Opaline Cements of the Altamaha Formation in Central Georgia, A Petrographic Analysis

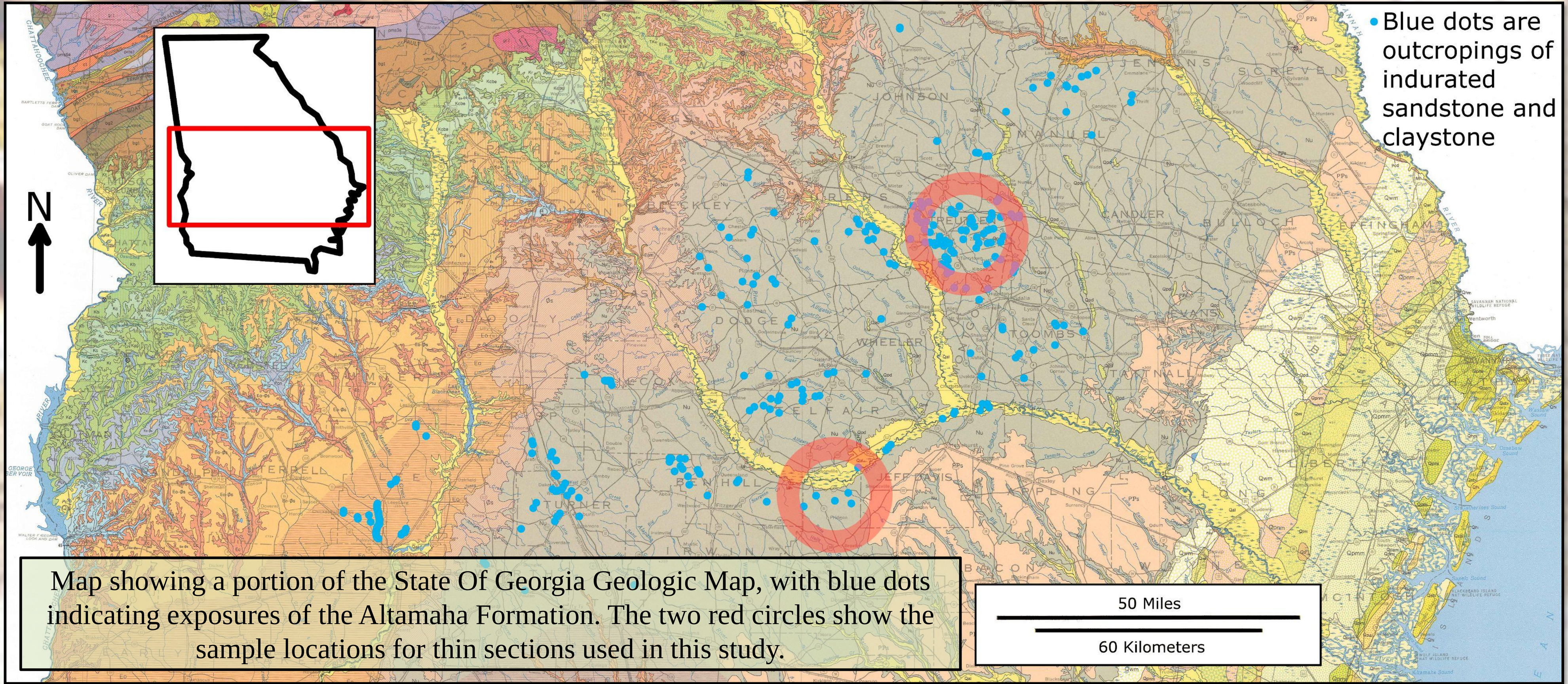
Travis M. West
Faculty Sponsor: Dr. Mark Groszos
Department of Physics, Astronomy, and Geosciences

Abstract

The Altamaha Formation of central Georgia consists of well-indurated Miocene sandstones. Previous workers, as well as this study, have documented opaline and silica cements in these rocks. The origin of these cements and their associated depositional environment is unclear. This study is an attempt to better characterize these cements through petrographic analysis and hand sample examination. Various samples have been collected from the Central Georgia Coastal Plain region including locations from Ashburn, Georgia to Soperton, Georgia. These rocks are poorly sorted, angular, well-indurated, feldspathic to sub-feldspathic sandstones. They generally show significant volumes of matrix and silica cements. Minor amounts of clay and carbonate cements have also been observed. The previously mentioned matrix is problematic because these rocks are not graywackes. The formation is interpreted to be terrestrial due to the presence of terrestrial fossils along with terrestrial depositional features. Initial analysis of thin sections revealed that some of the cement is true opaline though other portions of cement appear to be chalcedonic quartz or in transition from opaline to chalcedonic quartz. In hand sample, these cements are opaque white with conchoidal fracture and do not show opaline luster.

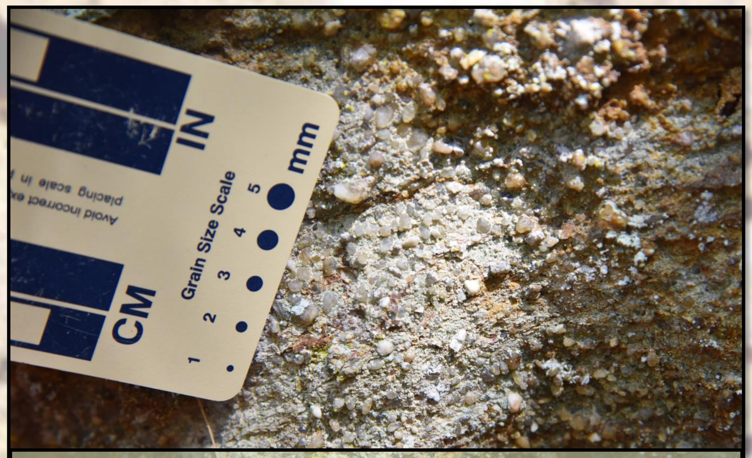
Introduction

The main objective of this thesis is to better understand and characterize the matrix within the Altamaha Formation sandstones in Georgia. In order to properly analyze this matrix a petrographic analysis is required of the samples using standard point counting techniques. This analysis allows the statistical mineralogic composition of the sample to be determined. A petrographic microscope is used to identify the minerals in the sample. A "point count" is completed to determine the sample's mineralogical composition. A total of 615 points have been counted in each slide. Point counts, or modes, are required to classify this sandstone and further to determine the composition of its matrix.



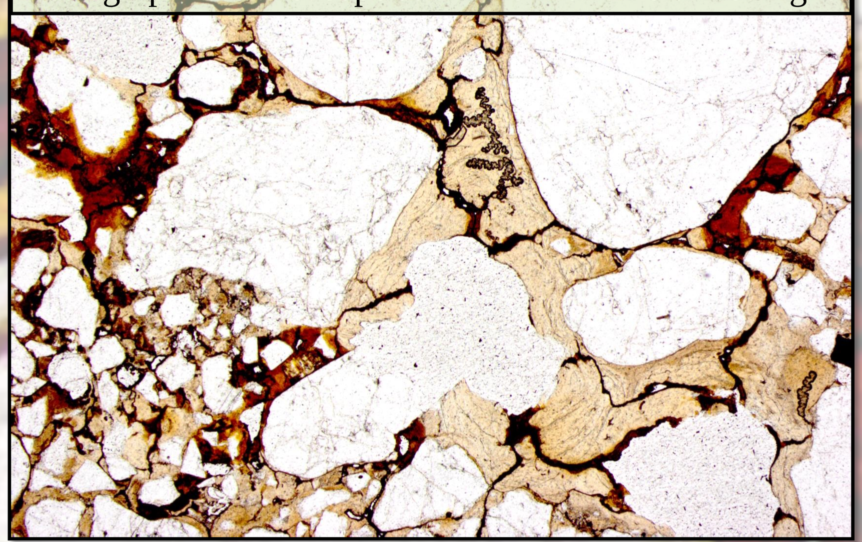
Map showing a portion of the State Of Georgia Geologic Map, with blue dots indicating exposures of the Altamaha Formation. The two red circles show the sample locations for thin sections used in this study.

Close-up outcrop photograph of typical Altamaha sandstone from the Broxton Rocks, GA, area.

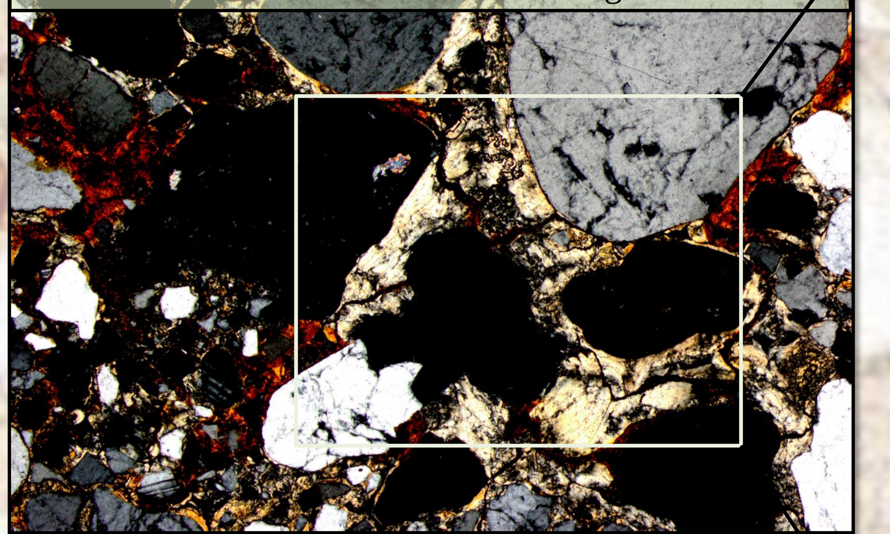


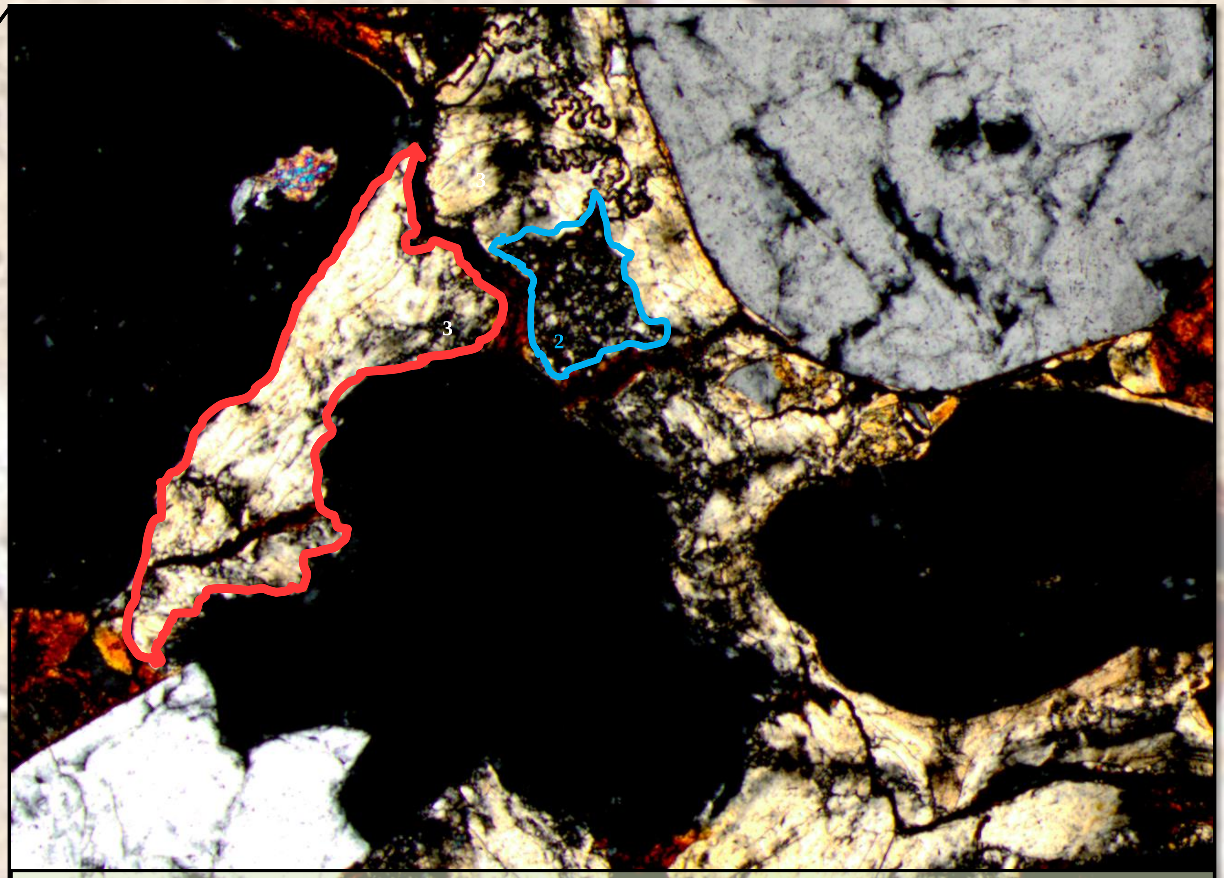
Close-up outcrop photograph of typical Altamaha sandstone from the Soperton, GA, area.

A thin section of sample: BR1603 viewed with Petrographic Microscope at 4x and Plane Polarized light



The same thin section of sample: BR1603 viewed at 4x and Crossed Polarized light





This close-up shows the opaline matrix (light yellow areas) as well as several sand grains (white, gray, and black). The red/orange areas are iron oxide stains

Point Counting a Thin Section using The Olympus BX51

Outcrop of the Altamaha Formation, Samples were collected in Ashburn, Ga

Methods

In November of 2019, hand samples were collected of the Miocene sandstone from an outcrop in Ashburn, Georgia located next to Interstate I-75 at Rest Area-10 Northbound. The purpose of this trip was to collect multiple hand samples for petrologic analysis. These samples were compared to other samples of the same rock, studied with a hand lens, then photographed and cataloged. Previous samples were collected by Eric Parrish and Wiley Griffin from Broxton, Georgia and Soperton, Georgia respectively. Parrish and Griffin had their samples cut and prepared into thin sections. The goals of their studies were to characterize these rocks using standard petrologic and petrographic techniques. During their work, it became clear that the opaline cements that occur here were unusual and not well understood. The goal of this study is to describe and quantify the opaline cements. The thin sections used in the Parrish and Griffin research were evaluated once again using a Petrographic Microscope. This time however, the focus was exclusively the opaline cement.

Results and Conclusions

Results of hand sample examination: The rocks are mostly pale tan to white in color though some were a darker tan to red in color. Fe-oxides were clearly present in veins and staining. Most exposures were relatively soft and friable, but individual samples can be hard and well-indurated. The exposed areas had definite signs of weathering leading to the friable more oxidized exposures.

Results of Petrographic examination: A total of 4 thin sections were analyzed. BR1603 was visibly higher in Fe-oxides than the other slides. All slides contained some amount of pure opaline matrix which appears solid black in the crossed polarized view. Though some of the black areas in this view belong to clasts with orientations directly parallel to the mineralogical optic axis, there remains clear distinction in both plane polarized light and through observation of their extinctions through a rotation of the slide. Furthermore a transitional form of this opaline matrix was observed along with some matrix that is purely chalcedonic and does not fit the petrographic description of Opal. In some cases all three iterations of this silica cement is present. The transitional opal and the chalcedony are observed in tandem and appear to have mostly formed in the same process whereas the pure opaline matrix is often cutting through the former or fully separate. This indicates multiple cementation events happening during lithification leading to this complex matrix.

Conclusions: Though this rock currently fits within the Dott classification of a Graywacke, clearly the abundance of matrix is a secondary process. Observations of this study leads to multiple processes that can indicate an abrupt process or event. The amount of silica can not all be accounted for without the introduction of highly siliceous fluids.

	Eric Parrish Samples		Wiley Griffin Samples		
	BR 1601	BR 1603	AF18 2B	AF18 7	AVG.
Pure Opal Matrix[1]	25.53%	8.46%	12.36%	8.35%	13.68%
Transition Opal Matrix[2]	23.41%	30.08%	19.19%	31.97%	26.16%
Chalcedony Matrix[3]	1.46%	2.93%	14.31%	4.88%	5.90%
Undifferentiated Matrix	5.53%	1.79%	2.76%	2.20%	3.07%
Iron (Fe) Oxides	2.44%	5.69%	0.16%	2.05%	2.59%
Quartz Overgrowths	0.81%	0.81%	0.33%	0.16%	0.53%
Voids	0.98%	0.00%	0.16%	1.10%	0.56%
Clasts	39.84%	50.24%	50.73%	49.29%	47.53%

VALDOSTA STATE UNIVERSITY