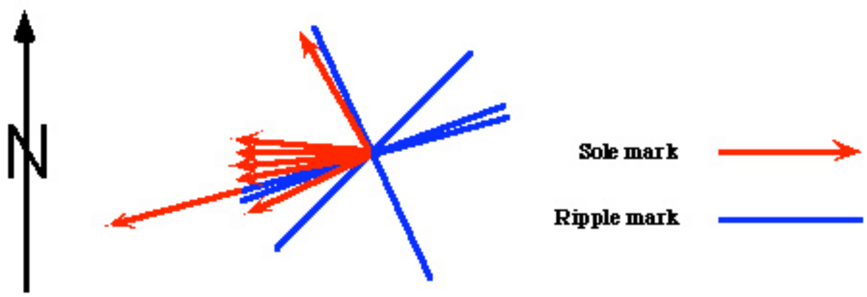
EAS 2200 – The Earth System
Lab #3: Enfield Glen

ANSWERS

(1) Keep track of any paleocurrent indicators that you see, and note their orientation. We'll try to get exact measurements with a geologic compass, if this is possible.

Students should have sketches ripplemarks and sole marks. Orientations will be variable.



(2) The total thickness of upper Devonian rocks in this area is approximately 6000 feet. These sedimentary rocks were deposited over approximately 14 million years.

(a) What was the average sedimentation rate in inches/year?

Sed rate = (6000ft)(12in/ft)/(14x10^6years) = 0.005in/yr

(b) Consider the "sand cylinder" experiment that we performed in the picnic area. Explain how alternating layers of sandstone and shale might form at the foot of the submarine Catskill Delta.

Each pulse of sedimentation forms a sand layer that grades upward into a shale layer. Rivers transport sediment in "pulses," for example during severe storms or spring runoff. Thus each pair of sandstone/shale layers represents one depositional event, separated by a long period of non-deposition.

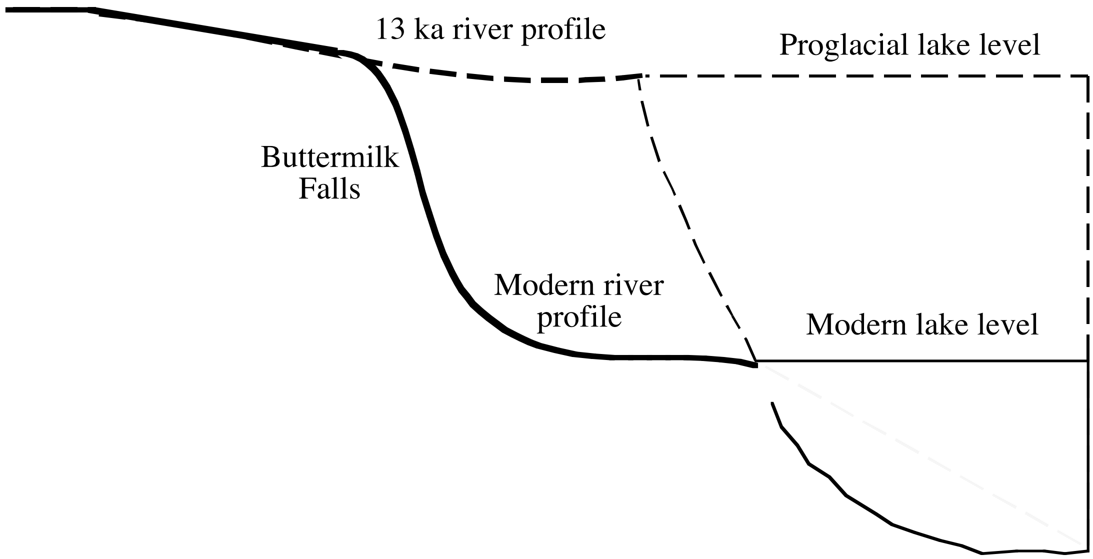
(c) What is the relative time required to form a sandstone layer as opposed to a shale? When you calculated the sedimentation rate in part (a), do you think this rate is constant through time, or does this represent an average of very different rates? Explain.

The sandstone layers form very quickly--in a matter of days. The shale layers take much longer--years, or possibly 10-100's of years (depending on what else was going on and whether or not sedimentation switched to another lobe of the delta).

(3) Measure the orientation of some of the joints. How many distinct joint sets can you identify? Use a protractor to plot your measurements in the circle on the regional joint map (next page). How do your measurements compare with the mapped joints?

Almost everyone found the three major joint sets: N25W, N10E and N65W. They may have a number of other measurements as well.... You can be rather generous regarding their compass readings, although most are usually quite good.

(4) Use the graph paper provided to make a sketch showing the river profile of Enfield Creek 13,000 years ago when it flowed into proglacial Lake Ithaca, and the river profile today as Enfield Creek flows into Cayuga Lake.



At 13 ka the river would have had a very low gradient along its entire length. At present the upper part of the stream has a low gradient but then there is a significant waterfall as it drops into the valley of Cayuga inlet.

(5) Form a hypothesis that would account for the change in position of Enfield Creek. What might have caused it to erode through the Devonian bedrock instead of in its old channel?

The course of Enfield Creek is very strongly joint controlled. The joints provide a natural path of least resistence for the water to expliot. The upper part of Buttermilk gorge is oriented exactly N10E, while below the bridge the N65W set also channels water flow.

(6) Plot your paleocurrent data in the circle on the map of the NE US on the following page. For bi-directional data use a line segment, for unidirectional data use an arrow pointed in the downstream direction.

Measurements should fan, but show a predominantly westward trend.

(7) We've seen many different features here, whose formation is separated in time by millions of years! Now it's time to put all of your observations and measurements together. Your field report this week should be a lucid and compelling geologic history of Enfield Glen. Use maps and figures *as well as your own data* to tell your story. Give dates, positions, orientations etc. Take the point of view of the author of an informational pamphlet for the State Park--can you explain everything you've learned to a park visitor? If so, you know you've got it wired. Good luck!

Students may choose the answer questions #1-6 as part of this write-up. If so, look for these in the text, as well as the following events:

- *Continental collision and formation of the ancient Acadian Mountains, east of the present position of Ithaca during early Devonian time.*
- *Erosion from the Acadian Mtns by west-flowing streams carried debris to the edge of the Devonian ocean, depositing sand and mud in the Catskill Delta complex. Paleocurrent indicators such as ripple and sole marks are the evidence for this. Each pulse of sedimentation produces SS/SH couplet.*
- *Sediment becomes compressed and cemented to form sandstone and shale.*
- *Continental collision during Permian time causes Catskill Delta rocks to arch upward and fracture, forming joints.*
- *Rifting in Triassic time opens the Atlantic ocean, and releases pressure on North America, producing a second set of orthogonal joints.*
- *Landscape erodes for appx. 200 million years.*
- *Pleistocene glaciation: glacial advance gouges NS trending valleys and fills EW valleys with sediment.*
- *Melting glaciers form proglacial lakes with meltwater trapped between the retreating ice front and the terminal moraine. Lake levels drop, causing tributary streams to deeply erode bedrock and form interglacial gorges, and leaving some valleys "hanging," as at Lucifer Falls.*
- *At Enfield Glen, the path of the modern creek is strongly controlled by the position of the Permian joints (N25W, N10E, N65W).*
- *Continued erosion causes the gorges to deepen, primarily through the upstream migration of waterfalls.*