Geoscience 001 Spring 2006 Field Trip Lab The Bellefonte Formation and Nealmont Formations

Materials:

Students: hand lens, field notebooks

Site:

Hwy 322 By-Pass, 2 locations, along the east side of the road. This is a busy road, so stay well off the shoulder at all times and keep your wits about you. The exposure itself is very steep and you should avoid climbing up onto the face — you can see plenty from the ground level.

Background:

The Bellefonte Formation and overlying Nealmont Formation are both Mid-Ordovician in age, which means about 471 to 461 Ma. These formations are found over a broad region up and down the Appalachian mountains. During this time period, North America and Africa (and any microcontinents or volcanic arcs between them) were still separated. We know from paleomagnetic studies that this area was close to the equator.

With sedimentary rocks, there are a number of questions to answer. The main questions are related to understanding what the environment of deposition was like. Was it marine or terrestrial? Was it shallow water or deep water? How shallow, or how deep? Within the photic zone? (less than about 20 m) Above or below the storm wave base? (less than 100-200 m) What are the sediment particles composed of? Where might they have come from? Was there some eroding landmass nearby? What kinds of fossils are present (if any)? What do these fossils tell us about the environment? Are their shells well-preserved or all broken up? Are the shells delicate looking or robust? Are there trace fossils (i.e., worm burrows)? If so, what can they tell you about the degree of oxygenation or the suddenness of deposition? (no burrows could mean low oxygen on the bottom of the sea or it could mean very rapid sedimentation, maybe even just a pulse of rapid deposition such as occurs after a storm). The list of questions can go on and on, but you can see that they all contribute to developing a picture of what the depositional environment was like.

If you see a sequence of sedimentary rocks that look like they are deposited in shallow water and the thickness is greater than the presumed water depth, then it means that in a relative sense, sea level was rising during the deposition. For instance, if we see stromatolites or ooids, we'll assume the water depth was only a couple of meters, so if you see more than 2 meters of carbonate sediments on top of the stromatolites, you know that relative sea level was rising. A relative sea level rise could be due to a global (eustatic) sea level rise, or it could be due to subsidence (sinking) of the crust, or both.

Remember that carbonate sediments (limestones and dolostones) are usually formed from fossil fragments that grew in or very near the site of deposition and the size of the particles is not so significant, because it may just be a function of how big the organisms were, not how strong or energetic the water was at the site of deposition. In contrast siliciclastics (sandstones and their cousins) are derived from weathering exposed rocks on the continents and then transportation of those sediments to the depositional site; the

grain size of those sediments is a measure of current strength (related to wave energy and thus water depth) and distance from the shore in the case of marine siliciclastic rocks; sands are deposited closer to shore, clays are deposited much further from shore, where the water energy on the seafloor is low enough to allow the clays to settle and accumulate. In carbonate rocks, the presence of fine-grained mud gives an indication of quiet water (the mud is swept away in shallower, energetic environments, leaving behind coarser carbonate composed of larger shell fragments).

Also, remember that sedimentary layers are deposited horizontally, so any departure from that is interesting and tells us something about the tectonic forces affecting this area in the past.

Goals:

The goals in this lab are to describe the different kinds of rock that make up this formation and study their arrangement stratigraphically and to look for (and describe/document) clues that relate to the depositional environment. One thing to consider here is what the vertical succession of rock types might mean — what might have caused the changes you observe. Are there cycles of rock types that repeat over time?

We also want to measure the strike and dip of the beds in two locations and sketch a simple cross-section that connects the two measurements.

What to turn in:

Each group of three people should make one detailed stratigraphic column for a 3-4 m thick section that spans the Bellefonte Fm. and the Nealmont Fm. (TAs will show you the contact), that includes information about bed compositions, thicknesses, bedding plane contacts (sharp, gradational, flat, undulatory, etc.), sedimentary structures, fossils or fragments of fossils, color, approximate particle size (clay, silt, fine sand, medium sand, coarse sand). These stratigraphic columns can be hand-drawn and you may use color if you please. They will be graded in part on neatness and in part on accuracy. Carefully studyt the example given here as a model to mimic when making your strat column.

As a group, write 1-2 paragraphs summarizing your observations and interpretations, focusing on the question of what the depositional environment was like — what was going on here during this period of time? Does one formation have more carbonate than the other? More clay than the other? Thicker beds than the other? More fossils than the other? Does one formation reflect deeper water conditions (quieter, farther from shore) than the other? Be sure to include the observations that form the basis for your conclusions (well, *conclusions* is probably too final-sounding; these should be "working hypotheses" subject to revision as more is learned).

Finally, each group should complete the cross-section provided here, reporting the strike and dip measurements your group made at the two stops.

Making a Stratigraphic Column

A stratigraphic column is a graphical means of representing a wide range of observations about the sequence of strat you observe in a particular place, or a broader region. Graphical symbols are used to represent different rock types; the height of the rectangle is proportional to the thickness of the layer being described and the width of it is proportional to its resistance to erosion (more resistant beds stick farther out to the right). Below, I show a fictional sample stratigraphic column to give you an idea of the kind of detail you should strive for.

You need to make as many observations as possible while in the field — the more notes you take, the better off you'll be later. You could even bring a digital camera to record the outcrop and help refresh your memory later. It is a good idea to make a very rough sketch of the startigraphic column while in the field, without paying attention to precise thicknesses.



THE WIDTH OF THESE BOXES REPRESENTS HOW RESISTANT TO EROSION A BED IS RELATIVE TO ADJACENT BEDS

A few representative symbols for sedimentary rocks (note that you can

blend these symbols and create hybrids to represent what you see)



