

WEATHERING, EROSION, and DEPOSITION REVIEW

Weathering: The breaking up of rock from large particles to smaller particles.

- a) This Increases surface area of the rock which speeds the rate of chemical weathering.
- b) Rock weather on the surface of the earth only. Rocks underground or under-water do not weather.

1) There are 2 basic kinds of weathering:

a) **Chemical weathering**

- 1) Changes kind of material (ex. iron into iron oxide - rust)
- 2) Surface phenomenon - reactions occur on the surface of rocks, not inside them (usually).
- 3) Like most chemical reactions, water is required.
- 4) Hotter = faster
- 5) Fastest chemical weathering occurs in warm/moist climates
 - a) **oxidation** (ex. iron combines with oxygen to form rust)
 - b) **hydration** - minerals in rocks combine with water.
 - c) **carbonation** - rocks, especially limestone react with carbonic acid.
- 6) Depends on KIND of rock. Some rocks (limestone) are chemically reactive. Other rocks (quartz) tend not to react with chemicals.

b) **Physical weathering** (aka **Mechanical weathering**).

- 1) **Frost action**: Water gets into cracks - freezes - expands - enlarges the crack. Requires alternating freeze-thaw cycles.
- 2) **Wave action**: Waves pounding against rocks - sand and rocks in the waves help to break up the shoreline.
- 3) **Stream abrasion** - The rounding and smoothing of rocks as they tumble in a stream. These rocks are the '**cutting tools**' of the stream which '**downcut**' the stream's V-shaped channel as they roll along.
- 4) **Wind abrasion** - Important in dry climates. The wind picks up sand and blows it against rocks causing '**pitting**' (sandblasted appearance).
- 5) The rate of physical weathering depends on the **resistance (hardness)** of the rock and on the kind of climate.

Weathering is of vital importance in the formation of soils. If rocks didn't weather there would be no minerals, needed by plants and animals, in soils.

2) **Erosion (Leveling) - transport of sediments from one place to another.**

A) **Gravity is FORCE** driving all erosion

1) Rocks found at the base of a cliff got there by gravity only.

B) **Agents** of erosion:

1) **Running water** is the dominant (most important) agent of erosion in most places on Earth.

a) How does running water transport particles?

1) in **suspension**

2) by **floatation**

3) **rolling** along the bottom (**saltation**)

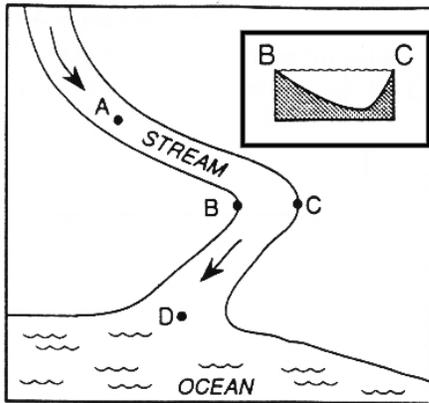
4) in **solution**

> Key concepts of water erosion.:

1) **V-shaped stream channels** are a sign of water erosion.

2) **The rate of stream erosion depends on**

the velocity (speed) of the stream.



The velocity of the stream depends on:

> **slope (steep = fast)**

> stream volume (**aka discharge**):

More volume = faster

> shape/size of channel

a) **Fastest** stream flow occurs on the **outside of a curve** (erosion) 'C' in diagram.

b) Fastest stream flow occurs at a point **farthest away from the bottom and the sides** where drag occurs. This means that the rate of flow is greatest in the center near the surface.

> Flow is fast if the **channel is narrow.**

The rate slows if the channel

widens or if the stream enters a lake or the ocean: 'D' in diagram.

Note: The inset in the diagram shows a cross-section of the stream at location B-C.

It is deeper at location C because C is the outside of the curve where water velocity and erosion are greater.

3) Particles transported by a stream **become rounded, smoothed and polished.**

4) **Vertical & horizontal sorting** of materials are the hallmarks of stream deposition.

5) The **size** of particles that can be carried by a stream **depends on** the stream's **velocity**. See graph on page 6 of the reference tables.

6) In **warm/moist climates** where water is the predominant agent of erosion the landscape features are all **rounded** (ex. the Catskill mountains).

2) Erosion by ice (glaciers)

A) Varieties:

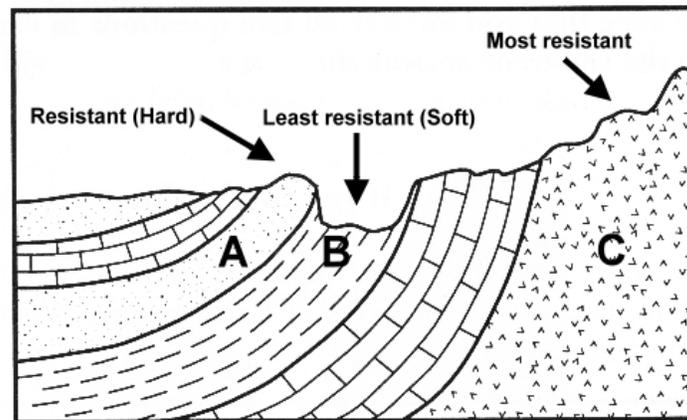
- a) Valley (small, local - between mountains)
- b) Continental (global ice sheets such as those covering Antarctica today)

B) Evidence of glacial action:

- a) parallel grooves cut into rocks
- b) U-shaped valleys
- c) scratched & polished rock.
- d) erotics - large boulders that are unrelated to the bedrock beneath them.
- e) deep parallel lakes (ex. The Finger Lakes of NY)
- f) unsorted sediments (large and small particles all mixed together).

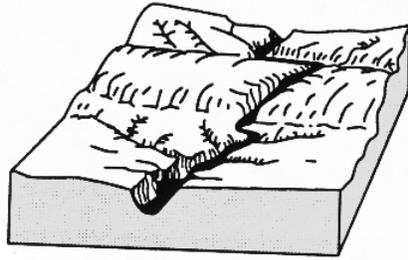
3) Wind erosion - not really significant except in dry climates.

- 1) Pitted rocks (sandblasting)
- 2) Only small particles can be carried by wind.
- 3) Sharp, angular, landscape features (Mesas) such as those found in the American southwest.

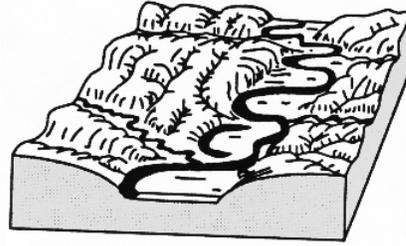


The amount of erosion in a region will also depend on the characteristics of the bedrock in the area. In the diagram above, layer A protrudes because it has been eroded least. This is because it is hard, resistant rock. Layer B, a soft rock, has experienced the greatest amount of erosion. Layer C is the hardest, most resistant rock and has been eroded least.

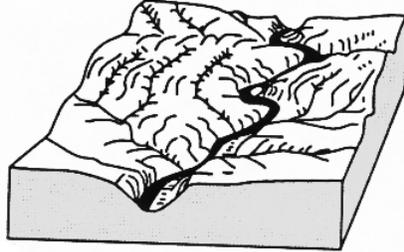
NOTE: Even though the same forces have been at work on this entire region, the surface is unevenly eroded because of the different types of rock that are exposed.



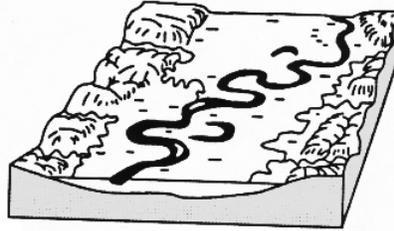
(1) Youngest stream - steep slope - few tributary streams



(3) Older still - Wider valley. Stream is beginning to meander

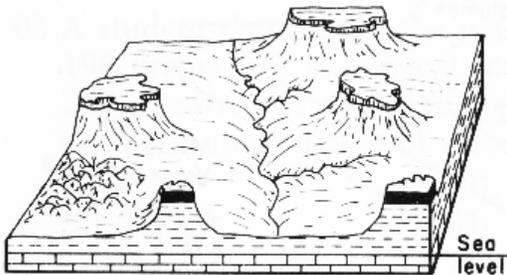


(2) Older - Deeper valley and more tributaries

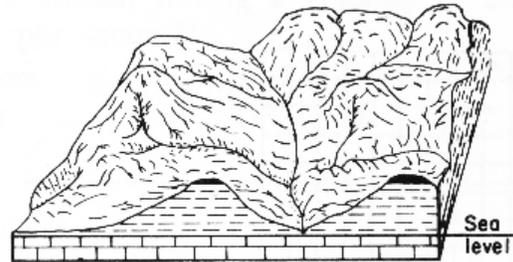


(4) Stream in old age. Wide, heavily eroded valley. Nearly flat slope. Very low velocity. Many meanders.

Effects of Climate on Landscape Development



Landscape in ARID climate. Note the flat features (mesas) and few streams.



Same landscape in more humid climate. Note more rounded features and more tributaries feeding the main stream.

DEPOSITION:

A) Energy in an erosional - depositional system.

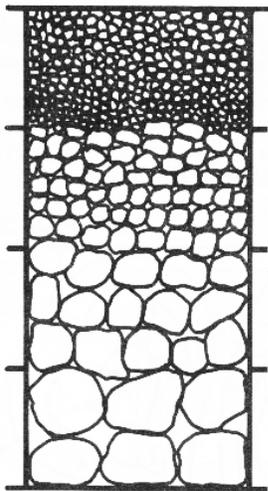
Remember - *Ke is the energy of motion*

Pe is the energy of position (higher up = more Pe)

Earth materials that are at high elevations have high Pe but no Ke (since they are not moving. Erosion increases the Ke by moving them, but decreases the Pe because things are always moving downhill due to gravity. Finally, when material is deposited at a lower elevation it has no Ke and has lost Pe.

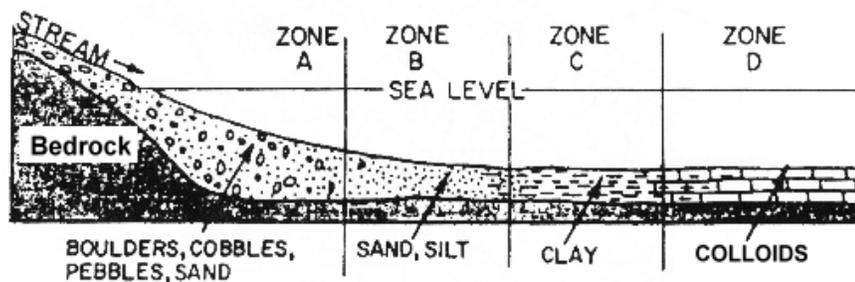
B) By water: always causes sorting (Horizontal or Vertical)

- 1 (SETTLING RATE of particles)
 - a) **By size** - biggest on bottom, smallest on top
 - b) **By density** - most dense on bottom, least dense on top
 - c) **By shape** - most round on bottom, most flat on top
- 2) Greatest **deposition is on the inside curves** where water slows.
- 3) **Colloids** are the smallest particles and take longest to settle.
- 4) Materials in **solution (salt) NEVER settle** out but can precipitate if the water evaporates (**precipitation**).



Vertical Sorting

Horizontal Sorting



C) **By glaciers:**

- 1) Always leave **unsorted/unconsolidated sediments**.
- 2) **Erratics** - large boulders unrelated to the bedrock beneath.

D) Long Island is entirely a feature of glacial deposition.

4) Additional material:

Q: If erosion is a constant process, why hasn't the earth been worn flat?

A: Because erosion is opposed by the **forces of uplift**. In any area **one force is usually dominant over the other**. If the forces of erosion (leveling) and uplift were equal, then the elevation would remain constant.

In NYS, erosion is dominant over uplift. Landscape elevations are decreasing.

If erosion (leveling) is dominant, then elevation decreases.

If uplift is dominant, then elevation increases.

If the 2 forces were in dynamic equilibrium, then the elevation would remain unchanged.

SOILS:

A) **Residual soils**: Formed from the bedrock immediately beneath them and have chemical properties similar to the bedrock.

1) **These are rare** because erosion usually transports weathered particles far from their original location.

B) **Transported soils**: Rock particles formed in one location and transported to another

1) These are **most common**.

2) All the soil in NYS is transported from somewhere else. Most soil was removed during the last ice age.

C) **Soil consists of weathered rock particles and organic material from plants and animals**. The faster rocks weather and the more plants grow, the thicker the soil becomes.