Weathering, Erosion and Mass Wasting

Weathering is the breakdown of solid rock at or near the Earth’s surface.

Chapter 16
Weathering, Erosion, Mass Wasting

- Does weathering of rock remove or add CO₂ to the atmosphere?
  - A. Adds
  - B. Removes
  - C. No effect on CO₂

- Unfortunately it’s a bit slow.

Weathering may be mechanical or chemical

- Mechanical weathering is the physical abrasion due to the action of:
  - Water (Streams, Rivers and Surf)
  - Ice (Frost, Snow, Glaciers)
  - Wind

- Chemical weathering is the chemical reaction of minerals with the water and oxygen of our atmosphere.
**Mechanical Weathering**
- By the Action of Ice
- Granite, Joshua Tree

**Mechanical Weathering**
- By the action of Wind

**Chemical Weathering**
- By oxidation, hydration, or biological activity
- Granite, Joshua Tree

**Chemical Weathering:** Exfoliation

**Chemical Weathering**
- Increases with Temperature
- Increases with Moisture (Rainfall)
- Increases with Acidity (CO₂, SO₂)
- Decreases with Silica Polymerization (Bowen’s Reaction Series)

**Chemical Weathering of Igneous Rock Minerals**
- Oxides > Hydroxides
- Ferromags* > Mg-Fe Clay
  - *(olivine, pyroxene, amphibole, mica)
- Feldspar > Al-Clay + Na⁺ + K⁺ + Ca⁺⁺
- Mica > Al-Fe Clay + Na⁺ + K⁺ + Ca⁺⁺
- Quartz > Quartz Sand
Clicker Question

- The chemical weathering product of quartz (SiO₂) is
  
  - A. Quartz
  - B. Clay
  - C. Calcite
  - D. Hydroxides
  - E. Mica

Erosion and Transport

- Erosion is the reduction of exposed landforms.
- Transport is the movement of eroded material down slope.
- Transport by water sorts the particles by size.
- Because different minerals dominate different size fractions, the deposited material differs from the parent rock in mineralogy and chemistry.

Weathering Products Are Sorted by Size

- Coarse particles require moving water or wind
  - Rock grains: Pebbles, Cobbles, Boulders
  - Quartz: Pebbles and Sand
- Fine particles require standing water.
  - Clays Very fine (<10 μm)
- Dissolved ions require evaporation
  - Na⁺ + K⁺ + Ca²⁺ Dissolved

Depositional Environments

Clicker Question

- The process of erosion and transport sorts the weathering products by
  
  - A. Shape
  - B. Hardness
  - C. Color
  - D. Density
  - E. Grain size
Clicker Question

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Mass Wasting is the movement of solid material downslope.

- Creep: very slow movement of soils
- Slump: small-volume movement of soils
- Landslide: large-volume movement of soil and rock
- Rock Fall: small-volume fall of rock from an outcrop
- Debris Flow: water fluidized flow of debris
- Avalanche: air-fluidized flow of debris/ice/snow

Creep

- Creep is the unnoticed slow movement of unconsolidated soils downslope.
- It is commonly seen as curved tree trunks.
- Important to look for when buying real estate but not life-threatening.

- Curved trunks indicate soil movement

Slump

- Slumps are marked by movement of a coherent mass a short distance along a curved surface.
- Slumps are less dangerous because they generally move slowly, but they can still do damage to human construction.
- A fine local example is the slump at the intersection of highway 93 and U.S. 6 in Golden.
- They are now building houses on top of the slump.
Clcker Question

- The imperceptible slow movement of soil and debris downslope is known as:
  - A. Avalanche
  - B. Slump
  - C. Creep
  - D. Debris flow
  - E. Rockfall

Rock Fall

- Rock falls happen off of outcrops (cliffs and road cuts).
- Natural rock cliffs are usually quite stable except in areas of rapid erosion.
- Man-made cliffs (road cuts) are very unstable.
- There was a recent (May, 2003) rock fall of the ‘Old Man of the Mountain’
Landslides
- Landslides can be large and dangerous.
- They commonly start out as a coherent mass but may break up into a flow if a long distance is covered.
- Some local examples include the Slumgullion Slide near Lake City, CO.
- Another is the Gros Ventre near Jackson, WY.

Causes of Landslides
- Heavy Rain on unstable hillsides
- (Raising the water table)
- Seismic activity
- Volcanic activity
- Human construction
Avalanche

- An Avalanche is an air-fluidized flow of snow and ice or rock and soil debris downslope.
- Snow avalanches are common here in Colorado.
- Rock and soil avalanches are rare.

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Clicker Question

- The water-fluidized flow of volcanic ash and rock downslope is a(n)
  - A. Avalanche
  - B. Lahar
  - C. Creep
  - D. Debris flow
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Clicker Question

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Clicker Question

• The air-fluidized rapid low of snow, ice, soil, or debris downslope is a(n)
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  - B. Slump
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Weathering Terms

• Chemical weathering
• Mechanical weathering
• Spheroidal weathering
• Hydration
• Oxidation
• Exfoliation
• Erosion

Mass Wasting Terms

• Creep
• Slump
• Landslide
• Rock fall
• Debris flow
• Avalanche
• Lahar

Read Next Chapter 17
Hydrologic Cycle and Ground Water

• How does liquid water exist underground?
  - In pools and pockets?
  - As underground rivers?
  - In pores between grains in rock?
  - In spaces between atoms?