GEOLOGY 12: STREAM PROCESSES

stream - body of flowing water confined to a channel (e.g. rivers, babbling brooks, etc.)
- small streams that feed into larger ones (rivers) are called **tributaries**

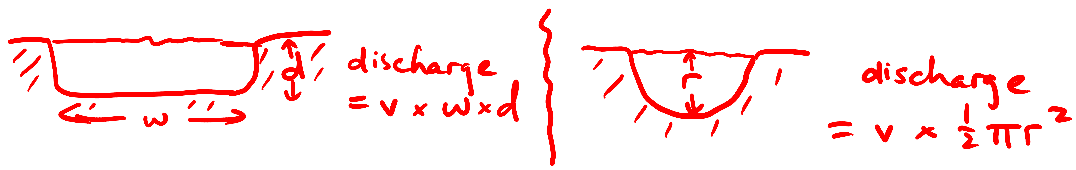
The sediment that forms sedimentary rock can be transported by streams; the amount and size of particles (clasts) carried depends on the speed of stream flow, which in turn depends on:

→ ***gradient*** – the slope of the terrain; in alpine regions, streams flow quickly and can pick up sediments, but will slow down and drop sediments as the terrain flattens out

→ ***discharge*** – the volume of water flowing past a point in a given time; discharge is calculated by

x-section **Discharge = $\overbrace{\text{average velocity}}^{v}$ x cross-section area**

e.g.:



– note that as discharge increases, so does stream velocity

→ ***channel characteristics*** – the shape and roughness of the stream bed; for example, a small stream has more contact with its **bed** (floor) and **banks**, causing more friction which slows down the stream and allows erosion to occur

A stream's ***capacity*** refers to the maximum amount of sediments that the stream can carry; the total amount carried at any one time (which may not be at capacity) is called a stream's ***load***, of which there are three types:

→ ***bed*** load – largest debris carried, usually small boulders or large pebbles
– typically this material is only carried during spring (melt) or winter (heavy rains)

→ ***suspended*** load – lighter material like sand and pebbles which can be carried by water, so long as the velocity is high enough.
– for the larger intermediate particles, ***saltation*** often occurs:

x-section

FIG. 1

→ ***dissolved*** load – mineral particles dissolved as ions are carried by water, regardless of speed (e.g. the salt dissolved in the ocean)
– generally, 20-50% of the sediment load of a stream is dissolved

A stream (and moving water in general) tends to round off the transported rock fragments because of collisions with other fragments, rolling, saltation, which break off sharp edges. As well, larger clasts tend to be more well-rounded than smaller clasts (such as silt and sand), as the rolling and bouncing along a stream bed leads to more solid collisions.

EROSIONAL FEATURES: (note that moving water is the main agent of surface erosion on Earth)

→ **downcutting**: the process of a stream eroding into its bed

– factors that cause this: 1. discharge (speed + volume)

2. load

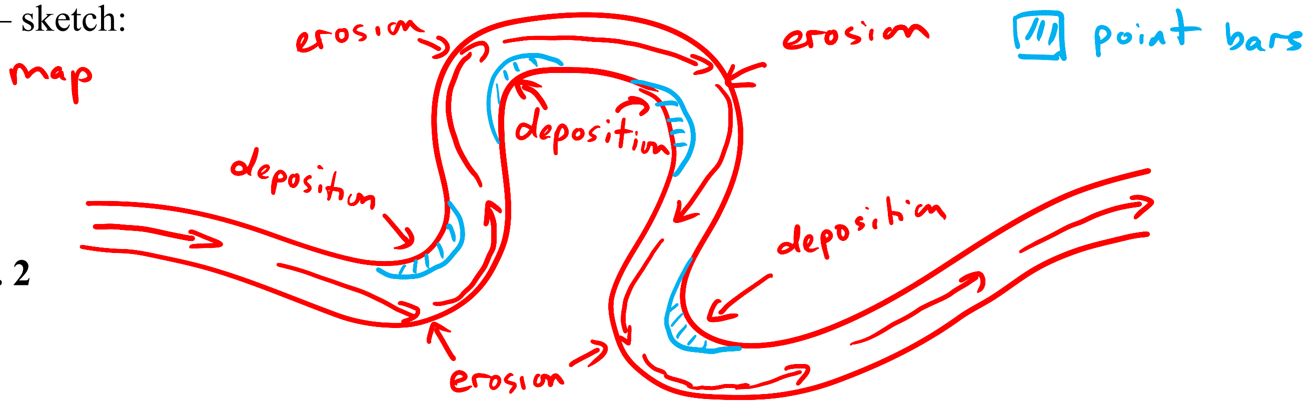
3. "hardness" of the bed

– if downcutting is rapid, **V-shaped** valleys form (common in alpine regions)

– if downcutting is slow, **meandering** results, due to lateral displacements; this will typically cause a widening of the valley over time, with variations in flow velocity causing variations in erosion and deposition

– sketch:

FIG. 2



– erosion is greatest on the outside bends (meanders), where the stream velocity is high

– deposition is greatest on the inside meanders, where stream velocity is slow

→ **terraces**: formed when rivers cut into its own **floodplain** to form a new, lower floodplain

– caused by faster downcutting due to increased velocity, which may in turn be due to (earthquake), sudden tilting changes (landslides)

→ **incised meanders**: a stream entrenched within deep, winding steep-sided valleys

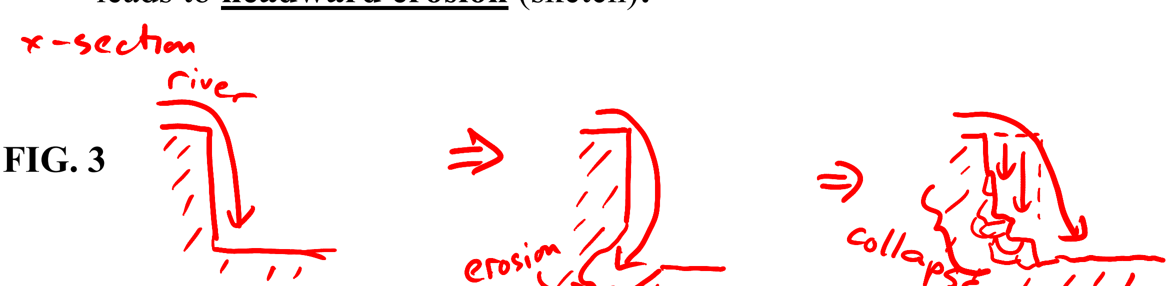
– possibly caused by damming of a river, causing capacity downstream to increase and erosion to occur

→ **knickpoints**: steep drops in channel bed elevation (waterfalls)

– possible causes: terrain, normal/reverse fault movement, flow from a "hard" bed to a "soft" bed

– leads to **headward erosion** (sketch):

FIG. 3



DEPOSITIONAL FEATURES:

A stream's deposits tend to be "sorted" according to size and density (i.e. materials dropped off at a particular location tend to be similar in size and weight). This is due to the fact that a stream's __speed__ controls the maximum size that can be carried. This means that where stream velocity is greatest, __pebbles__ will be seen; at slower locations, __sand__ will be left behind; and where the stream is nearly or completely stopped (such as at a __lake__ or __ocean__), fine sediment such as __silt__ and __clay/mud__ can be found.

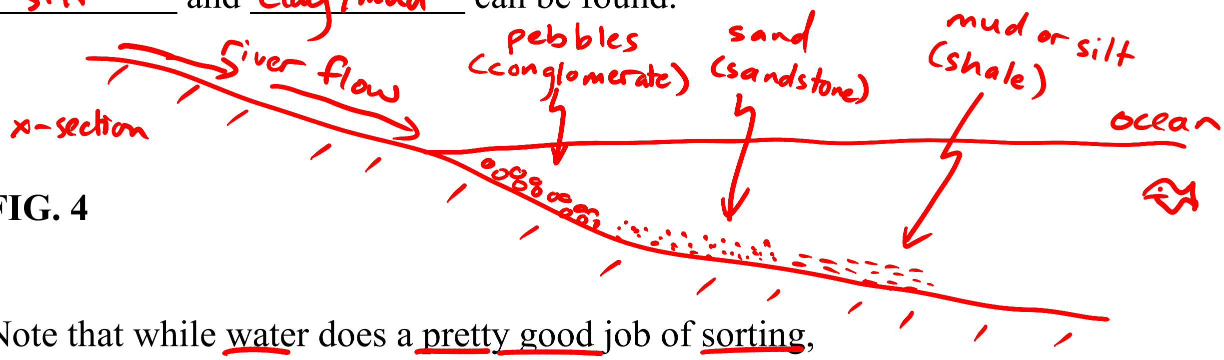


FIG. 4

Note that while water does a pretty good job of sorting,

1) wind deposits are much better sorted, as the material carried is typically sand-grained or smaller, so are uniform in size;

2) glacial deposits are __poorly__ sorted, since material carried by ice will tend to __be dropped off in one place__ when the ice melts.

→ **meanders**: curves in a stream (see above) which move laterally with time

→ **oxbow lakes**: horseshoe lakes formed when a meander in a stream is cut off
– caused by __Continuous erosion on the outside curves of a meander until the stream breaks through to "straigten" its path.__

→ **floodplains**: wide, flat plain that a meandering stream sits upon
– caused by __heavy rainfall or snowmelt causing a stream to overflow its banks and deposit/spread out sediments__
– width varies, depending on __stream size, the amount of meandering, amount of flooding__

→ **point bars**: formed on the inside curve of meanders; label in your **FIGURE 2** sketch

→ **braided stream**: islands formed in a stream where flow is restricted and sediments are dumped; vegetation stabilizes the islands

→ **overbank deposits**: caused by flooding within a floodplain

→ **levees**: ridges of overbank deposits along a channel's edge; material is coarse and heavy
– caused by __rivers overflowing their banks and depositing a ridge of sediments beside the main channel__

→ **alluvial fan**: deposits formed where a fast-moving stream slows down
– examples: __from steep (alpine) to flat (plains)__

→ **delta**: similar to an alluvial fan, but specifically formed where __streams flow into an ocean or lake__