

Getting to Know: Evidence for Plate Tectonics

Have you ever experienced an earthquake? If you did, it was probably a memorable experience. Earthquakes range greatly in magnitude. Some earthquakes are so small that you can't feel them, but others may be severe enough to destroy entire cities.

Oddly enough, whether you have personally experienced an earthquake depends largely on where you live. Some parts of the world are prone to frequent earthquakes. Other places have earthquakes rarely or not at all. The reason for this is explained by the theory of plate tectonics.



Some earthquakes can be extremely destructive, such as this one that took place in Port au Prince, Haiti, in 2010.

What is the theory of plate tectonics?

Plate tectonic theory states that the Earth's *lithosphere*, or outer shell, is divided into several huge plates that glide on the slowly moving rock of Earth's mantle. These plates move in a number of different directions, and their movement is responsible for geological events such as mountain formation, volcanic activity, earthquakes, and continental drift.

How does Earth's structure affect plate tectonics?

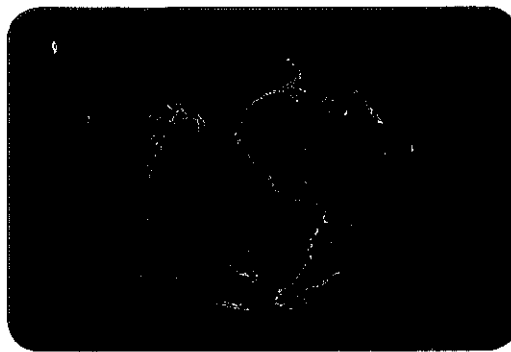
Earth is divided into several layers. At the very center is an *inner core*, which is made of very hot solid iron. Surrounding the inner core is a layer of hot, liquid rock called the *outer core*. Beyond the outer core is the *mantle*, which is cooler and less liquid than the outer core but still relatively fluid. The outer part of the mantle is a thin, hard layer that sits beneath Earth's crust. Tectonic plates are made of pieces of Earth's crust and the uppermost part of the mantle.



Misconception 1: *I always thought Earth was made of solid rock, and you could drill straight down to the core. Is that true?*

Earth's interior is made up of several layers. The outer layers are rocky and hard, but the inner layers are very hot and fluid. At the center is a solid core of iron. The extreme heat and pressure of Earth's interior would prevent drilling down to Earth's core.

The tectonic plates glide over the Earth's mantle. Material in the mantle is constantly circulating as a result of heat within the mantle. As the partially molten rock flows, the tectonic plates move as well. Sometimes the plates move away from each other, and magma underneath rises to fill the gap and form new crust. These are known as *divergent* boundaries. Other plates push against each other and one slides under the other, resulting in *subduction zones* where crust is destroyed. These are called *convergent* boundaries. Volcanoes are associated with convergent boundaries. Plates may also slide past one another at *transform* boundaries, resulting in "slip-strike" areas that are prone to frequent earthquakes.



This image shows what Earth would look like if all of the water and vegetation were removed. You can see the rising magma that indicates tectonic plate boundaries.

What evidence supports the theory of plate tectonics?

There is a great deal of scientific evidence in support of plate tectonics. For example, the movement of the continents over time has left a great deal of physical evidence. Coastlines on opposite continents appear to fit together like puzzle pieces, indicating that they were once joined. The fossil record also supports the theory of continental movement. Rocks and fossils found in South America, for example, match those found in Africa, although there is an ocean in between. This also indicates that the two continents were once joined.

Other evidence of plate tectonics includes *seafloor spreading*, which involves the creation of new crust at divergent plate boundaries. As the plates move apart, magma flows out and forms new crust. This crust eventually spreads out and moves away from the boundaries. As a result, crust that is farther from the plate edge is older than crust that is closer to the plate edge. The crust is eventually destroyed in subduction zones at convergent boundaries, where it is pushed down into the mantle and melts to become magma.

Volcanic activity and earthquakes are also evidence of plate tectonics. Divergent and convergent boundaries are both prone to frequent volcanic activity. Earthquakes occur frequently at transform boundaries because the plates are constantly moving past each other. The rubbing of the plates produces the tremors that we feel as earthquakes.



Misconception 2: Does the lava in volcanoes come straight from Earth's core?

Earth's core is made of solid iron, not magma, so lava cannot come directly from the core. Actually, most of the magma chambers that feed volcanoes are found in Earth's crust. However, a few magma chambers, located at areas called *hot spots*, transport molten rock from the upper mantle.