

River Systems II

Erosion and Transportation

1. Erosion

- a. Removal and transport of rock, sediment, soil
- b. Running water is the major cause of erosion
- c. Source of Materials in a stream
 - i. Mass Wasting
 - ii. Lateral erosion of banks
 - iii. Downward erosion of stream channel
 - iv. Headward erosion
 - v. Sheetflow
 - vi. Chemical Weathering

2. Stream Dynamics – Sediment Load

a. Bed Load

- i. Particles too large to be lifted into suspension
- ii. Sediment moves along stream bed
- iii. Particles move by sliding, rolling, or saltating (short leaps)
- iv. Accounts for 10 to 25% of sediment load
- v. Agent of downward erosion

b. Sediment Load – Suspended Load

- i. Light sediment lifted above stream bed by current
- ii. Mostly silts and clays
- iii. Accounts for most of stream load ($\geq 60\%$)

c. Sediment Load – Dissolved Load

- i. Chemical ions produced from chemical weathering of minerals
- ii. Ca^{2+} , Cl^- , Mg^{2+} , SO_4^{2-} , Na^+ , K^+ , HCO_3^- , etc.
- iii. Acquired from groundwater, sheetflow, or dissolving rock along a stream's course.

iv. Generally $\approx 10\%$, but can be up to 50% of sediment load.

3. Effects of Transport on Particles

a. Rounding

- i. caused by abrasion
- ii. Increases with distance particle is transported

b. Sorting

- i. Varies with the competence of the stream
- ii. As competence decreases large particles are deposited

4. Controls of Sediment Load

a. Capacity

- i. The amount (weight) of sediment a stream can carry
- ii. It is a function of discharge (velocity)
- iii. $\text{Velocity} \propto (\text{proportional to}) \text{Capacity}^{3 \text{ to } 4}$
- iv. Example, if velocity doubles (2) – capacity increases between $8 \sqrt[3]{2}$ to $16 \sqrt[4]{2}$ times

b. Competence

- i. The maximum particle size a stream can transport

- ii. Function of velocity and fluid density
 - iii. Velocity \propto (proportional to) Competence²
 - iv. Example, if velocity doubles (2) – competence increases 4 (2²) times
 - v. As stream density increases with more suspended and dissolved sediment, competence increases
5. Velocity's role in Erosion
- a. Threshold Velocity – minimum velocity required to move grains of a certain size
6. Deposition of Material
- a. Occurs when streams lose velocity (competence decreases)
 - b. Velocity decreases due to
 - c. Lower gradients
 - d. Flow into still or slow moving waters (reservoirs, lakes, etc.)
 - e. Changes in channel shape (widening or narrowing)
7. Effects of Changes in Base Level
- a. Changes in base level change the energy of the system, which changes the velocity of the water.
 - b. What would happen if base level was increased, say with a dam?
8. Meanders - Cut Banks & Point Bars
- a) Meander – curve in a stream designed to decrease the gradient and increase the volume of water a stream can carry
 - b) Develop within the flood plain
 - c) Cut Bank – outside edge of a meander where erosion (cutting) occurs, area of high velocity
 - d) Point Bar – inside edge of meander where deposition occurs, area of low velocity
 - e) Meander Development
 - i) Meander loops migrate laterally and downstream
 - ii) As meanders migrate and streams continues to erode and deposit sediment, a meander can be cutoff creating an oxbow lake.
 - iii) What would happen to the streams gradient?