

## Earth Science

### Chapter 14 – Weathering and Erosion

#### Section 1 – Weathering Processes

**E.Q.: *What are the two main types of weathering and what are some examples of each?***

#### 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.

#### Objectives:

- **Identify three agents of mechanical weathering.**
- **Compare mechanical and chemical weathering processes.**
- **Describe four chemical reactions that decompose rock.**

#### Weathering Processes

**weathering - the natural process by which atmospheric and environmental agents, such as wind, rain, and temperature changes, disintegrate and decompose**

- **There are two main types of weathering processes—mechanical weathering and chemical weathering.**
- **Each type of weathering has different effects on rock.**

#### Mechanical Weathering

**mechanical weathering - the process by which rocks break down into smaller pieces by physical means**

- Mechanical weathering is strictly a physical process and does not change the composition of the rock.
- Common agents of mechanical weathering are ice, plants and animals, gravity, running water, and wind.
- Physical changes within the rock itself affect mechanical weathering.

### Ice Wedging

- A type of mechanical weathering that occurs in cold climates is called *ice wedging*.
- Ice wedging occurs when water seeps into the cracks in rock and freezes.
- When the water freezes, its volume increases by about 10% and creates pressure on the surrounding rock.
- This process eventually splits the rock apart.

### Abrasion

abrasion - the grinding and wearing away of rock surfaces through the mechanical action of other rock or sand particles

- Abrasion is caused by gravity, running water, and wind.
- Wind is another agent of abrasion.

### READING CHECK

Describe two types of mechanical weathering.

*Two types of mechanical weathering are ice wedging and abrasion. Ice wedging is caused by water that seeps into cracks in rock and freezes. When water freezes, it expands and creates pressure on the rock, which widens and deepens cracks. Abrasion is the grinding away of rock*

**surfaces by other rocks or sand particles. Abrasive agents may be carried by gravity, water, and wind.**

### **Organic Activity**

- **Plants and animals are important agents of mechanical weathering.**
- **As plants grow, the roots grow and expand to create pressure that wedge rock apart.**
- **Earthworms and other animals that move soil expose new rock surfaces to both mechanical and chemical weathering.**

### **Chemical Weathering**

**chemical weathering - the process by which rocks break down as a result of chemical reactions**

- **Chemical reactions commonly occur between rock, water, carbon dioxide, oxygen, and acids.**
- **Bases can also chemically weather rock.**
- **Chemical weathering changes both the composition and physical appearance of the rock.**

### **READING CHECK**

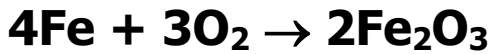
**Describe two effects of chemical weathering.**

**Two effects of chemical weathering are changes in the chemical composition and changes in the physical appearance of a rock.**

### **Oxidation**

**oxidation - a reaction that moves one or more electrons from a substance such that the substance's valence or oxidation state increases; in geology, the process by which an element combines with oxygen**

- Oxidation commonly occurs in rock that has iron-bearing minerals, such as hematite and magnetite.
- Iron, Fe, in rocks and soil combines quickly with oxygen, O<sub>2</sub>, that is dissolved in water to form rust, or iron oxide, Fe<sub>2</sub>O<sub>3</sub>.



- The red color of much of the soil in the southeastern United States is due to mainly the presence of iron oxide produced by oxidation.
- Describe two effects of chemical weathering.
- Two effects of chemical weathering are changes in the chemical composition and changes in the physical appearance of a rock.

### Hydrolysis

- hydrolysis a chemical reaction between water and another substance to form two or more new substances
- Water plays a crucial role in chemical weathering.
- Minerals that are affected by hydrolysis often dissolve in water.
- Water can then carry the dissolved minerals to lower layers of rock in a process called *leaching*.



### Carbonation

**carbonation** - the conversion of a compound into a carbonate

- When carbon dioxide,  $\text{CO}_2$ , from the air dissolves in water,  $\text{H}_2\text{O}$ , a weak acid called *carbonic acid*,  $\text{H}_2\text{CO}_3$ , forms.



- Carbonic acid has a higher concentration of hydronium ions than pure water does, which speeds up the process of hydrolysis.

### **Organic Acids**

- Acids are produced naturally by certain living organisms.
- Lichens and mosses grow on rocks and produce weak acids that can weather the surface of the rock.
- The acids seep into the rock and produce cracks that eventually cause the rock to break apart.

### **Acid Precipitation**

**acid precipitation** - precipitation, such as rain, sleet, or snow, that contains a high concentration of acids, often because of the pollution of the atmosphere

- Acid precipitation weathers rock faster than ordinary precipitation does.
- Rainwater is slightly acidic because it combines with small amounts of carbon dioxide.
- But when fossil fuels, especially coal, are burned, nitrogen oxides and sulfur dioxides are released into the air. These compounds combine with water in the atmosphere to produce nitric acid, nitrous acid, or sulfuric acid.
- The occurrence of acid precipitation has been greatly reduced since power plants have installed scrubbers that remove much of the sulfur dioxide before it can be released.