

528 - Sedimentary Basin Analysis

Fall, 2005

Stratigraphic Analysis Lab

There is no substitute for excellent stratigraphic control of rock samples used for sedimentologic interpretation. Typically, sedimentary data are placed into some sort of stratigraphic framework which involves the measurement and description of key stratigraphic sections.

There is not a universally accepted set of symbols, standards, or techniques for making stratigraphic sections. The rocks, exposures, and conditions dictate the technique used by the field geologist, as does the purpose of measuring the section. Unfortunately, many stratigraphic and sedimentologic interpretations have suffered because the field geologist did not know how to record and adequately present data.

The purpose of this lab is to acquaint you with some of the basic techniques of field data acquisition and the graphical presentation of sedimentologic data via a measured stratigraphic sections and lithostratigraphic charts. In this lab, we will examine Campanian strata of the Carten Creek Formation near Garrison, Montana.

There are a multitude of ways in which sections can be measured and the data recorded. Among the most common techniques are measurements through the use of a tape measures and/or jake staffs.

Measuring sections using a tape: This technique works best when a thick package of rock needs to be measured in a relatively short amount of time. Resolution is rather limited, and typically it's best to use this technique for situations where sub-meter resolution is not necessary. The technique itself involves working through the section as orthogonal to strike as possible, and placing your observations into a series of taped intervals. For each interval, it will be necessary to record the length and azimuth of the tape, the slope angle and slope direction of the tape, and the bedding attitude. It is not always possible to make a bedding attitude measurement for each taped interval, and so it may be necessary to interpolate bedding attitudes between taped intervals. With this information, it's possible to calculate the true stratigraphic thickness of the taped interval using trigonometry. One of the benefits of this technique, in addition to its speed, is that is possible to project sedimentologic observations directly into the tape. For example, if the taped length is 25 meters and you observe a sandstone bed beginning at meter mark 10 and extending to meter mark 16, you can simply project these contacts into your tape and solve for the bedding thickness later. One of the disadvantages of using this technique is that, unless you measure true stratal thicknesses and indicate as such in your notes, you have to solve for the stratigraphic position of each contact. Using a spreadsheet to do your trigonometric calculations makes this step fairly painless, however.

Measuring sections using a jake staff: This technique works best if the section is well exposed and if you are working a slope where the beds dip away from you, back into the subsurface. The technique basically involves holding the jake staff, which is of known length, orthogonal to bedding and sighting along the top of the staff to a bedding plane upsection. By holding the jake

orthogonal to bedding and sighting along a bedding plane, the thickness of stratigraphy being covered by that particular "jaked interval" is equal to the length of the jake staff. The advantage of this technique is that you can directly measure the stratigraphic thickness of your section without having to later calculate it in the lab. The disadvantages of the jake technique are: 1) every jake measurement usually involves some error which compounds each time another jake measurement is made; 2) in areas of poor exposure, finding a bedding plane to sight on can be difficult if not impossible and 3) running the jake and making observations can get complicated and it's easy to lose one's place in the section. To get around this third problem, it's a good to first jake the section, fix duct tape with the interval thickness directly to the outcrop, then go back and key your observations to the intervals.

Many times, it is beneficial to measure the entire section at a given locality at a fairly coarse resolution, then measure several more detailed, higher resolution sections of particular sedimentologic interest.

Tasks to complete in this lab:

Part 1: Divide up into working groups consisting of no more than four people. Before your group begins to do any measuring, take 15 minutes or so to walk through the entire road cut as a group, getting a general sense of the nature of the deposit you will be measuring. Discuss your observations together, and begin to develop a strategy for measuring the section. Things to think about are your scale of resolution (you want it to be as high as possible while still having time enough to measure a reasonable amount of section), and the division of labor (who will make the observations, who will record data, etc.) As your group walks through the section, you will also want to begin to form some preliminary interpretations as to depositional environment.

Part 2: Go back to the beginning of the section, decide on the exact line of traverse, and mark the thickness intervals you will measure by affixing flagging tape to the section at an appropriate interval.

Part 3: Now go back and record your sedimentologic observations, keying them to the measured interval thicknesses. Make your observations as detailed as possible. You will want to include information about grain size, color, lithology, any sedimentary structures (cross bedding, ripple marks, etc.), any samples you collect. It is also very important to get some sense of the lateral continuity of beds and record that information. A 30 cm thick bed that pinches out over 10 m likely will have a very different interpretation than a 30 cm thick bed that is laterally continuous for 100's of m. Have someone in your team walk as many of the beds out laterally as possible, so your team can get some sense of the lateral continuity of the beds. You will want to correlate the beds in your section with the beds in the sections of adjacent teams later on, so be sure to have someone "walk out" the key beds in your section and tie them to the sections of your classmates. For example, if your team measures a prominent bed of sandstone, your team might arbitrarily call this "sandstone bed #1". One of your team will then walk this sandstone bed over to the adjacent team's section location and inform them of the bed's identification. The second team would note this ID in their strat section, so both teams could use this as a correlation "marker bed" to tie the two sections together.

Part 4 (back at UM): Draft up your completed section. I recommend you use a computer

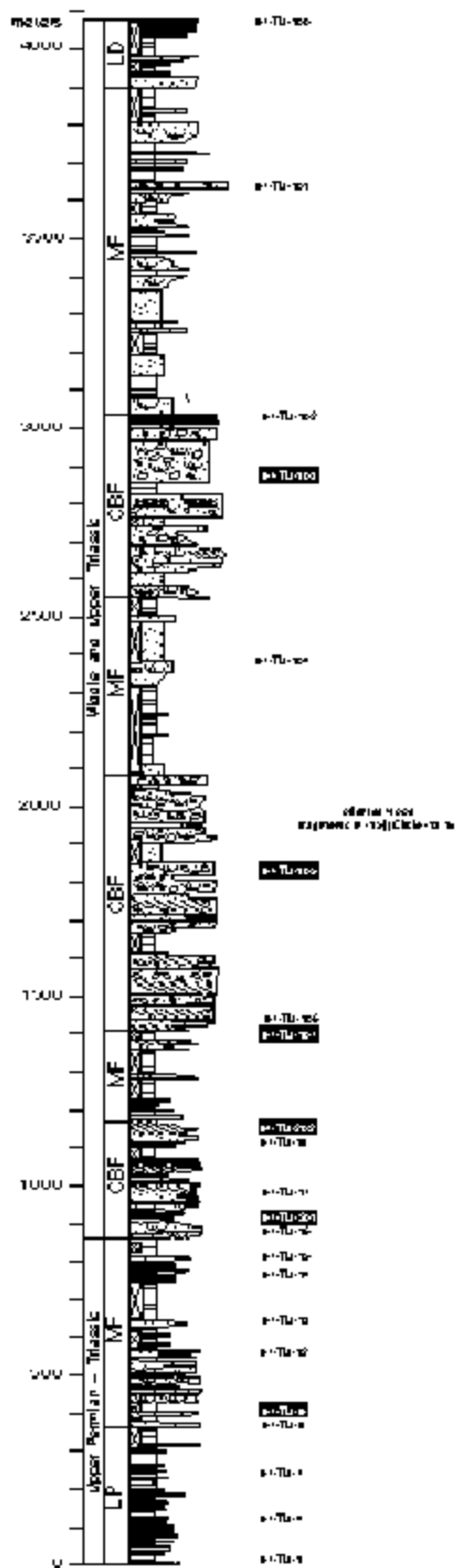
graphics program to draft your section, although you may do so by hand. Before doing your drafting, touch base with the other groups and decide on a common scale to which you will all draft your sections. A good scale to use might be 50 cm of stratigraphy to 1cm of drafted section. You want to be able to show as much detail in your final drafted section as possible, and increasing the scale is the best way to do this. Do not try to squeeze the section on to a single piece of paper, because the detail will probably be compromised. Your final drafted section will probably be something like 30-50 cm long.

Each group should **hand in the following at class time on Monday, September 21.**

- 1) Your group's completed stratigraphic section
- 2) a short (1-2 paragraph) description of your methods, from the beginning to end of the exercise
- 3) a short (1-2 paragraph) interpretation of the depositional environment(s) you infer for the stratigraphic section that you measured. Feel free to examine any relevant published literature that you can find and use that literature review to help you formulate a sense of environmental interpretation.

In order to provide you with some idea as to what a professional-looking measured sections and lithostratigraphic charts look like, I've attached a couple of examples from recent sedimentary geologic research conducted at UM.

Tost Uul Section, southern Mongolia



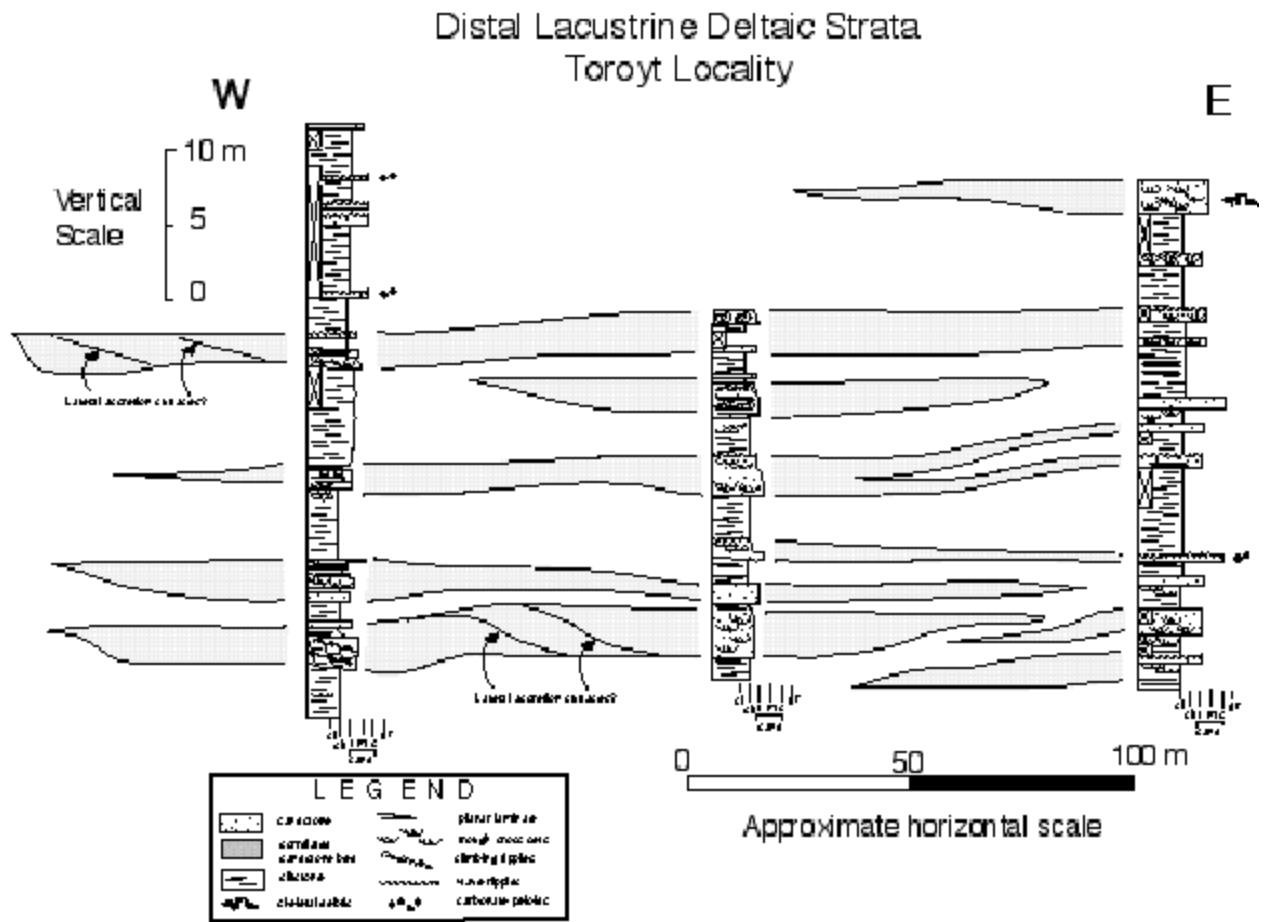
Example of a measured stratigraphic section

LEGEND

<ul style="list-style-type: none"> conglomerate sandstone siltstone mudstone 	<ul style="list-style-type: none"> meter-scale lamination cross-section (barfosses?) rough cross-section wave ripples 97-TU-220 sandstone sample 97-TU-300 conglomerate clast sample
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7A
7B

 approximate facies boundaries used to construct paleogeographic maps in figure 7



Hendrix et al., Figure 5