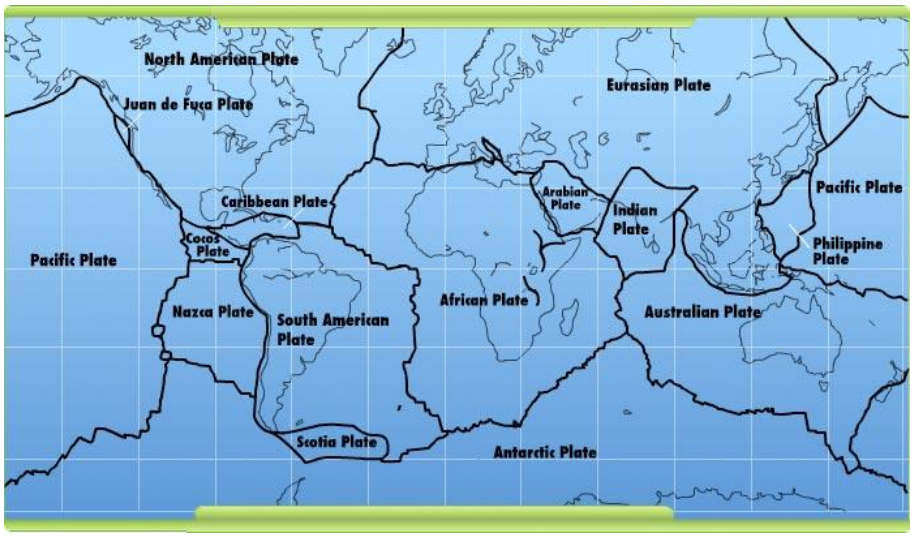
Plates & Boundaries

The earth's continents are constantly moving due to the motions of the tectonic plates.

As you can see, some of the plates contain continents and others are mostly under the ocean. The type of crust that underlies the continents is called **continental crust**, while the type found under the oceans is called **oceanic crust**. Continental crust is thicker — about 20 to 40 miles (35 to 70 km) thick — and usually older than oceanic crust, which is only 4 to 6 miles (7 to 10 km) thick. All the plates have names, usually referring to landmasses, oceans, or regions of the globe where they are located.



Slip, Slide, & Collide

The border between two tectonic plates is called a **boundary**. All the tectonic plates are constantly moving — very slowly — around the planet, but in many different directions. Some are moving toward each other, some are moving apart, and some are sliding past each other. Because of these differences, tectonic plate boundaries are grouped into three main types.

Red-hot lava and plumes of ash spew out of a volcano in the Philippines. An undersea earthquake in the Indian Ocean spawns a tsunami that crashes into Indonesia. The Himalayan Mountains grow taller every year.

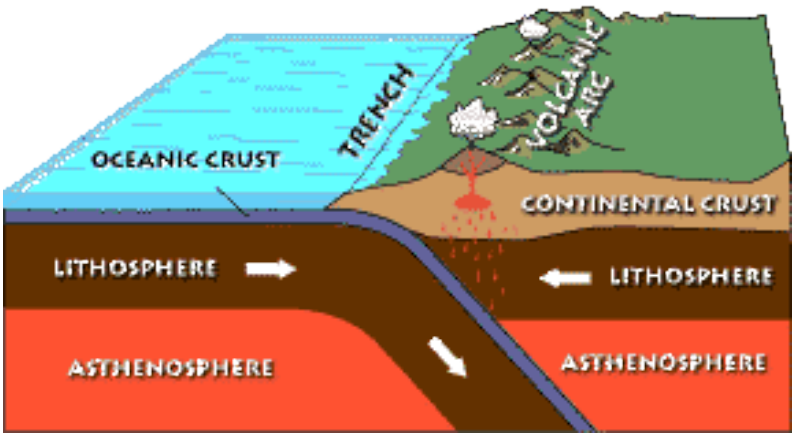
Many of the most dramatic geological phenomena we experience on Earth — volcanic eruptions, earthquakes, tsunamis, and more — are caused by the slipping, sliding, and colliding of tectonic plates.

As you might expect by now, most major geologic events occur at the boundaries between tectonic plates, where huge, massive pieces of the earth's crust interact. Each kind of plate boundary is associated with particular events, so if you know about the movements taking place at a plate boundary, you can often predict what's likely to occur there — volcanoes, earthquakes, mountains, trenches — in the future!

Convergent Boundaries — Colliding Plates

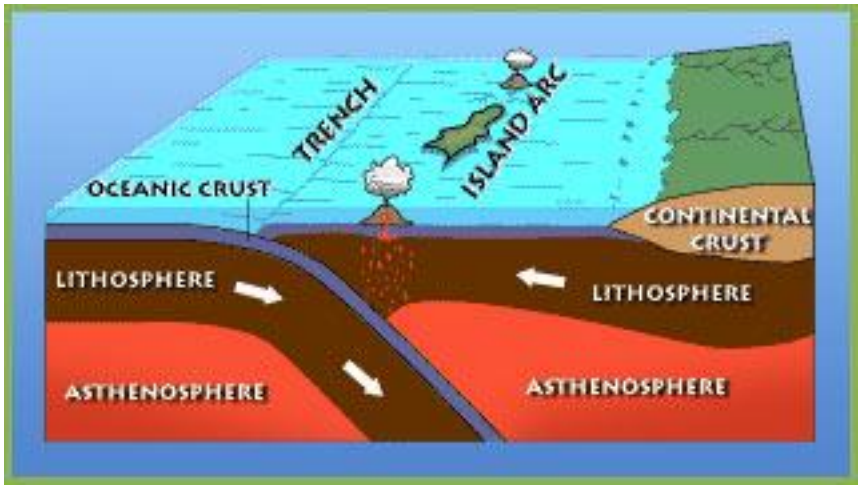
At convergent boundaries, tectonic plates collide with each other. The events that occur at these boundaries are linked to the types of plates — oceanic or continental — that are interacting.

(Continental Crust—Oceanic Crust)



At some convergent boundaries, an oceanic plate collides with a continental plate. Oceanic crust tends to be denser and thinner than continental crust, so the denser oceanic crust gets bent and pulled under, or subducted, beneath the lighter and thicker continental crust. This forms what is called a **subduction zone**. As the oceanic crust sinks, a deep oceanic **trench**, or valley, is formed at the edge of the continent. The crust continues to be forced deeper into the earth, where high heat and pressure cause trapped water and other gasses to be released from it. This, in turn, makes the base of the crust melt, forming **magma**.

The magma formed at a subduction zone rises up toward the earth's surface and builds up in magma chambers, where it feeds and creates **volcanoes** on the overriding plate. When this magma finds its way to the surface through a vent in the crust, the volcano erupts, expelling lava and ash. An example of this is the band of active volcanoes that encircle the Pacific Ocean, often referred to as the Ring of Fire.



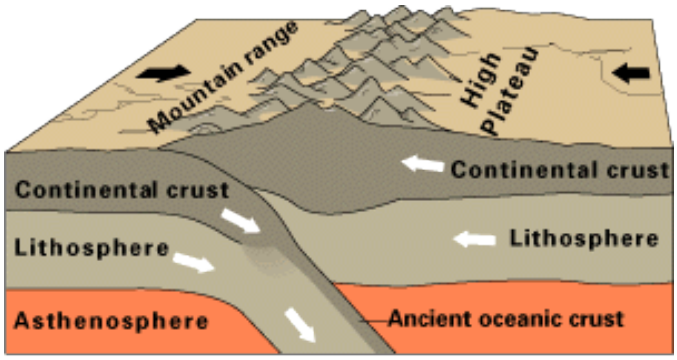
(Oceanic Crust—Oceanic Crust)

A subduction zone is also generated when two oceanic plates collide — the older plate is forced under the younger one — and it leads to the formation of chains of volcanic islands known as **island arcs**. Examples include the Mariana Islands in the western Pacific Ocean and the Aleutian Islands, off the coast of Alaska.

Since the collision and subduction of plates is not a smooth process, large, powerful earthquakes are another phenomenon that result from this type of interaction. Earthquakes generated in a subduction zone can also give rise to tsunamis. A **tsunami** is a huge ocean wave caused by a sudden shift on the ocean floor, such as an undersea earthquake. If the wave reaches land, it can cause incredible destruction, like the Asian Tsunami, which killed more than 200,000 people in 11 countries across the Indian Ocean region in December 2004.

(Continental Crust—Continental Crust)

What happens when two continental plates collide? Because the rock making up continental plates is generally lighter and less dense than oceanic rock, it is too light to get pulled under the earth and turned into magma. Instead, a collision between two continental plates crunches and folds the rock at the boundary, lifting it up and leading to the formation of mountains and mountain ranges.



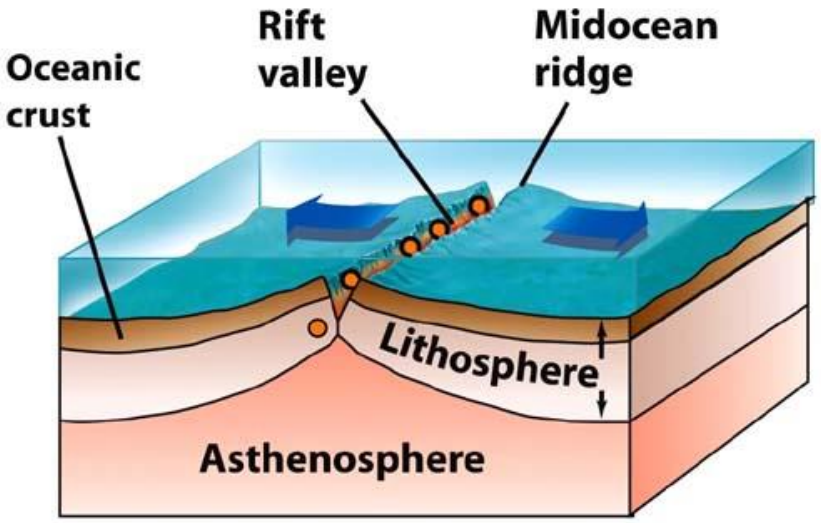
Continental-continental convergence

Divergent Boundaries — Spreading Plates

At divergent boundaries, tectonic plates are moving away from each other. But if these huge masses of crust are moving apart, what happens in the space left between them?

Seafloor Spreading

Divergent boundaries in the middle of the ocean contribute to **seafloor spreading**. As plates made of oceanic crust pull apart, a crack in the ocean floor appears. Magma then oozes up from the mantle to fill in the space between the plates, forming a raised ridge called a **mid-ocean ridge**. The magma also spreads outward, forming new ocean floor and new oceanic crust. The Mid-Atlantic Ridge, part of the mid-ocean ridge, is an example of a divergent plate boundary.



DIVERGENT BOUNDARY

Rifts

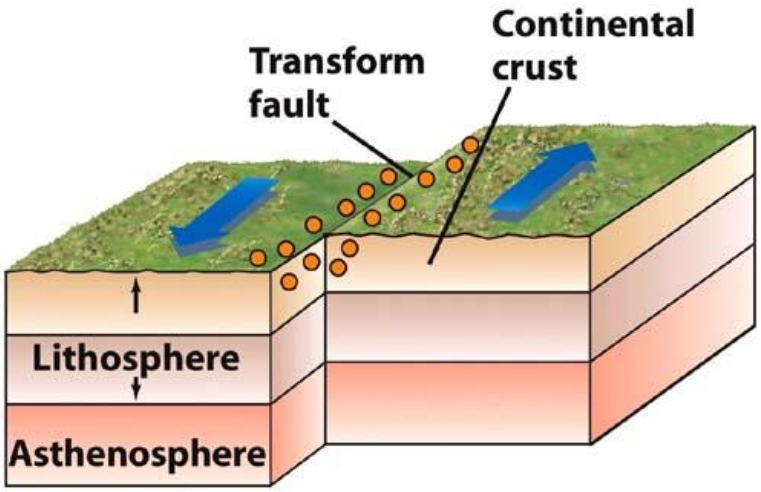
When two continental plates diverge, a valley-like rift develops. This **rift** is a dropped zone where the plates are pulling apart. As the crust widens and thins, valleys form in and around the area, as do volcanoes, which may become increasingly active. Early in the rift formation, streams and rivers flow into the low valleys and long, narrow lakes can be created. Eventually, the widening crust along the boundary may become thin enough that a piece of the continent breaks off, forming a new tectonic plate. At this point, water from the ocean will rush in, forming a new sea or ocean basin in the rift zone.

Transform Boundaries — Grinding Plates

At transform boundaries, tectonic plates are not moving directly toward or directly away from each other. Instead, two tectonic plates grind past each other in a horizontal direction. This kind of boundary results in a **fault** — a crack or fracture in the earth's crust that is associated with this movement.

Faults and Earthquakes

Transform boundaries and the resulting faults produce many earthquakes because edges of tectonic plates are jagged rather than smooth. As the plates grind past each other, the jagged edges strike each other, catch, and stick, "locking" the plates in place for a time. Because the plates are locked together without moving, a lot of stress builds up at the fault line. This stress is released in quick bursts when the plates suddenly slip into new positions. The sudden movement is what we feel as the shaking and trembling of an **earthquake**.



TRANSFORM FAULT BOUNDARY

The motion of the plates at a transform boundary has given this type of fault another name — a **strike-slip fault**. The best-studied strike-slip fault is the San Andreas Fault in California. It is located at the boundary between the Pacific and North American plates and runs roughly 800 miles (1,300 km) through Northern and Southern California. As the two plates grind past each other — the Pacific Plate moving northwest and the North American Plate moving southeast — the motion produces numerous earthquakes along the fault. While many are small and cause only minor trembling, the San Andreas Fault has also been the site of major events: the 1857 Fort Tejon earthquake, the 1906 San Francisco earthquake and fire, and the 1989 Loma Prieta earthquake. Many scientists believe that the San Andreas Fault is due to unleash another large earthquake — a "big one" — in the coming decades.