Investigation of Keyser Limestone Paleoenvironments at the Cumberland Bone Cave

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Abstract

The Keyser Limestone represents shallow patch reef environments dating from the Later Silurian to the Early Devonian. It is a member of the Helderberg Group, a unit of limestone formations located on the eastern edge of the Appalachian basin. Multiple shallow marine facies are present in the Keyser Limestone, ranging from tidal flats to open marine shelf. At the Cumberland Bone Cave, famous for its Pleistocene Epoch fossils, an outcrop of Keyser Limestone has not yet been subject to analysis. The objective for the research will be to record the stratigraphy present at the outcrop and compare it to work done previously on the Keyser Limestone. The null hypothesis is that no facies change will be observed, with three special hypotheses: a transgressive sequence is observed, a regressive sequence is observed, or some combination of transgression/regression is observed. Data to be obtained with field work will be measurements of bed thickness and descriptions of lithology. Measurements were made using a measuring tape recording the distance between the top and bottom surfaces of each bed. Error was done by taking multiple measurements of the first five beds, finding the standard deviation at each bed. Lithology descriptions will be made with field observations and samples taken. Currently, 1.68 meters of section have been measured, with three major lithology changes observed within the section. Evidence taken from samples indicates the facies become progressively deeper, showing initially a transgressive sequence. Future work will involve continued trips to the field site, finishing measurements and sample collection

Introduction

Taken from Dorobek and Reed (1986), The Keyser Limestone is the oldest formation of the Helderberg Group of the central Appalachians. The formation represents four major facies (listed from shallow to deep): tidal flats, lagoons, barrier islands, and open marine shelf (Makurath 1977). These facies are identified by their different lithologies and fossil contents. At the Cumberland Bone Cave in western Maryland there is an outcrop of the Keyser limestone that has yet be subject to any analysis. The outcrop is a railroad cut displaying approximately 118 meters thickness. The thicknesses previously recorded for the Keyser Limestone have gone up only to 80-90 meters, so it is possible that there is a contact with some formation above or below the Keyser Limestone. The objective for this project is to record the stratigraphy of this site, and compare it to previously done work on the Keyser Limestone.

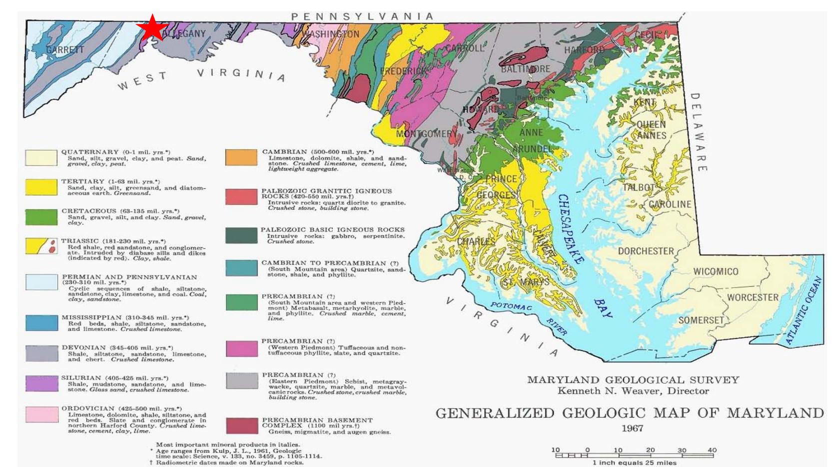


Fig. 1 Geologic map of Maryland with the location of the Cumberland Bone Cave marked as a star.

Null Hypothesis: No particular facies change is present at this site
Special Hypotheses:
- A transgressive sequence is represented at this site
- A regressive sequence is represented at this site
- A series of transgressive/regressive cycles are represented at this site

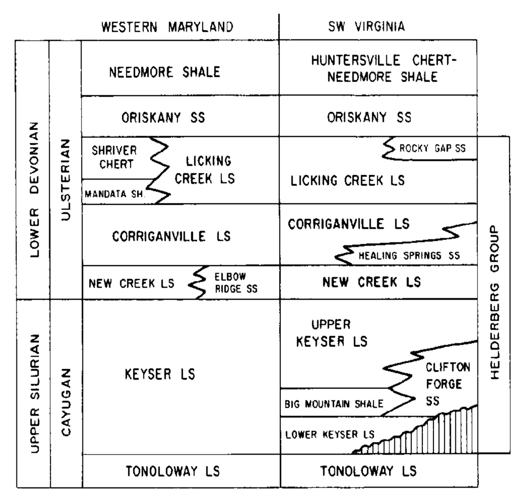


FIG. 4.—Regional stratigraphic correlation chart, Helderberg Group, central Appalachians.

Fig. 2 Stratigraphic column that shows the Keyser Limestone's location within the Helderberg Group (Dorobek 1986)

	Tidal Flat	Lagoon	Barrier	Shelf
Ostracoda	X	X	X	X
Trilobita				X
Tentaculitida	X			X
Stromatoporoidea	X	X	X	X
Gastropoda	X	X		X
Rugosa		X	X	
Bryozoa		X	X	X
Crinoidea			X	X
Cystoidea			X	X
Brachiopoda		X	X	X

Table 1. A summary of common fossil fauna present within the Keyser Limestone (Makurath 1977)

Results

Uncertainty measurements came from the first five beds observed. The first five beds varied in their thickness, so all were used to find a range of standard deviations. The average standard deviation found is 1.45 cm, while the minimum and maximum respectively are 0.91 cm and 2.22 cm

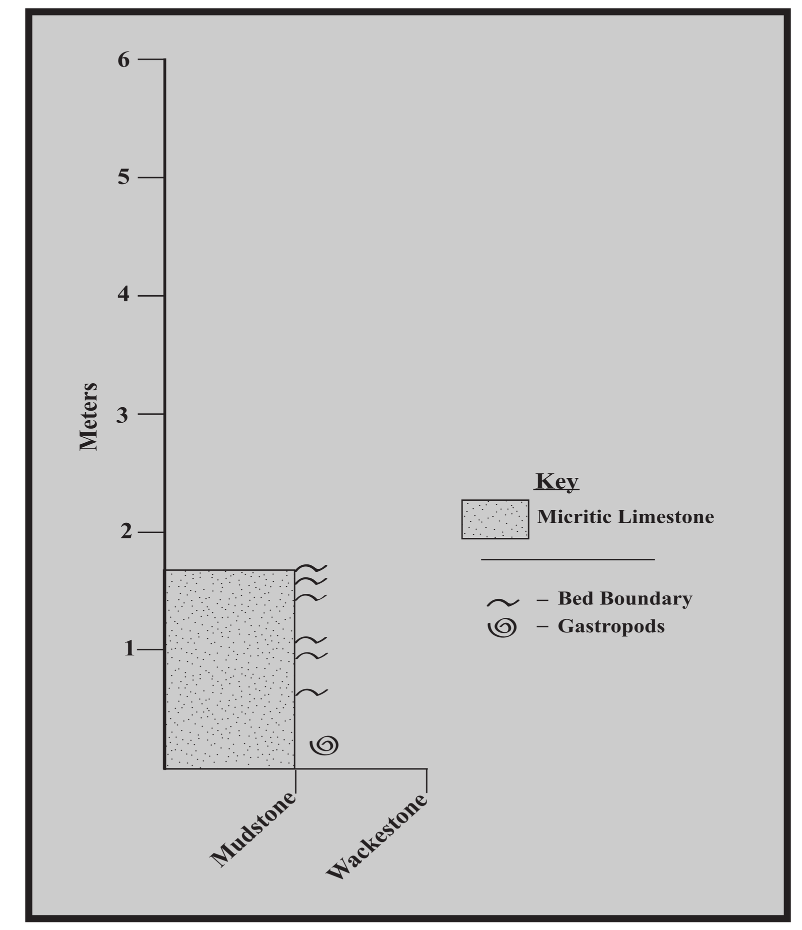
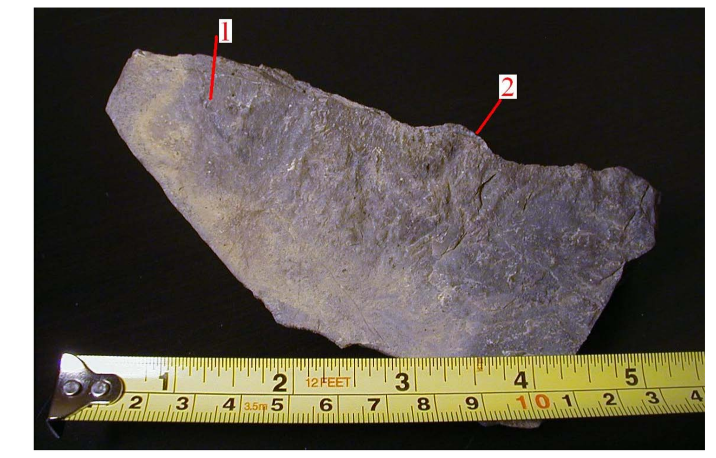


Fig. 4 Measured section for the first 1.68 meters measured. Data represented here come from the initial measurements taken on the first 6 beds. The lithology and fossil data comes from the sample taken at the marker bed (zero meters).



Sample 1. Rock taken at the marker bed. The rock is classified as a micrite/mudstone. Fossils present are an unidentified structure that could possibly be some body part of a crinoid (1) and brachiopod shells (2).

Sample 2. Taken at the first major lithology change observed. This rock is also a micrite/mudstone. The rock shows fine layers of what appear to be algal mats (1).

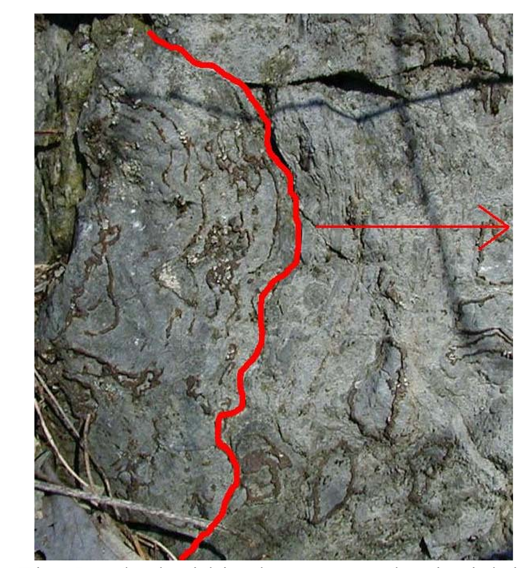
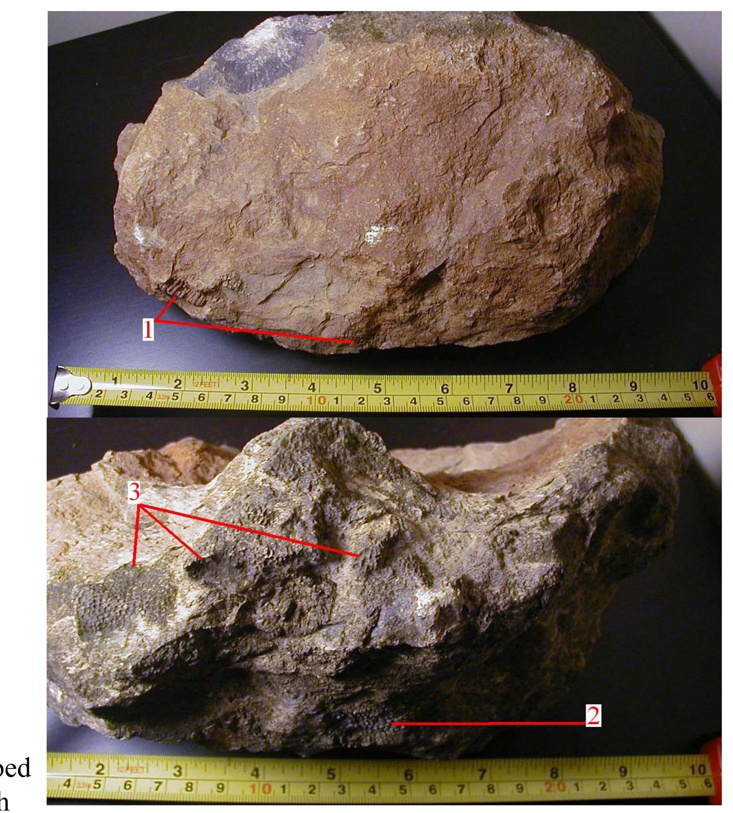


Fig. 5 A bed within the outcrop that is rich in stromatoporoids. As these grow, they develop a dome-shaped structure with the tip of the dome facing up. This bed was used as a geopedal structure in order to idicate which direction was facing up during deposition. A red outline shows the shape of a stromatoporoid with a red arrow displaying the "up" direction.



Sample 3. The second major lithology change observed. Rock type is a biomicrite/wackestone. Much higher fossil content in this rock, showing the infilling of tabulate corals (1 and 2) along with bryozoans resembling *Diplostenopora siluriana*, a Keyser member (3).

Methods

Bed Thickness

Thickness will be measured with a measuring tape. This is possible because the outcrop was cut through for a railroad, exposing the rock near-perpendicular to strike. The thickness measured is the distance between the top and bottom bedding planes.

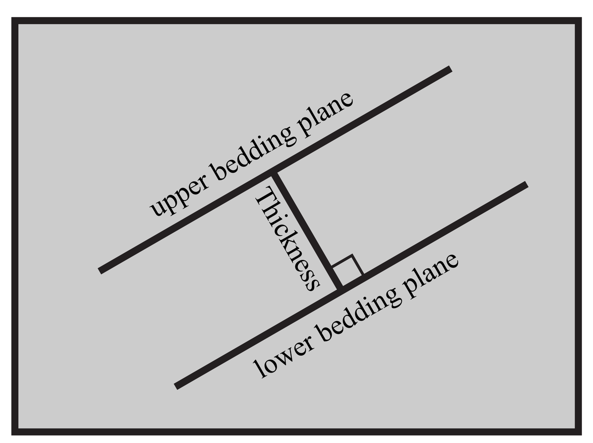


Fig 3. Simple visualization of how bed thickness will be measured.

Lithology

At each observed change in lithologies, rock samples will be taken. These rock samples will be described with three variables: rock type, sedimentary structures, and fossil content. Both Folk (grain size and matrix composition) and Dunham (depositional texture) methods will be used to classify the rock type. Sedimentary structures and fossil content will be observed within each sample. If possible, fossils will be matched to a species using catalogs of fossils found in the Helderberg Group. In the case a match cannot be made, the fossil will be identified as a member of its larger family.

Data on the bed thickess and lithology of the outcrop will be used to construct a measured section. Lithology data present in the measured section will be bed thickness, rock type, and grain size. A structures or fossil content will be noted where they are present.

Discussion

The three changes in lithology observed so far appear to give an indication on the migration direction of the shoreline. The first facies is characteristic of a tidal flat or lagoon facies. The upper bedding planes for these rocks showed evidence of greatly decreased sedimentation rates. It is possible this is the outcome of the water level dropping below from tides.

The second facies is showing a calm environment with little distubance of the sediment. Algal mats make up the primary structure in the rock samples collected, showing up as laminations. This is evidence of a low-energy shallow zone that rarely disturbs the sediment. It is possible that this represents some sort of lagoon facies.

Massive biomicrites make up the third observed facies. Rock samples here have much higher fossil content, probably characteristic of patch reefs present within the keyser limestone. The beds here are very thick and show extensive weathering.

This data works to support that a transgressive sequence is being observed here. Interpretation of the data shows movement from a peritidal to subtidal environment. This means that the sea level is rising, and the coast moving in towards the land. All measurements and observations have yet to be done, so no absolute conclusions can be made at this time.

Future Work

The main task for this project is to complete the measurements of the approximately 118 meter section. Over the summer and into the next semester, more trips will be made to the field site in order to take measurements. The trips will begin in mid-July. Measurements should be close to completed by the time the fall semester begins.

Conditions that might affect this plan are weather and the schedule for the trian running through the site. Because there will be over a month during the summer that is available to reach the site, making sure that weather conditions are favorable on days I visit should not be an issue. There is also a scenic train that runs through the field site during the summer months. This is more of a safety concern, to the plan is to avoid it when possible. The train does not run from Monday to Wednesday, so these are the best potential days to visit the site.

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