

Are Plate Tectonics, Volcanoes, and Earthquakes Related?

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The Earth rumbles and a hiss of steam issues from the top of Mt Ruapehu. Are these two events related? Is the earthquake caused by the volcano? Or is the steam caused by the earthquake?

Tectonic plates

When Alfred Wegener first proposed the idea of continental drift, it didn't quite explain the full story. While he correctly showed that Africa and South America fitted together, his model wasn't able to explain the violent forces that occur around the Earth's crust.

It wasn't until the 1960s that a full explanation began to develop – the theory of plate tectonics. This theory explained many pieces of the puzzle that scientists had observed, for example, continental fit, the movements of the ocean floor, and the location of fossils of ancient animals and plants.

Scientists now believe that the crust of the Earth consists of rigid interconnecting plates. Plates are thought to float on the partially molten mantle, moving away from oceanic ridges where new plate material is produced and moving past each other or colliding along plate boundaries. Earthquakes and volcanoes are related to this movement.

Diverging plates

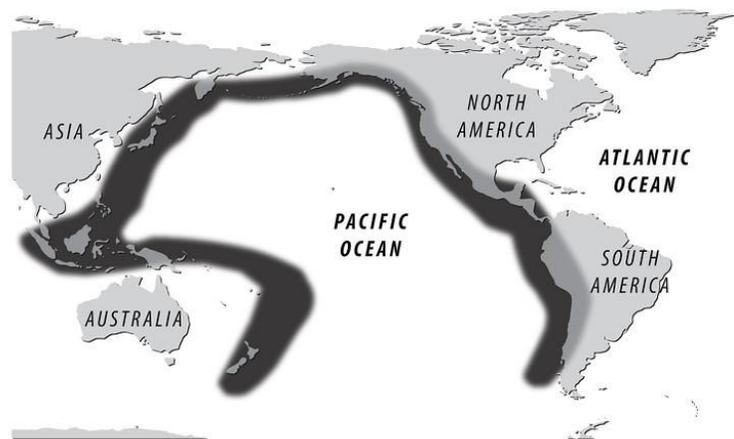
When plates move away from each other, the space between them gets filled with material, which rises to the surface, cools and forms mid-oceanic ridges. The Pacific Ocean is growing wider by about 18cm per year as the plates diverge and the mid-oceanic ridge is built up.

Colliding plates

Where plates come into contact, energy is released. Plates sliding past each other cause friction and heat. Subducting plates melt into the mantle, and diverging plates create new crust material.

Subducting plates, where one tectonic plate is being driven under another, are associated with volcanoes and earthquakes. This activity is focused along the edge of the plate boundary where two plates come into contact, forming regions such as the Pacific Ring of Fire – a chain of earthquake and volcanic activity around the edge of the Pacific Ocean – which generates 75% of the world's volcanoes and 80% of the world's earthquakes.

Ring of Fire



Subducting plates

Plate material that is produced along the ocean floor is generally quite dense and relatively heavy. When an oceanic plate is pushed towards a continental plate, it tends to subduct or dive below the continental plate. During this process, water is also being subducted with the oceanic plate. Friction increases the heat along such boundaries, which causes this material to melt and mix the oceanic plate material, the continental plate material, and the water.

Volcanoes and earthquakes

Volcanoes tend to form at subduction boundaries. As the oceanic plate collides with the continental plate, mantle rock can melt, forming liquid magma. This magma may rise upward between cracks that are caused by the plate collision, erupting at the surface as a volcano.

Earthquakes occur because plates that collide or slide past each other can get stuck. When this happens, a tremendous amount of pressure builds up. This causes stress in the Earth's crust, which in turn produces faults (breaking of rock along which movement occurs) and folds (bending of rock when squeezed together). When the plates finally snap out from being stuck, this build up of stress is released as energy.

Volcanoes and earthquakes are often found in the same place, but are they related? Does one trigger the other? The answer seems to be yes – but not always. They are sometimes linked but are often independent events.

When a volcano erupts, the pressure of the rising magma forcing its way through the crust to the surface will often trigger earthquake activity. Scientists have been able to demonstrate this link and also know what type of earthquake to look for.

Conversely, an earthquake may trigger subsequent eruptions. As the crust changes and moves in a major earthquake, fissures or cracks can form that may act as pipelines for magma and future volcanoes. This is harder to monitor and test and is an area of active research.