

Continental Drift Theory

- Abraham Ortelius

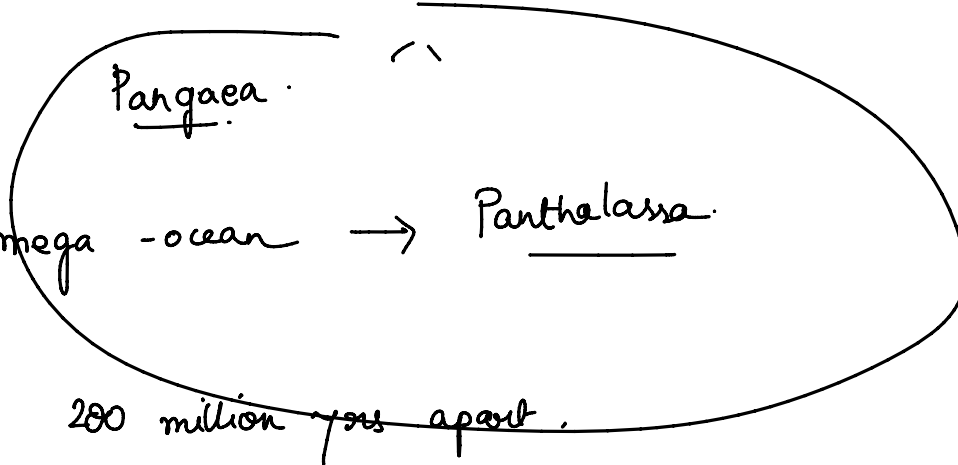
↳ Dutch mapmaker - 1596.

- Antonio Pellegrini

↳

- Alfred Wegener

1912 German meteorologist.



① Laurasia [N]

② Gondwana land (S).

- Pieces of puzzles.

Africa + South America.

- Same age of Rocks.

Brazilian coast 2000 ^{million} yrs ago.

western Africa

→ similar marine deposits
South America.

African continents

- Tillite. ✓

↳ deposits of glaciers.

- Placer Deposits.

coast of Ghana (gold mines).

Brazilian coast (")

• Distribution of fossils:

Lemurs (Madagascar).
(India + Africa) } Lemuria.

Mesosaurus . → Permian times.
shallow saline water bodies.

South America.

South Africa and Brazil.

Force for Drifting

- Rotation of the Earth.
- Tidal force.

After the W.W II, post drift studies.

Arthur Holmes:

↳ Conventional current theory (1930s).

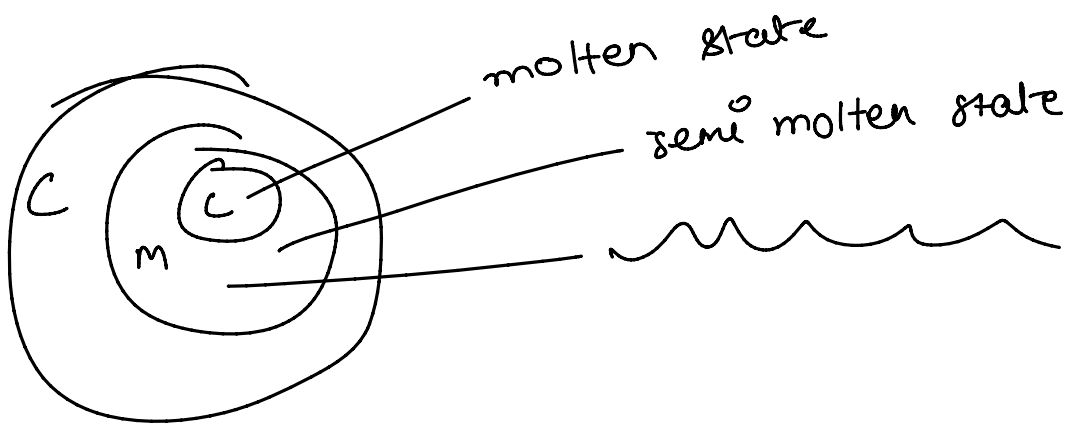


Plate Tectonics Theory

1960s: ↳ continental + oceanic plates.

outer layer → lithosphere (60 miles)
(100 kms)

mantle → Asthenosphere (semi molten state).

1967.

- Pacific Plate:
- Eurasian plate.

Major.

- Antarctic.
- N. American
- S. " plate
- Pacific "
- India - Australia - N. Zealand
- Africa (east - African plate)
- Eurasian tectonic plate.

Minor.

- Arabian Plate
- Cocos "
- [C. America and Pacific Plate]
- Nazca "
- [S. America & Pacific Plate]
- Philippine "
- [S. America & P. plate.]
- Caroline "
- [Philippine and Indian plate]
- Fiji "

[Northeast of Australia)

• Juan De Fuca)

(S. east of North American plate) .

T. Plate Boundary

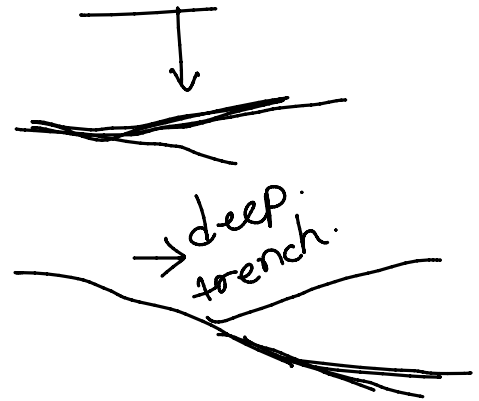
• Convergent

↳ cold

↳ destructive

boundary .

↳ subduction zones .



E.g Himalayan mountain range
50 million years ago

India + Asia → ←

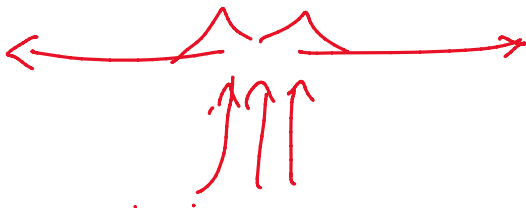
The diagram shows the text 'India + Asia' followed by two arrows pointing towards each other. Above the arrows, a simple sketch of a mountain range is drawn, representing the Himalayas.

Mariana Trench . \rightarrow oceanic - oceanic
convergent boundary .
 \rightarrow deepest
point on Earth.

Divergent Boundaries.



constructive boundaries.

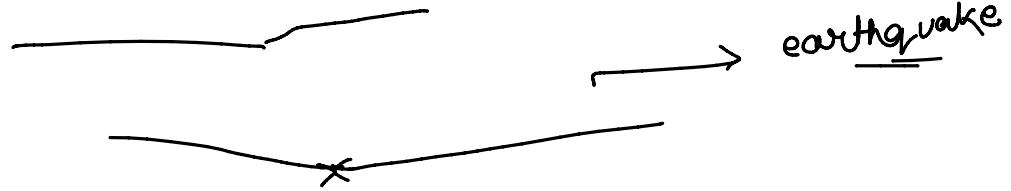


• Mid - Atlantic Ridge

\rightarrow American tectonic plates from (African
tectonic plates + Eurasian
tectonic plates).

• The Great Rift Valley - Africa.

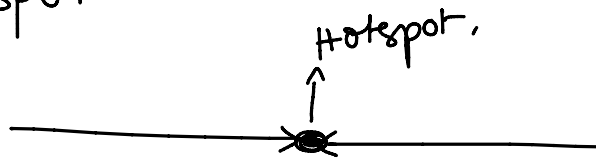
Transform Boundaries



1901 San Francisco. (got destroyed).

Rings of Fire → Pacific Ocean.

Hotspot.



40 to 50

• Afar Hotspot → N. Ethiopia

• Reunion Hotspot → below the Reunion Island
[Indian Ocean]

Pangaea [all lands]

Parthalassa [all seas]

New York was on the equator millions of years ago.

Antarctica was once a rainforest.

India broke away from Africa, slammed into Eurasia.

Atlantic Ocean is getting wider by an inch a year
and Pacific Ocean shrinking.

France is slowly tilting northwards.

→ between Zaire and East Africa.

Andes Mountains of South America are rising.

Surtsey → volcanic island 1963.
↳ Iceland.

Intra plate volcanoes.

↳ Hawaiian Islands. (volcanic chain)

Notes on Continental Drift Theory, Sea floor Spreading and Plate Tectonics

Continental Drift Theory

Theorists -

- Abraham Ortelius -

This possibility of one single continent was first predicted by the famous Dutch mapmaker Abraham Ortelius in 1596.

- Antonio Pellegrini -

Then, Antonio Pellegrini drew a map and showed all the three continents together.

- Alfred Wegener

In 1912, a breakthrough came in this argument. Alfred Wegener, a German meteorologist, made a profuse argument known as the continental drift theory.

As per the continental drift theory, there was a single massive continent floating on a mega ocean. This supercontinent was called Pangaea, and the mega-ocean was named Panthalassa. Then, around 200 million years ago, the supercontinent began to drift apart. This drifting caused the formation of two new continent masses- Laurasia (the northern component) and Gondwana land (the southern component). Then as time went by, they also started to tear up which led to the formation of seven smaller continents.

Evidence in support of Continental Drift Theory:

The numerous facts that support the continental drift theory are:

1. Pieces of Puzzles -

The continents look like pieces of a massive puzzle. The shorelines of the continents of Africa and South America are somewhat similar if you take a closer look at the map.

2. Same age of Rocks –

The process of radioactive dating helped in finding the relation between the rocks of two different continents. The rocks from the Brazilian coast formed around 2000 million years ago were an exact match to those in Western Africa.

Researchers also found out that the first marine deposits along the coastline of the South American and African continents date to the Jurassic period. It means that there were no ocean bodies between the continents before the dinosaurs.

3. Tillite –

The sedimentary rocks that are made from the deposits of glaciers are called Tillite. The sediments from the Gondwana part of India had counterparts that belonged to six different landmasses of the Southern Hemisphere. The rest of this succession was detected in the parts of Africa, Falkland Island, Madagascar, Antarctica, and Australia respectively.

At the base, the system has a thick glacial tillite indicating extensive glaciation.

4. Location of Placer Deposits-

The most astonishing fact is that there are gold mines on the coast of Ghana; however, no clue of the source rock of the mine is present there. It is because there are gold mines in Brazil that have the same properties as the mines present in Ghana. Thus, one can say that the gold deposits of Ghana are derived from these Brazilian gold mines!

5. Distribution of Fossils-

Lemurs are a kind of animal that is native to Madagascar, however new research reveals that their fossils were also found in India and Africa. This directly indicates that these three places were once located together on a single mass land called Lemuria.

Also to support this theory, Mesosaurus belonged to the lizard family from the early Permian times and they lived in shallow saline water bodies. However, most of their fossils were found in South America. But, later their skeletons were also found in the parts of South Africa and Brazil! The Continental Drift Theory is the only possible reason for this.

Force for Drifting

The continental Drift Theory suggested that the force of drifting apart of continents could be possible because of two reasons:

1. It may be because of the polar-fleeing force. It also causes the rotation of the earth.
2. The second reason for this drifting could be the tidal force. The tidal force is caused due to the attraction of the sun and moon, which then cause tides in the ocean.

Post-Drift Studies

After World War II, numerous discoveries changed the face of geological literature. These discoveries and revelations added more details to the picture, making it clearer, and are called post drift studies.

Arthur Holmes proposed the conventional current theory in the 1930s. It discussed the possibility of convection current generated in the mantle portion of the earth. The currents are because of differences in the thermal energy of radioactive elements.

The theory of plate tectonics was introduced in the 1960s. According to the theory of plate tectonics, Earth has an outer layer, called the lithosphere, which is almost about 60 miles (100kms) thick and overlays a semi-solid molten layer known as the Asthenosphere. The lithosphere is divided into seven large plates of continents and oceans. These plates move correlatively at a rate of 5 to 10 cm converging, diverging, or slipping over each other every year, interacting with their boundaries.

The interaction between these boundaries can be a reason for most of the seismic and volcanic activity on Earth. However, volcanoes and earthquakes can happen in the plate interiors. Plate movements can cause mountains to leap up and continents to fracture. The continents are rooted in the tectonic plates and go with the current passively, resulting in substantial changes in the Earth's geography.

A tectonic plate is an enormous, non-uniformed solid rock, usually composed of continental and oceanic plates. The lithosphere comprises the crust and the top mantle that ranges between 5-100kms in ocean parts and 200km in landform parts, while the Asthenosphere, a semi-solid fluid, lies just below the lithosphere in the zone of Earth's mantle.

The theory of plate tectonics was first formulated in 1967. A tectonic plate can be a continental plate and an oceanic plate, which occupies the larger part of the tectonic plate.

The Pacific Plate is the largest oceanic plate, while the Eurasian Plate is a continental tectonic plate.

Alfred Wegener formulated the Theory of Continental Drift, in which he proposed that the seven continents of Earth were once a single supercontinent altogether named Pangea. He suggested that these seven continents (Pangea) broke millions of years ago and moved to their current regions.

McKenzie and Parker coined that rotational vectors, described by Euler's theorem, tell the behaviour of tectonic plates and the formation of ridges, transforming faults and trenches.

Major Tectonic Plates

The major tectonic plates include Young Fold mountain ridges, transform fault and oceanic trenches.

- The Antarctic and the area surrounding the oceanic plate
- The North American Plate (western Atlantic plate distinct from South American Plate with Caribbean islands)
- The South American Plate (western Atlantic plate distinct from South American Plate with Caribbean islands)
- The Pacific Plate
- The India-Australia- New Zealand tectonic plate
- The Africa (eastern Atlantic plate)
- Eurasian tectonic plate with adjacent ocean plate

Minor tectonic plates

- Arabian tectonic plate (lies in the Saudi Arabian landform)
- Cocos tectonic plate (lies between Central America and Pacific Plate)
- Nazca tectonic plate (lies in the middle of South America and Pacific Plate)
- Philippine tectonic plate (lies in the Asiatic and Pacific Plate)
- Caroline tectonic plate (lies between Philippine and Indian Plate)
- Fuji tectonic plate (Northeast of Australia)
- Juan De Fuca tectonic plate (Southeast of North American Plate)

What is a tectonic plate boundary

It is a border between two tectonic plates. The tectonic plates gradually and constantly move in different directions. Some move towards each other, some move apart from each other, while some collide past each other.

Types of Tectonic Boundaries

There are three types of tectonic boundaries-convergent, divergent, and transform faults.

Convergent Boundaries

Convergent boundaries are formed when tectonic plates collide. They are also known as destructive boundaries. These destructive boundaries are often subduction zones, where the heavier tectonic plate slides under the lighter tectonic plate, forming a deep trench. This subduction converts the dense mantle substance into floating magma which arises through the crust to the Earth's surface.

- The Himalayan mountain range is an example of convergent tectonic plate boundaries. About 50 million years ago, India and Asia collided, rising to the Himalayas, the highest mountain on Earth
- Mariana Trench is an example of oceanic-oceanic convergent boundary, the deepest point on Earth

Divergent Boundaries

- Divergent boundaries form when tectonic plates pull apart from each other. They are also known as constructive boundaries
- The Magma from Earth's mantle rises towards the surface and pulls two or more plates apart. Volcanoes and mountains leap up along the gap
- One of the examples of a divergent tectonic plate boundary is the Mid-Atlantic Ridge, where the American tectonic plates are disassociated from the African tectonic plates and Eurasian tectonic plates
- On terrains, The Great Rift Valley in Africa, where plates are wrenched apart. If it continues to happen, Africa will eventually split from the continent and form a new landmass

Transform Boundaries

The transform boundaries are created as tectonic plates that slip horizontally, but these plates get touched where they collide.

- The plate interaction here happens without creating or destroying the crust
- They don't result in extravagant rising of the mountains or formation of a new ocean, but they result in earthquakes because of the halting motion
- Such a movement of plates almost destroyed San Francisco in 1901
- Majority of the earthquakes happen in The Rings of Fire (the area around the rim of the Pacific Ocean)

Hotspots

Mostly the volcanic activities happen in or adjacent to the plate boundaries, but sometimes these activities happen between two tectonic plates, called Hotspots.

The hotspots are fixed, unlike the tectonic plates. There are nearly 40 to 50 hotspots all over the world.

Major hotspots are:

- The Afar Hotspot lies under northern Ethiopia

- The Reunion hotspot lies below the Reunion Island in the Indian Ocean

