

Earth Science

Chapter 14 – Weathering and Erosion

Section 3 - Soil

E.Q.: *Explain how the composition of rock affects soil composition and what types of soil form in different climates?*

STANDARDS:

SES3. Students will explore the actions of water, wind, ice, and gravity that create landforms and systems of landforms (landscapes).

- a. Describe how surface water and groundwater act as the major agents of physical and chemical weathering.
- b. Explain how soil results from weathering and biological processes acting on parent rock.
- c. Describe the processes and hazards associated with both sudden and gradual mass wasting.
- d. Relate the past and present actions of ice, wind, and water to landform distribution and landscape evolution.

SES5. Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

- a. Explain how latitudinal variations in solar heating create atmospheric and ocean currents that redistribute heat globally.
- b. Explain the relationship between air masses and the surfaces over which they form.
- c. Relate weather patterns to interactions among ocean currents, air masses, and topography.
- d. Describe how temperature and precipitation produce the pattern of climate regions (classes) on Earth.
- e. Describe the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming).

Objectives:

- **Summarize how soil forms.**
- **Explain how the composition of parent rock affects soil composition.**
- **Describe the characteristic layers of mature residual soils.**

- Predict the type of soil that will form in arctic and tropical climates.

Soil

soil - a loose mixture of rock fragments and organic material that can support the growth of vegetation

- One result of weathering is the formation of *regolith*, a layer of weathered rock fragments that covers much of Earth's surface.
- *Bedrock* is the solid, unweathered rock that lies beneath the regolith.

Characteristics of Soil

- The characteristics of soil depend mainly on the rock from which the soil was weathered, which is called the soil's *parent rock*.

Soil Composition

- Soil composition refers to the materials of which it is made.
- The color of soil is related to the composition of the soil.
- Soil moisture can also affect color.

Soil Texture

- Rock material in soil consists of three main types: clay, silt, and sand.
- Clay particles have a diameter of less than 0.004 mm.
Silt particles have a diameter from 0.004 to 0.06 mm.
Sand particles have diameters from 0.06 to 2mm.
- The proportion of clay, silt, and sand in soil depends on the soil's parent rock.

Soil Profile

soil profile - a vertical section of soil that shows the layers of horizons

horizon a horizontal layer of soil that can be distinguished from the layers above and below it; *also a*

boundary between two rock layers that have different physical properties

- **Transported soils are commonly deposited in unsorted masses. However, residual soils commonly develop distinct layers over time.**

humus - dark, organic material formed in soil from the decayed remains of plants and animals

- **Residual soils generally consist of three main horizons.**
- **The *A horizon*, or *topsoil*, is a mixture of organic materials and small rock particles.**
- **The *B horizon* or *subsoil*, contains the minerals leached from the topsoil, clay, and sometimes, humus.**
- **The *C horizon* consists of partially-weathered bedrock.**

The image below shows the soil horizons of residual soils.

Surface litter fallen leaves and partially decomposed organic matter

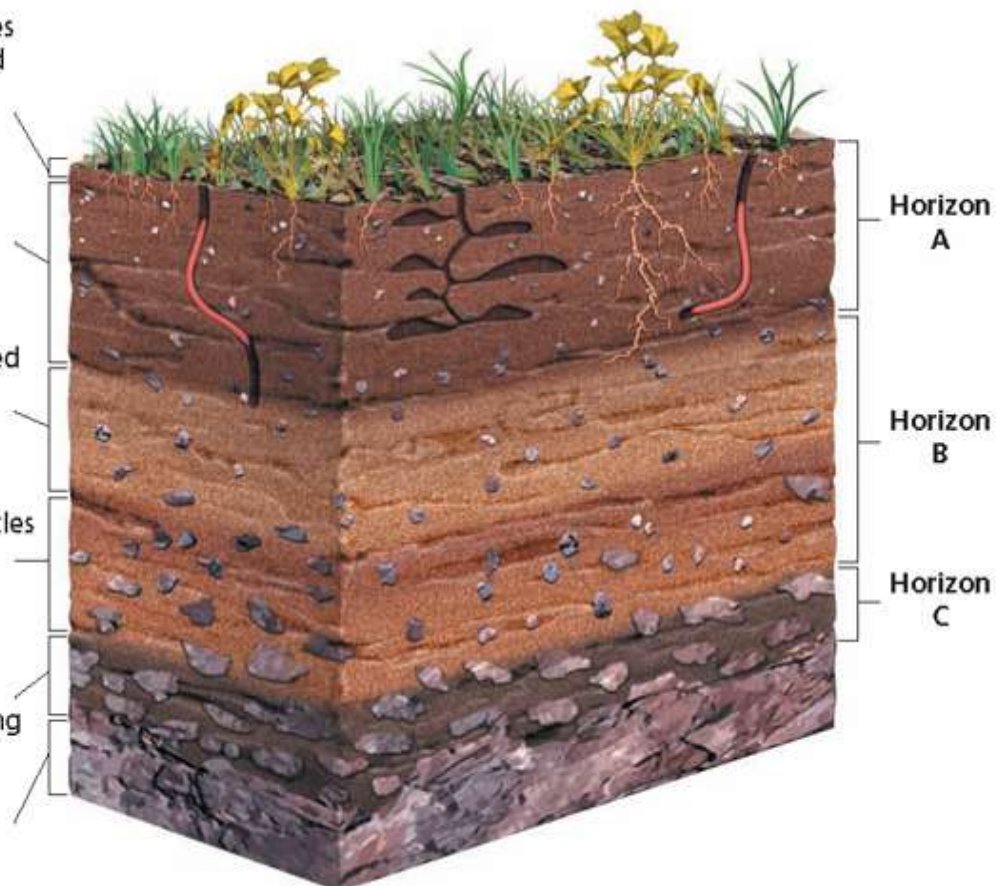
Topsoil organic matter, living organisms, and rock particles

Zone of leaching dissolved or suspended materials moving downward

Subsoil larger rock particles with organic matter, and inorganic compounds

Rock particles rock that has undergone weathering

Bedrock solid rock layer



Soil and Climate

- Climate is one of the most important factors that influences soil formation.
- Climate determines the weathering processes that occur in a region.
- These weathering processes, in turn, help determine the composition of soil.

Tropical Soils

- In humid tropical climates, where much rain falls and where temperatures are high, chemical weathering causes thick soils to develop rapidly.
- Leached minerals from the A horizon sometimes collect in the B horizon.
- Heavy rains, which are common in tropical climates, cause a lot of leaching of the topsoil, and thus keep the A horizon thin.
- A thin layer of humus usually covers the B horizon.

Temperate Soils

- In temperate climates, where temperatures range between cool and warm and here rainfall is not excessive, both mechanical and chemical weathering occur.
- All three soil horizons in temperate soils may reach a thickness of several meters.

READING CHECK

Compare the formation of tropical soils and temperate soils.

Large amounts of rainfall and high temperatures cause thick soils to form in both tropical and temperate climates. Tropical soils have thin A horizons because of the continuous leaching of topsoil. Temperate soils have three thick layers, because leaching of the A horizon in

temperate climates is much less than leaching of the A horizon in tropical climates.

Desert and Arctic Soils

- In desert and arctic climates, rainfall is minimal and chemical weathering occurs slowly.
- As a result, the soil is thin and consists mostly of regolith—evidence that soil in these areas form mainly by mechanical weathering.
- Desert and arctic climates are also often too warm or too cold to sustain life, so their soils have little humus.

Soil and Topography

- Because rainwater runs down slopes, much of the topsoil of the slope washes away.
- Therefore, the soil at the top and bottom of a slope tends to be thicker than the soil on the slope.
- Topsoil that remains on a slope is often too thin to support dense plant growth.