Volcanoes

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Volcanoes

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Table of Contents

This volcano shows signs of activity.

The Eruption of Vesuvius

Few people in the Roman city of Pompeii paid much attention to the earthquakes that began shaking the region in AD 79. They had suffered through **seismic** activity in the past and had rebuilt their city whenever any significant damage happened. Usually, though, the earthquakes were minor, and people had grown accustomed to them. The residents of Pompeii loved their beautiful city and would not leave just because the ground occasionally shook or a building fell down.

No one connected the trembling ground with the wisp of smoke that steadily hissed from nearby Mount Vesuvius. After all, people had lived in Pompeii for centuries without ever witnessing a volcanic eruption. The slopes of Mount Vesuvius were carpeted with trees, flowers, and grass. It had been a thousand years since the volcano had erupted, so most people assumed that it was **dormant**, or even **extinct**.

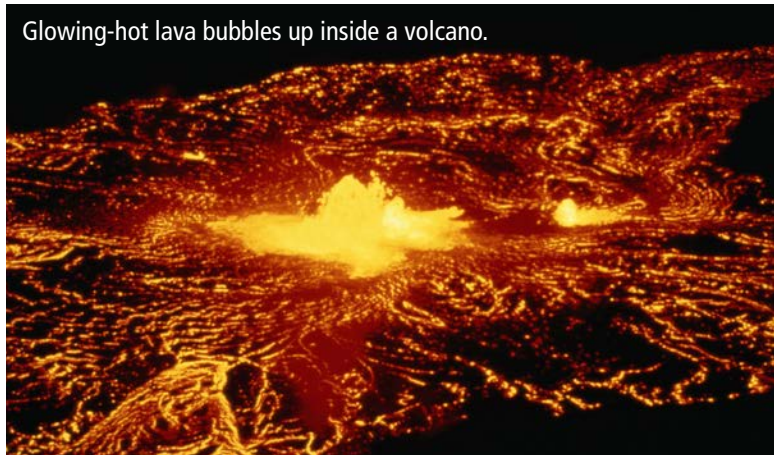
But everything changed on August 24 around one o'clock in the afternoon. Suddenly, a huge explosion shook the area around the mountain. Dust, ash, and melted rock spewed from the summit of the volcano, darkening the sky. This dust, ash, and stone (collectively known as *tephra*) blanketed the city, covering the ground as far away as 16 kilometers (10 mi) from the mountain.

By three o'clock, lava began pouring from the mouth of the volcano, destroying everything in its path. By six o'clock, the cloud of dust and ash had ascended to a height of 32 kilometers (20 mi), and the powerful energy inside it generated lightning bolts. The ash continued to fall over the area, covering the ground to a depth of 1 meter (3.3 ft). Buildings collapsed under the weight of the falling **debris**.

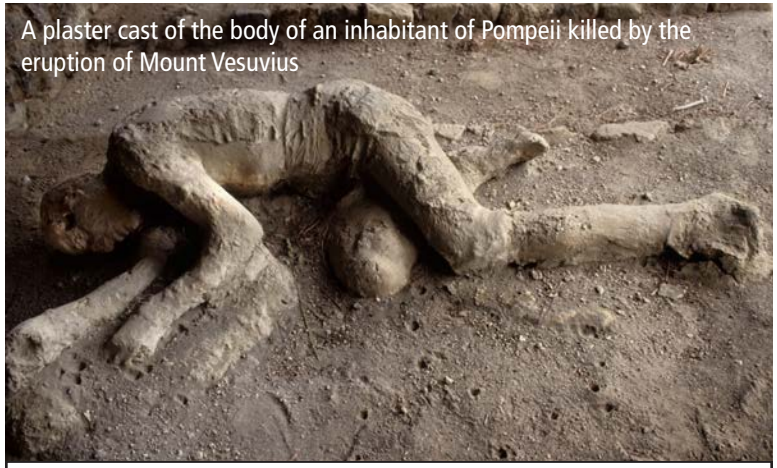
Mount Vesuvius overlooks the excavated ruins of Pompeii.

People in the cities surrounding Mount Vesuvius tried to flee as the volcano demolished their homes and farms. They gathered their most portable treasures and hurried their families away from the disaster. Some people tried to walk over the thick layers of ash, but the ash was so deep and hot that many people died. Others were struck and killed by stones falling from the dark sky. Many choked to death on the ash- and dust-clogged air.

Around midnight, the crisis grew even worse. The massive cloud of ash, poisonous gases, glowing-hot dust, and smoke had become so huge and heavy that it could no longer stay in the air. The cloud collapsed into a **pyroclastic flow**, racing down the mountain at speeds of up to 500 kilometers per hour (310 mph).



Glowing-hot lava bubbles up inside a volcano.



A plaster cast of the body of an inhabitant of Pompeii killed by the eruption of Mount Vesuvius

Do You Know?

Pompeii, a city not far from Mount Vesuvius, was completely buried by a surge cloud. As the bodies of victims decayed over time, they left pockets of air in the hardened ash and mud that surrounded them. These air pockets preserved the exact shapes of the bodies they once contained. Archaeologists filled the holes with plaster to make casts showing how the people looked when they died.

This was Mount Vesuvius's first **surge cloud**. Within a few moments, people in the cities of Pompeii and Herculaneum were scorched and buried by the collapsing cloud. As more dust and ash **billowed** from the volcano, more surge clouds followed. When the eruption was over, two cities of the Roman Empire were completely buried and wiped off the face of the Earth. They would not be found again for more than one thousand years.

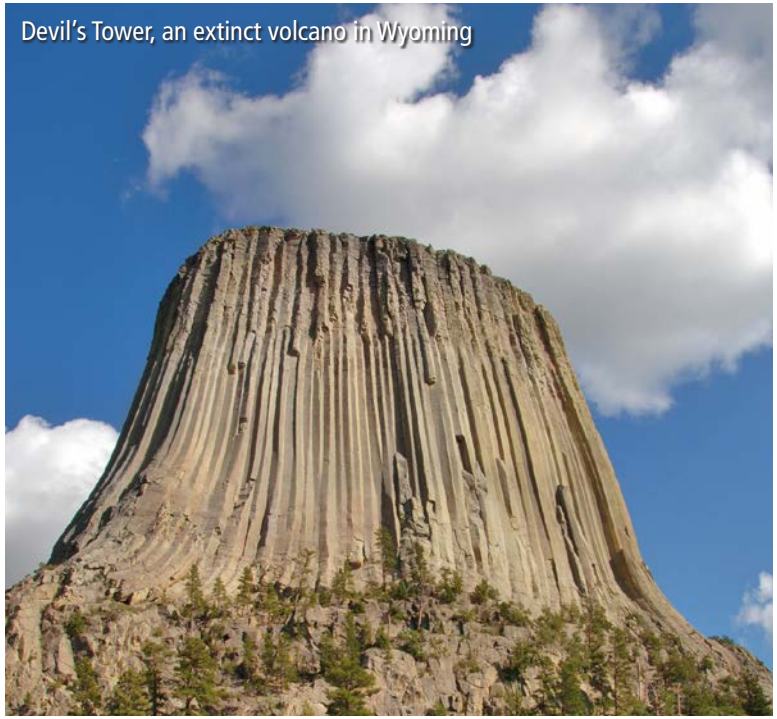
What you just read is an account of a real event. But how did it happen? What could cause such a violent explosion? And if volcanoes are so dangerous, why do people choose to live near them?

People and Volcanoes

People live near volcanoes for many reasons. They often find nutrient-rich soil for farming in these regions or wonderful hot springs where they can take warm baths. Still, they have learned to respect volcanoes. Long ago, people had no way to predict or understand volcanoes. They told stories to explain the dangerous eruptions. For instance, people in Hawaii believed the goddess Pele (PAY-lay) caused the volcanoes to erupt when she was angry. Some types of volcanic glass are named in honor of this goddess, such as *Pele's hair* and *Pele's tears*.

Pele's tears are small drops of lava that cool and become solid while flying through the air.

Native Americans told stories about an extinct volcano in Wyoming known as Devil's Tower. They explained that it was created by magic and shaped by the claws of an angry bear. In ancient Greece and Rome, people believed volcanoes were the **forges** where lightning bolts were made. The word *volcano* comes from the name of the Roman god Vulcan, who made the lightning bolts. Even today, **volcanologists** say that volcanoes smell like a blacksmith's forge. And in Japan, people still climb Mount Fuji, a volcano that last erupted in 1707, as a form of religious practice.


Devil's Tower, an extinct volcano in Wyoming

Today, scientists use a variety of tools and instruments to help them gather information about volcanoes. They understand the forces that create mountains and have equipment that can help them predict when a volcano will next erupt.

Where and Why Volcanoes Form

The first volcanoes appeared about 3.5 billion years ago. They covered vast areas with hot lava that spewed from deep within Earth. Earth's hard surface, or crust, is made of many enormous sheets of rock called **tectonic plates**. Some plates make up the continents, while others make up the ocean floors. Just under the surface of the plates, Earth is extremely hot—so hot that rock melts into a liquid called **magma**. Magma is about 1,200° Celsius (2,192°F). Sometimes the magma works its way up to the surface and seeps out through cracks in the crust.

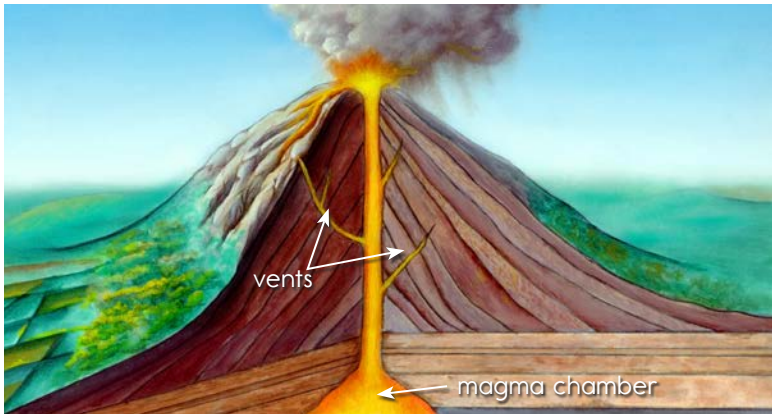
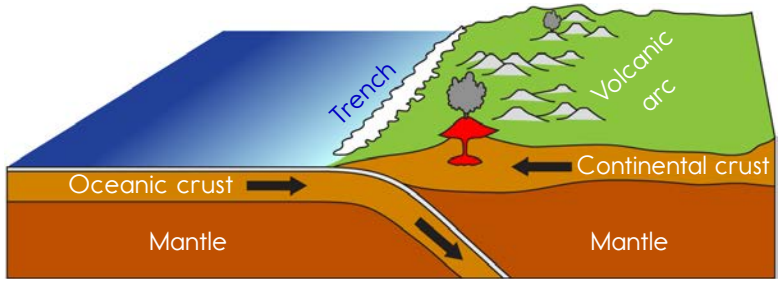


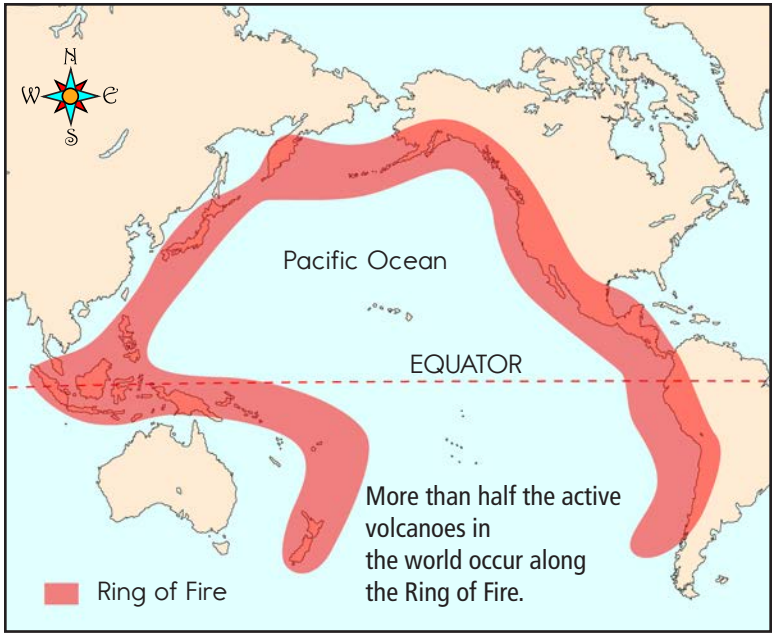
Plate Movement



When an ocean plate crashes into a continental plate, the ocean plate moves down, creating an active volcanic region.

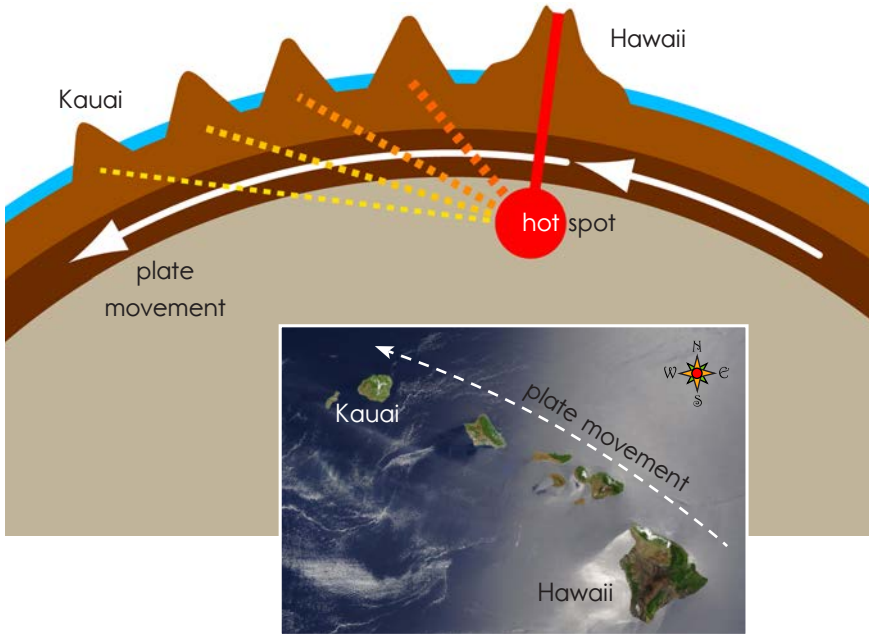
Scientists estimate that more than fifteen hundred different volcanoes have erupted in the last ten thousand years. Every year, about thirty-five or forty volcanoes erupt at various places around the world. Sometimes observers are only able to see a small amount of smoke or steam emerging from an erupting volcano. Some volcanoes are always erupting, but they do it very slowly. Others, like Vesuvius, can remain quiet for thousands of years between eruptions.

Volcanoes usually form at the edges of the tectonic plates. The plates are slowly floating on the thick liquid magma underneath them. The various plates each move in different directions, crashing into, pulling away from, or grinding past other plates. As the huge plates slide and rub against each other, their movements create large cracks in the crust. At some of these cracks, the magma breaks through to form volcanoes.



There are at least five hundred active volcanoes in the world, most of which are located near the edges of tectonic plates. The edge of the Pacific Ocean plate is a particularly dense volcanic region known as the *Ring of Fire*. Another notably active volcanic region runs along the Mid-Atlantic Ridge, a mountain chain in the Atlantic Ocean. Two plates are drifting apart in the Atlantic Ocean, allowing magma to seep up through the ocean floor, where it **accumulates**. Over time, the magma can build up and create mountains so tall that they emerge from the water. The island country of Iceland sits atop the summits of large volcanoes of the Mid-Atlantic Ridge.

Other volcanoes are located in areas far from the edges of the plates. The islands of Hawaii are in the center of the Pacific Ocean plate. They are located above a "hot spot," a place where hot magma sits very close to the surface of Earth's crust. Sometimes the magma creates a new island, but the process is very gradual, taking tens of thousands of years. In Wyoming's Yellowstone National Park, which is located in the middle of the North American plate, an underground hot spot sits directly below underground lakes and waterways. The magma heats up the ground and the water, creating hot springs and **geysers** that shoot water high into the air.



Different volcanoes erupt in different ways, depending on where and why the volcano forms. Some volcanoes erupt peacefully and slowly, while others suddenly explode with the force of many atomic bombs. Let's examine different kinds of volcanoes and learn how they erupt.

Composite Volcanoes

Mount Vesuvius, which you read about earlier in this book, is a composite volcano on the west coast of southern Italy. Composite volcanoes are explosive volcanoes—their eruptions can be extremely violent and destructive. Also called *stratovolcanoes*, they are the most common type of volcano. Composite volcanoes are usually large mountains with steep sides and evenly shaped peaks, often with a bowl-shaped **crater** at the top. The crater is a hollow area where the magma, hot gases, and ash come out.


The impressive shape of a composite volcano

Mount St. Helens before 1980 eruption

Mount St. Helens after 1980 eruption

Do You Know?

When Mount St. Helens, in Washington State, erupted on May 18, 1980, 63 people died and 311 square kilometers (193 sq mi) of forest were flattened by hot winds that blew down the mountainside.

Most composite volcanoes occur where the magma near the surface is thick and slow moving. Magma moves toward the surface in tubes called **vents**. When the magma is unusually thick, it can cool and harden inside a vent, plugging the vent and trapping the magma below. Because the heat and gases beneath the plugged vent have nowhere to go, the pressure slowly begins to increase. Eventually the pressure becomes so great that it reaches a critical level, and the volcano explodes. Sometimes the explosion is so violent that the whole mountain is destroyed in the blast. When Washington State's Mount St. Helens erupted in 1980, the entire northern side of the mountain was **obliterated**.

When composite volcanoes erupt, they send massive clouds of dust, ash, smoke, hot gas, and rock into the air. These clouds rise for many kilometers, turning the sky black and raining ash onto the ground. When a cloud of debris becomes too dense to remain in the air, it collapses in a violent surge cloud.

Many composite volcanoes are very tall, and they are often capped with ice and snow. In an instant, an explosion can melt all of the ice and snow, sending a flood of water, mud, and rock racing down the mountain at up to 100 kilometers per hour (62 mph).

Melting ice and snow sent a massive mudslide racing down the side of this volcano.

Crater Lake is a well-known caldera in Oregon. This huge caldera was formed when the volcano collapsed in on itself.

Do You Know?

The Klamath Indians in southern Oregon used to tell a story about the origin of Crater Lake. In the story, the first coyote fell in love with a star and found a way to join her in the sky. When he fell back to Earth, his impact made a hole that became Crater Lake.

Some volcanic ash clouds are so huge that they send ash and dust traveling around the world, blocking out sunlight and cooling the entire planet. After the 1815 eruption of Tambora, a volcano in Indonesia, people living far away in North America experienced a cold, snowy summer.

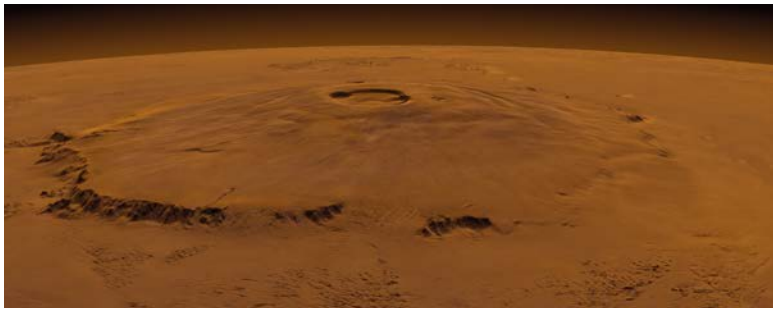
Sometimes an entire underground lake of magma can pour out of a composite volcano, leaving a huge empty space below. With nothing to support it, the surface collapses into the empty chamber, leaving a large bowl-shaped basin called a **caldera**. Calderas can measure as much as 100 kilometers (62 mi) from side to side. Over time, they often fill with water, creating large lakes.

Composite volcanoes can destroy huge forests, bury entire cities, and kill thousands of people. These volcanoes are very dangerous because they often remain quiet for hundreds of years between eruptions. People forget that the volcano might erupt, and they build their homes dangerously close to the mountain.

Shield Volcanoes

You may have seen a video of bright orange lava flowing or spraying from the top of a volcano. The lava, which is very runny, flows smoothly and quickly, moving like water in a stream. The lava spreads out over the land before slowly hardening and building up. This type of lava comes from a shield volcano. Shield volcanoes usually have gentle, smooth mountain slopes in the shape of shields.

Mauna Loa, a shield volcano in Hawaii



Olympus Mons, on the surface of Mars, is the largest volcano in the solar system. It would cover the entire state of Arizona.

Eruptions of shield-volcanoes are usually gentle rather than explosive, although the lava flows can still destroy roads, homes, and forests. Sometimes a shield volcano contains hot gases or steam that sprays from the crater, creating a bright lava fountain. Since the paths of the lava flows are stable and predictable, scientists are often able to get very close to study them.

Shield volcanoes can remain quietly active for long periods of time and can grow to become extremely large in the process. Mauna Loa on Hawaii is the tallest volcano in the world, rising 9,170 meters (30,080 ft) from its base on the seafloor, making it taller than Mount Everest. However, even Mauna Loa seems tiny when compared to the largest known volcano in our solar system—Olympus Mons on Mars. This enormous Martian shield volcano stands 27 kilometers (17 mi) in height.

Cinder Cones and Lava Domes

Some volcanoes are not active long enough to form large mountains. Instead, they may just spray small bits of lava into the air for brief periods of time. The small lava chunks and bits of ash harden into lightweight black rocks called **cinders**. The cinders pile up around the vent into a cone-shaped hill with a crater at the top. Such hills are called *cinder cones*.

Brand-new volcanoes that suddenly appear often form cinder cones. Other cinder cones pile up inside the craters or calderas of larger, older volcanoes. Most cinder cones erupt only once. Because cinder cones are made of loose rocks, they usually erode quickly in the wind and rain.

Cinder cones at Mauna Kea volcano, Hawaii

Lava dome atop Novarupta vent, Katmai National Park and Preserve, Alaska (above); a scientist monitoring a lava dome inside a crater

Lava domes also result from small, brief eruptions, but the lava that forms these structures is a thick, pasty liquid that oozes from the vent and quickly hardens. Sometimes, more lava pushes up and expands through the center of the dome, cracking the outside. These domes often form in areas with other volcanic activity. They are often found in the craters and calderas of larger volcanoes. Like composite volcanoes, lava domes often explode violently.

Conclusion

Volcanoes are the most spectacular evidence we have that Earth is a changing planet. Lava pouring from a volcanic vent creates new rock and new land. Volcanic ash makes extremely fertile soil that is useful for farming. In some places, people use the **geothermal** energy from volcanoes to run power plants and produce electricity. Some people even live inside volcanoes! In Rabaul, in the country of Papua New Guinea, volcanoes sometimes erupt inside the town. Volcanic mountains, including Mount Fuji in Japan, Mount Rainier in Washington, and Mauna Loa in Hawaii, are some of the most recognizable and beautiful mountains in the world.

Beautiful Mount Fuji in Japan

It is no wonder that humans often choose to live near volcanoes. But we should always remember that volcanoes can be violent, dangerous places. Volcanoes unleash some of Earth's most powerful forces.

Glossary

accumulates *(v.)* builds up or collects over time; increases (p. 12)

billowed *(v.)* bulged and swelled out in response to wind (p. 7)

caldera *(n.)* a large bowl-shaped basin where land has collapsed into an empty magma chamber (p. 17)

cinders *(n.)* lightweight black rocks or pebbles formed by small pieces of flying lava and ash (p. 20)

crater *(n.)* a bowl-shaped hollow area in a volcano where lava, ash, and gases come out (p. 14)

debris *(n.)* scattered pieces of something that are left after the rest has gone or been destroyed (p. 5)

dormant *(adj.)* quiet for many hundreds of years (p. 4)

extinct *(adj.)* not having erupted in thousands of years and showing no sign of future eruptions (p. 4)

forges *(n.)* hot fires where metal is melted to be shaped by blacksmiths (p. 9)

geothermal *(adj.)* of or relating to the heat produced naturally inside Earth (p. 22)

geysers *(n.)* springs that shoot out jets of heated water and steam (p. 13)

magma *(n.)* melted liquid rock beneath Earth's surface (p. 10)

obliterated *(v.)* completely destroyed (p. 15)

pyroclastic flow *(n.)* a very hot mixture of rocks, water and gases that moves rapidly in response to gravity (p. 6)

seismic *(adj.)* relating to the shaking of the Earth, as by an earthquake (p. 4)

surge cloud *(n.)* a fast, superheated cloud of ash, gas, dust, and rock that moves along the ground (p. 7)

tectonic plates *(n.)* the large sheets of rock that make up Earth's crust (p. 10)

vents *(n.)* openings in Earth's crust through which magma and gases emerge (p. 15)

volcanologists *(n.)* scientists who study volcanoes (p. 9)