Weathering and Erosion
Chapter 7

Does not contain complete lecture notes. To be used to help organize lecture notes and home/test studies.

Earth's external processes

- **Weathering – the physical breakdown (disintegration) and chemical alteration (decomposition) or rock at or near Earth's surface**
- **Mass wasting – the transfer of rock and soil downslope under the influence of gravity**

Earth's external processes

- **Erosion – the physical removal of material by mobile agents such as water, wind, ice, or gravity**

Weathering

- Two types of weathering
  - Mechanical weathering – breaking of rocks into smaller pieces
  - Four types of mechanical weathering
    - Frost wedging – alternate freezing and thawing of water in fractures and cracks promotes the disintegration of rocks

Weathering

- Mechanical Weathering continued
  - Unloading – exfoliation of igneous and metamorphic rocks at the Earth's surface due to a reduction in confining pressure
  - Thermal expansion – alternate expansion and contraction due to heating and cooling
  - Biological activity – disintegration resulting from plants and animals

Weathering

- Chemical Weathering
  - Breaks down rock components and internal structures of minerals
  - Most important agent involved in chemical weathering is water (responsible for transport of ions and molecules involved in chemical processes)

Weathering

- **Major processes of chemical weathering**
  - **Dissolution**
    - **Aided by small amounts of acid in the water**
    - **Soluble ions are retained in the underground water supply**
  - **Oxidation**
    - **Any chemical reaction in which a compound or radical loses electrons**

Weathering

- **Major processes of chemical weathering**
  - **Oxidation continued**
    - **Important in decomposing ferromagnesian minerals**
  - **Hydrolysis**
    - **The reaction of any substance with water**
    - **Hydrogen ion attacks and replaces other positive ions**

Weathering

- **Alterations caused by chemical weathering**
  - **Decomposition of unstable minerals**
  - **Generation or retention of materials that are stable**
  - **Physical changes such as the rounding of corners or edges**

Weathering

- Rates of weathering
  - Advanced mechanical weathering aids chemical weathering by increasing the surface area
- Others factors affecting weathering
  - Rock characteristics
    - Rocks containing calcite (marble and limestone) readily dissolve in weakly acidic solutions

Weathering

- Others factors affecting weathering
  - Rock characteristics cont'd
    - Silicate minerals weather in the same order as their order of crystallization
  - Climate
    - Temperature and moisture are the most crucial factors
    - Chemical weathering is most effective in areas of warm, moist climates

Weathering

- Differential weathering
  - Masses of rock do not weather uniformly due to regional and local factors
  - Results in many unusual and spectacular rock formations and landforms

Soil

- Soil is a combination of mineral and organic mater, water, and air
  - That portion of the regolith (rock and mineral fragments produced by weathering) that supports the growth of plants

Soil

- Factors controlling soil formation
  - Parent material
    - Residual soil – parent material is the underlying bedrock
    - Transported soil – forms in place on parent material that has been carried from elsewhere and deposited

Soil

- Factors controlling soil formation
  - Time
    - Important in all geologic processes
    - Amount of time for soil formation varies for different soils depending on geologic and climatic conditions
  - Climate
    - Most influential control of soil formation
    - Key factors are temperature and precipitation

Soil

- Factors controlling soil formation
  - Plants and animals
    - Organisms influence the soil's physical and chemical properties
    - Also furnish organic matter to the soil
  - Slope
    - Steep slopes often have poorly developed soils
    - Optimum terrain is a flat-to-undulating upland surface

Soil

- The soil profile
  - Soil forming processes operate from the surface downward
  - Vertical differences are called horizons – zones or layers of soil

Soil

- The soil profile
  - O horizon – organic matter
  - A horizon – organic and mineral matter
    - High biological activity
    - Together the O and A horizons make up the topsoil
  - E horizon – little organic matter
    - Zone of eluviation and leaching

Soil

- The soil profile
  - B horizon – zone of accumulation
  - C horizon – partially altered parent material
- The O, A, E, and B horizons together are called the solum, or “true soil”

Soil

- Soil types
  - The characteristics of each soil type primarily depend on the prevailing climatic conditions
- Three very generic soil types
  - Pedalfer
    - Accumulation of iron oxides and Al-rich clays in the B horizon

Soil

- Three very generic soil types
  - Pedalfer continued
    - Best developed under forest vegetation
  - Pedocal
    - High accumulations of calcium carbonate
    - Associated with dry grasslands and brush vegetation

Soil

- Three very generic soil types
  - Laterite
    - Hot and wet tropical climates
    - Intense chemical weathering

Soil

- Soil erosion
  - Recycling of Earth materials
  - Natural rates of soil erosion depend on
    - Soil characteristics
    - Climate
    - Slope
    - Type of vegetation

Soil

- Soil erosion
  - In many regions the rate of soil erosion is significantly greater than the rate of soil formation
  - Sedimentation and chemical pollution
    - Related to excessive soil erosion
    - Occasionally soil particles are contaminated with pesticides