Geology 29 - Structural Geology

ROCK UNITS AT TURNER'S FALLS

This lab examines a sequence of rocks that are well exposed below the dam on the Connecticut River at Turner's Falls. The rocks are unmetamorphosed, Triassic terrestrial sedimentary strata and basalt that are part of the Connecticut valley rift basin. We have already studied these rocks for the suite of primary sedimentary and extrusive structures well displayed by the strata that occur there. The purpose of this lab is to (1) consider the working definition of a *mappable* rock unit (formation); (2) gain more experience in lithologic descriptions; (3) make a stratigraphic column; (4) learn to determine true thickness from outcrop width; and (5) use these results as the basis from which to map the Turner's Falls area.

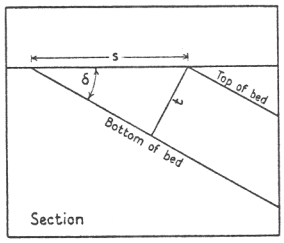
Determining map units and constructing a stratigraphic column of those units:

When we visited Turner's Falls during our first field lab, we noted that the sedimentary rocks there form a sequence of interbedded sandstones, siltstones and mudstones. How would we divide this continuous sequence into map units? Is it reasonable to make each change in lithology, which at Turner's Falls would mean nearly each bed, into a separate map unit? Map units must, first and foremost, be *mappable* at the scale being used. This means they must be (1) thick enough to be represented accurately on the map, and thin enough to allow enough units on the map to fully represent the rocks and structures present in the study area; (2) laterally continuous, again at the scale of map being used; (3) distinctive enough in their nature and boundaries to be objective, that is, anybody could find them again from your definition; and, if possible, (4) correlatable to units beyond the map area.

This week you will decide how to divide the Turner's Falls sequence into units that you will use to map the area. When you get back to the outcrop, you will want to walk through it from one end to the other to see the full sequence of different rocks. Consider what units you would like to use and where you think it is best to place the boundaries or contacts between the units. You will document your interpretation by producing a *stratigraphic column* of the sequence and by placing contacts on the map. In order to draw up a column back in the lab, you will need to do the following in the field:

1) Using a steel measuring tape and a Brunton measure the outcrop width of each of your units. Be sure to measure the outcrop width of the unit *perpendicular* to bedding. True thickness can only be determined for units whose top *and* bottom contacts are exposed. Measure the minimum thickness (the exposed thickness) of units that form the top and bottom of the whole sequence. Your column must show the TRUE thickness of the unit, not its width along the ground surface. Make sure you understand the difference, and how to derive the one from the other. (See the figure below.) Show a representative calculation in your lab write-up so that I can check your work.

TRUE UNIT THICKNESS FROM OUTCROP WIDTH



A

Case a

Thickness, if the ground surface is horizontal, and if the breadth of outcrop of the bed is measured at right angles to its strike. As shown in cross section in Fig. E3-2A,

$$\sin \delta = \frac{t}{s}$$

or

$$t = s \sin \delta \qquad (1)$$

where t = thickness of the bed, δ = angle of dip of the bed, and s = breadth of the outcrop at right angles to the strike, measured along a horizontal surface.

2) Fully describe the characteristics of each unit. Your description should include the nature of the *rocks* in the unit (refer to the crib sheets handed out with this lab) *and* a description of the unit as a whole (e.g., thinly bedded siltstone grading upwards into 1.5 meter thick massive beds of quartzite showing cross-bedding and load casts).

3) Note the nature of the *contact* between each of your rock units. Is it conformable or an unconformity?

Mapping Turner's Falls:

Some of the steps you will take to determine map units and to construct a stratigraphic column of them are also the initial steps in making a map of the area. The mapping process is "simple". Assess the *attitude* of the rock units you observe, that is, their strike and dip. (You will need to do this to determine true thickness from outcrop width for each of your units anyway.) Record the strike and dip measurements you make on your map using the standard strike and dip symbol accurately located at the site, or *station* at which the data were collected. (You should also record these observations in your field notebook by giving each station a number.) When you decide on the map units you will use, locate the contacts between the units on the map. Determine the strike and dip of these surfaces and, because the topography is horizontal, draw the contacts in on your map at the attitude of strike. (Remember that the width of your map unit between the contacts should remain *constant* along strike, and that sedimentary contacts - unless they are unconformities - are parallel.) Contacts and intervening units are *projected* across the map according to their strike. Follow your contacts across the map area on the east side of the Connecticut River, checking to see if their attitude remains consistent.

Mapping is best done while in the field! You should leave Turner's Falls today with contact lines for your units drawn on the map.

Write-up:

Take these data home and construct a stratigraphic column of the units at Turner's Falls. When you are drawing up your column be sure to include a vertical scale and to show your units with their measured thicknesses (drawing columns on graph paper, or through a computer graphics program facilitates this). The width of the column is commonly used to show the relative grain size of the rocks in each unit (e.g. shale=narrow column; sandstone=medium width; conglomerate=widest column). Be sure there is a horizontal scale for this too. Use standard symbols within the column to indicate general rock type (again, see crib sheets). Finally, write your unit descriptions in parallel with the column on the right hand side. If you knew the specific ages of each unit, these would appear along the left-hand side of the column. Examples of typical stratigraphic columns are attached to this lab.

Finalize your map of this portion of the Turner's Falls area. Create a map key for the units you determined, and color in the units between the basalt and the dam as you mapped them.

ONE FINAL NOTE:

Neatness *is* important when presenting geologic maps, cross sections and columns. Careful drafting with fine lines and accurate measurements is crucial. This is not just compulsiveness, a sloppy map *cannot* be accurate and therefore *cannot* be correct. Neat work is always closer to the truth than poorly drafted work.