KECK GEOLOGY CONSORTIUM

21ST KECK RESEARCH SYMPOSIUM IN GEOLOGY SHORT CONTRIBUTIONS

April 2008

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Keck Director
Franklin & Marshall College

Keck Geology Consortium
Franklin & Marshall College
PO Box 3003, Lancaster Pa, 17603

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Origin of big garnets in amphibolites during high-grade metamorphism, Adirondacks, NY
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Carbonate Depositional Systems of St. Croix, US Virgin Islands
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Sedimentary Environments and Paleoecology of Proterozoic and Cambrian "Avalonian" Strata in the United States
Mark McMenamin (Mount Holyoke College) and Jack Beuthin (U of Pittsburgh, Johnstown)
Students: Evan Anderson, Anna Lavarreda, Ken O'Donnell, Walter Persons, Jessica Williams

Development and Analysis of Millennial-Scale Tree Ring Records from Glacier Bay National Park and Preserve, Alaska (Glacier Bay)
Greg Wiles (The College of Wooster)
Students: Erica Erlanger, Alex Trutko, Adam Plourde

The Biogeochemistry and Environmental History of Bioluminescent Bays, Vieques, Puerto Rico
Tim Ku (Wesleyan University) Suzanne O'Connell (Wesleyan University), Anna Martini (Amherst College)
Students: Erin Algeo, Jennifer Bourdeau, Justin Clark, Margaret Selzer, Ulyanna Sorokopoud, Sarah Tracy

Funding provided by:
Keck Geology Consortium Member Institutions and NSF (NSF-REU: 0648782)

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JOHN D. BEUTHIN: University of Pittsburgh, Johnstown

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Research Advisor: C. Frederick Lohrengel II

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JESSICA A. J. WILLIAMS: Southern Utah University
Research Advisor: C. Frederick Lohrengel II

INTRODUCTION

This study is a portion of a larger research project in the Hewitt's Cove area of Boston Harbor. Because vegetation and recent sediments cover most of the study area, location of suitable study sites required considerable exploration. Only a few sites suitable for sedimentological study were found and a 14-meter sequence, which will be referred to as 'Locality F,' was selected for this study. The 14-meter section of rock exposed at Locality F was divided into four lithologic units. This outcrop contains oversized clasts (up to 10 cm) that are "floating" in a mass of silt and fine-grained sand. These oversized clasts are present only in the basal portion of the exposed section, to date, and have not been found in any of the other rock outcrops in the Hewitt's Cove area.

Figure 1. Locality F at Hewitt's Cove, Hingham, Massachusetts.

METHODS

Field Methods:

Initially, members of the project scoured the shore area of Hewitt's Cove searching for outcrops that would be suitable for sedimentological study. Locality F is one of seven project sites selected. Three days of intensive field effort were devoted to measuring and describing, in sub-meter detail, this rock sequence. During this process 15 oriented samples were collected. An extensive photo collection was done simultaneously.

Laboratory Methods:

Significant effort was applied to collecting and studying literature concerning the study area. The field samples were cut perpendicular to bedding. Large format thin sections were produced from the selected specimens in order to attain the maximum amount of information about the sedimentological history of Locality F. The large format thin sections were studied using both a petrographic and a binocular microscope. The features that were most intensely studied included: grain size, sorting, rounding, composition, texture, nature of stratification, thickness of stratification, nature of contacts, and post-depositional tectonic features. Photomicrographs of the thin sections were made to enhance the detailed notes.

RESULTS

Study of 22 large format thin sections from Locality F yielded the following results: sediment consisting of clean, well-sorted, fine-grained clastics domi-

Figure 2. Large format thin section, F2b/0.9, showing finely laminated sediments ranging in thickness from 0.5 mm to 15 mm and one coarser grained laminae with a thickness of 7 mm. Grain size ranges from fine sand to fine silt. Small-scale scour mark on right side of slide.

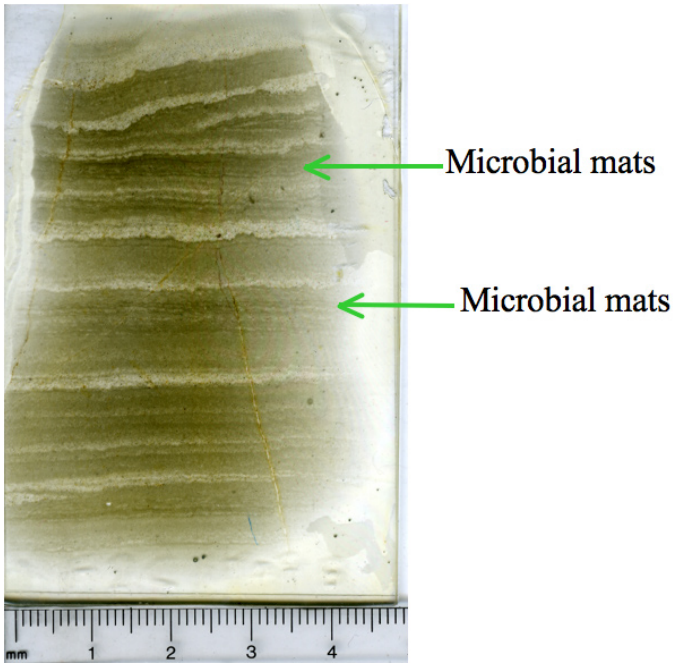

Figure 3. Large format thin section, F2c/TopB, showing microbial mats. Microbial mats were identified on the basis of crinkled morphology.

nated by silts and interlaminated fine-grained sands; algal mats are present in thin section (F2c/TopB); contacts between laminae represent ordinary deposition but also include small-scale scour marks; soft-sediment deformation; and some small-scale brecciation. Sediments underlying the oversized clasts were deformed into a depression. Overlying sediments form an on-lap, overarching structure. Petrographic study of the oversized clasts indicated they are mostly igneous, but one is sedimentary.

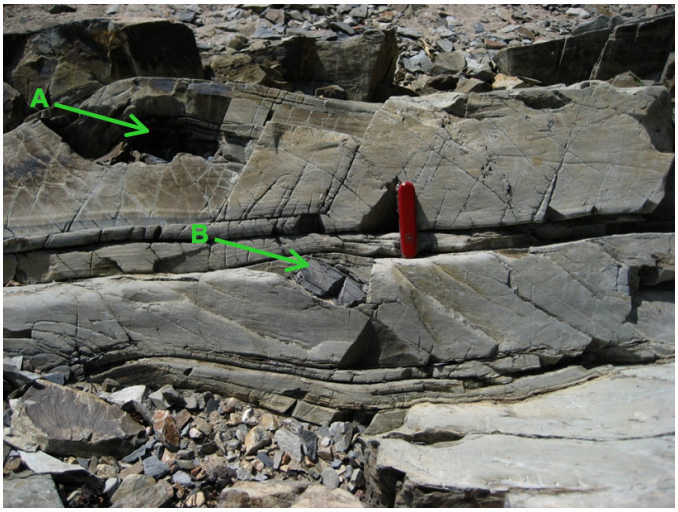

Figure 4. Locality F contains numerous dropstones including one shown in this picture that is no longer present (at point A) and an example of a relatively large dropstone with deformed laminae at point B.

INTERPRETATION

The well-sorted, fine-grained clastics in these samples indicate a stable shoreline. The silt has no intermixed clay, indicating it is well washed. The presence of algal mats requires the depositional environment to have been within the photic zone, probably less than 15 meters.

The small-scale scour marks that occur widely throughout the section may have been produced by either sediments or water currents. Because the sediments are so fine-grained, even a low velocity water current could disturb the sediments enough to leave a scour mark. Many of the thin sections show soft sediment deformation, suggesting that the dep-

ositional environment was periodically above storm wave base. Soft sediment deformation present in the slides makes it difficult to study the laminae. However on a larger scale deformed laminae are apparent around the oversized clasts.

The oversized clasts observed at Locality F could be an entire project of their own, but preliminary study gives some insight as to how they might have been emplaced. The down warping of the laminae below the oversized clasts plus the distortion above by the next layer of sediments indicates that they were dropped. Study of the references yield the most likely analogy to be ice rafted dropstones. The dropstones may have been transported by something as large as glacier-formed icebergs or as small as ice blocks from a frozen river. The provenance of the dropstones was probably igneous. A likely tectonic setting for the provenance would be the trailing edge of a stable craton. Note that a single granitoid lonestone was discovered, strongly supporting the case for a dropstone interpretation.

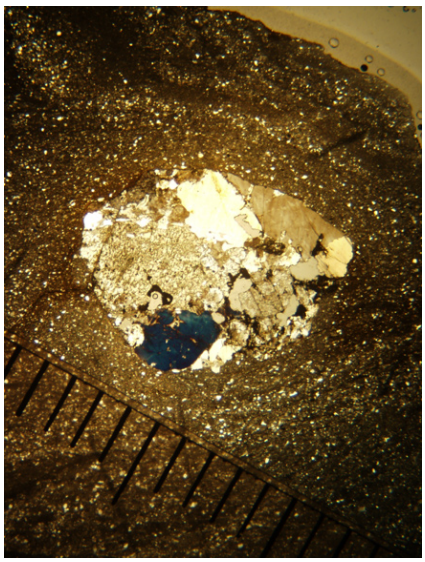

Figure 5. Thin section of a granitic dropstone with deformed laminae both above and below. Quartz is present (blue crystal) as well as albite twinning in the plagioclase. Other feldspars appear chemically weathered. Scale bar in millimeters. Photo by Mark McMenamin.

FURTHER RESEARCH

This research is only a preliminary examination of the sedimentology of the laminations as well as the dropstones. Future research requires experts in the field of microbial materials to examine the thin sections more thoroughly. More attention needs to be focused on the origin of the dropstones as well as on their transportation agent(s).

CONCLUSIONS

The clean, well-sorted character of the fine-grained clastic material suggests a stable shoreline environment in which these sediments were thoroughly washed. The presence of microbial mats suggests the water depth to be shallow, probably less than 15 meters deep. The presence of dropstones in such shallow water suggests transportation from a periglacial outwash region by river ice rather than icebergs.

ACKNOWLEDGEMENTS

I would like to thank Dr. Mark Colberg at Southern Utah University for looking at the mineralogy of the dropstones. Thank you to Dr. Robert Eves at Southern Utah University for guiding me in the right direction with how to analyze sedimentary rocks under the microscope. Thanks are also extended to Gerad Marchand (Jerry) at Mount Holyoke College for making the large format thin sections.

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