GEOSCIENCE LAB

OBSERVING CHANGES IN SEDIMENTARY ENVIRONMENTS: THE REEDSVILLE AND BALD EAGLE FORMATIONS

Abstract

This field trip allows students to visit a sedimentary stratigraphic sequence from the Upper Ordovician of Central Pennsylvania. Students are exposed to the Reedsville Formation, an Upper Ordovician turbidite sequence, and are able to make observations of the sedimentary rocks and measure a stratigraphic section. The Bald Eagle Formation sits directly above the Reedsville Formation, and allows students to observe the transition from marine to terrestrial sedimentary rocks. Students will make observations of sediment color, grain size and mineralogy, and sedimentary structures; for example, cross-bedding and mud cracks.

Introduction

There is a large exposure south of Potter's Mills, Pennsylvania approximately 12 miles east of State College, where we can study the Reedsville and Bald Eagle Formations, which overlie the Coburn Formation. The Reedsville is still within the Upper Ordovician period and has a total thickness in this area of around 200 m; we are going to look at the uppermost section of it, just below the overlying Bald Eagle Formation. Take advantage of both the ground and elevated views of the outcrop.

You should refer to your textbooks chapter(s) on "*Sedimentary Rocks*" that discusses the kinds of things we generally want to know about sedimentary rocks.

Goals

The goals of this lab are: 1) describe the lithologies that make up the Reedsville and Bald Eagle Formations; 2) study their arrangement stratigraphically; and 3) look for (and describe/document) clues that relate to the depositional environment. One thing to consider here is what the vertical succession of lithologies might mean: What might have caused the changes you observe? Are there cycles of lithologies that repeat over time? How does the orientation of the stratigraphy relate to the tectonic setting?

Reedsville Formation

Have a glance at the upper Reedsville, seen at the far southern edge of this exposure; it is similar to the lower Reedsville in that it consists of this easily eroded sedimentary rock that you should be able to identify (i.e., identify this before proceeding). Work your way up-section, to the north, until you start seeing more resistant beds sticking out of the weaker material — this is the part of the Reedsville we want to focus on. These resistant beds are turbidites, deposits from submarine avalanches. Turbidites represent fairly dramatic events; they are usually triggered by large earthquakes, travel rapidly and deposit sediment quickly (~an hour). They are also a means of transporting coarser sediment (because the current velocity is quite high) into a deep-water setting, where clays and muds would normally be found.

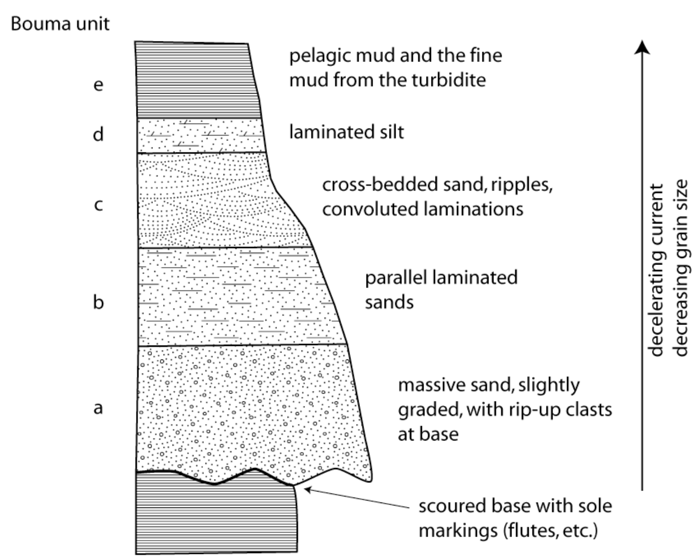
What to Turn In for the Reedsville Formation:

1. A detailed 2 m stratigraphic column of a part of the Reedsville Formation, paying close attention to the composition and bedding contacts and grain size variations within the resistant beds. Use the template provided below.

2. A short (a couple of paragraphs) report that presents your observations and interpretations about this sequence of rocks. What can you say about the depositional environment of the easily eroded parts of this formation? What are the turbidites composed of (what minerals compose the sediment particles)? Closely spaced turbidites (short stratigraphic distance between adjacent turbidite layers) means higher frequency of the turbidites. Turbidites may vary in thickness due to distance from the source of the avalanche, or from varying sizes of avalanches. Look for and then comment on stratigraphic trends you observe in thickness or frequency, does this imply anything about changing distance from the source of the turbidites over time?

The following figure of an idealized turbidite or Bouma unit, may be useful as you study the Reedsville Formation turbidites.

The Idealized Turbidite



Closer to the source, you may see units a or a and b, further from the source, you may see c,d,e, or d,e

Bald Eagle Formation

The Bald Eagle Formation is was also deposited within the Upper Ordovician period and has a total thickness in this area of around 200 m; we're going to look at a section near the base of the formation.

There are a number of features to make observations of in this section and take notes on, and questions to answer, but the aim of this section is for you to get a sense of what the depositional environment was like, what the regional geography might have looked like, and how these changed relative to the time of the Reedsville Formation deposition.

In the way of background, recall that sandstones, and all clastic sedimentary rocks, are composed of particles that are derived from the weathering, erosion, and transport from some uplifted source. The composition of the sediment can give us some general clues about the type of area that was providing the sediment: was it a volcanic arc, a region of uplifted metamorphic rocks, or a region of folded and uplifted sedimentary rocks? The best clues about the source region come from the largest particles, so it is worth focusing some attention on the largest grains you see, which will be pebbles in this case. The roundedness of the grains, and the range of mineralogy can provide some clues about the transport distance and time (well-rounded grains of quartz suggest long transport; less well-rounded grains of a variety of compositions suggest briefer transport). Sedimentary structures like cross-beds, ripples, and mud-cracks, can also provide some useful information about the environment of deposition and the flow direction and strength of flows associated with the deposition of the sediment.

Sediment color can sometimes provide useful information, but it is not a conclusive piece of information. For instance, reddish color in sandstones and shales comes from hematite, which commonly forms in terrestrial environments (i.e., above sea level), whereas, greenish and dark gray colors are more commonly associated with deeper, marine environments.

Finally, pay attention to the larger-scale relationships of the stratigraphic beds. In river environments, it is common to see channel deposits, where a coarse sandstone fills a scoured-out depression cut into the underlying beds. In contrast, there are fewer channels in deltaic environments due to stronger subsidence, and in shallow marine shelf sands due to the lack of focused current flow such as occurs in a river.

What to Turn In for the Bald Eagle Formation:

Prepare a report in which you document, explain, and interpret your observations on the following aspects of the Bald Eagle Formation seen in this exposure. Your report should include sketches. The diagrams in this lab should provide useful in making observations and interpreting them.

1. Sedimentary Structures

A. Sketch 2 different sedimentary structures you can find. Include a scale bar in your sketches and a brief statement of what you infer about the depositional environment based on the sedimentary structure. The examples provided with this lab give you a general idea of what the sketches should look like (see diagrams below).

B. Describe the approximate flow direction indicated by at least 2 different sets of cross-beds (see diagram below).

2. Composition

What is the mineralogy of the larger grains in these beds? What is the or lithology of the grains if the pebbles are actual rocks rather than single minerals? What do the mineralogy and lithology suggest in terms of a source region?

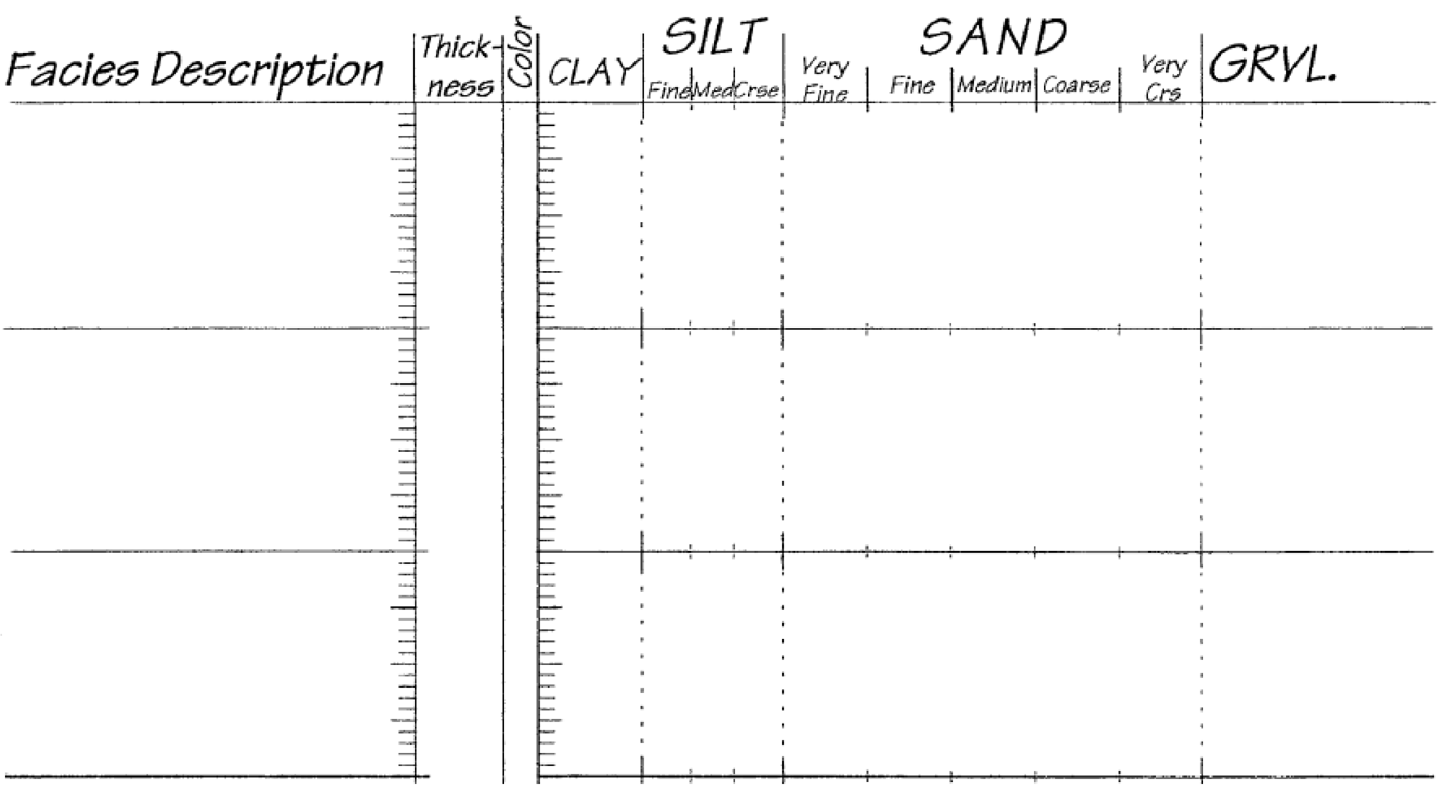
3. Grain Size, Shape, and Color

How big are the largest particles? Please give approximate diameter in mm. Are the grains well-rounded, slightly-rounded, angular, or variable (i.e., some rounded and some angular)? What color are the sediment particles?

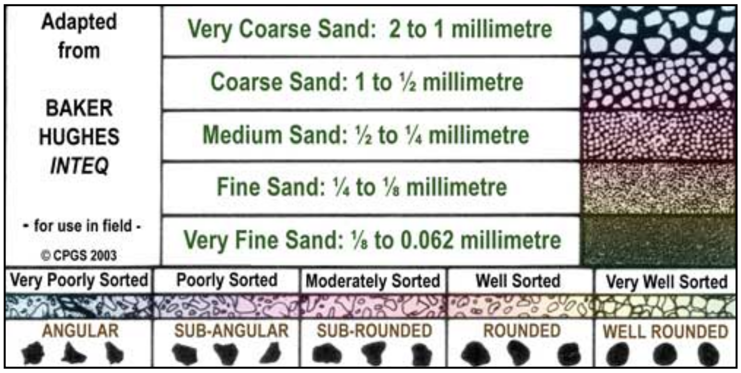
4. Summary of Observations and Interpretations

Write a couple of paragraphs in which you summarize the inferences derived from the above observations, being sure to answer the following: 1) What was the depositional environment?; 2) Where was this depositional environment relative to sea level?; 3) What was the source region like?; and 4) Where was the source region most likely located?

Part One: Reedsville Formation: Use this template to create your 2 m stratigraphic section of a turbidite from the Reedsville Formation using your measurements and observations.



Part Two: Bald Eagle Formation: Use the graphs and charts below to help you in making observations of the grain size and shape of the sediment in the Bald Eagle Formation, as well as the sedimentary structures.



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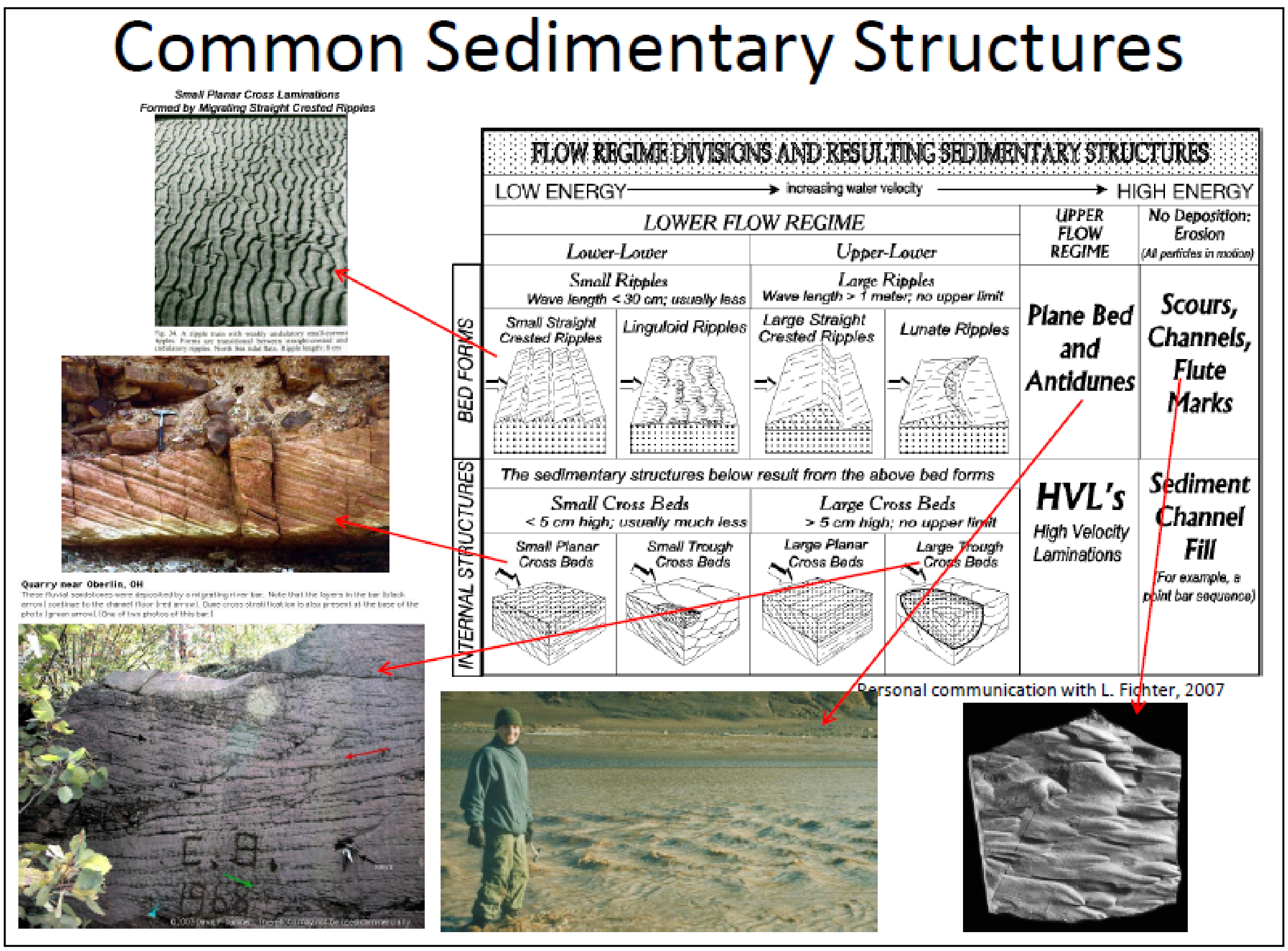

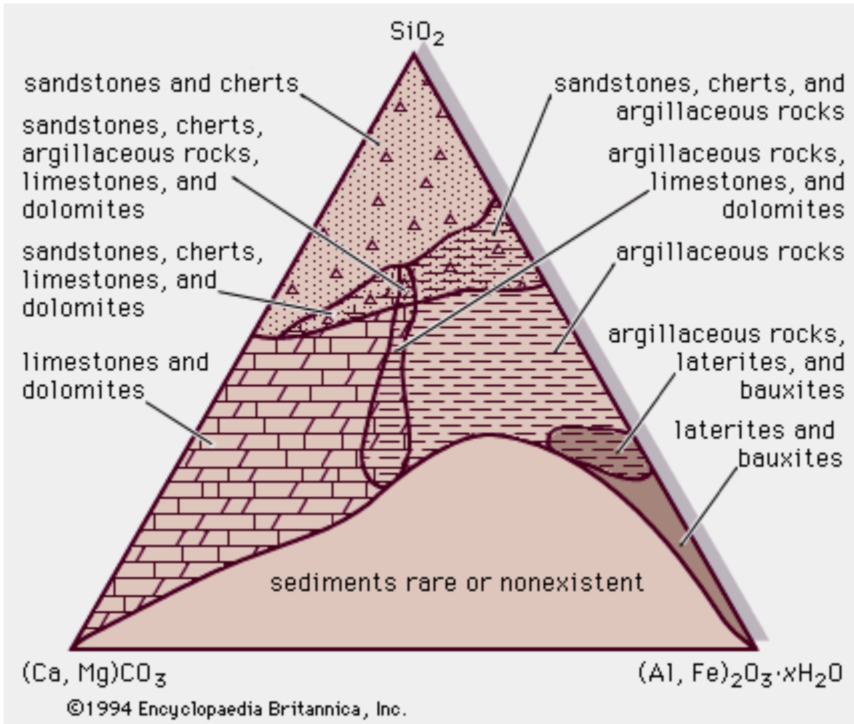

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