

## **Weathering: Chemical and Physical Processes**

### **Introduction**

Today we are going to take a closer look at how we can get sedimentary rocks from the weathering and erosion of other rocks. These will be key in understanding and interpreting the formation of different sedimentary rocks we will be looking at the next few times.

Rocks are continually made and broken down in a process known as the **rock cycle**. We have learned that igneous rocks are formed from magma. We have learned that sedimentary rocks are formed from the sediment of rocks, plants and animals. We will learn about how metamorphic rocks are formed through chemical changes of already existing rocks. **Sediment** is composed of pieces of rocks, plants and animals that have been broken down through processes of weathering, and transported through processes of erosion. In this activity we will discuss the processes of weathering. The following chapter discusses the process of erosion.

### **What is weathering?**

Weathering is a process that breaks down or changes rocks into smaller pieces. Various atmospheric aspects are responsible for weathering processes. Weathering is different from erosion. Erosion is the movement of rock pieces and sediment from one area to another. Weathering is the breaking down of rocks and erosion is a wearing away of rocks. There are two main types of weathering: physical (or mechanical) weathering and chemical weathering. Quite often, both forms of weathering will occur together.

### **Results of weathering**

Weathering results in **sediment**. Sediment is pieces of rocks, plants and animals that are mixed together. Sediment is a key component in the formation of both soil and sedimentary rocks. Sediment can occur in various sizes. It can be small like clay, silt and sand; or it can be medium sized like pebbles. Sediment can also be large, like rocks and boulders.

### **Rates of weathering**

The rate of weathering depends on the atmospheric variations within climatic regions. Variations between humidity, rainfall, temperature and sunlight all determine how fast or slow weathering will occur. Weathering also depends on the type of rock. Limestone, for example, generally dissolves more easily in rainwater. This is because rainwater is becoming increasingly acidic from pollution.

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### Physical (mechanical) weathering

Physical weathering is also known as mechanical weathering. This type of weathering occurs when rocks and other landforms are broken down by physical factors in the environment. These physical factors include wind, water, sun, ice and temperature changes. This type of weathering does not change the chemical composition of the rock or minerals. An example would be waves crashing against a rocky shoreline, slowly breaking apart the rocks into smaller pieces.

### Types of physical weathering

There are various ways that physical weathering can take place. We explore some of the most common forms of physical weathering.

**Frost wedging**, or **freeze-thaw** weathering usually occurs in temperate humid climates. Water enters into the cracks within a rock. During the night, temperatures drop and the water freezes. When water freezes it expands, putting pressure on the rock. During the day, the temperatures rise and the water melts. This cycle will eventually put enough pressure on the rock to cause pieces to break off.

**Thermal expansion** or **insolation** weathering usually occurs in arid regions. During the day, temperatures rise, heating the rocks and ground. As they heat up, expansion occurs. During the night, temperatures drop and the rocks and land lose their heat. This causes contraction. This cycle will cause cracks in the top layers of soil, rocks and landforms. Eventually, surface pieces will peel away in a process called **exfoliation**.

**Biological weathering** occurs when something living interacts with the weathering processes, causing the rock to break down. Biological weathering can be considered a type of physical weathering. Sometimes biological weathering is referred to as the third type of weathering. An example of biological weathering would be a tree root finding a crevice to grow in, and eventually splitting the rock apart.

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### Chemical weathering

Chemical weathering occurs when there are changes in the chemical compositions of the rock or minerals from exposure to the environment. Chemical weathering includes chemical changes that may decompose, dissolve or break down various parts of the rock or other landform. These changes are a result of other minerals and chemicals that seep into rocks, usually in rain water or as gases. Acid rain is a prime cause of chemical weathering.

### Types of chemical weathering

There are various types of chemical weathering. Chemical weathering most often occurs because of interactions between water, oxygen and carbon dioxide with the chemical compositions within the rock.

Oxidation and hydration are both caused by an increase in minerals or crystal size within the rock. **Oxidation** occurs when oxygen combines with minerals, such as calcium and magnesium, to create iron oxide. Iron oxide is a reddish brown color and causes rocks to crumble. **Hydration** occurs when water (H<sub>2</sub>O) is absorbed by the minerals, creating crystals and causing the rock to expand. This also results in the rock crumbling apart.

Hydrolysis, carbonation and solution are all caused by a chemical change within the rock minerals. **Hydrolysis** occurs when water reacts with minerals in the rock and changes the chemical composition of the rock. This change weakens the rock and makes it more susceptible to breaking down. **Carbonation** occurs when carbon dioxide (CO<sub>2</sub>) from moisture in the air reacts with carbonate minerals. Carbonic acid can break down rocks when combined with water. **Solution** occurs when minerals in the rock are dissolved by water that enters cracks and fissures.