Weathering, Erosion and Transportation

Rocks exposed at Earth's surface are constantly being changed by water, air, varying temperature, and other environmental factors. The processes that alter rock are *weathering*, *erosion*, and *transportation.*

The term **weathering** refers to the group of destructive processes that change the physical and chemical character of rock at or near the surface.

Erosion is the picking up or *physical removal* of rock particles by an agent such as running water or glaciers. Rainwater flowing down a cliff or hillside removes the loose particles produced by weathering.

Transportation is the movement of eroded particles by agents such as rivers, waves, glaciers, or wind. Weathering processes continue during transportation.

Weathering and Earth Systems

Weathering takes place on Earth because of our atmosphere (which contains oxygen and carbon dioxide) and the abundance of water.

Atmosphere

Our atmosphere is crucial to the processes of weathering. Oxygen and carbon dioxide are important for *chemical weathering*, as described later. Water (evaporated from the hydrosphere and distributed as moisture, rain, and snow) is critical to both chemical weathering and *mechanical weathering.*

Hydrosphere

Water is necessary for chemical weathering to take place. Oxygen dissolved in water oxidizes iron in rocks. Carbon dioxide mixed with water makes a weak acid that causes most minerals to decompose; this acid is the primary cause of chemical weathering.

Biosphere

Plants can physically break apart rocks when they grow in cracks. Animals can also contribute to weathering and erosion. Plants and animals contribute greatly to weathering when they die. When animals and plants decompose, they become mostly water and carbon dioxide. While carbon dioxide dissolved in rain makes the water slightly acidic, carbon dioxide mixed with water in soil with decaying plants produces much more acid.

How Weathering Alters Rocks

Mechanical weathering (physical disintegration) includes several processes that break rock into smaller pieces. The change in the rock is physical; there is

little or no chemical change. For example, water freezing and expanding in cracks can cause rocks to disintegrate physically. **Chemical weathering** is the decomposition of rock from exposure to water and atmospheric gases (principally carbon dioxide, oxygen, and water vapor). As rock is decomposed by these agents, new chemical compounds form.

Spheroidal weathering occurs where rock has been rounded by weathering from an initial blocky shape. It is rounded because chemical weathering acts more rapidly or intensely on the corners and edges of a rock than on the smooth rock faces.

Differential weathering describes the tendency for different types of rock to weather at different rates. For example, shale (composed of soft clay minerals) tends to weather much faster than sandstone (composed of hard quartz mineral).

Factors Affecting Weathering

Temperature is a factor in chemical weathering. The most intense chemical weathering occurs in the tropics, which are both wet and hot. Polar regions experience very little chemical weathering because of the frigid temperatures and the absence of liquid water. Mechanical weathering intensity is also related to climate (temperature and humidity), as well as to slope. Temperate climates, where abundant water repeatedly freezes and thaws, promote extensive frost weathering. Steep slopes cause rock to fall and break up under the influence of gravity. The most intense mechanical weathering probably occurs in high mountain peaks where the combination of steep slopes, precipitation, freezing and thawing, and flowing glacial ice rapidly pulverize the solid rock.