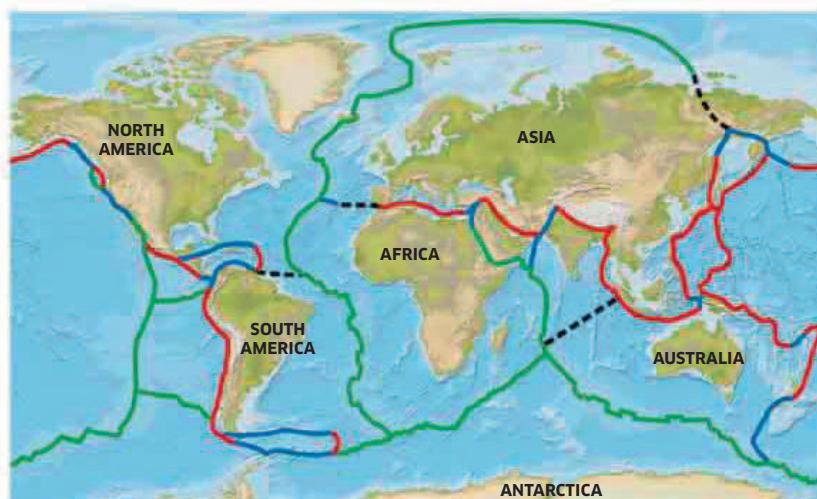


## SHIFTING PLATES

Earth's surface appears to be still, but it is actually a collection of plates that is always moving. These plates move around due to currents deep inside the Earth. Plates that are under oceans are much thinner and less dense than those under continents—where they push into each other the oceanic plate gets forced down underneath the continental plate.

### Jigsaw planet

Tectonic plates fit together to make up Earth's surface. They move constantly, and can change our planet's features, depending on how they meet. Where they push together, mountains and volcanoes form. Where they pull apart, new ocean floor is created.



#### Tectonic plate boundaries

Plate boundaries are classified depending on whether plates are moving together (converging), apart (diverging), or past each other (transform).

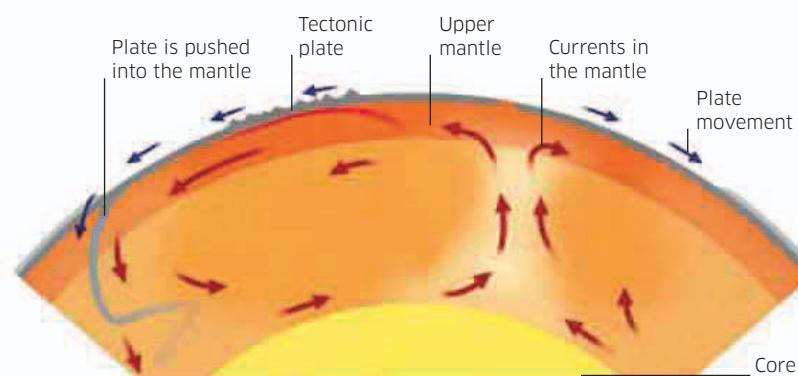
#### Key

- Convergent
- Transform
- Divergent
- Uncertain

**THE LARGEST TECTONIC PLATE IS THE PACIFIC PLATE. IT IS THE ONLY LARGE PLATE THAT DOESN'T CARRY A CONTINENT.**

### How plates move

No one knows exactly why tectonic plates move, but scientists think it is likely that they shift around on top of currents in the mantle layer underneath. These currents are thought to move in steady loops—rising when an area is heated by processes at the center of Earth, then sinking down again when they are cooled by moving nearer to the surface.



#### Moving mantle

Though mostly solid, the mantle moves. As currents rise, cool, and sink, they drag the plates around on top of them.

# TECTONIC EARTH

The outside layer of the Earth is broken up into giant pieces called tectonic plates. Over millions of years these plates move, bump together, overlap, and slide past each other, in the process making new areas of ocean floor, building mountains, causing earthquakes, and creating volcanoes.

## EARTHQUAKES

Most earthquakes happen where tectonic plates rub against each other, in places called faults. Some faults move with a steady, very gradual creep. In other places, a length of fault can remain locked for years, decades, or centuries, before giving way in a few seconds. Earthquakes are caused by the shaking of the ground after a rupture like this. The shallower the depth where the rupture begins, the more severe the shaking is at the surface.

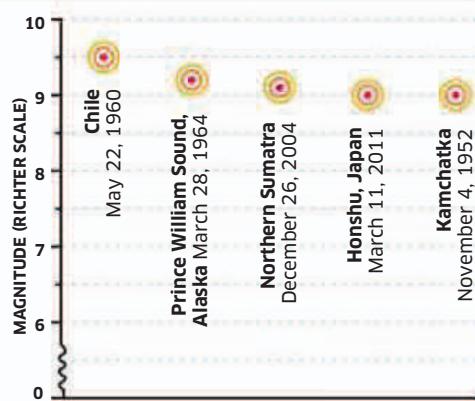
### Measuring quakes

The magnitude of an earthquake is a measure of the energy it releases. It can be measured using the Richter scale, where a difference of one point corresponds to a 30-fold difference in energy. The intensity of an earthquake can be measured using the Mercalli Intensity scale (below), which grades earthquakes from I to XII, according to their effects.

|        |  |  |          |  |   |
|--------|--|--|----------|--|---|
| I-II   |  | Hardly felt by people, but can be measured by instruments.         | VII-VIII |  | General alarm, cracks appear in buildings, tree branches break. |
| III-IV |  | Felt indoors as a quick vibration. Hanging objects swing slightly. | IX-XI    |  | Most buildings destroyed, underground pipes torn apart.         |
| V-VI   |  | Rocking motion felt by most people, buildings tremble.             | XII      |  | Almost all buildings destroyed, rivers change course.           |

### Living with earthquakes

Earthquakes can occur anywhere in the world, but the most damaging ones usually happen near plate boundaries. Earthquakes can be very dangerous—buildings can fall down and huge cracks open up in the ground. In earthquake-prone areas, buildings can be designed to sway when there is an earthquake, so that they are not shaken apart. Their foundations must be built in solid rock rather than on sandy or wet ground.



#### Biggest quakes

There have been many powerful earthquakes in the last 100 years. The largest, in Chile, was strong enough to move rivers.

## VOLCANOES

A volcano occurs where molten rock called magma erupts up from under Earth's surface. An exploding volcano is one of the most incredible and dangerous sights on our planet. Volcanoes often form near the boundaries between tectonic plates, but they can also form elsewhere, at hotspots where hot rock moves upward from deep inside the Earth. There are about 550 active volcanoes on land, and more under the sea.

### Lava

Hot, molten rock that flows across the ground is called lava. It keeps this name even after it has cooled down and solidified into rock. Lava comes in different forms, depending on what it is made of, how stiff or runny it is, and how fast it flows.



#### A'a lava

This is a thick lava flow made of basalt. Its surface is made up of loose, broken, and sharp chunks of lava that can tumble down the front of the lava flow as it moves.



#### Pahoehoe lava

This is a basalt lava with an unbroken surface. As it flows, its surface skin is gradually stretched. The end result can end up looking either smooth or ropelike.

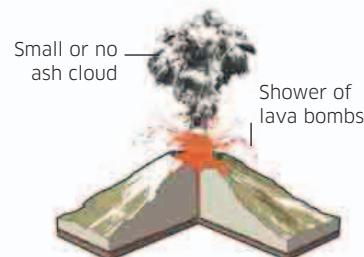


#### Blocky lava

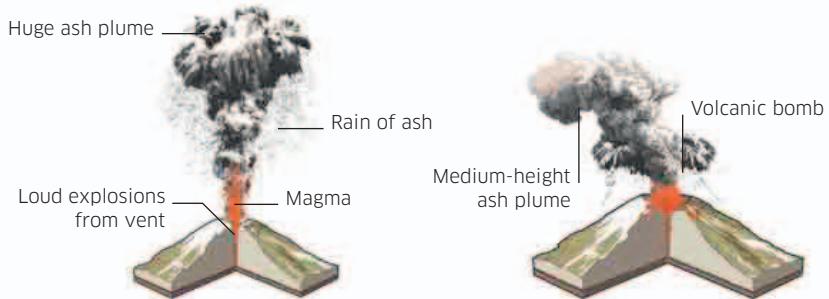
These chunks of lava form when stiff-flowing lava breaks up into angular blocks. These lava blocks have smoother faces than a'a lava.

### Eruption types

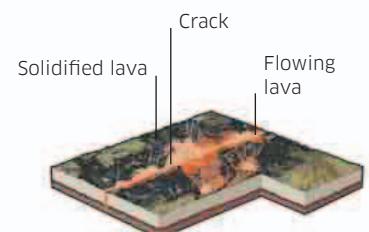
Volcanoes can erupt with massive force, a small explosion, or even just a steady dribble. The way each volcano erupts depends on how thick its magma is and how much gas is in the magma. In a gas-rich magma, violent expansion of bubbles can shatter the magma and project volcanic ash into the sky with huge force, creating an ash cloud. More gentle eruptions feed lava flows that ooze slowly down the side of the volcano.



**Strombolian**  
Short and explosive eruption that creates showers of cinders and lava bombs.



**Plinian**  
The most explosive and violent type of eruption. A steady, powerful stream of gas and magma is blasted into the air.



**Hawaiian**  
Usually mild eruptions that create fountains and streams of runny lava.

**Vulcanian**  
A violent eruption that begins with a cannonlike explosion. Lumps of rock called bombs are thrown out.



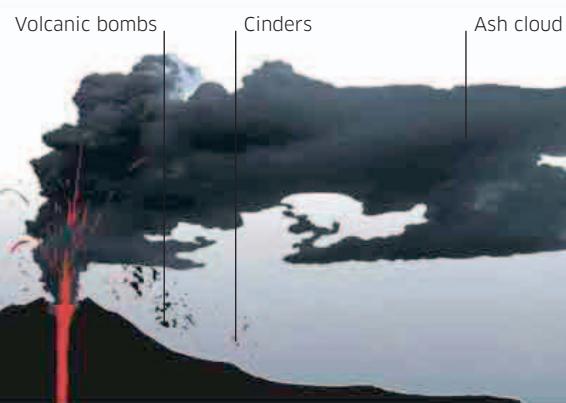
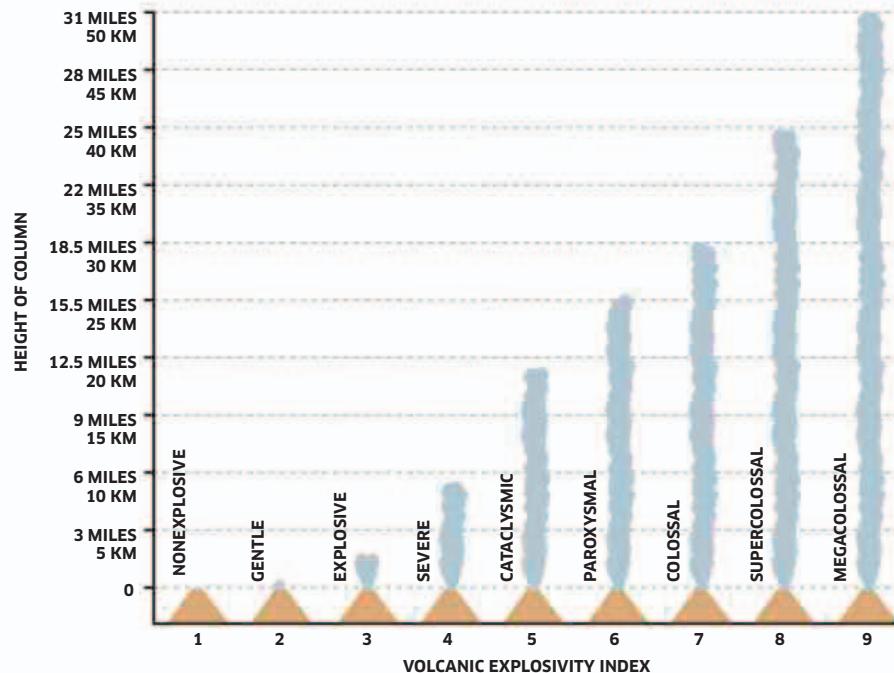
**Fissure or Icelandic**  
These are quiet, without loud explosions. They happen along long cracks in the ground.

### Ash columns

When volcanoes erupt, they can create tall columns of ash. The height of these columns varies, depending on the amount of energy in the eruption, and how much magma is thrown out. The most energetic phase of a major volcanic eruption can last for many hours.

#### How high?

Column height is one way of estimating how explosive a volcanic eruption is. Eruption types have different names and correspond to different grades of the Volcanic Explosivity Index.



### Volcanic fallout

If there is wind, a volcanic ash cloud will be blown to one side of the volcano, so that ash from the cloud falls to the ground in a belt that can extend hundreds of miles away from the volcano. Although it is cold by the time it reaches the ground, ash fallout can strip the leaves from plants and is dangerous to inhale. Aircraft must avoid flying through airborne ash, because it can clog up their engines.

#### What falls where?

The larger fragments created in an eruption, such as bombs and cinders, fall closest to the volcano. Fine ash travels the furthest.