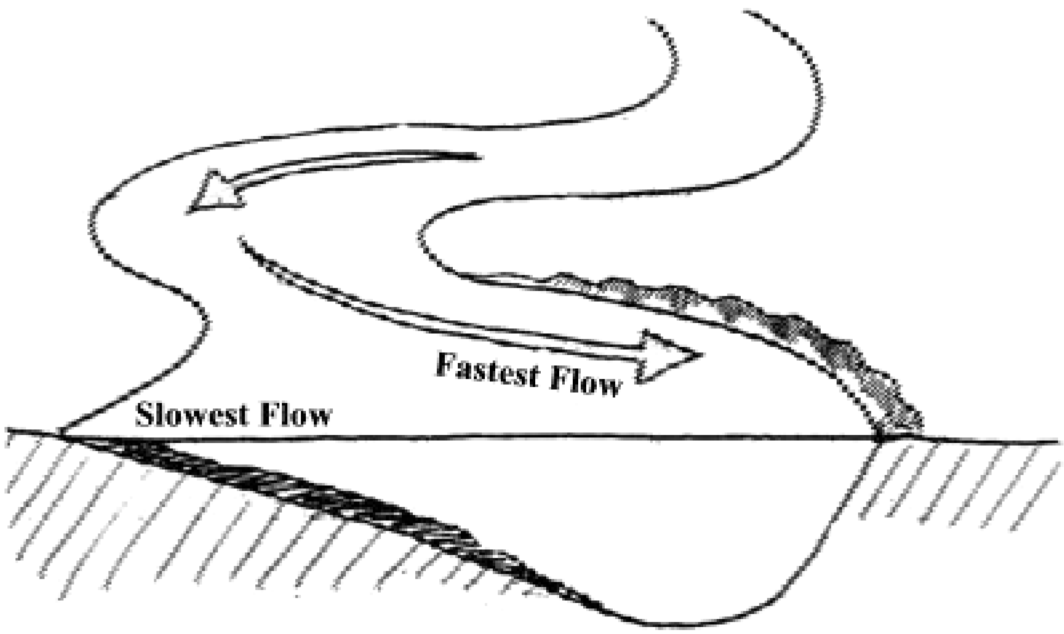
EART120 - Sedimentary structures and facies Name: ____________________

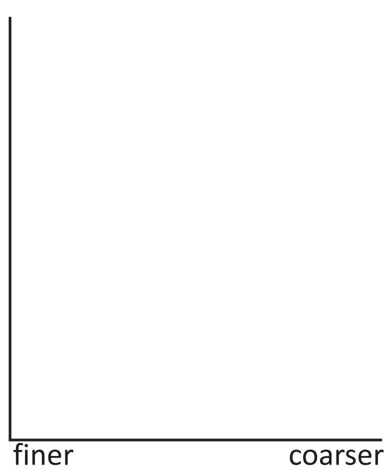
Today's exercise builds upon your knowledge of fluvial environments and of the relationships between water flow velocity, grain size, bedforms, and sedimentary structures. This is also the first introduction to sedimentary facies (which will be discussed in more detail for next class). The goals are to give you practice predicting grain size and sedimentary structures from current velocity, and interpreting depositional environments from grain size and sedimentary structures.

Part 1: Meandering river point bar

Given the sketch below and the distribution of current velocity, indicate the predicted distribution of bedforms (ripples, dunes, etc.) on the river bed. Distinguish between 2-D and 3-D dunes. Note that rivers almost never have sufficient current velocity to generate antidunes.



Given the lateral distribution of bedforms on the river bed, and the typical migration of a meandering river channel and its point bar, draw a stratigraphic column with the expected vertical succession of sedimentary structures. Also draw a line to indicate the relative grain size profile. Look at page 2 for an example of what such a stratigraphic column will look like.



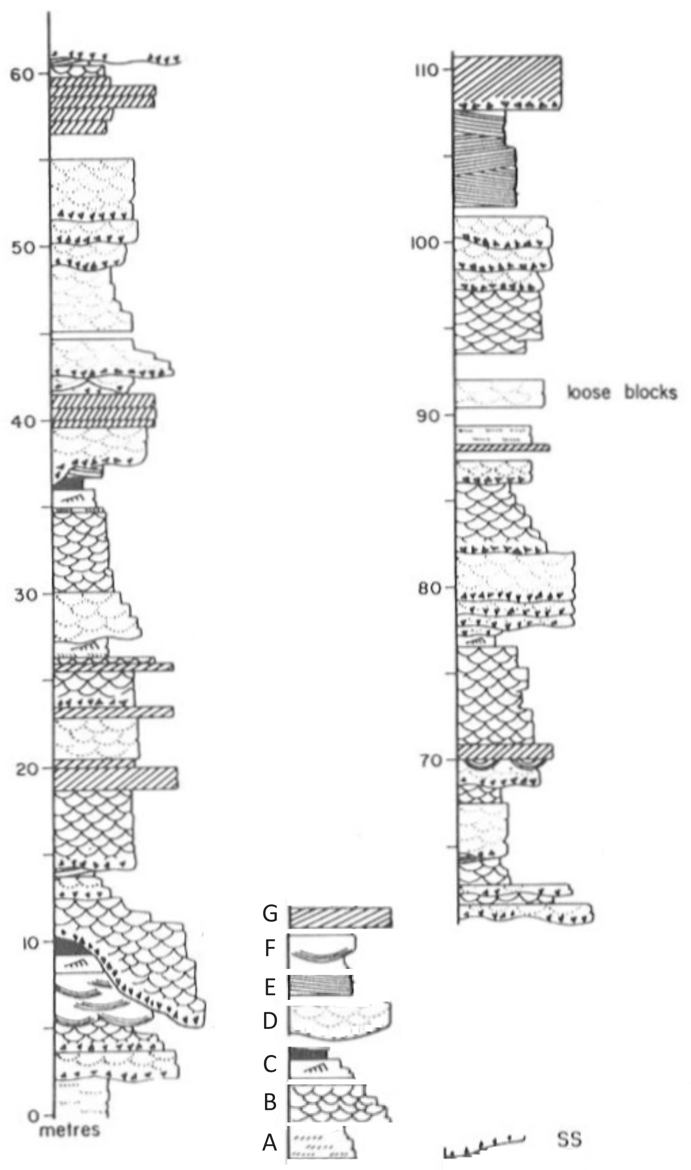
Battery Point Facies Model Exercise

The stratigraphic column shown below is 110 m of the Lower Devonian Battery Point Sandstone measured by Cant & Walker (1976). They recognized 7 facies in the section (Facies A-G); the description of each facies is given below. Your job is to construct a facies model for this section.

First, using what you have learned about sedimentary processes, interpret the type of bedforms that would have produced each facies and try to determine the nature of water flow during deposition of each.

Second, identify any important erosional surfaces (where Walther's law would not apply) and determine the characteristic or idealized succession of facies. Not all cycles will have this idealized succession and it may never be completely developed at all!

Finally, try to put together your idealized succession with the environments in each facies to reconstruct the depositional setting.



1. How would you interpret each facies?

Facies A

Bedform(s):

Water energy/river feature:

Facies B

Bedform(s):

Water energy/river feature:

Facies C

Bedform(s):

Water energy/river feature:

Facies D

Bedform(s):

Water energy/river feature:

Facies E

Bedform(s):

Water energy/river feature:

Facies F

Bedform(s):

Water energy/river feature:

Facies G

Bedform(s):

Water energy/river feature:

2. What do you think the idealized facies succession is?

SS __ __ __ __ __ __ __

3. Combine your idealized facies succession with the environment represented by each facies to reconstruct changing environmental conditions during deposition. What type of river (braided or meandering) do you think this is? Why?

Facies Descriptions

Scoured Surfaces (SS): erosion surfaces overlain by layers of massive, coarse sandstone with abundant mudstone clasts. The maximum depth of erosion observed was about 5 m. Overlying the erosion surface, the mixture of mudstone clasts and coarse massive sandstone reaches a maximum thickness of about 25 cm. Not a facies.

Small Scale Planar-Tabular Cross-Bedded Facies (A): small scale, planar-tabular sets of cross-bedding, with individual sets ranging in thickness from 12 to 30 cm. Paleocurrent directions fairly constant, maximum range of about 20°. Cross-bedding within sets normally sharply angular without reactivation surfaces; inclined strata shown up by thin, darker, slightly finer layers. Sets composed of well sorted, fine to medium sand, with mean sizes ranging from about 0.25-0.5 mm in different cosets. As individual sets become thicker, there is a transition into facies G.

Well Defined Trough Cross-Bedded Facies (B): well defined sets of trough cross bedding, with trough depths averaging 15 to 20 cm (range 10 to 45 cm). Trough widths vary from 30 cm to 1.5 m. Sets composed of well sorted medium sand; well defined cross strata are shown up by fine, darker colored layers. Also, many individual cross strata graded, further emphasizing the layering. The mean grain size about 0.4 mm (medium sand). A few of the coarser sets have granules and pebbles concentrated at their bases. Gradational with Facies D.

Cross-Laminated Sandstone and Mudstone Facies (C): cross-laminated sandstones, and alternating cross-laminated sandstones and mudstones. Cross-laminated sandstones without mudstones consist of tabular sets of cross-lamination or trough cross-lamination with abundant organic material. One example of the interbedded fine sandstones / mudstones consists of coarsening-upward sequences, which grade from basal mudstones into trough cross-laminated fine sandstone and granule sandstone. The other consists of > 5 sandstone-to-mudstone fining-upward sequences. Sandstones have sharp bases, commonly contain climbing ripples with eroded stoss sides.

Poorly Defined Trough Cross-Bedded Facies (D): poorly defined sets of trough cross bedding, with trough depths averaging about 30 cm (range 15 to 60 cm). Internal strata poorly defined because of poor sorting and lack of fine material necessary to show up the cross strata. Pebbles up to 5 cm in diameter scattered through the troughs, rather than concentrated at their bases, or else form discontinuous inclined strata, which rarely persist through the total thickness of the set. Mudstone intraclasts up to 5 cm diameter occur at the bases of some troughs, rendering the internal organization of the troughs even poorer. The mean grain size of the sand about 0.75 mm (coarse).

Low Angle Stratified Sandstone Facies (E): low angle (< 10°) stratified sandstones ranging in thickness from 30 to 90 cm. The sweeping slightly curved layers are very continuous laterally, and in almost all cases have an original dip of less than 10°, flattening to horizontal at the base of each set. Individual layers are about 1 cm thick, and are well defined by alternating finer layers. In places, the top surfaces of the layers show a well developed parting lineation, which is parallel to the depositional strike of the inclined layers. The grain size is fine sand, with mean grain sizes in the range 0.10 to 0.25 mm.

Asymmetrical Scour Facies (F): large, asymmetrical scours and scour fillings, up to 45 cm deep and 3 m wide. Layers not at the angle of repose, but are parallel to the lower bounding surface. The layers show up by darker, finer partings, and within some scours there are minor erosion surfaces and 2-3 cm sets of cross-lamination. In some places where the layers can be seen in plan view, a moderately well developed parting lineation is oriented parallel to the inferred axes of spoon-shaped scours. Most are filled with well sorted sand (mean diameters range from 0.25 to 0.75 mm), but some have pebbly sand fills.

Large Scale, Planar-Tabular Cross-Bedded Facies (G): planar-tabular sets average about 60 cm in thickness (range 30 cm to 3 m). The inclined foresets shown either by thin partings of finer sand, or because of normal grading from bottom to top of individual inclined layers. Grain size generally in the coarse sand range (avg 0.75 mm, range 0.5 to 1.0 mm), and in the rare sets where pebbles are present, they are scattered within the set rather than being concentrated at the base.