

# PLATE TECTONICS AND PLATE BOUNDARIES

VIDEO AND INFORMATIONAL TEXT NOTES

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Your drive folders contains tons of information.

**Some important ideas that should be noted are:**

Convection currents from the mantle including crust and mantle

Details of oceanic crust

Details of continental crust

Convergent plate boundaries

Divergent plate boundaries

Can you locate each boundary type on the Earth's surface? I will have maps in the classroom during the activity.

**Convergent plate boundaries are locations where lithospheric plates are moving towards one another. The plate collisions that occur in these areas can produce earthquakes, volcanic activity and crustal deformation.**

### **Convergent Plate Boundary - Oceanic and Continental Plates**

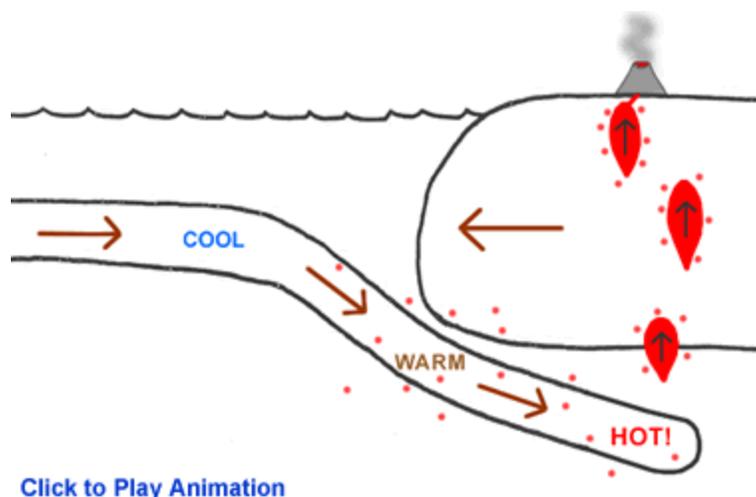
When continental and oceanic plates collide the thinner and more dense oceanic plate is overridden by the thicker and less dense continental plate. The oceanic plate is forced down into the mantle in a process known as "subduction". As the oceanic plate descends it is forced into higher temperature environments. At a depth of about 100 miles (160 km) materials in the subducting plate begin to approach their melting temperatures and a process of partial melting begins.

This partial melting produces magma chambers above the subducting oceanic plate. These magma chambers are less dense than the surrounding mantle materials and are buoyant. The buoyant magma chambers begin a slow ascent through the overlying materials, melting and fracturing their way upwards. The size and depth of these magma chambers can be determined by mapping the earthquake activity around them. If a magma chamber rises to the surface without solidifying the magma will break through in the form of a volcanic eruption.

The Washington-Oregon coastline of the United States is an example of this type of convergent plate boundary. Here the Juan de Fuca oceanic plate is subducting beneath the westward moving North American continental plate. The Cascade Mountain Range is a line of volcanoes above the melting oceanic plate. The Andes Mountain Range of western South America is another example of a convergent boundary between an oceanic and continental plate. Here the Nazca Plate is subducting beneath the South American plate.

Two locations show this type of plate boundary - the Cascade volcanoes along the Washington-Oregon coast of North America and the Andes mountain range on the western margin of South America.

Effects of a convergent boundary between an oceanic and continental plate include: a zone of earthquake activity that is shallow along the continent margin but deepens beneath the continent, sometimes an ocean trench immediately off shore of the continent, a line of volcanic eruptions a few hundred miles inland from the shoreline, destruction of oceanic lithosphere.



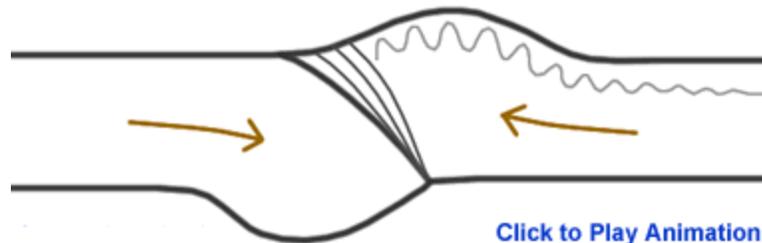
## Convergent Plate Boundary - Continental plates

This is a difficult boundary to draw. First it is complex and second, it is poorly understood when compared to the other types of plate boundaries. In this type of convergent boundary a powerful collision occurs. The two thick continental plates collide and both of them have a density that is much lower than the mantle, which prevents subduction (there may be a small amount of subduction or the heavier lithosphere below the continental crust might break free from the crust and subduct).

Fragments of crust or continent margin sediments might be caught in the collision zone between the continents forming a highly deformed melange of rock. The intense compression can also cause extensive folding and faulting of rocks within the two colliding plates. This deformation can extend hundreds of miles into the plate interior.

The Himalaya Mountain Range is the best active example of this type of plate boundary. The Appalachian Mountain Range is an ancient example of this collision type.

Effects found at a convergent boundary between continental plates include: intense folding and faulting, a broad folded mountain range, shallow earthquake activity, shortening and thickening of the plates within the collision zone.



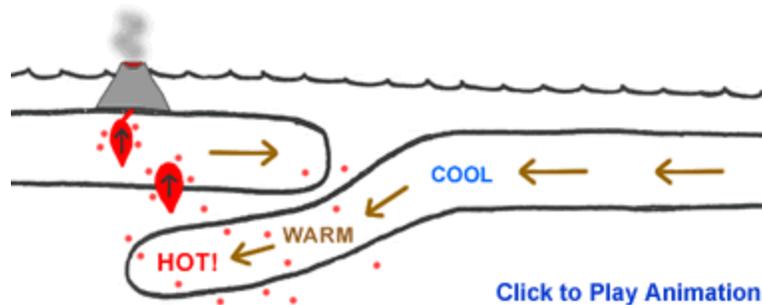
<http://geology.com/nsta/convergent-plate-boundaries.shtml>

### Convergent Plate Boundary - Oceanic plates

When a convergent boundary occurs between two oceanic plates one of those plates will subduct beneath the other. Normally the older plate will subduct because of its higher density. The subducting plate is heated as it is forced deeper into the mantle and at a depth of about 100 miles (150 km) the plate begins to melt. Magma chambers are produced as a result of this melting and the magma is lower in density than the surrounding rock material. It begins ascending by melting and fracturing its way through the overlying rock material. Magma chambers that reach the surface break through to form a volcanic eruption cone. In the early stages of this type of boundary the cones will be deep beneath the ocean surface but later grow to be higher than sea level. This produces an island chain. With continued development the islands grow larger, merge and an elongate landmass is created.

Japan, the Aleutian islands and the Eastern Caribbean islands of Martinique, St. Lucia and St. Vincent and the Grenadines are examples of islands formed through this type of plate boundary.

Effects that are found at this type of plate boundary include: a zone of progressively deeper earthquakes, an oceanic trench, a chain of volcanic islands, and the destruction of oceanic lithosphere.



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## Divergent Plate Boundary – Oceanic plates

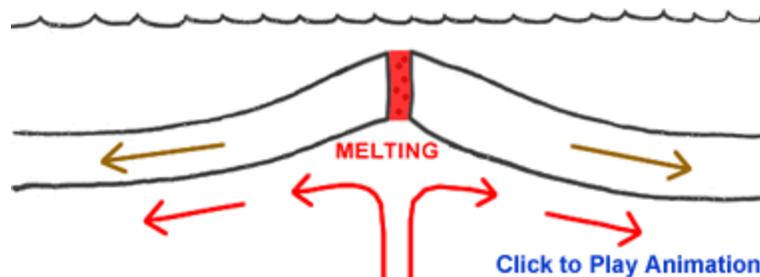
Divergent plate boundaries are locations where plates are moving away from one another. This occurs above rising convection currents. The rising current pushes up on the bottom of the lithosphere, lifting it and flowing laterally beneath it. This lateral flow causes the plate material above to be dragged along in the direction of flow. At the crest of the uplift, the overlying plate is stretched thin, breaks and pulls apart.

When a divergent boundary occurs beneath oceanic lithosphere, the rising convection current below lifts the lithosphere producing a mid-ocean ridge. Extensional forces stretch the lithosphere and produce a deep fissure. When the fissure opens, pressure is reduced on the super-heated mantle material below. It responds by melting and the new magma flows into the fissure. The magma then solidifies and the process repeats itself.

The Mid-Atlantic Ridge is a classic example of this type of plate boundary. The Ridge is a high area compared to the surrounding seafloor because of the lift from the convection current below. (A frequent misconception is that the Ridge is a build-up of volcanic materials, however, the magma that fills the fissure does not flood extensively over the ocean floor and stack up to form a topographic high. Instead, it fills the fissure and solidifies. When the next eruption occurs, the fissure most likely develops down the center of the cooling magma plug with half of the newly solidified material being attached to the end of each plate.

Visit the Interactive Plate Boundary Map to explore satellite images of divergent boundaries between oceanic plates. Two locations are marked: 1) the Mid-Atlantic Ridge exposed above sea level on the island of Iceland, and 2) the Mid-Atlantic Ridge between North America and Africa.

Effects that are found at a divergent boundary between oceanic plates include: a submarine mountain range such as the Mid-Atlantic Ridge; volcanic activity in the form of fissure eruptions; shallow earthquake activity; creation of new seafloor and a widening ocean basin.



<http://geology.com/nsta/divergent-plate-boundaries.shtml>

Bill Nye Seafloor Spreading

<https://www.youtube.com/watch?v=GyMLILxbfa4&list=PLZ010NAkhFGOizjhtzr2ikPikEUummX>

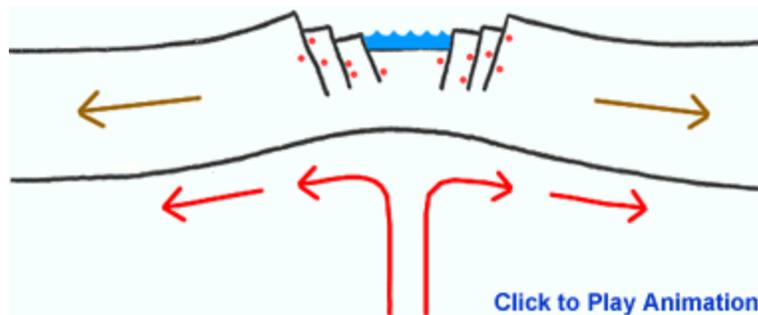
## Divergent Plate Boundary – Continental plates

When a divergent boundary occurs beneath a thick continental plate, the pull-apart is not vigorous enough to create a clean, single break through the thick plate material. Here the thick continental plate is arched upwards from the convection current's lift, pulled thin by extensional forces, and fractured into a rift-shaped structure. As the two plates pull apart, normal faults develop on both sides of the rift and the central blocks slide downwards. Earthquakes occur as a result of this fracturing and movement. Early in the rift-forming process, streams and rivers will flow into the sinking rift valley to form a long linear lake. As the rift grows deeper it might drop below sea level allowing ocean waters to flow in. This will produce a narrow, shallow sea within the rift. This rift can then grow deeper and wider. If rifting continues a new ocean basin could be produced.

The East Africa Rift Valley is a classic example of this type of plate boundary. The East Africa Rift is in a very early stage of development. The plate has not been completely rifted and the rift valley is still above sea level but occupied by lakes at several locations. The Red Sea is an example of a more completely developed rift. There the plates have fully separated and the central rift valley has dropped below sea level.

Two locations of a rift valley is of East Africa and another location is within the Red Sea.

Effects that are found at this type of plate boundary include: a rift valley sometimes occupied by a long linear lakes or a shallow arm of the ocean, numerous normal faults bounding a central rift valley and shallow earthquake activity along the normal faults. Volcanic activity sometimes occurs within the rift.



<http://geology.com/nsta/divergent-plate-boundaries.shtml>

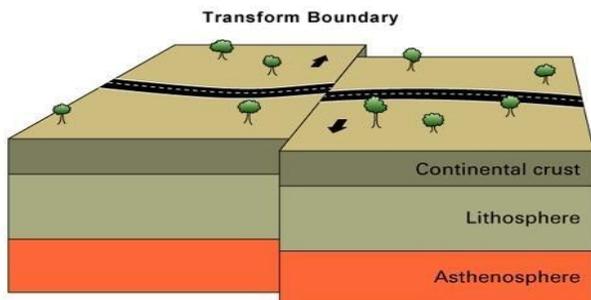
## Transform Plate Boundary

**Transform Plate Boundaries** are locations where two plates slide past one another. The fracture zone that forms a transform plate boundary is known as a transform fault. Most transform faults are found in the ocean basin and connect offsets in the mid-ocean ridges. A smaller number connect mid-ocean ridges and subduction zones.

Transform faults can be distinguished because the sense of movement is in the opposite direction (see illustration at right). A transform fault is formed between two different plates, each moving away from the spreading center of a divergent plate boundary. When you look at the transform fault diagram above, imagine the double line as a divergent plate boundary and visualize which way the diverging plates would be moving. A smaller number of transform faults cut continental lithosphere. The most famous example of this is the San Andreas Fault Zone of western North America. The San Andreas connects a divergent boundary in the Gulf of California with the Cascadia subduction zone. Another example of a transform boundary on land is the Alpine Fault of New Zealand.

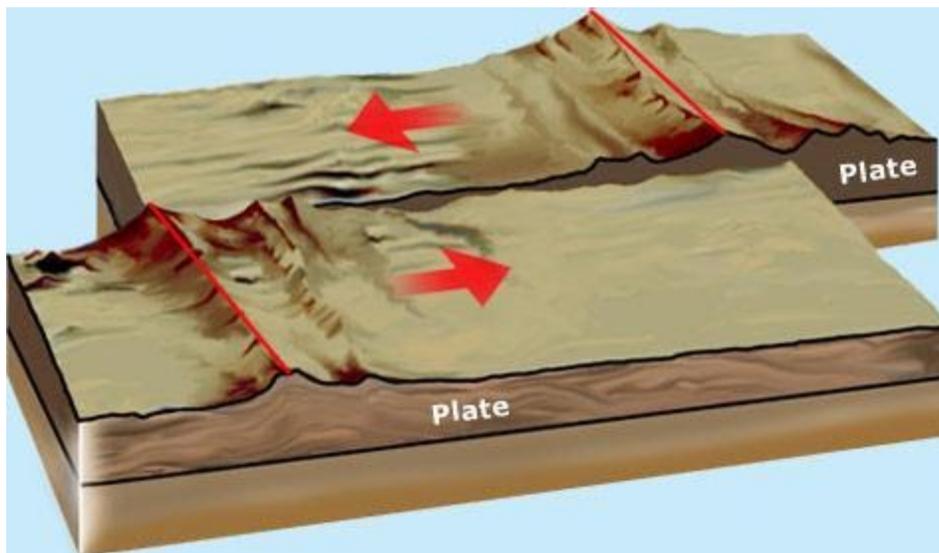
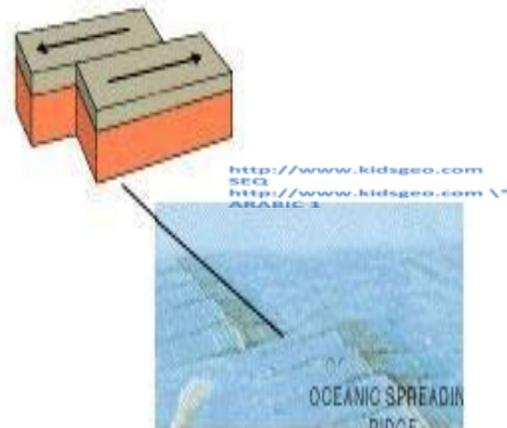
Transform faults are locations of recurring earthquake activity and faulting. The earthquakes are usually shallow because they occur within and between plates that are not involved in subduction. Volcanic activity is normally not present because the typical magma sources of an upwelling convection current or a melting subducting plate are not present.

<http://geology.com/nsta/transform-plate-boundaries.shtml>



As plates move around on Earth's surface, there are places where, rather than converge or diverge, the plates grind past each other. This may occur as perpendicular offsets at spreading boundaries or as the boundary itself. The most well known example of this type is the San Andreas Fault in California.

Source: The SAGUARO Project



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