Physical Weathering at Work

This text is excerpted from an original work of the Core Knowledge Foundation.

The process of weathering breaks rock into smaller pieces. Some of these tiny pieces combine with once-living material to form topsoil. Other small pieces of rock collect as sediments. This breakdown of rocks happens as they interact with air, water, and living things. There are two basic types of weathering. One of them is physical weathering**.**

Physical weathering breaks big rocks into smaller ones without changing the minerals they contain. Widely swinging temperatures cause physical weathering. For example, rocks in a desert bake during the day beneath the sun's scorching heat. As rocks get hot, they expand. At night, temperatures in the desert fall. As rocks cool down, they contract, or shrink slightly. Expand, contract, expand, contract- this endless cycle gradually causes the rocks' outer layer to crumble or flake off.

Water also causes physical weathering. Water seeps into tiny cracks in rocks. If temperatures drop below freezing, the water turns to ice. Water expands as it freezes, pushing outward and enlarging the cracks. Geologists call this process ice wedging. Each time the water freezes, it opens cracks a little wider. Eventually, the rocks split apart. Ice wedging is what makes potholes in streets, too.

Examples of physical weathering

Plants and animals also cause rocks to weather. Tree roots squeeze into the cracks in rocks. As the roots grow, they act like wedges, forcing the cracks wider and wider. Eventually the rocks break apart. Badgers, chipmunks, and other animals burrow into cliffs and hillsides like tiny bulldozers. As they dig or tunnel into the ground, they push buried rocks to the surface where most weathering takes place.

Chemical Weathering of Rocks

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The process of weathering breaks rock into smaller pieces. Some of these tiny pieces combine with once-living material to form topsoil. Other small pieces of rock collect as sediments. One basic type of weathering is chemical weathering.

Chemical weathering breaks down rocks by changing the minerals they contain. Rain is a powerful chemical weathering force. As rain falls, it mixes with the gas carbon dioxide in the air. The result is acid rain. Acid rain is strong enough to dissolve some minerals in rocks. Once dissolved, the minerals easily wash away, weakening the rock. Acid rain very slowly carves some rocks into different shapes. It gradually erases the lettering on old gravestones, and blurs the faces of stone statues. It eats away at the outside of ancient and even modern buildings. Where rain seeps into the ground, carbonic acid causes weathering of buried rocks as well. Over long periods of time, this often unobserved weathering creates caves deep underground.

Another gas in the air-oxygen-causes chemical weathering in rocks. With a little help from water, oxygen reacts with iron-containing minerals. The reaction changes the minerals, making the rocks brittle and crumbly, and turning them a rusty red color.

Some plants release rock-weathering substances. Take a peek under a patch of moss growing on a rock and you'll see little pits in the rock's surface. Acid from the moss plant caused the damage.

As a result of all weathering, rocks are broken down into smaller pieces and ultimately into sediments.

Towering rock formations created by chemical weathering rise straight up out of the ground near Kunming, the capital of China's Yunnan Province. Some formations are as tall as a 10-story building. The Chinese call this place Shilin, or the Stone Forest.

Sediments in the Wind

This text is excerpted from an original work of the Core Knowledge Foundation.

Delicate Arch, Arches National Park, Utah

Geologists describe erosion as any process or force that moves sediments to new locations. Wind, flowing water, moving ice, and gravity all transport sediments from place to place. These forces are the primary causes of erosion.

Have you ever stood on a sandy beach on a windy day? Did you notice that gusts of wind sent sand flying past? When air moves quickly across the ground, it picks up sediments and carries them away. Powerful winds can carry sediments for hundreds, even thousands, of miles.

On the windy beach, did your skin sting as it was struck by blowing sand? Wind carrying sediments can act like a sandblasting machine to wear away rocks in its path. When wind-driven sand hits rock, it chips off tiny pieces. The wind then whisks the pieces away. Over time, this form of weathering can polish rock surfaces or pepper them with tiny holes. It can shape huge blocks of rock into delicate stone arches and lofty towers. Weathering and wind erosion can also leave massive boulders balanced on slim supports. Have you seen wind-carved rocks like this?

As wind slows down, the sediments it carries fall back to Earth. They are deposited on land or in water. Where winds deposit sediments regularly, layers of sediment slowly build up. Over time, those layers may be transformed into sedimentary rock.

When Water Moves Sediments

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Erosion is any process or force that moves sediments to new locations. Wind and water both cause erosion. The tug of gravity pulls sediments out of wind and water. Flowing water picks up sediments and carries them downhill to new locations. A summer rain can wash fine sediments onto sidewalks and into gutters. A rushing mountain stream can sweep small stones into a valley. A flooded river can surge along with enough force to move large rocks many miles downstream.

Glaciers, like this one in Alaska, are powerful forces that can cause erosion.

As moving water slows, sediments sink to the bottom of the river or stream. The heaviest sediments are the first to be deposited. The finest sediments are the last. Layers of sediment accumulate at the mouths of rivers and on the bottoms of lakes. Vast layers of sediment are also deposited on the ocean floor over long periods of time. Like wind-deposited sediments, those laid down by water may someday be transformed into sedimentary rock.

Water doesn't have to be in its liquid state to erode sediments. Glaciers are enormous masses of ice found in polar regions and near the tops of tall mountains. Although ice is solid, glaciers do move. They flow-very, very slowly-downhill. As countless tons of ice creep over land or down mountainsides, they push, drag, and carry eroded sediments along. Moving glaciers also create sediments as they grind against rocks beside or below them. Glaciers are such powerful forces that they can carve huge U-shaped valleys through mountain ranges.

When glaciers melt, they deposit the sediments they have been carrying. About 20,000 years ago, glaciers covered large parts of North America, Europe, and Asia. As the climate warmed, the glaciers melted and retreated northward. They left behind massive deposits of sand, gravel, and silt, along with collections of rocks and boulders. You can still see these deposits as hills, mounds, and ridges on the landscape.

How the Hoodoos Formed

This text is adapted from an original work of the Core Knowledge Foundation.

Mount Erciyes looms on the horizon near the towns of Cappadocia in Turkey. It is an active volcano and the highest mountain in this part of Turkey. Erciyes's rocky peak is 12,848 feet high. In winter, it is often dusted with snow.

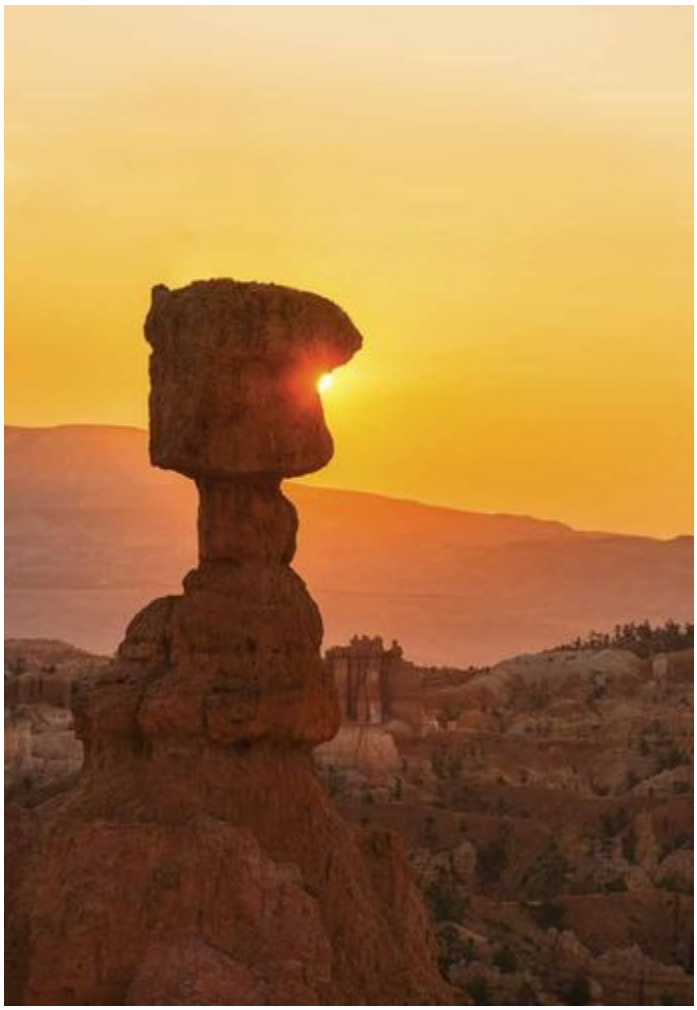
Effects of volcanic rock erosion in Cappadocia

Only minor eruptions have shaken Erciyes in recorded history. At times in the distant past, however, Erciyes and other volcanoes near it were much more active. During one or more major eruptions, these volcanoes blasted out enormous amounts of ash. The volcanic ash rained down on the surrounding countryside. It collected in some areas to form large, thick deposits. Over time, this volcanic ash solidified. It hardened into a type of volcanic rock geologists call tuff. In parts of what is now Cappadocia, layers of tuff formed that were hundreds of feet thick.

Then weathering and erosion went to work. Wind and water slowly carved the tuff into ridges, mounds, and sharp pinnacles. The tallest of these slender, soaring rock formations are called hoodoos. Some rise more than 100 feet above the Cappadocian landscape.

Hoodoos are not just found in Turkey. You can find hoodoos on almost every continent. Most are formed from sedimentary rock rather than volcanic tuff. All of them, though, are the product of weathering and erosion. Bryce Canyon in the western United States has an

abundance of hoodoos. Wind, rain, and ice wedging have carved them out of sedimentary rock that is 40 to 60 million years old. Geologists and visitors have named some of Bryce Canyon's largest hoodoos. One of the most impressive is Thor's Hammer.



Thor's Hammer

Some people call hoodoos "fairy chimneys" because they look like something you might read about in a fairy tale.

Fairy chimneys

Time, Weathering, and Erosion Shape Our World

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The Grand Canyon

Weathering and erosion work slowly. It takes a long time to see their effects. Given time, these processes reshape Earth's surface on a scale so large it's almost impossible to grasp. For example, the Grand Canyon in the southwestern United States did not exist when dinosaurs roamed North America. Wind, rain, and the Colorado River slowly created it. These forces cut and shaped the landscape into what it is today-one of the world's largest canyons.

Millions of years ago, the Appalachian Mountains in eastern North America were a towering mountain range. The highest peaks may have been more than 20,000 feet above sea level. Weathering and erosion gradually wore the Appalachians down. Their highest point today is just 6,684 feet high. As permanent as mountains seem, weathering and erosion inevitably change them. Even Earth's tallest peaks-Everest in Asia, Aconcagua in South America, Africa's Kilimanjaro, and Europe's Mont Blanc-won't last. They will eventually be worn down by these endless geological processes. But don't worry. Other geological processes are creating new mountains to take their place.