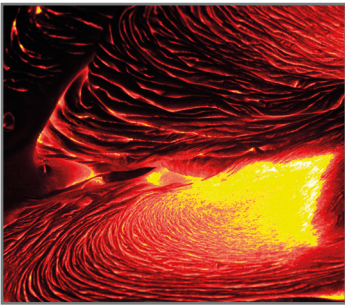


DRIVING QUESTION

1

Is It a Volcano?

Glossary Terms



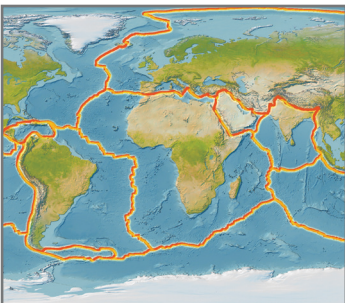
Magma

molten rock beneath the Earth's surface



Lava

molten rock that has erupted from a volcano



Tectonic plates

massive slabs of solid rock which form the Earth's surface

What is a volcano?

A volcano is a point on the Earth's surface through which **magma** (molten rock from within the Earth) erupts as **lava**. Lava is extremely hot when it erupts, with temperatures typically ranging from 700–1,200°C, but eventually cools and solidifies into volcanic rock.

The features that can be seen above the surface of the Earth are only part of the system of a volcano. Magma from the Earth's mantle collects in chambers below the surface. Since the magma is less dense than the surrounding rocks, it tends to rise upward. The magma is under tremendous pressure, and eventually it escapes to the surface through **vents** and fractures. Magma exits the volcano, becoming lava.

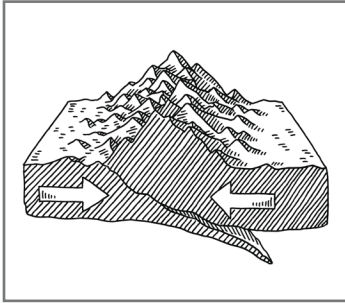
The Earth's Structure

- The Earth is made up of four layers:
- A solid inner core
- A liquid outer core
- A viscous layer known as the mantle
- A solid outer crust.

The crust and upper part of the mantle are divided into segments called **tectonic plates**, which move very slowly. The place where two tectonic plates meet is called a **fault line**.

Is It a Volcano?

Glossary Terms



Subduction

the process of one tectonic plate being pushed below the other at a convergent boundary

Where are volcanoes found?

Volcanoes are generally found in places where the Earth's crust is thin or has a weakness. This is often at the Earth's fault lines.

Volcanoes can form at divergent plate boundaries, where two tectonic plates are moving apart. This creates a crack or rift between the two plates, and magma rises up to fill the gap. This type of volcanic activity created the island of Iceland.

Volcanoes can also form at convergent plate boundaries, where two tectonic plates are moving together. When one plate is forced below the other in a process called **subduction**, the descending plate melts due to increased heat and pressure. This molten material feeds magma chambers, which then erupt as volcanoes. The islands of Japan are a result of this process.

Volcanoes don't only form at plate boundaries—they can also occur over hot spots, or areas where magma rises up from the mantle through the Earth's crust. The Hawaiian island chain was formed by countless volcanic eruptions at a hot spot in the middle of the Pacific plate.

The Ring of Fire

The Pacific Ocean's Ring of Fire is one of the most violent and destructive areas of the world. Comprising the west coast of North and South America and large parts of eastern Asia, the 40,000-kilometer ring is the site of more than 80% of the world's major earthquakes, as well as hundreds of volcanoes. The reason for this activity is that the Ring of Fire is the site of the world's largest tectonic plate—the Pacific plate—which rubs against the surrounding plates. The plate covers an area of 100 million km², or around one-fifth of the entire surface of our planet.

Is It a Volcano?

Glossary Terms



Strata

layers of volcanic material which build up to form the shape of a volcano



Caldera

a huge, deep depression formed by the collapse of a volcano into an empty magma chamber

What are the different volcano types?

Although the underground systems of all volcanoes are similar, their features aboveground can be very different. These differences are caused by variations in magma viscosity, gas content, and the number of eruptions. There are three main types of volcanoes:

- **Cinder cone volcanoes**, the most common volcano type, are usually fairly small with steep sides and a bowl-shaped crater. They throw out mostly small pieces of rock from near the vent, and form a small cone from the build-up of lava which is made up of burned rock fragments, or cinders. Parícutin is a cinder cone volcano located in the Mexican state of Michoacán.
- **Shield volcanoes** are formed almost entirely from great amounts of liquid lava. The lava flows out of a vent and slides down the side of the volcano, making a wide, gently-sloping cone. Mauna Loa, in Hawaii, is a shield volcano, and the largest volcano in the world.
- **Stratovolcanoes** have a tall conical shape with very steep sides—they look the way most people imagine volcanoes. They form during very violent eruptions of rock, ash, and lava. Fujisan in Japan is one example of a stratovolcano.

How do volcanoes change over time?

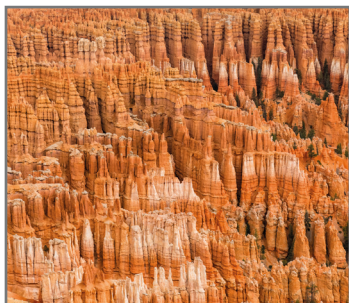
Volcanoes can undergo significant physical changes over time. A volcanic landform typically begins as a crack or fissure in the ground or seafloor. After lava is ejected from the volcano, it starts to cool and eventually hardens into solid rock. If a volcano erupts many times, the rock will build up in layers known as **strata**. These strata create a mountain—like Vesuvius in Italy, Fujisan in Japan, and Mount St. Helens in the United States.

Even after a mountain has formed, volcanoes can continue to change. For example, lava with a low viscosity might create a shield volcano, flowing across the Earth's surface to form a broad, gentle slope. Over time, however, the magma beneath the surface may become thicker, meaning that the lava will cool to form a steeper and taller slope. Eventually, the shield volcano will become a stratovolcano.

Dramatic changes can occur when a magma chamber empties during a very explosive eruption. Without the support of the molten rock beneath the surface, the volcano can collapse in on itself, forming a huge depression known as a **caldera**.

Is It a Volcano?

Glossary Terms



Sedimentary

rock that has solidified from magma or lava



Metamorphic

rock that has undergone a transformation due to heat and pressure



Compaction

a process where layers of sediments are compressed by high pressure

How do different rock types form?

There are three types of rocks on Earth: **igneous**, **sedimentary**, and **metamorphic**.

Igneous rocks form when molten rock cools and solidifies. Rock that forms from solidified magma underground is known as intrusive rock. Rock that forms from erupted lava aboveground is known as extrusive rock. Intrusive rock cools slowly, resulting in coarse-grained rocks like granite. Extrusive rock cools more quickly, and the result is fine-grained rocks such as basalt.

Sedimentary rocks are formed by processes on the Earth's surface, such as weathering and erosion. For example, when water moves downstream, it flows over rocks and minerals, gradually wearing it away. This creates tiny particles known as sediments. The sediments gradually settle on the bed of a lake, sea, or other body of water. As more and more layers of sediments accumulate, the weight of the upper layers exerts immense pressure on the layers below, compressing the sediments in a process known as **compaction**. Eventually, the pressure forces all the water from the layers, and new minerals bind them together to form solid rock. This process is called **cementation**. Flint and shale are examples of sedimentary rock.

When rocks are subjected to high pressures and temperatures, their composition can be drastically altered, producing metamorphic rock. An increase in temperature and pressure can occur for a number of reasons. For example, rocks buried deep within the Earth are subjected to geothermal heat and pressure, while intrusive igneous rocks can produce enough heat to cause the surrounding rock to undergo metamorphic change. Marble is one example of a metamorphic rock, formed when limestone is exposed to high pressure and temperature. This metamorphism usually takes place at a convergent plate boundary, but it can also occur when underground magma heats nearby limestone.

What is the rock cycle?

Rocks are constantly being broken down and reformed, changing from one type to another over millions of years in what geologists call the rock cycle. For example: an intrusive igneous rock is created within the Earth and brought to the surface at a fault line. Over time, weathering and erosion wears it down to a fine sediment, which is deposited on the ocean floor. The sediment becomes buried and, as other layers of sediment are deposited on top of it, compacted to form sedimentary rock. As the sedimentary rock is buried deeper and deeper, and heat and pressure builds, it transforms into metamorphic rock. Deeper still, the heat causes the metamorphic rock to melt into magma. Eventually, the magma erupts from a volcano as lava, and cools to form extrusive igneous rock—and the cycle continues.