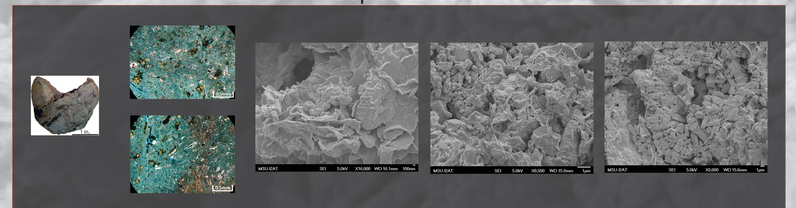
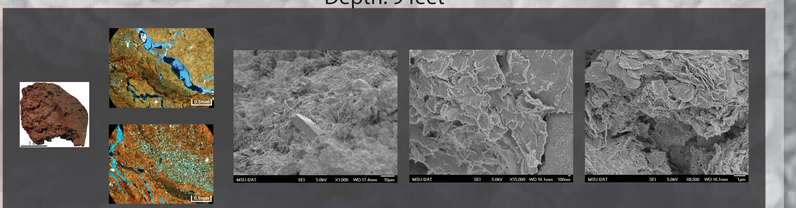


481

Depth: 9 feet



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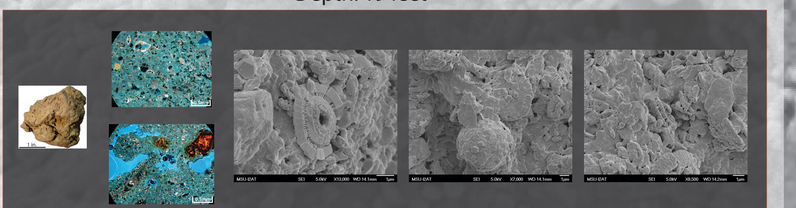
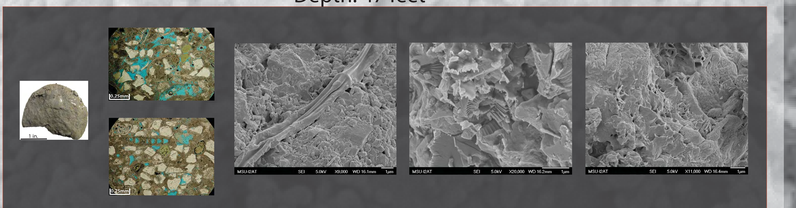
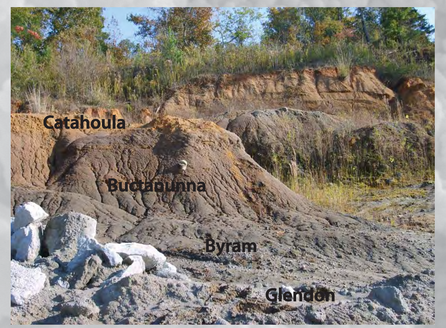


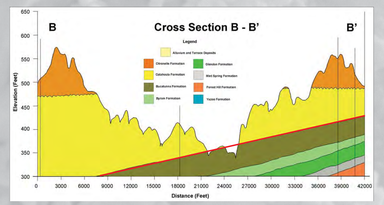
Depth: 47 feet



RESULTS

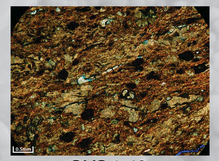


Catahoula, Bucatunna, Byram, and Glendon formations exposed at the Smith County Lime Plant. Hat on Bucatunna Formation for scale. Purple hues in the Bucatunna Formation suggest a history of exposure.

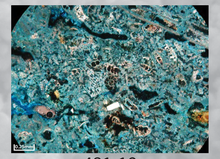


Red line indicates the area of interest.

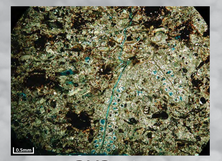
THIN SECTION RESULTS



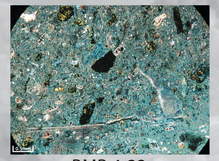
BMB 1-48



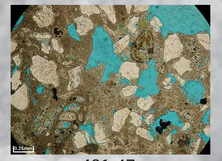
481-19



BMB 4-15

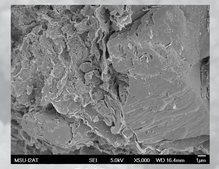


BMB 4-22

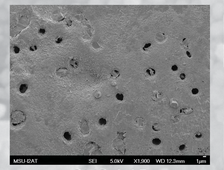


481-47

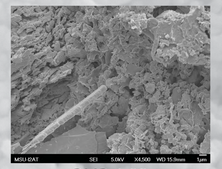
SEM RESULTS



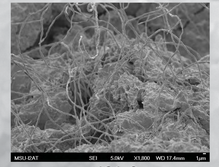
BMB 1-42



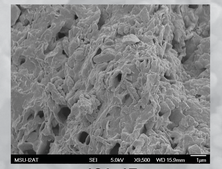
BMB 4-15



BMB 4-22



481-9



481-47

DNA Results for 481-9	
Archaea	Actinobacteria (43)
	Proteobacteria (23)
	Firmicutes (5)
Bacteria	Acidobacteria (2)
	Spirochaetes (1)
	Planctomycetes (1)
	Bacteroidetes (1)

DISCUSSION AND CONCLUSIONS

> Abundant microporosity; interpreted as dissolution of calcite

> Multiple exposure events

> Abundant bacteria
- bacteria may have played a role in formation of microporosity and formation of bentonite

> Unlikely that volcanism is the source of bentonite
- nearest volcanoes are significantly older than this deposit
- glass shards were not found
- abundance of fossils suggests marine origin

> The hypothesis is accepted

Acknowledgments:

This research was supported in part by grants from USDA Forest Service and Pickering, Inc.
Funding for thin sections was graciously provided by the Russell Fund in the Department of Geosciences at MSU.
Thanks to the I2AT staff for assistance with SEM and XRD.
Thanks to the Biogeochemistry and Geoscience Education Research Group (BGERG) and Laboratory for assistanc and use of the lab.

References:

Luper, E.E., 1972, *Smith County Geology and Mineral Resources*, Mississippi Geological, Eronomic, and Topographical Survey, Jackson, MS.
McIlwain, J.A., 2007, Hydrogeologic Assessment of a Proposed Reservoir Site, Smith County, Mississippi.