GEOLOGY 334: SEDIMENTOLOGY AND STRATIGRAPHY – FALL '12

LAB 8: STRATIGRAPHY

I. Introduction

The pattern of various sediment types and depositional environments in a sedimentary basin can reveal something about the conditions that existed when the basin was being filled with sediment. Lateral migration of depositional environments through time causes sediments representing laterally adjacent and contiguous environments (e.g. beach, shallow marine) to be deposited vertically on top of one another. This idea is known as *Walther's Law*. *Progradation* occurs when coarse-grained sediment expands into a sedimentary basin.

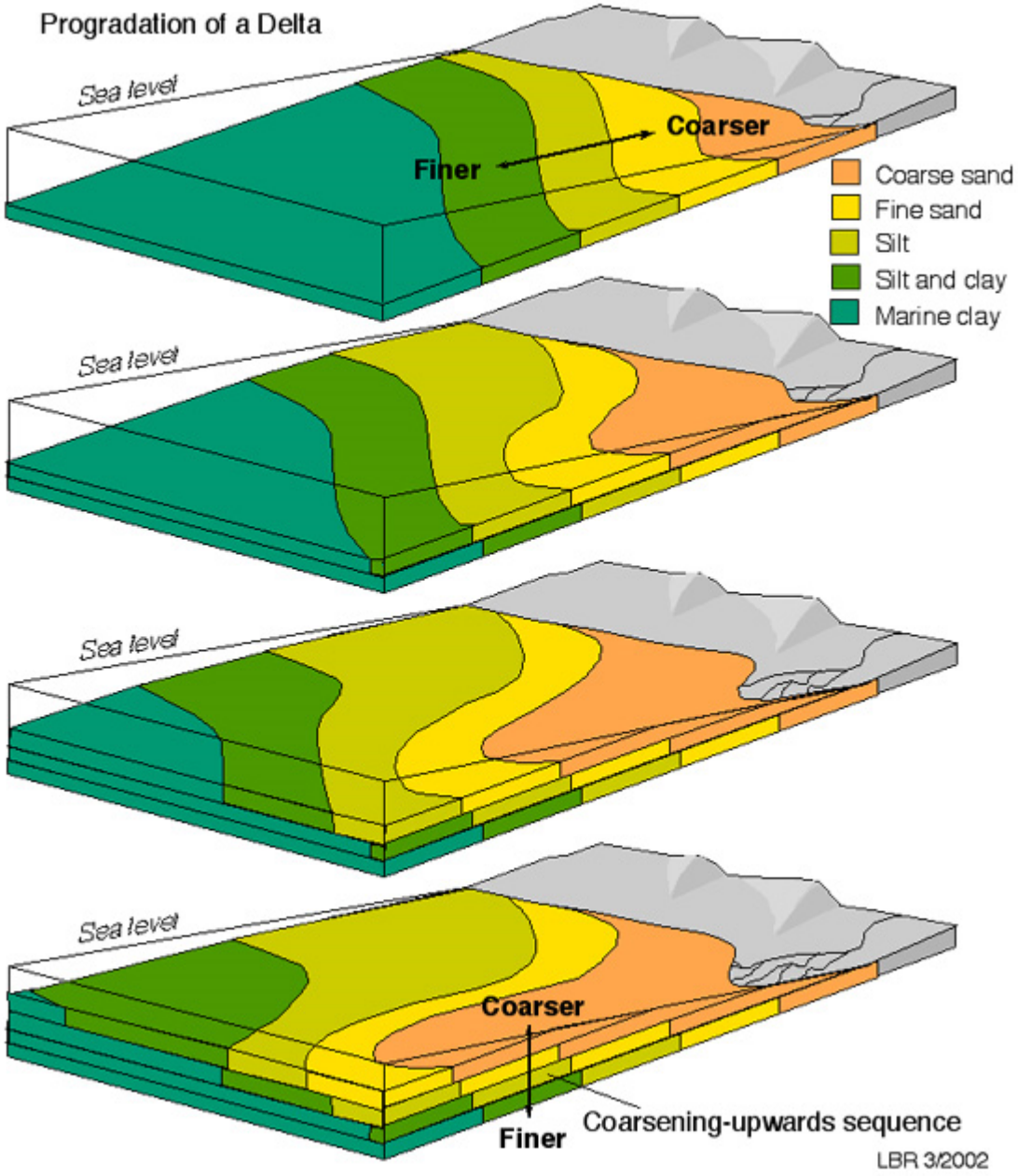


Fig.1

Figure 1 shows an example of a delta prograding into a sedimentary basin. As the delta grows, coarser-grained, more proximal sediments expand into the basin. At any one place, a vertical stratigraphic section will reveal an upward-coarsening pattern.

Retrogradation is the opposite of progradation. Retrogradation occurs where coarser-grained sediments retreat to the margins of the basin. The vertical pattern left behind by this process will be one of upward-fining.

Stratigraphic Sections

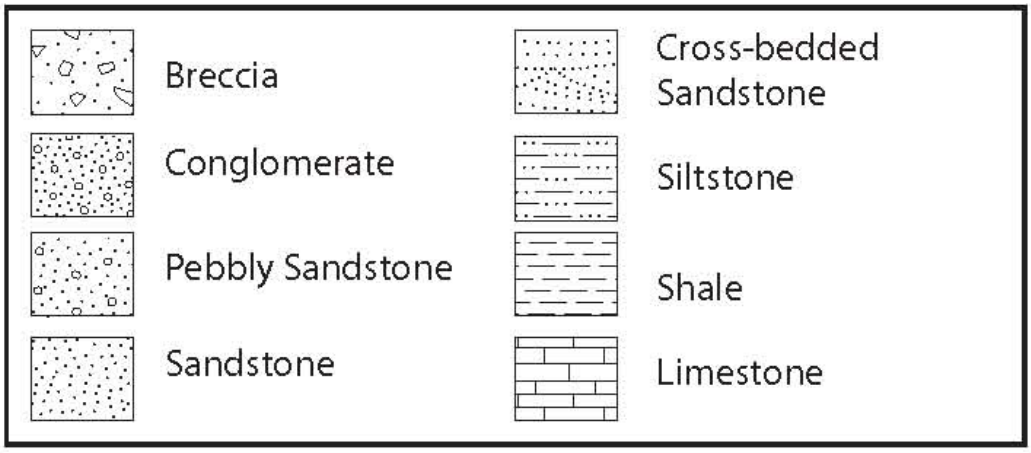
A stratigraphic column is a to-scale drawing by a geologist that describes the sedimentary rocks that are present in a stratigraphic succession. This allows other geologists, who have never seen these rocks in person, to understand the stratigraphy and geology of that area. You have seen these in class by now, and as you are aware there are a set of conventions, or rules, that stratigraphers use when they draft a measured section:

Here are a few guidelines that we typically use for drafting stratigraphic sections:

A) Stratigraphic thickness is plotted on the the Y-axis

B) Grain size is shown on the X-axis, with grain size increasing from left to right

C) Different sediment types are represented with different patterns. There are not strict rules for this, but the following examples are very common.



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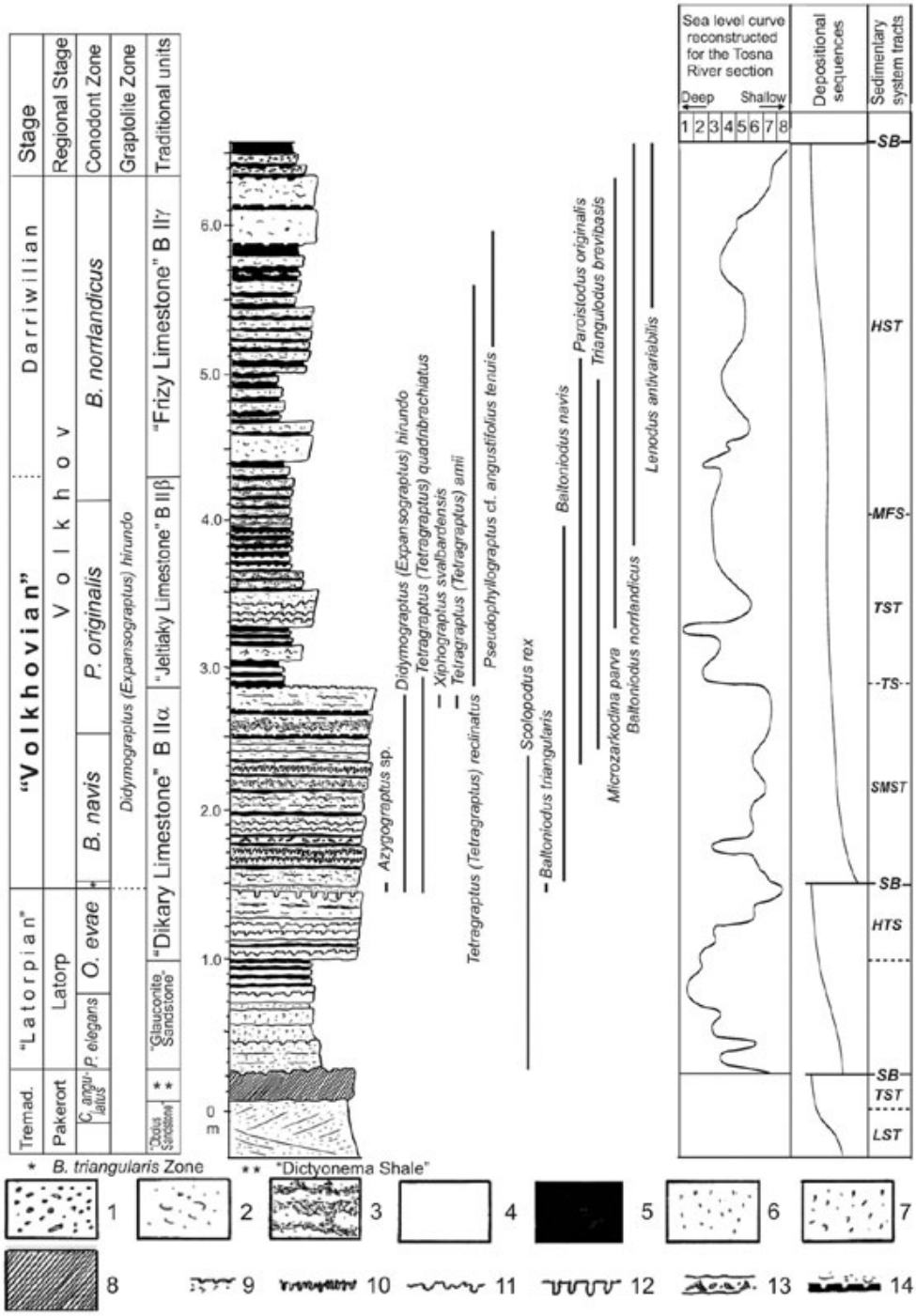
Stratigraphic columns can display a great deal of information in a small space, as the example below (by Dronov et al., 2003) demonstrates. This column represents a succession of Ordovician sedimentary deposits. Please note that the authors include an interpretation of relative local sea level as a curve to the right of the stratigraphic column.



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1. Virtual Stratigraphic Succession

Here we will pretend that you are measuring a stratigraphic section through sedimentary rocks on the Oregon coast. The section is **200 m thick.** Below you will be given rock descriptions, names, and thicknesses of units in the section. First you will interpret the depositional environments associated with each sample description, and then you will construct a stratigraphic column. When interpreting depositional environments, simply choose between these options: Fluvial, Shallow Marine, or Deep Marine for siliciclastic rocks, and Intertidal, Supratidal, Shallow Subtidal, or Deep Subtidal for carbonates. Unless told otherwise assume all contacts between units are gradational.

A) Rock Identification

0-30 Meters

Sample 4.3:
Textural rock name: *Fine grained, well sorted, laminated shale with marine fossils*

What is the depositional environment of this interval:

_____.

30-50 Meters

Sample 4.1
Textural rock name: *Medium grained, subangular, moderately sorted sandstone with marine fossils and hummocky cross-stratification*

What is the depositional environment of this sandstone (30-50 m)?

_____.

What was the likely change (rise or fall) in relative sea level from the lower (0-30 meters) to the upper part (30-50 meters) of this interval?

_____

50-80 Meters: Interbedding of lithofacies is represented by the following two samples

Sample 55-U-1:

- Two textural rock types are interbedded here: *Poorly sorted conglomerate, laminated siltstone, and mudstone with mud cracks and plant fossils*
- Some cross-bedding occurs in the finer-grained units

Sample CO-PL: *Coal*

What is a plausible depositional environment of this interval (50-80 m)?

_____

80-100 Meters

Sample 4.7

Rock description: *Sandy limestone with marine fossils and burrows*

What is the depositional environment of this stratigraphic interval?

_____

100-130 Meters

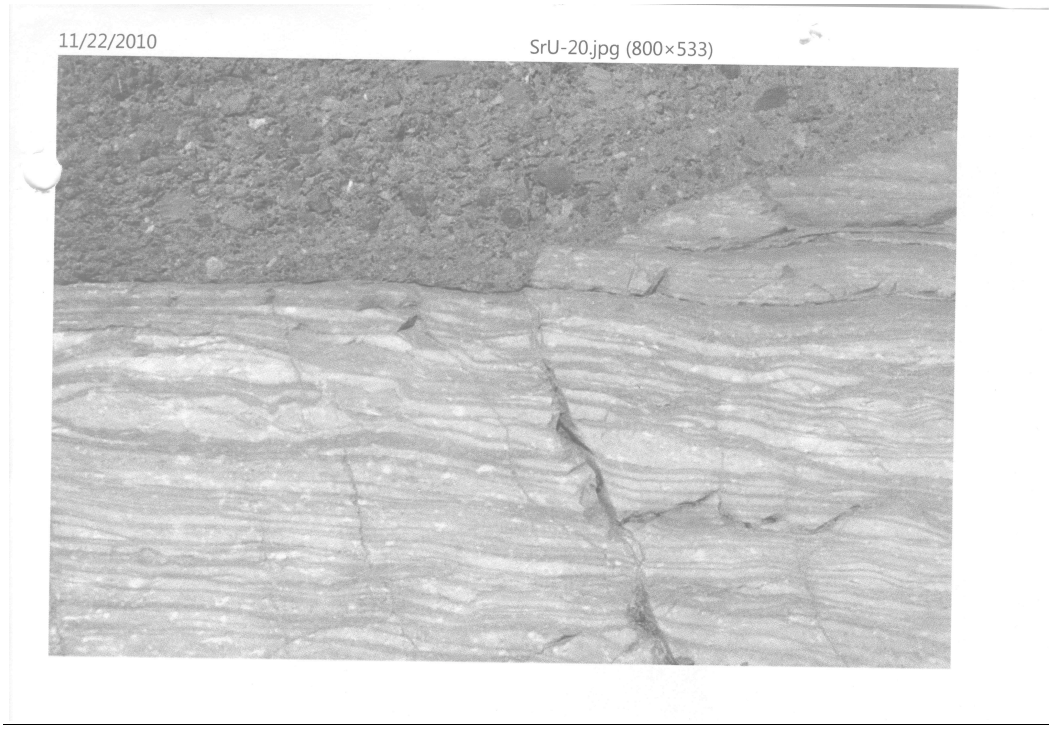
This part of the sedimentary section contains three different rock types:

(1) 100-110 meters
   (a) Sample B79GC
   Rock name: *Wackestone*
(2) 110-130 meters
   (b) Sample 14
   Rock name: *Skeletal Packstone*
   (c) Sample SSU5
   Rock name: *Oolitic Packstone*

What do you think was happening to relative sea level between deposition of the lower and upper parts of this stratigraphic interval?

_____

At 130 meters in the section we observe this contact:



What is the nature of this contact? (erosional, gradational etc.):_____.

130-150 Meters

Sample 2

Rock description: *Poorly sorted sandy pebble conglomerate with interbeds of siltstones containing root casts and paleosols.*

Is this conglomerate texturally mature or immature and why?

_____

What is the depositional environment of this stratigraphic interval?

_____

150-170 Meters

Eugene Formation

Rock Name: *Fine-grained, well sorted, siltstone with shallow marine fossils*

What is the depositional environment of this stratigraphic interval?

170-200 Meters

Sample 16

Rock name: *Laminated shale with burrows and shark teeth!*

What is the depositional environment of this stratigraphic interval?

B) Stratigraphic Column

Now that you have the raw data, you can generate a stratigraphic column. Use the provided sheet to draft the column. *Neatness and legibility are important*. Use the conventional sedimentary fill patterns given above on page 2. You may invent your own symbols to represent fossils and other sedimentary structures and features if you want, but if you do so please be sure to include a small legend explaining the symbols. For each stratigraphic interval, please label the depositional environment in the space provided.

C) Relative Sea Level Curve

Now you are ready to interpret the changes in relative sea level that this area underwent during deposition of the sediments. Draw a schematic curve in the space provided on the right. Some changes in relative sea level are gradual, while others are quite abrupt.
Note: It is important to note that we are talking about changes in *relative* sea level. The changes in lithology we observe require deposition in different water depths. However, the cause of this change in depth is not always discernable from the sediments alone. Recall that changes in relative sea level can be caused by changes in global (eustatic) sea level, tectonic uplift or subsidence, or a combination of the two. This is why we call it *relative*, instead of *absolute* sea level in our interpretation.

D) Analysis

Provide a short write-up describing the measured section and your interpretation of relative sea level. How did relative sea level change through time? What types of deposits formed in which water depths? Were changes in water depth abrupt or were they gradual (or both)? If changes were abrupt, where in the measured section do the abrupt changes occur, and what is the stratigraphic signal (result) observed in the measured section?

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