Chapter 5 Weathering, Soil, and Mass Movements

Summary

5.1 Weathering

Mechanical weathering occurs when physical forces break rock into smaller and smaller pieces without changing the rock’s mineral composition.

In nature, three physical processes are especially important causes of mechanical weathering: frost wedging, unloading, and biological activity.

- In nature, water finds its way into cracks in a rock. When the water freezes, it expands. This enlarges the cracks in the rock. Over time, the rock breaks into pieces. This is called frost wedging.
- Sections of rock that are wedged loose may tumble into large piles of rock debris called talus, which typically form at the base of steep, rocky cliffs.
- Unloading is when large masses of igneous rock are exposed through uplift and erosion, reducing the pressure on the igneous rock. Slabs of the outer rock separate like the layers of an onion and break loose in a process called exfoliation.
- Plants, animals, and humans all cause mechanical weathering.

Chemical weathering is the transformation of rock into one or more new compounds.

- The most important agent of chemical weathering is water.
- Chemical weathering changes the properties of rock.
- Spheroidal weathering is a type of chemical weathering that changes the physical shape of the rock as well as its chemical composition.
- Mechanical weathering increases the rate of chemical weathering.

Two other factors that affect the rate of weathering are rock characteristics and climate.

- Different rock types weather at different rates.
- Temperature and moisture both affect the rate of weathering.

5.2 Soil

Soil is the part of the regolith that supports the growth of plants.

- Regolith is the layer of rocks and mineral fragments that covers nearly all of Earth’s land surface.
- Composition, texture, and structure are three important characteristics of soil.
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Soil has four major components: mineral matter, or broken-down rock; organic matter, or humus, which is the decayed remains of organisms; water; and air.
- The amount of these components in soil varies depending on the type of soil.
- Soil texture is the proportions of different particle sizes in soil. Texture strongly affects a soil’s ability to support plant life.
- Plant cultivation, erosion, and water solubility are all affected by soil structure.

The most important factors in soil formation are parent material, time, climate, organisms, and slope.
- Parent material is the source of the mineral matter in soil.
- Temperature and precipitation, or climate, has the greatest effect on soil formation. 
- In the nitrogen cycle, bacteria convert nitrogen gas into nitrogen compounds that plants can use.

Soil varies in composition, texture, structure, and color at different depths.
- These variations divide the soil into zones known as soil horizons.
- A vertical section through all of the soil horizons is called a soil profile.
- Mature soils often have three distinct soil horizons—the A horizon or topsoil, the B horizon or subsoil, and the C horizon, which contains partially weathered parent material.

Three common types of soil are pedalfers, pedocals, and laterites.
- Pedalfers usually form in temperate areas that receive more than 63 cm of rain each year. They contain large amounts of iron oxide and aluminum-rich clay.
- Pedocals are found in the drier western United States in areas that have grasses and brush vegetation. They contain abundant calcite and are a light gray-brown.
- Laterites form in hot, wet tropical areas where chemical weathering is intense. These are rich in iron oxide and aluminum oxide. Laterites contains almost no organic matter and few nutrients.

Human activities that remove natural vegetation, such as farming, logging, and construction, have greatly accelerated soil erosion.
- Soils are one of the most abused resources on Earth.
- Water, wind, and other forces such as climate, soil characteristics, and slope all affect the rate of erosion.
- Erosion can be controlled through planting windbreaks, terracing hillsides, plowing in contours, and rotating crops.
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5.3 Mass Movements

The transfer of rock and soil downslope due to gravity is called mass movement.

- Most landforms are caused by both weathering and mass movement.

Among the factors that commonly trigger mass movements are saturation of surface materials with water, oversteepening of slopes, removal of vegetation, and earthquakes.

Geologists classify mass movements based on the kind of material that moves, how it moves, and the speed of movement.

- A rockfall occurs when rocks or rock fragments fall freely through the air. This is common on steep slopes.
- In a slide, a block of material moves suddenly along a flat, inclined surface. Slides that include segments of bedrock are called rockslides.
- A slump is the downward movement of a block of material along a curved surface.
- A mudflow is a mass movement of soil and rock fragments containing a large amount of water, which moves quickly downslope.
- Earthflows are flows that move relatively slowly—from about a millimeter per day to several meters per day. They occur most often on hillsides in wet regions.
- The slowest type of mass movement is creep, which usually travels only a few millimeters or centimeters per year.