

Mechanical Weathering = no change in rock composition
Big Rocks -----> Little rocks -----> Sediment-----> Soil

Chapter 12: Weathering, Soil, and Mass Wasting

I. Weathering

A. Weathering is the breaking down of rock into smaller pieces or different substances.

1. Mechanical Weathering is the breaking down of rock into smaller pieces. When rocks are mechanically weathered there is no change in the chemical composition of the rock.

pg 258 a. Ice Wedging - Water expands by 10% when it freezes. Ice wedging occurs when water flows into cracks in rock, freezes, expands, and breaks the rock.

b. Gravity - gravity causes the rock to break under its own weight.

pg 260 c. Exfoliation - Rocks break off along weak layers. Occurs after overburden pressure is released.

2. Chemical Weathering is the breaking down of rock into a new substance. During chemical weathering a change in the composition of the rock takes place.

a. Oxidation - Oxygen combines with different elements causing a change in the chemical composition of that element.

Example: Oxygen combines with iron to form rust.

b. Hydration - Water can dissolve certain minerals and remove them from the rock causing a change in the chemical composition of the rock.

c. Limestone Caves - Boiling Springs

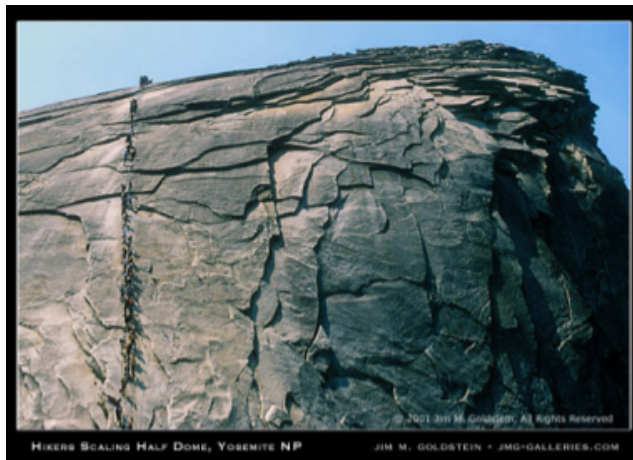
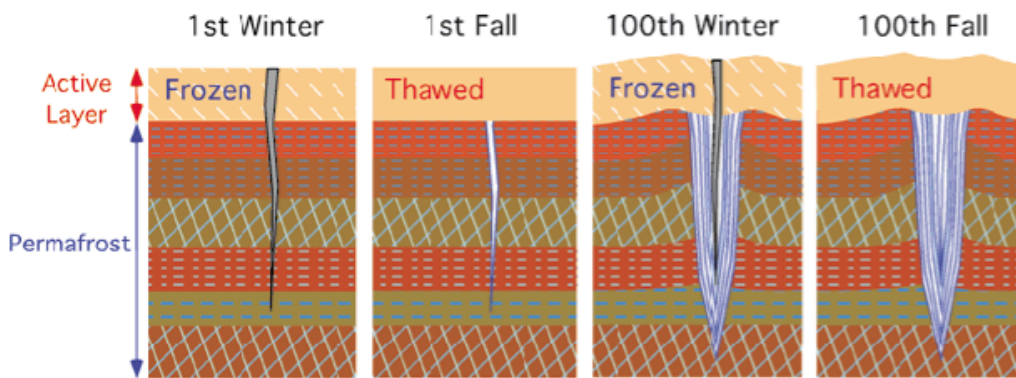
3. Biological Weathering is physical or chemical weathering which is the result of living things.

Root Wedging pg 259

a. The roots of plants grow into the cracks of rock, expand while growing and break the rock. (Biological / Mechanical)

b. Plant roots can excrete chemicals which cause minerals to dissolve so the plant can absorb them. (Biological / Chemical)

Example: Lichens are plants that can live on solid rock. They excrete an acidic substance that helps them get minerals to live from the rock they are on.



Exfoliation

B. The rate of weathering is affected by 5 factors.

Precipitation
Temperature



1. **Climate** - The climate of the area affects how fast the rock will weather.

a. **Mechanical weathering** works best in climates where there is a great deal of moisture and the temperature crosses the freezing point often.

Chemical reactions work best in warm, wet climates

b. **Chemical weathering** works best in climates where there is a great deal of moisture and the temperature is warm.

c. Most climates allow for all types of weathering to take place.

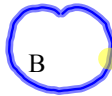
2. **Composition** - The composition of the rock (the minerals that make it up) affects how fast the rock will weather.

a. Rocks with a great deal of quartz do not weather easily.



b. Rocks with calcium in it are easily dissolved in slightly acidic water.

c. Sedimentary rocks are only as good as the cement that holds them together. Calcium - Silica - Oxides - cement sediments



3. **The Presence of Cracks or Openings in the Rock** - Openings or cracks in the rock increase the amount of surface area exposed to weathering.

Igneous rocks - weather more easily

4. **Environment** - The environment in which the rock was formed affects how fast it will weather. Generally, rocks which form under lower temperatures and pressures near the earth's surface are more resistant to weathering than rocks which form at high temperatures and pressures.

5. **The History of the Weathering Process** - The different types of weathering environments and the length of time the rock has been exposed to different weathering environments will affect the rate at which it weathers. Mt - Seashore - River bed - Field - Volcano

C. The Product of Weathering

1. **The main product of weathering is soil.** Soil is the bridge between living and nonliving world because all life owes its existence to a dozen or so elements which come from the earth's crust. **Weathering converts rock containing vital elements to regolith. Regolith is the part of the soil that is made of rock and mineral fragments.** Then plants carry out their role by taking these elements from the soil and making them available to animals.

2. **Soil is a combination of regolith, living and nonliving organic matter, air, and water.**

Texture

Sand 1/16 mm to 2 mm

Silt 1/256 mm to 1/16 mm

Clay smaller than 1/256 mm

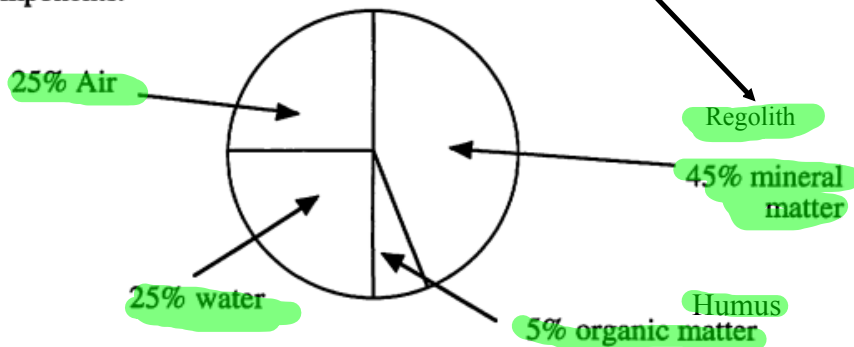


Anna Henry, Wife of John P Henry
 Aged: 40Y 11M 21D Died: Jan 8, 1845
 Amanda Cemetery, Lemon Township
 Section 26, Butler County, OH



a. Although the proportions of regolith, living and nonliving organic matter, air, and water may vary these things are found in all soils.

3. Soil in good condition for plant growth contains the following proportions of components.



4. The Soil Profile - If you were to dig a trench, you would see that its walls consisted of a series of layers. These layers called horizons make up the soil profile.

A HORIZON - "Surface Soil" - This top layer of soil contains the greatest amount of biological activity.

Top Soil

Darker soil = more organic

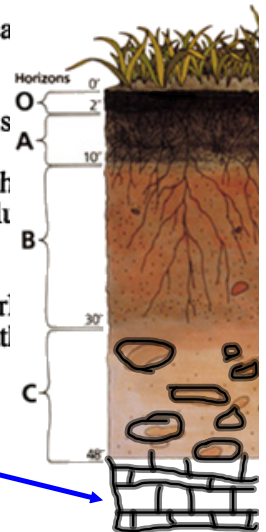
(Horizons A+B together constitute the solum or true soil)

B HORIZON - "The Zone of Accumulation" - As rain falls on the A horizon and percolates through, it carries tiny particles and soil matter to the B horizon where it accumulates. CLAY

Minerals

C HORIZON - "Altered Parent Material" - A layer made of the underlying bedrock which has been physically or chemically weathered.

BEDROCK - The natural rock of a given area underlying the soil.



a. Soils which have distinct boundaries between the horizons are called mature. Soils which lack boundaries between horizons are called immature, because the soil building or weathering process has only been going on for a short time.

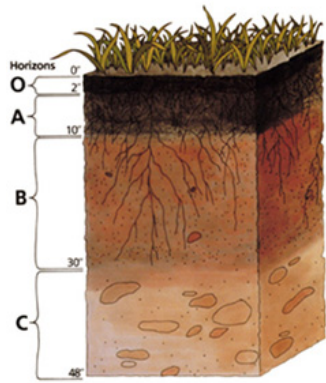
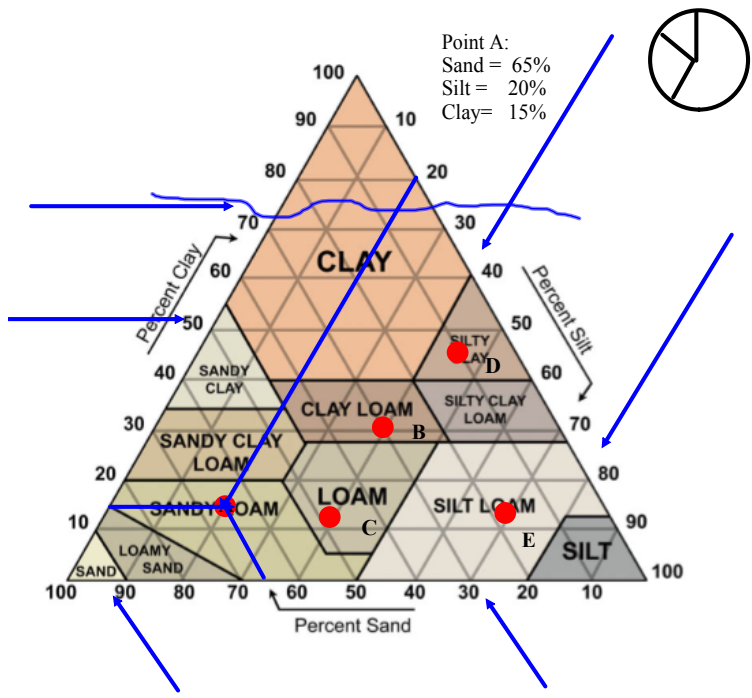
Transported = brought in from some other location

Residual = formed from Bedrock

5. Controls of Soil Formation - Soil is the result of many complex factors, including climate, time, plants and animals, slope and parent material.



a. Climate - The most important factor in determining the rate of soil formation. It controls the rate of mechanical + chemical weathering.



b. **Time** - The length of time the weathering process has occurred affects how fast the soil accumulates.

Plants reduce soil erosion c. **Plants and Animals** - Plants and animals chief function is to supply organic matter to the soil. Earthworms and burrowing animals help to mix the soil.

Steep Land = thin soil d. **Slope** - The slope affects the rate of erosion, the water content of the soil, and the amount of sunlight the soil receives.

e. **Parent Material** - The type of rock which forms the parent material affects the rate at which the soil forms and the fertility of the soil.

f. **Topography** - The shape of the land will affect the development of soils

Biomes g. **Geographic Location** - **Global location** (Temperate, Tropical, Polar, Desert, etc.) will affect the type and amount of soil that develops.

II. Erosion

Weathering ---> Erosion ----- Deposition

A. Erosion is the movement of sediment. There are 4 agents of erosion. They are in the order of most effective to least effective.

1. Water
2. Gravity
3. Wind
4. Glaciers

B. When erosion stops and sediments come to rest it is called deposition.

1. Two of the major forces which change the topography or shape of the land are weathering and erosion.

2. **Weathering and erosion are responsible for wearing the land away.**
Deposition = builds up the land

III. Weathering, Erosion, and Deposition by Gravity

Fast or Slow

A. Erosion by gravity is the movement of sediment from high altitudes to lower altitudes. Movement of sediment by gravity can be classified into two categories, rapid mass movement and slow mass movement.

1. **Rapid Mass Movement** - a large sudden movement of sediment down a slope.

a. **Slump** - a downward slipping of a mass of rock or unsorted material along a curved surface.

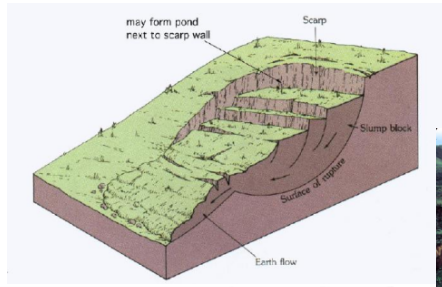
Snow
Earth
Mud
Rock

What moves?
How fast it moves
How it moves

Fall Slides Flows

Free falling

Slips slides downhill Liquid



Slump
Fast / Rapid



North Dakota State University, Pamphlet Paper C-100 www.ndsu.edu/water/technical/geology/geomorphology/ncr.html

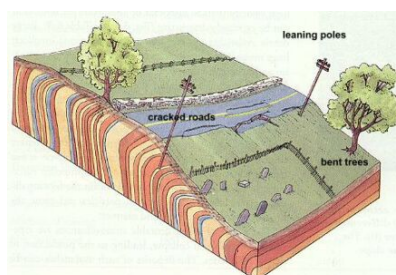


Chronicle / Darryl Bush, File

Angle of Repose =
stable angle of a slope



Creep



b. **Rockslides** - a sudden movement of unsorted material down slope. Rock

c. **Mudflow** - A sudden downhill movement of sediment and water down slope. Mudflows often occur in semi-arid regions which receive large amounts of rainfall after long dry periods. Volcanoes =Lahar

e. **Avalanches** - The sudden downhill movement of snow and sediment.

2. **Slow Mass Movement** - The slow downhill movement of sediment.

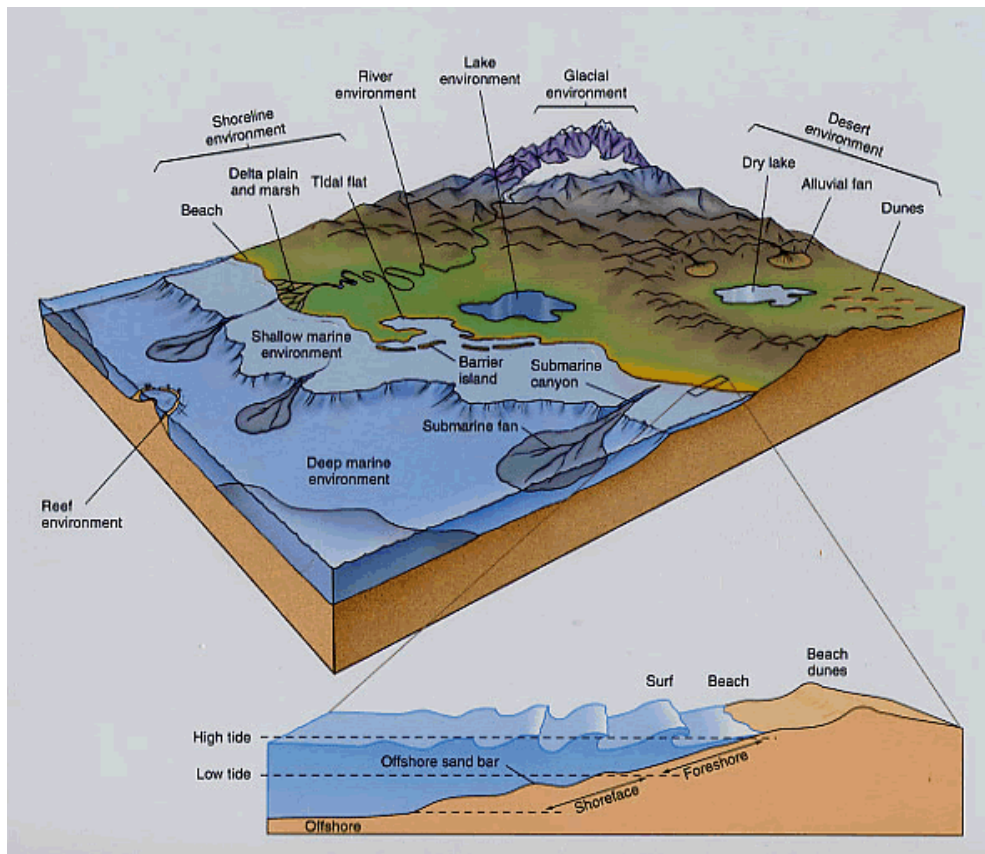
Most Common a. **Creep** - The slow downhill movement of particles due to a loose layer of material slipping on and down slope over another more resistant layer. Creep can be seen in tilted trees and telephone poles and broken retaining walls.

Tundra / Arctic b. **Solifluction**- this type of mass movement occurs in areas of extreme cold where only the upper few meters of ground thaw during the warmer months of summer. Since water cannot soak into the frozen ground below, it collects and slowly causes the ground to flow down even the most gentle slope.

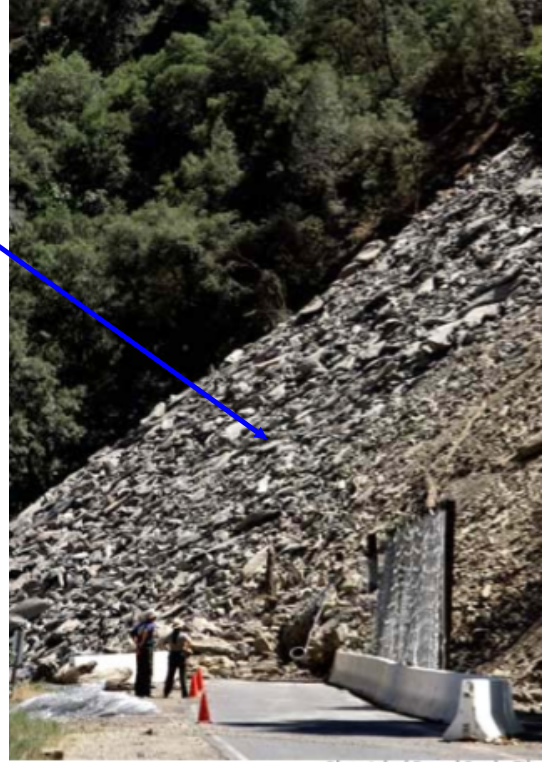
B. **Weathering by Gravity** - Weathering and erosion often happen together. Stress created by the pull of gravity and the force of falling rock and sediment can cause weathering to occur. **It should be noted that gravity is the only agent of erosion that is not in motion.** Gravity causes motion but it self is not in motion

C. **Deposition by Gravity** - Sediments coming to rest at the bottom of a slope forms a pile of **unsorted** sediment called a **talus pile**.

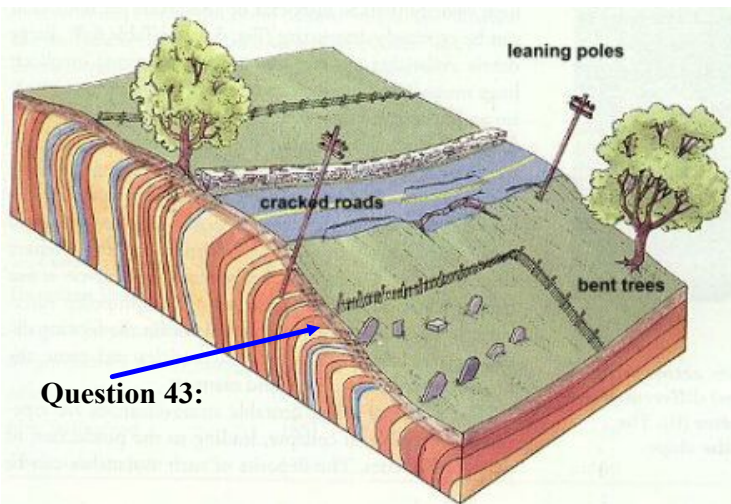




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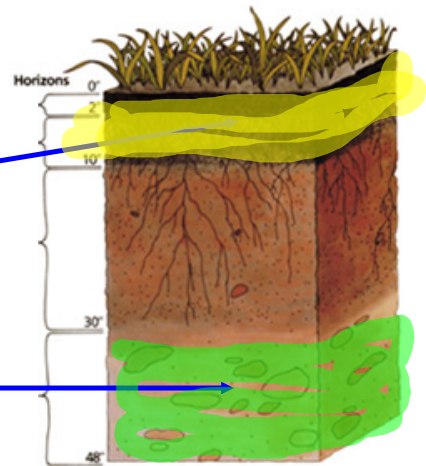


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Question 43:

Question 45



Question 44