

Section 3

Effects of Volcanic Eruptions

Key Concept The effects of volcanic eruptions can change human and wildlife habitats.

What You Will Learn

- Volcanic eruptions can cause the loss of human life and the devastation of wildlife habitats.
- Volcanic eruptions can cause the average global temperature of Earth to decrease.
- Volcanic eruptions provide benefits to humans and to the environment.

Why It Matters

Volcanic eruptions can be both destructive and beneficial to humans.

In 1816, Chauncey Jerome, a resident of Connecticut, wrote that the clothes his wife had laid out to dry had frozen overnight. This event would not have been unusual except that the date was June 10! At that time, residents of New England did not know that the explosion of a volcanic island on the other side of the world had caused changes in the global climate.

Negative Effects of Volcanic Eruptions

Tambora volcano, shown in **Figure 1**, is located on the island of Sumbawa in Indonesia. The volcano erupted explosively in April 1815. Many of the negative images that people have of volcanoes are associated with this powerful eruption. An estimated 92,000 people lost their lives as a result of this event. About 10,000 people who lived in the area of the volcano were killed by pyroclastic flows and falling volcanic debris.



Figure 1 The 1815 eruption of Mount Tambora caused much loss of life and changed the global climate for one to two years. This is an image of the volcano today as seen from the space shuttle.

But the effects of the eruption of Mount Tambora were not only local. High in the atmosphere, ash and gases spread around Earth. As a result, the average global temperature decreased by as much as 3°C for one to two years. The lower temperature caused crop failures and starvation, particularly in New England and Europe. These effects led to the deaths of about 82,000 people.

Local Effects of Volcanic Eruptions

Volcanic eruptions can cause the loss of human life and can devastate wildlife habitats. The blast from an explosive eruption can knock down trees, destroy buildings, and kill humans and other animals. During an eruption, pyroclastic flows can race down the slope of a volcano and burn everything in their path. The hot volcanic materials can melt the

snowcap on a mountain, which can cause devastating floods. Volcanic ash can mix with water to produce **lahars**, fast-moving mudflows that bury everything in their way. The weight of falling ash can collapse structures, bury crops, and damage engines. Volcanic ash can also cause respiratory problems in humans. The result of a volcanic eruption is shown in **Figure 2**.



Figure 2 Ash from the eruption of Mount Pinatubo blocked out sunlight in the Philippines for several days. The eruption also affected the global climate.

Global Effects of Volcanic Eruptions

Large volcanic eruptions can affect Earth's climate for several years. During large eruptions, tremendous amounts of volcanic ash and sulfur-rich gases are released and may be pushed into the stratosphere. As the ash and gases spread around the planet, they may absorb and scatter enough sunlight to cause the average global temperature of Earth to decrease. For example, following the 1991 eruption of Mount Pinatubo in the Philippines, the amount of sunlight that reached Earth's surface was estimated to have decreased between 2% and 4%. This decrease caused the average global temperature of Earth to decrease several tenths of a degree Celsius for several years.

Standards Check Explain how large volcanic eruptions can change Earth's average global temperature.



Benefits of Volcanic Eruptions

Volcanic eruptions present various dangers to humans and to wildlife habitats. But volcanoes also provide benefits to humans and to the environment. These benefits include fertile soils, a renewable energy source, and construction materials.

Volcanic Soils

Volcanic soils are some of the most fertile soils on Earth. Volcanic rocks are made of minerals that contain a wide variety of elements that are important to plant growth. When volcanic rocks break down to form soils, these soils contain nutrients that plants can use. Volcanic soils are heavily farmed in many parts of the world, such as at the plantation shown in **Figure 3**.



Figure 3 These coffee plants are growing in volcanic soil on a coffee plantation in Ecuador.

Geothermal Energy

Magma heats the rocks that surround it. These rocks often hold water that also becomes heated. This heated water, called *geothermal water*, may reach temperatures of hundreds of degrees Celsius. As a result, the water contains large amounts of heat energy. This energy can be tapped by drilling wells to reach the hot water or by pumping water through the heated rocks. The water can be used to drive turbines that generate electricity, to heat homes, to grow crops, and to keep roads free of ice.

The world's largest producer of geothermal energy is currently the Geysers geothermal power plant, near Santa Rosa, California. The city of San Francisco gets some of its electricity from the Geysers plant. The world's greatest consumers of geothermal energy are the residents of Reykjavik, Iceland. In Reykjavik, 85% of the homes are heated by geothermal power. **Figure 4** shows another way in which geothermal energy may be used.



Figure 4 These Japanese macaques, commonly called snow monkeys, are staying warm in the waters of a hot spring during the Japanese winter.

Standards Check List four uses of geothermal energy.

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Other Benefits of Volcanic Eruptions

Volcanic rocks are often used in construction. In about 300 BCE, the Romans began to mix volcanic ash from Mount Vesuvius with wet lime to make concrete. This material was used to build the Colosseum in Rome, shown in **Figure 5**. As recently as the 20th century, volcanic ash was used to make concrete for dams in the United States. Today, basalt and pumice are often used in the construction of roads and bridges and in the production of concrete.



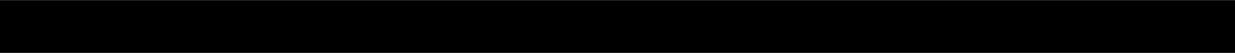
Figure 5 The Colosseum in Rome was built in 80 CE. The fact that the Colosseum still stands today is due in large part to the strength of the

materials, including concrete, of which it was built.

Volcanic rocks have many other uses. Volcanic ash absorbs moisture, so it is used in cat litter. Because pumice is abrasive, it is used in facial scrubs, soaps, cleaners, and polishes. Pumice is also added to soil to allow air and water to circulate more easily through the soil. And because metals in pumice are not water soluble, pumice is used alone or with silica sand to filter drinking water.

Section Summary

- Volcanic eruptions can have local effects on humans and on wildlife habitats.
- When ash and gases from a large volcanic eruption spread around the planet, they may absorb and scatter enough sunlight to cause a temporary decrease in the average global temperature.
- Benefits that volcanoes provide to humans and to the environment include fertile soil, a renewable energy source, and construction materials.



Chapter Summary

The Big Idea

Volcanoes form as a result of tectonic plate motion and occur where magma reaches Earth's surface.

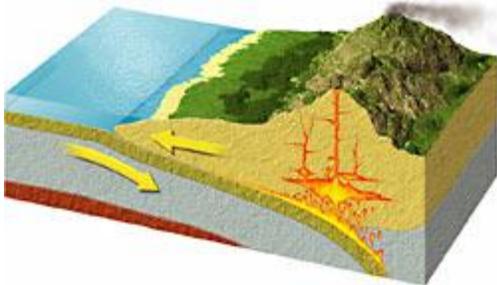
Section 1

Why Volcanoes Form

Key Concept Volcanoes occur at tectonic plate boundaries and at hot spots, where molten rock, or magma, forms and rises to the surface.

- Most volcanoes are located at or near tectonic plate boundaries.

- Volcanoes form at divergent boundaries, convergent boundaries, and hot spots.
- The temperature, pressure, and fluid content of rock play roles in the formation of magma.



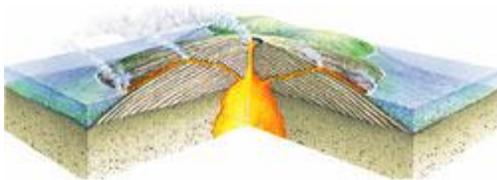
Volcanoes form at convergent boundaries, where one plate subducts beneath another plate.

Section 2

Types of Volcanoes

Key Concept Tectonic plate motions result in volcanic activity at plate boundaries.

- Nonexplosive eruptions of basaltic magma occur at divergent boundaries.
- Shield volcanoes that form from enormous volumes of basaltic magma occur at hot spots.
- Explosive eruptions of silica-rich magma occur at convergent boundaries.



This cutaway diagram shows the interior of a shield volcano.

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Volcanic eruptions can affect the people who live near the volcano.

