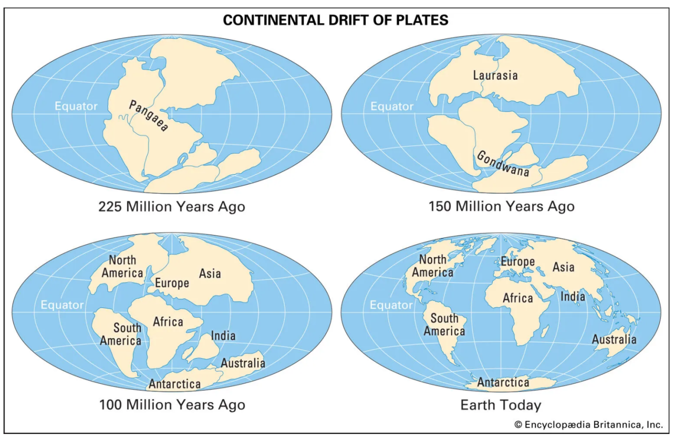
The **Continental Drift hypothesis** paved the way for the emergence and acceptance of the plate tectonics theory. It was proposed by a German meteorologist and geophysicist named **Alfred Wegener**.

Wegener hypothesized that long ago, there was a supercontinent that consisted of all landmasses on Earth. He named this supercontinent **Pangaea** (from the Greek words *pan* meaning "all" and *gaia* meaning "land"). He and other supporters of the continental drift hypothesis collected evidence to substantiate their claims.

Evidence of the Continental Drift Hypothesis

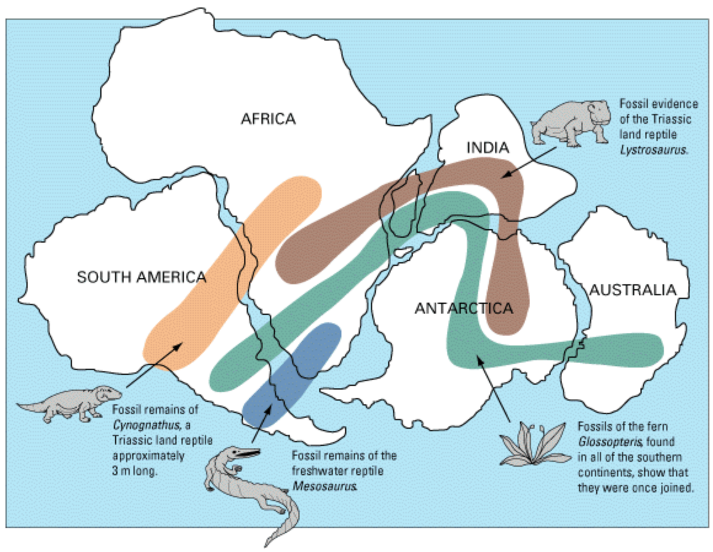
Evidence #1. Continental Jigsaw Puzzle



Credit: Encyclopedia Britannica

If you take the boundaries of each continent and try to fit them together, you'd get a landmass similar to the configuration of Pangaea. Wegener argued that the remarkable fit of the continents was more than a coincidence, citing the almost perfect fit of South America and Africa.

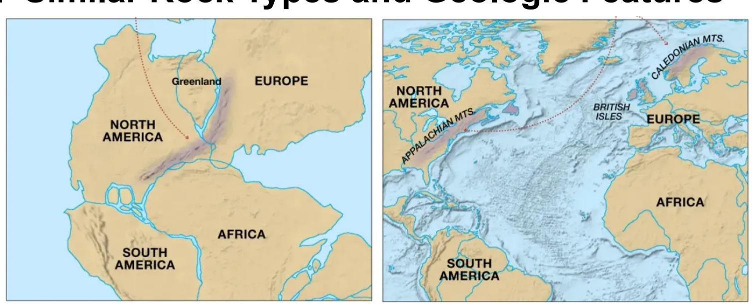
Evidence #2. Fossils



Credit: [USGS]

Similar fossil remains of plants and animals were found on continents that are currently separated by large bodies of water. Paleontologists agreed that these organisms wouldn't have been able to cross these oceans due to inherent characteristics (e.g., the Mesosaurus lived only in freshwater, the Glossopteris seeds were too heavy to be carried by the wind across great distances, etc.).

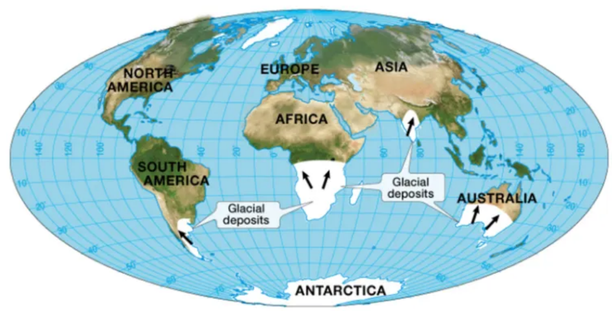
Evidence #3. Similar Rock Types and Geologic Features



Credit: SOEST Hawaii

Large mountain belts of similar ages and rock types could be matched with each other across continents. This is the case with the Appalachian Mountains in the eastern margin of North America being similar to the Caledonian Mountains in the western margin of Scandinavia.

Evidence #4. Ancient Climates

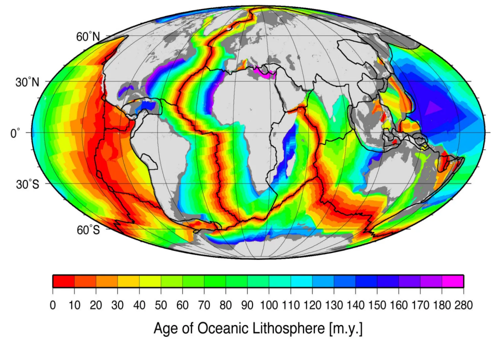
THEN	NOW
	

According to Wegener, evidence suggesting that there were glaciers before in present-day continents (such as Africa, South America, and Australia) located in the equator supported continental drift. However, the opposition to the hypothesis suggested that this may be due to a period of extreme global cooling.

Wegener asserted that this was not the case because there was also evidence showing that large tropical swamps co-existed with the glaciers at the time.

Despite all this evidence, the continental drift hypothesis was still not accepted by the scientific community mostly because of one problem: **Wegener could not explain *how* the continents drifted.** It wasn't until after his death would the mystery be solved.

The Development of the Plate Tectonics Theory

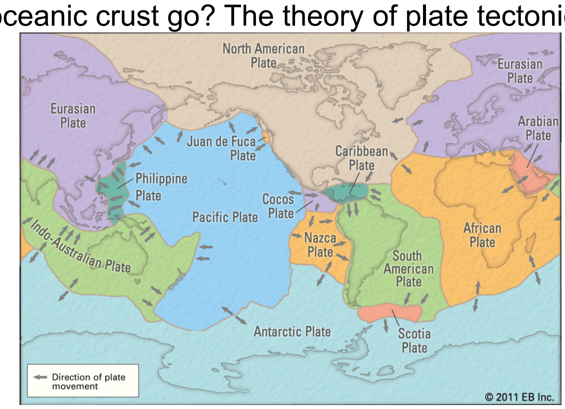


Credit: NOAA

After World War II, extensive ocean exploration led to the discovery of the global **oceanic ridge system** which spans around the globe, making it the longest mountain range in the world (around 80,000 km long).

New oceanic crust forms in the axis of this ridge system. Because of this, rocks become progressively older and thicker with sediment away from the axis. This phenomenon was termed as **seafloor spreading** by Harry Hess and Robert Dietz.

However, the dredging of the ocean floor showed that the oldest oceanic crust was no more than 180 million years old. If the new oceanic crust was constantly being generated along the ridge, where did the old oceanic crust go? The theory of plate tectonics addresses this question.



Credit: Encyclopedia Britannica

The plate tectonics model states that the lithosphere is broken up into rigid slabs called **tectonic plates** or simply **plates**. These plates overlie the ductile asthenosphere, allowing them to be in constant motion with respect to one another.

There are seven major plates which cover 94% of the Earth's surface area:

1. African plate
2. Antarctic plate
3. Eurasian plate
4. Indo-Australian plate
5. North American plate
6. Pacific Plate
7. South American plate

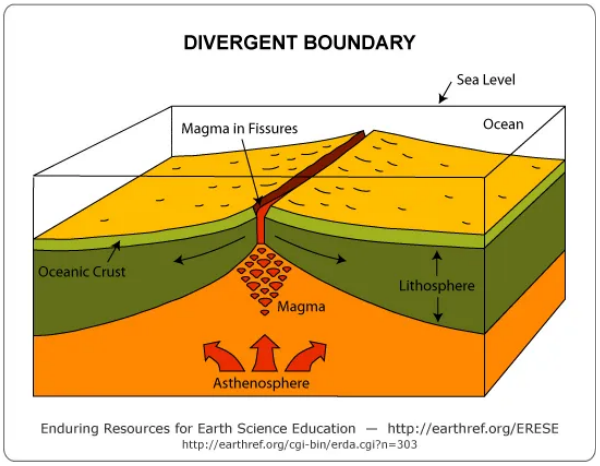
There are also minor plates such as the **Philippine Sea plate**, Juan de Fuca plate, Cocos plate, Nazca plate, Scotia plate, and Arabian plate.

As mentioned earlier, plates are always in constant motion. Because of this, the margins of the plates are always interacting with one another. The sites where these margins interact are called **plate boundaries**.

Three Main Types of Plate Boundaries.

1. Divergent Plate Boundaries (constructive margins).

Divergent plate boundaries are formed when two plates move apart relative to each other. These plate boundaries are also called **constructive margins** because the pulling apart of two plates results in the migration of molten material from the mantle to the surface, generating new crust. Divergent boundaries can be found both on the ocean floor and inland.

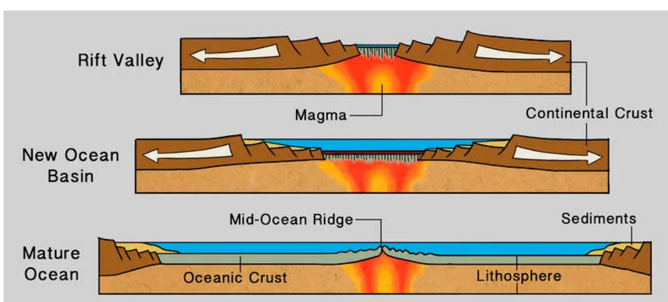


Credit: [ERSE]

Divergent boundaries on the ocean floor manifest as the oceanic ridge system, which was discussed earlier.

New seafloor is generated via seafloor spreading. As the seafloor gets older, it gets denser and moves toward the edge of the plate. Simply put, younger oceanic crust is hot and therefore less dense, while the older oceanic crust is cooler and denser.

The rate of spreading varies along the oceanic ridge system, going as slow as 2 cm/year or as fast as 15 cm/year.



Credit: [CK-12 Foundation]

Divergent boundaries that occur within a continent generates an elongated depression called a **continental rift**. These rifts form by the stretching and thinning out of the lithosphere.

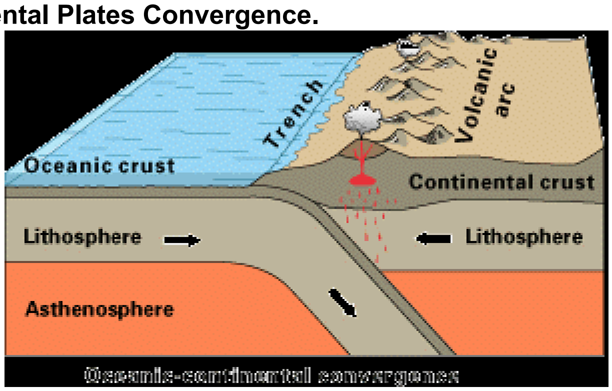
The rift valleys can grow wide enough to split the continent apart, producing large depressions. These depressions would eventually be filled up with water, producing new ocean basins.

A good modern-day example of continental rifting at work is the Red Sea in the East African Rift in Eastern Africa.

2. Convergent Boundaries (destructive margins).

Convergent boundaries are the sites where plates move towards each other, resulting in a collision or one plate going under the other in a process called **subduction**. They are called **destructive margins** because the crust is consumed in the process. There are three scenarios in which convergence could occur:

a. Oceanic-Continental Plates Convergence.



Credit: USGS

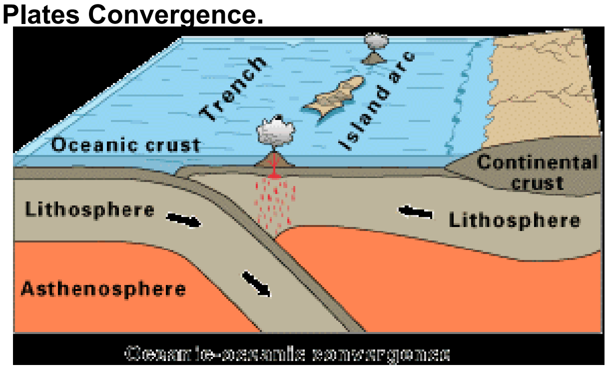
This set-up answers our question from earlier: *Where does the old oceanic crust go?*

In this case, the denser or heavier block subducts or goes underneath the lesser dense block. Because the oceanic crust is made up of basalt, it subducts underneath the continental crust made up of the lighter granitic material in a zone called the **subduction zone**.

In a subduction zone, **partial melting** is induced in the overlying continental crust, producing volcanic activity called **continental volcanic arcs**. The subduction of the oceanic crust usually results in large, deep linear depressions on the ocean floor called **deep-ocean trenches**.

The deepest oceanic trench in the world is the Marianas Trench in the western Pacific Ocean with a depth of nearly 11,000 km, deeper than the height of Mt. Everest (8,800 km).

b. Oceanic-Oceanic Plates Convergence.



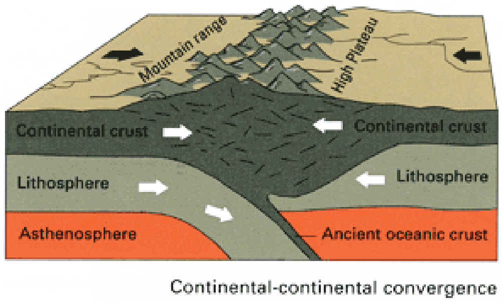
Credit: [USGS]

When two oceanic plates collide, the older and denser one subducts.

Much like oceanic-continental convergence, the subduction of one plate generates volcanism which forms a chain of volcanic islands called a **volcanic island arc** or simply an **island arc**.

Most of the island arcs are located in the western portion of the Pacific Ocean, while a few can be found in the Atlantic Ocean.

c. Continental-Continental Plates Convergence.

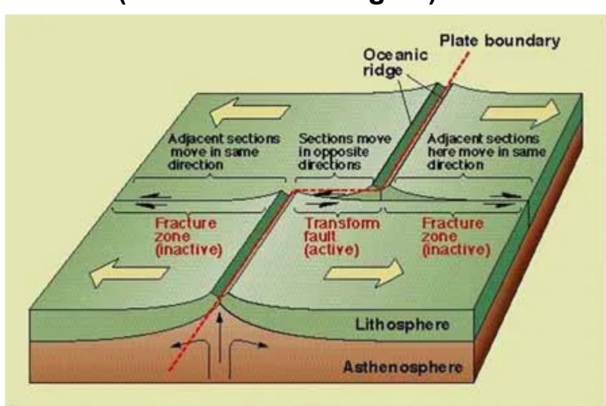


Credit: [USGS]

Because continental crust is too thick and buoyant to be subducted, the majority of the crustal material is deformed and pushed up instead. This results in the accumulation of sediments and rocks along the margin, forming mountain belts in a process called **orogeny**.

The most famous example of this would be the Himalayan mountain range formed from the collision of the Indian and Eurasian plates nearly 50 million years ago.

3. Transform Plate Boundaries (conservative margins)

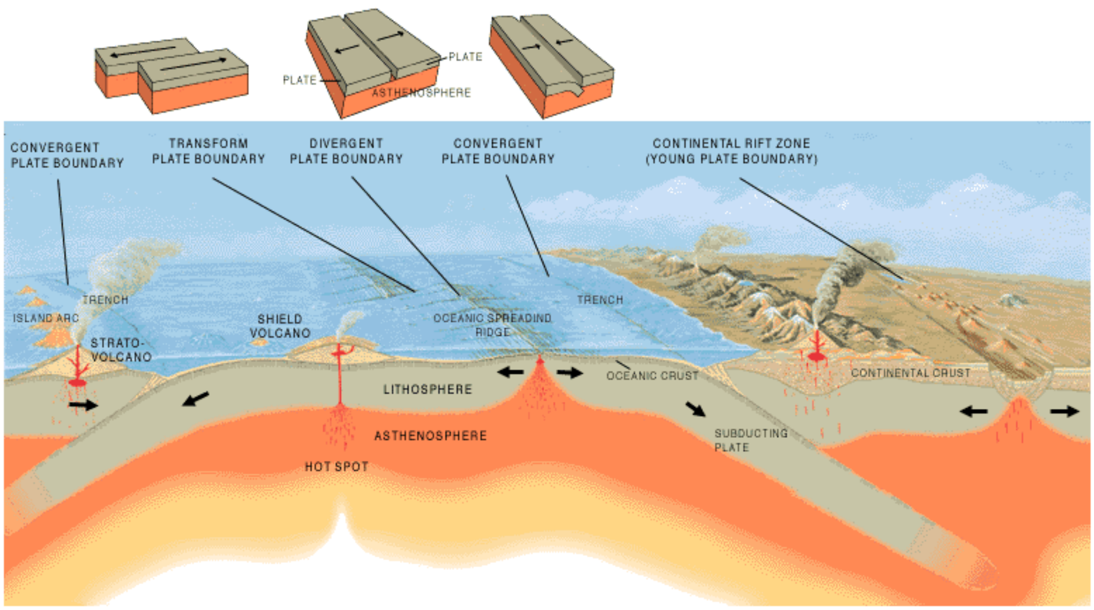


Credit: [The University of Sydney]

These plate boundaries are characterized by two plates sliding past each other, not destroying or producing new crustal material. They are also called **transform faults** and are usually found in fracture zones.

Fracture zones are linear breaks on the ocean floor that run perpendicular to oceanic ridges. An active transform fault lies between the two offset oceanic ridges, while the areas beyond the ridge zones are **inactive zones.**

Below is a diagram showing how different plate boundary types interact with one another:



Credit: USGS