Geography Class 12

REVISION OF THE PREVIOUS CLASS (9:08 AM):

- **Isostasy** refers to the idea that the lighter crust must float on the denser underlying mantle.
- This depends upon the **buoyancy** principle by **Archimedes.**
- **Eustasy** involves worldwide sea levels, including changes in the total volume of liquid seawater and the capacity of ocean basins.
- **Alfred Wegner** gave the **continental drift theory** under which it was held that the earth comprises three layers- Outer SiAl, Intermediate SiMa, and inner NiFe.
- SiAl is the continental mass, SiMa is the oceanic crust and Nife is the core.
- The continental masses are floating over the oceanic crust without any resistance.
- During the Carboniferous period- 280 million years ago, there was only one supercontinent called **Pangea** with one super-ocean **Panthalassa.**
- The supercontinent got separated into northern **Laurasia** and Souther **Gondwana** by a rift running from East to West.
- Polar fleeing force and the gravitational pull of the sun and the earth were believed to be responsible for the drift.
- Wegner gave six pieces of evidence in support of his theory:
- I. Jigsaw fit piece of evidence.
- II. Similar mountain structures.
- III. Similarities of rock formations.
- IV. Fossil evidence.
- V. Tillite evidence.
- VI. Placer evidences.

Sea Floor Spreading Theory:

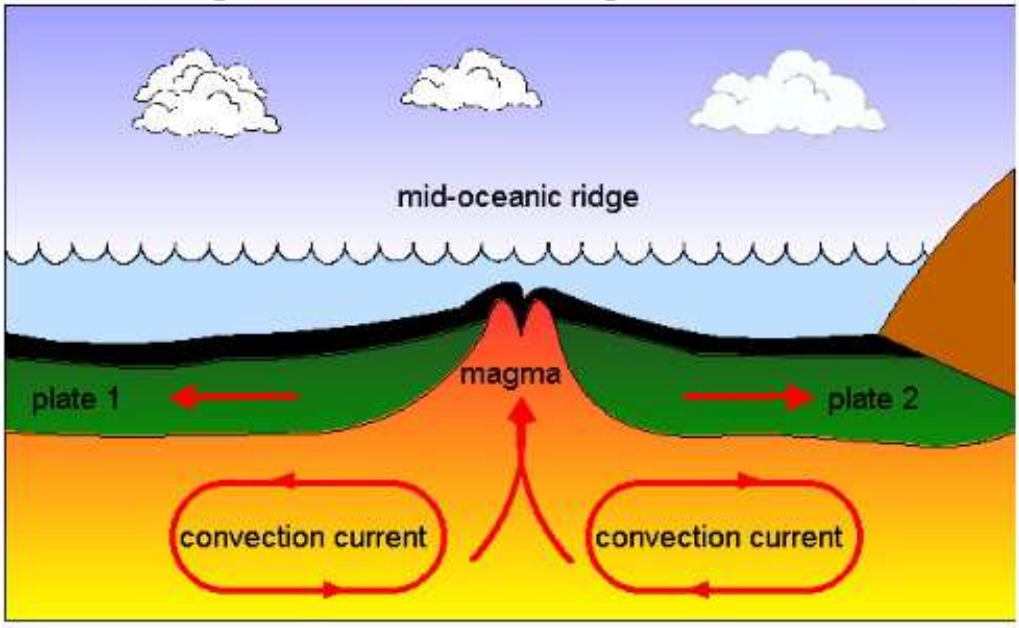
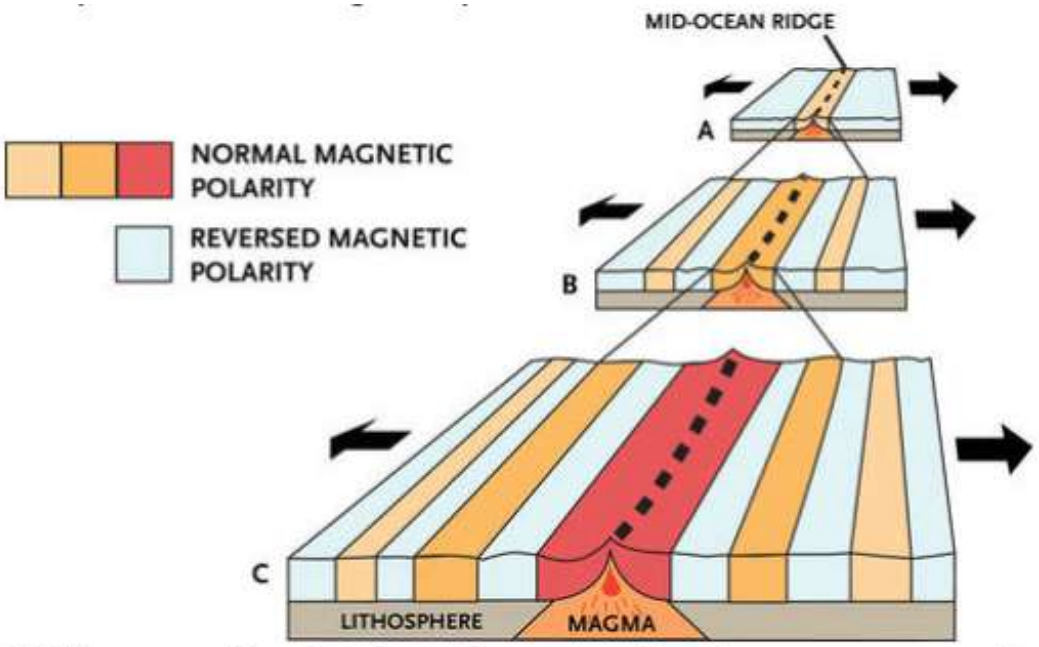
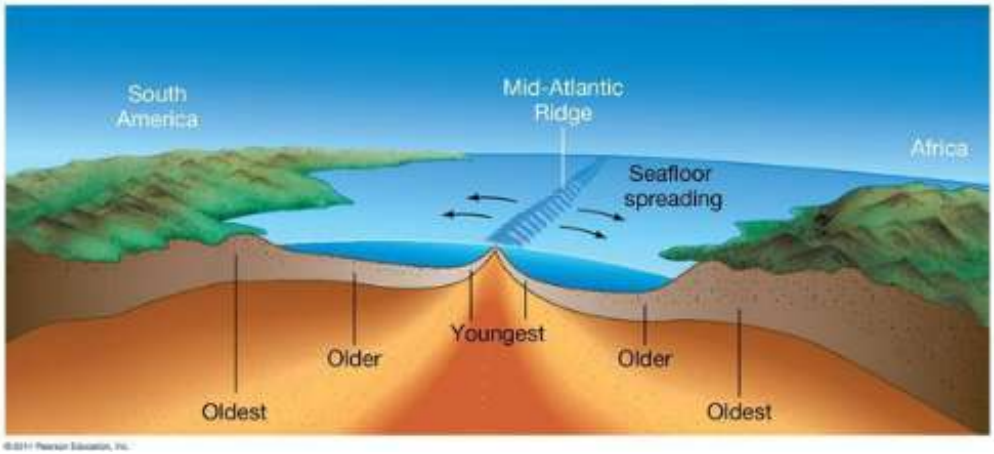
- Mapping of the ocean floor revealed the following information:
- **I.** Presence of mid-oceanic ridges along the sea floor.
- **II.** These ridges are active, resulting in continuous volcanic eruptions.
- 

Plate 1 and plate 2 move apart. Magma rises, cools and solidifies forming new igneous rock. This is sea-floor spreading and is a constructive plate boundary.
- **III.** The rocks on either side of the ridge are of the same age having similar composition and magnetic ~~polarities~~ properties.

- 

- **IV.** The age of rocks along the ocean floor increases away from the ridge.
- 

- **V.** Rocks of the ocean crust are younger and thinner than the continental crust.
- Based on the above observations, **Harry Hess** proposed the theory of sea-floor spreading in 1961.
- As per the theory, constant magma eruptions at the oceanic ridges cause the rupture of the oceanic crust.
- Due to this, new lava erupts, and wedges onto the oceanic crust.
- This pushes the oceanic crust on either side, causing the oceanic floor to spread.
- The spreading crust sinks down at the oceanic trenches and gets consumed.
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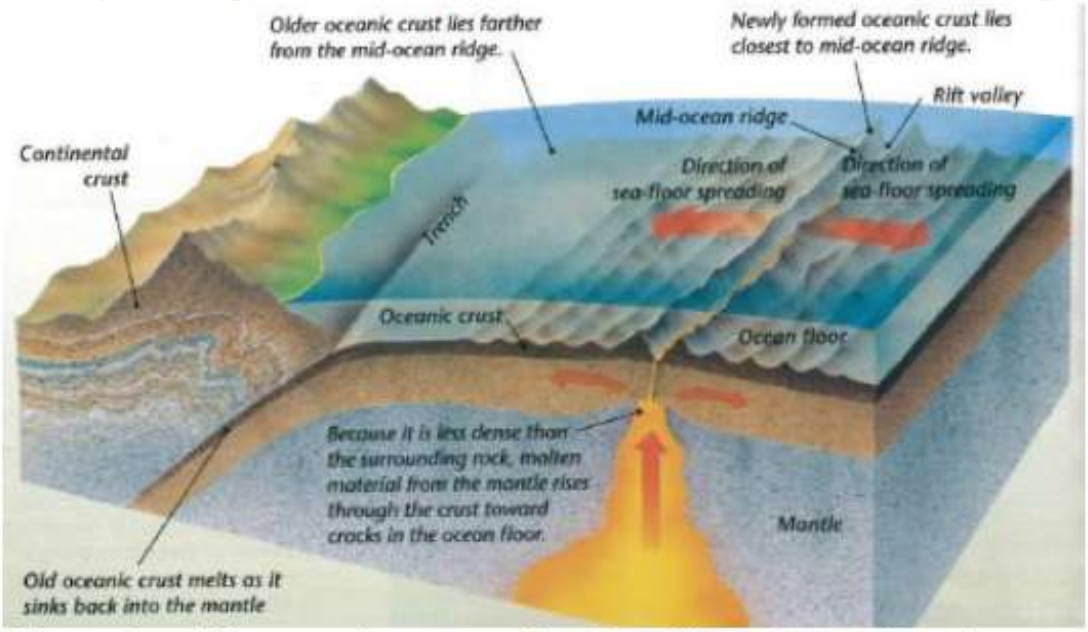


- The major difference between the Sea-Floor Spreading theory and the Continental Drift Theory (CDT)is that the CDT did not talk about oceanic ridges.
- The mechanism of the oceanic ridges is the missing link between the CDT and the Plate tectonics theory.

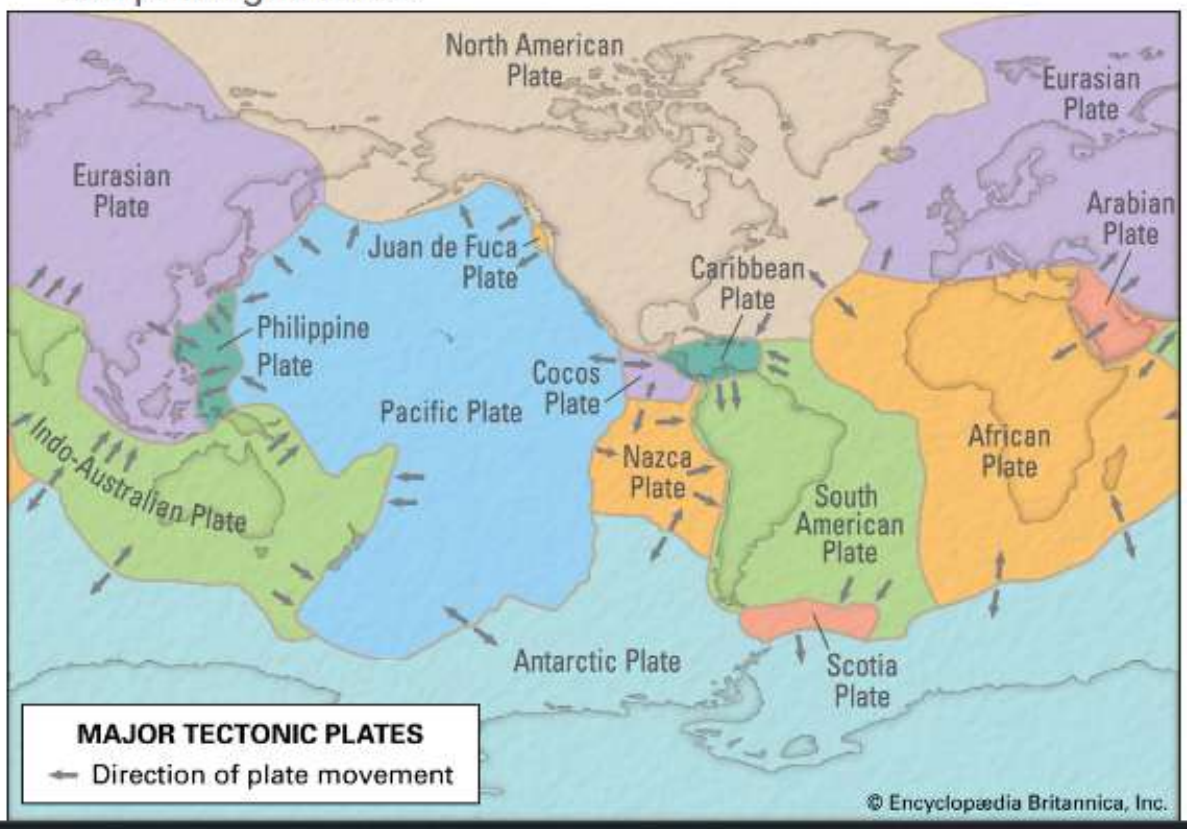
So plate tectonics theory is the upgraded version of CDT and the major reason behind movement of continents is oceanic ridges.

PLATE TECTONICS THEORY (9:30 AM):

- This theory developed over time with contributions from various scientists, including Alfred Wegner.
- The theory was first proposed by Mckenzie, Parker & Morgan in 1967.
- The term **plate** was coined by J.T. Wilson in 1965.
- "Plate" term was hence not used in the continental drift theory and in sea-floor spreading theory.

Plates:

- Plates are the broad and rigid segments of the lithosphere which include the rigid upper part of the upper mantle and crust.
- The plates are in motion on the underlying asthenosphere.
- Plate tectonics is the study of deformation within plates and of the interaction of plates around their margins.
- Plates are nearly a hundred kilometers thick and have high rigidity.
- Due to this, they are unable to get deformed except in response to a very strong and prolonged force.



Major Plates	Minor Plates
There are seven major plates- Eurasian Plate, Indo-Australian Plate, North American Plate, South American Plate, African Plate, Antarctic Plate, and Pacific Plate.	There are many minor plates such as the Nazca plate, Arabian plate, Philippines plate, Juan-de-Fuca plate, Cocos plate, etc.

- The plate tectonic theory justified the Continental Drift Theory with a much more detailed analysis.

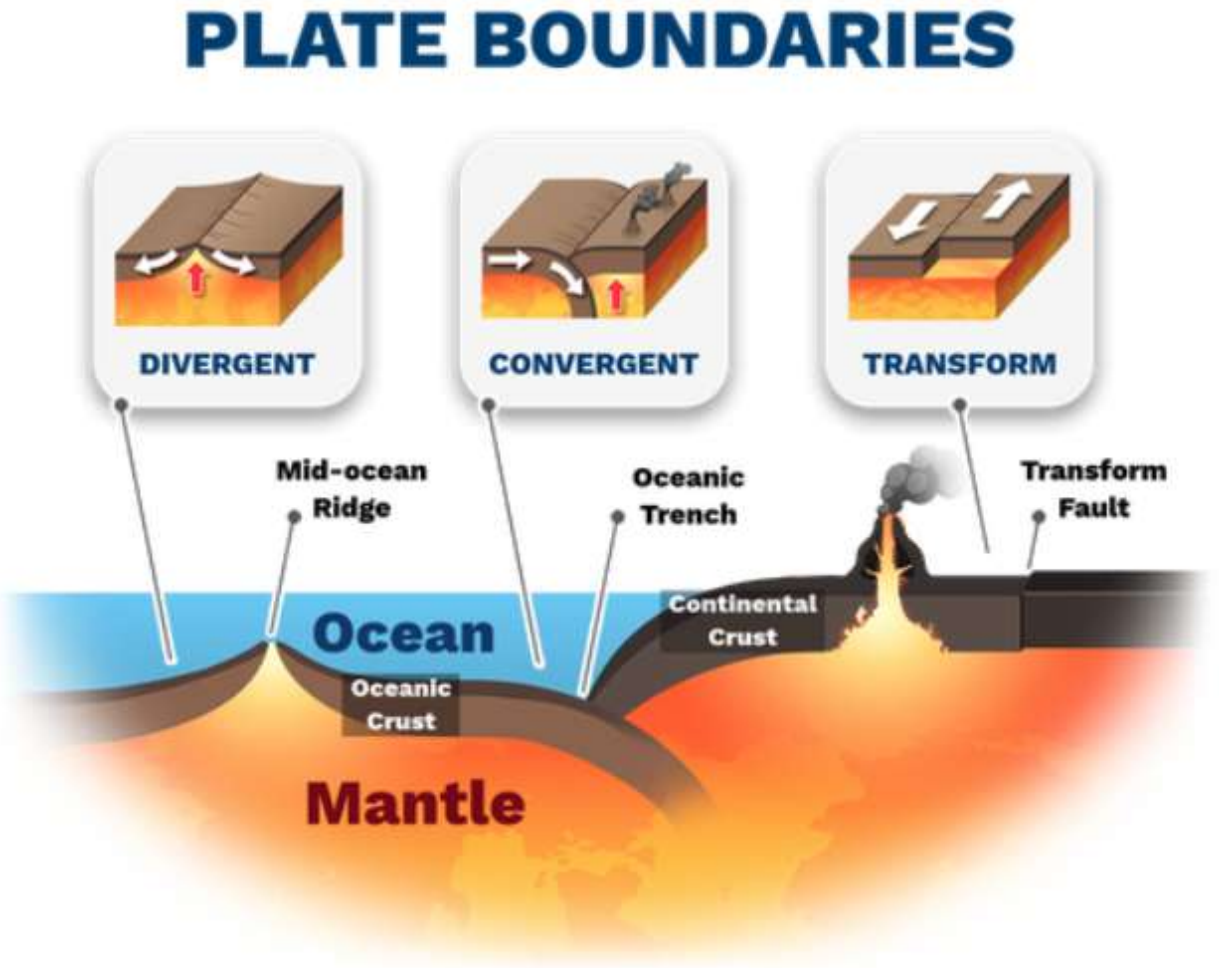
DIFFERENCES BETWEEN CONTINENTAL DRIFT THEORY & PLATE TECTONICS THEORY (10:00 AM):

Continental Drift Theory	Plate Tectonics Theory
Assumed the movement of the continental crust (SiAl) over the Oceanic Crust (SiMa)	Proposed that it is the plate which is made up of both continental and oceanic crust which moves above the asthenosphere.
Assumes free-floating of the continents-without any friction	Proposed that the plates moved with a high resistance causing deformation of the plates themselves.

Plate Motion:

- Plates are constantly in motion but with different speeds and different directions.
- This results in three types of plate boundaries:
- **I. Divergent:**
- A new crust is generated at the plate margins.
- The magma well up to solidify and forms new rocks.
- These areas get elevated as mountain-like structures.
- These are called **ridges**, for example- **Mid-Oceanic Ridge.**
- **II.Convergent:**
- At the convergent plate boundaries, the denser and the older crust subducts to create landforms.

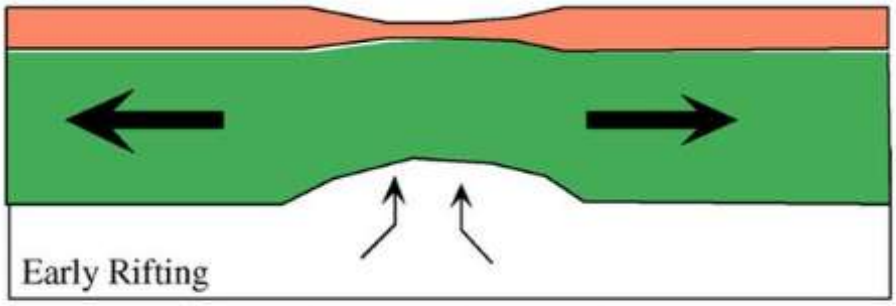
- **III.Parallel/ Transform:**
- The crust is neither produced nor destroyed as the plates slide horizontally past each other.



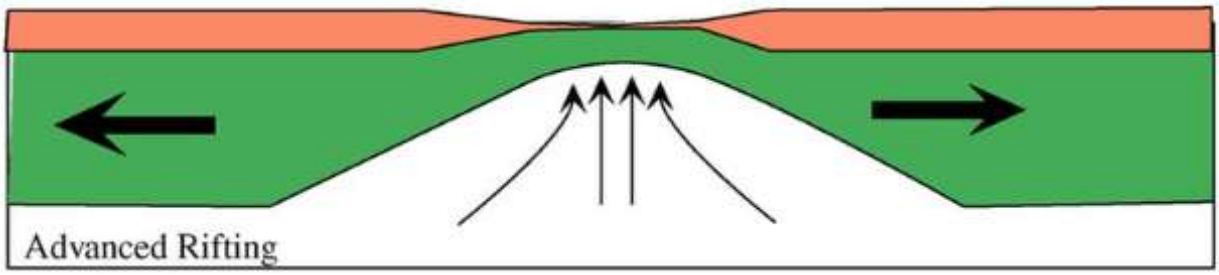
- A plate boundary is the zone of motion between two plates.

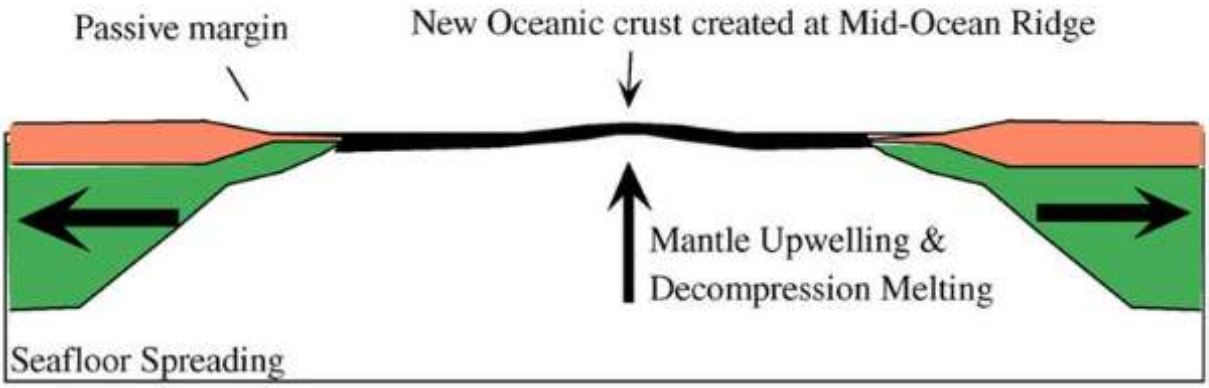
DIVERGENCE (10:30 AM):

- **Ocean-Ocean divergence:**
- At the plate margin, the lithosphere splits, separates, and moves apart in two opposite directions.
- Hot magma comes through the cracks and solidifies leading to the formation of the new oceanic crust.
- The continuous buildup of solid magma results in the formation of mid-oceanic ridges along the plate margins.



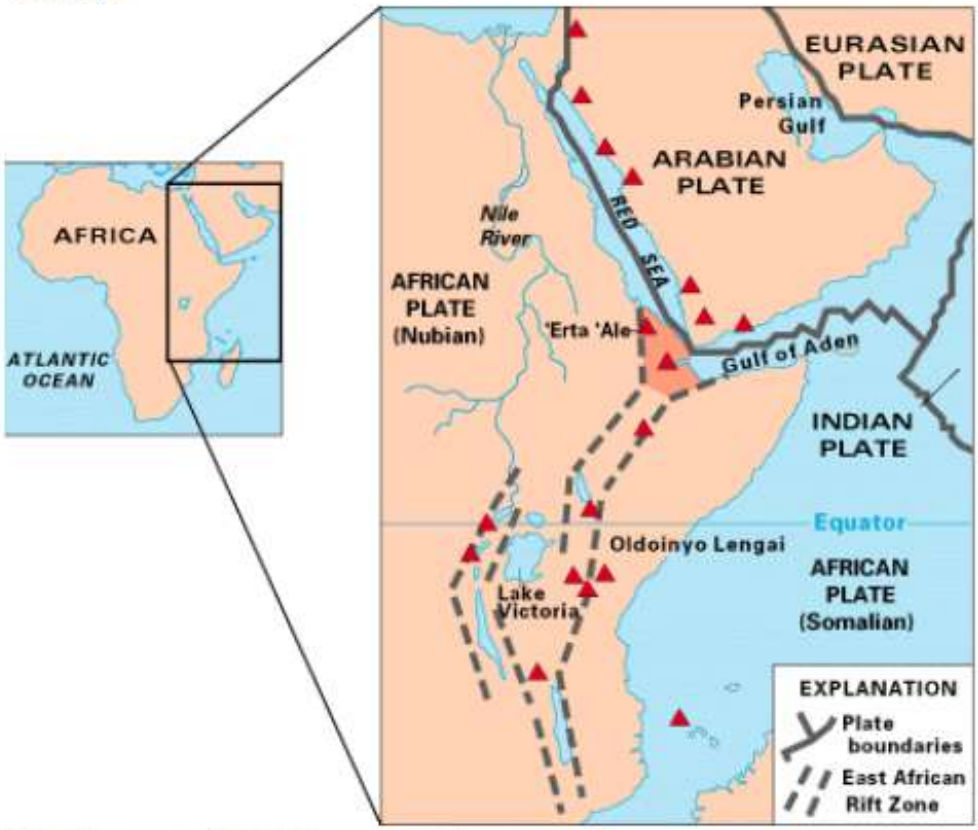
Continued thinning of crust and mantle lithosphere





- In this plate boundary, shallow earthquakes with a **Focus** of up to 70 kilometers are observed.

Continent-Continent Divergence:

- The formation of the divergent plate boundary along the continental plate involves three stages:
- **I. Intra-Continental Rifting:**
- The upward movement of magma below a continental crust causes the fragmentation of continents through the creation of numerous faults and cracks.
- Such a series of faults is known as a **rift valley.**
- Rising magma starts to come out through this rift valley, like the **East African Rift Valley.**
- 

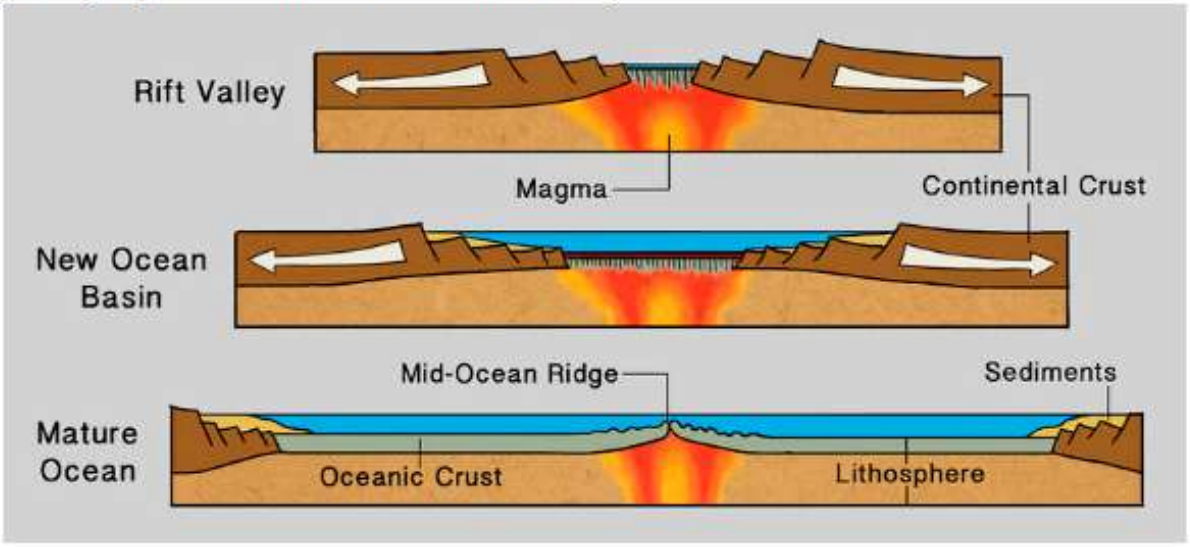
- Shallow earthquakes are observed here.

II. INTER PLATE-THINNING (11:00 AM):

- It involves the partial melting of the lithosphere and a gradual thinning of the continental crust.
- The rift valley starts to widen and it can get gradually filled with ocean water.
- This can cause the formation of a shallow sea.
- **For example-** the Red Sea.

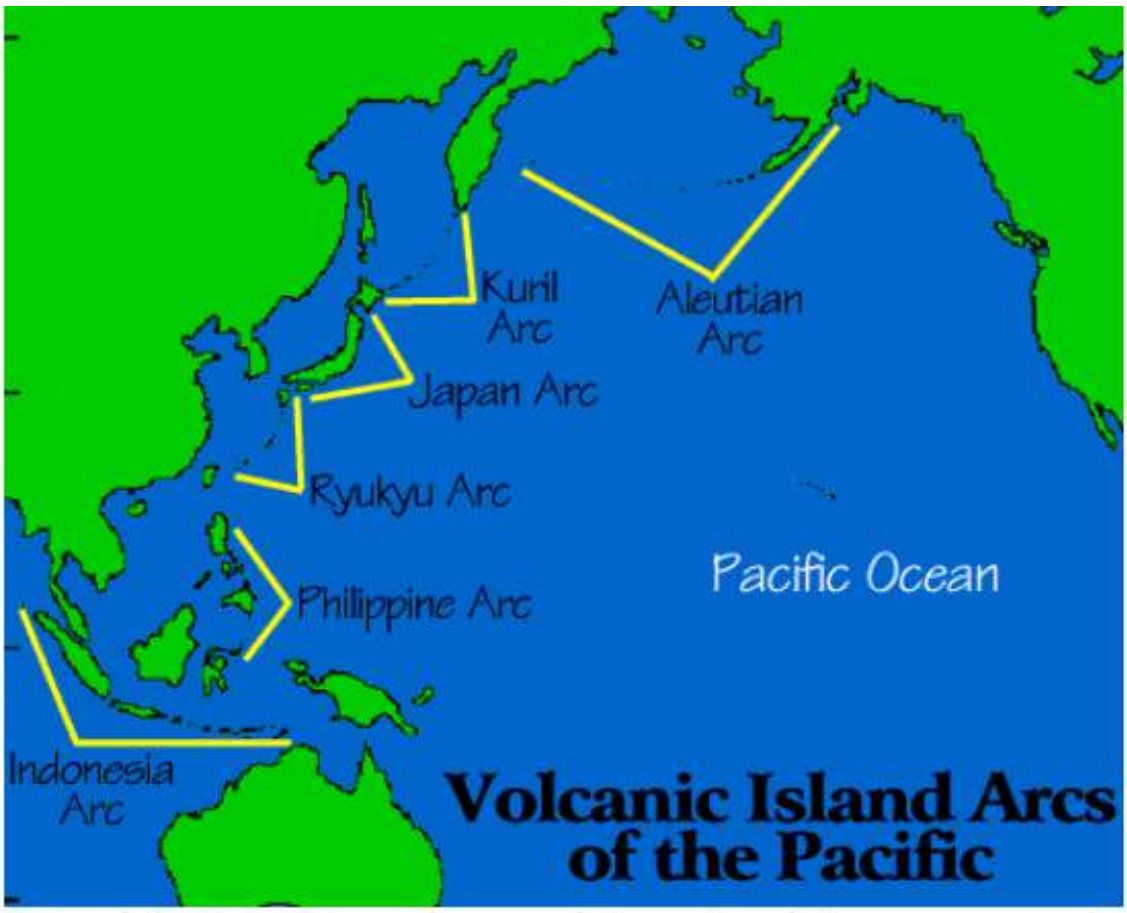
III. Formation of Mid-Oceanic Ridge:

- Continuous spreading of the continental plates away from each other and the creation of a new oceanic crust along the rift valley by the rising magma pushes the continental masses sufficiently apart.
- At this stage, there will be a new oceanic basin along both sides of the ridge.
- **For example-** Mid-Atlantic Ridge.
- Divergence showed that the landmasses are actually moving apart, hence justifying the Continental Drift Theory.



CONVERGENCE (11:30 AM):

- **Ocean-Ocean:** converge
- When two oceanic plate margins the oceanic plate of higher density descends into the asthenosphere.
- If both the plates have the same density, the older plate will subduct.
- This process is called **subduction** and the region of this process is called **subduction zone.**
- We see only subduction and not folding in such cases because the oceanic plate is too dense and heavy to get uplifted through the crustal forces.
- We are considering too wide rocks, almost the whole of the lithosphere which cannot be folded as such.
- The process of subduction leads to the formation of **trenches**, which are the deepest regions of the earth.
- **For example-** the Pacific plate subducted below the Eurasian Plate causing the Japan Trench, Marianna Trench, Kurile Trench, and Aleutian Trench.

- 

- The subducting plate undergoes deformation, intense compression, metamorphism, and melting as it reaches the deeper parts.
- Some of the molten material finds its way upwards in the form of **volcanic activity.**
- We will see violent volcanism because, unlike divergence where some magma was continuously being released on the surface, submergence volcanic eruption happens when the underlying magma is able to gather enough pressure to blast off.
- This molten material continuously piles up on the other oceanic crust resulting in the formation of volcanic mountains on the sea floor.
- The volcanic mountains rise above the water level and cause volcanic islands to be formed.
- These islands which are arranged parallel to the trenches in an arc shape are called **Island arcs.**

- **For example-** Japan, Kurile, Aleutian, Carribbean, etc.
- An **Archipelago** is a group of islands scattered in the ocean.
- It is formed around an Ocean-Ocean convergent boundary with intense volcanic activity.
- **For example-** Indonesia, the Philippines, etc.
- Subduction zones are the sites of the most widespread and intense earthquakes.
- In the ocean-ocean convergent plate boundaries, all three types of earthquakes- shallow, intermediate, and deep are formed.
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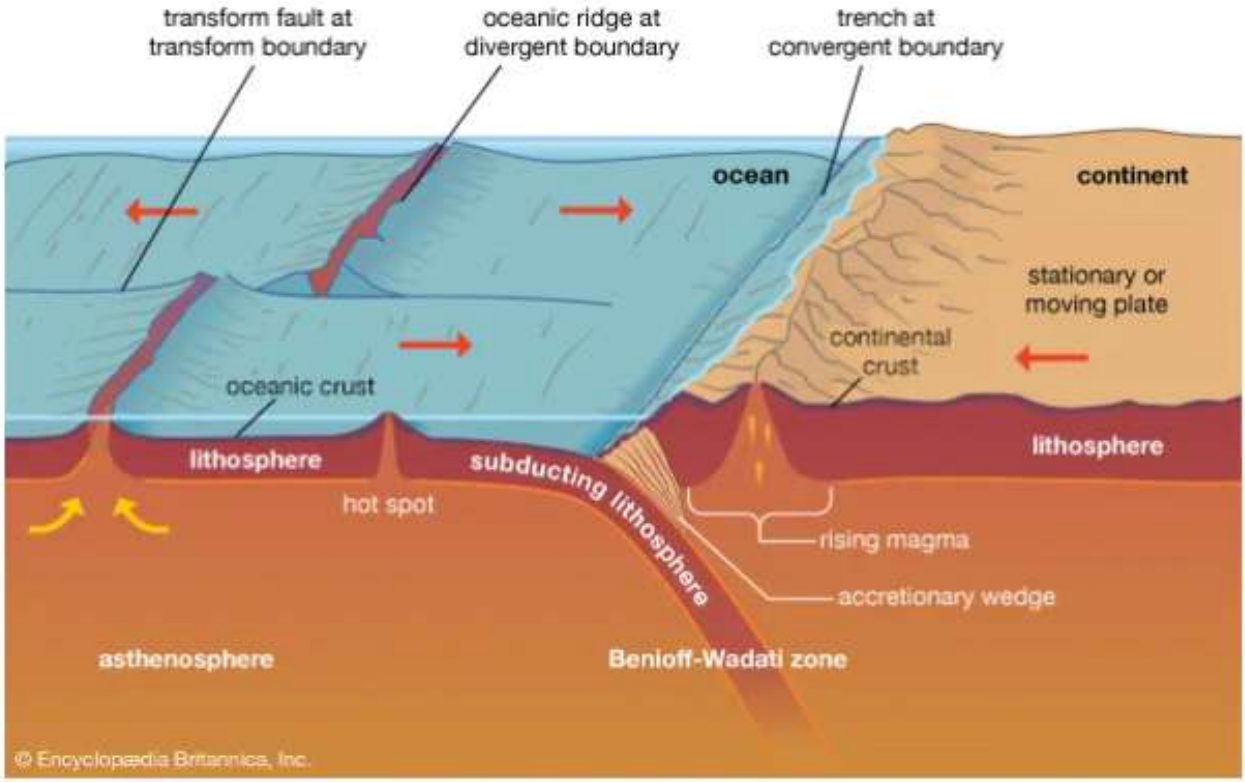
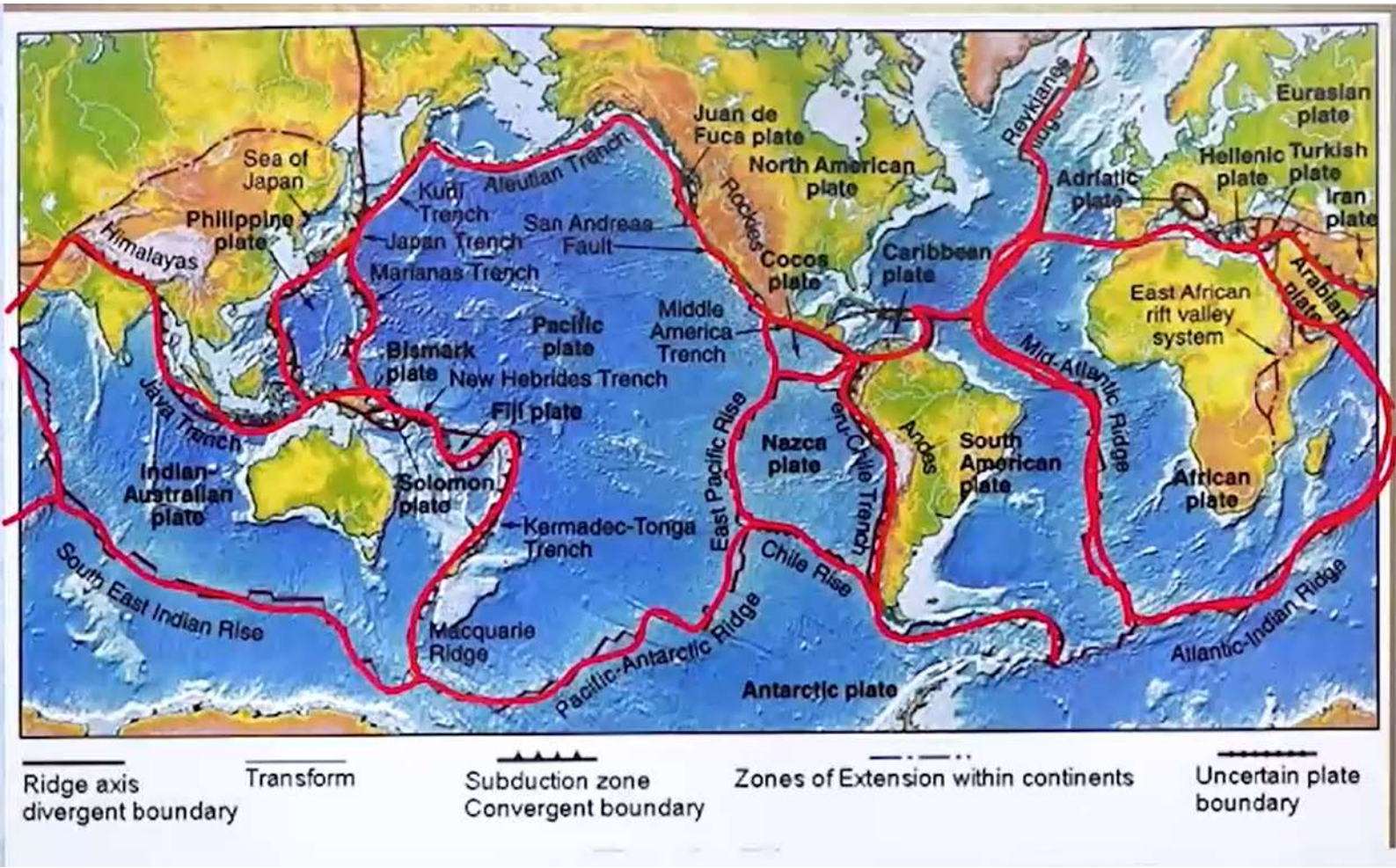
Type of earthquake	Depth of focus
Shallow	0-70 km
Intermediate	70km-300km
Deep	300km-700km

- The majority of the earthquakes appear to be confined to a narrow dipping zone along the subducting slab called **Benioff Zone.**



The topic for the next class is the continuation of the Plate Tectonics Theory.


Sea of Japan
Philippine plate
Himalayas
Kuril Trench
Aleutian Trench
Japan Trench
San Andreas Fault
Marianas Trench
Juan de Fuca plate
North American plate
Rockies
Cocos plate
Caribbean plate
Reykianes
Eurasian plate
Hellenic plate
Turkish plate
Adriatic plate
Iran plate
Arabian plate
East African rift valley system
Mid-Atlantic Ridge
Middle America Trench
Pacific plate
Bismark plate
New Hebrides Trench
Fiji plate
Java Trench
Indian-Australian plate
Solomon plate
Kermadec-Tonga Trench
East Pacific Rise
Nazca plate
Peru-Chile Trench
Andes
South American plate
African plate
Chile Rise
South East Indian Rise
Macquarie Ridge
Pacific-Antarctic Ridge
Antarctic plate
Atlantic-Indian Ridge
Ridge axis divergent boundary
Transform
Subduction zone Convergent boundary
Zones of Extension within continents
Uncertain plate boundary

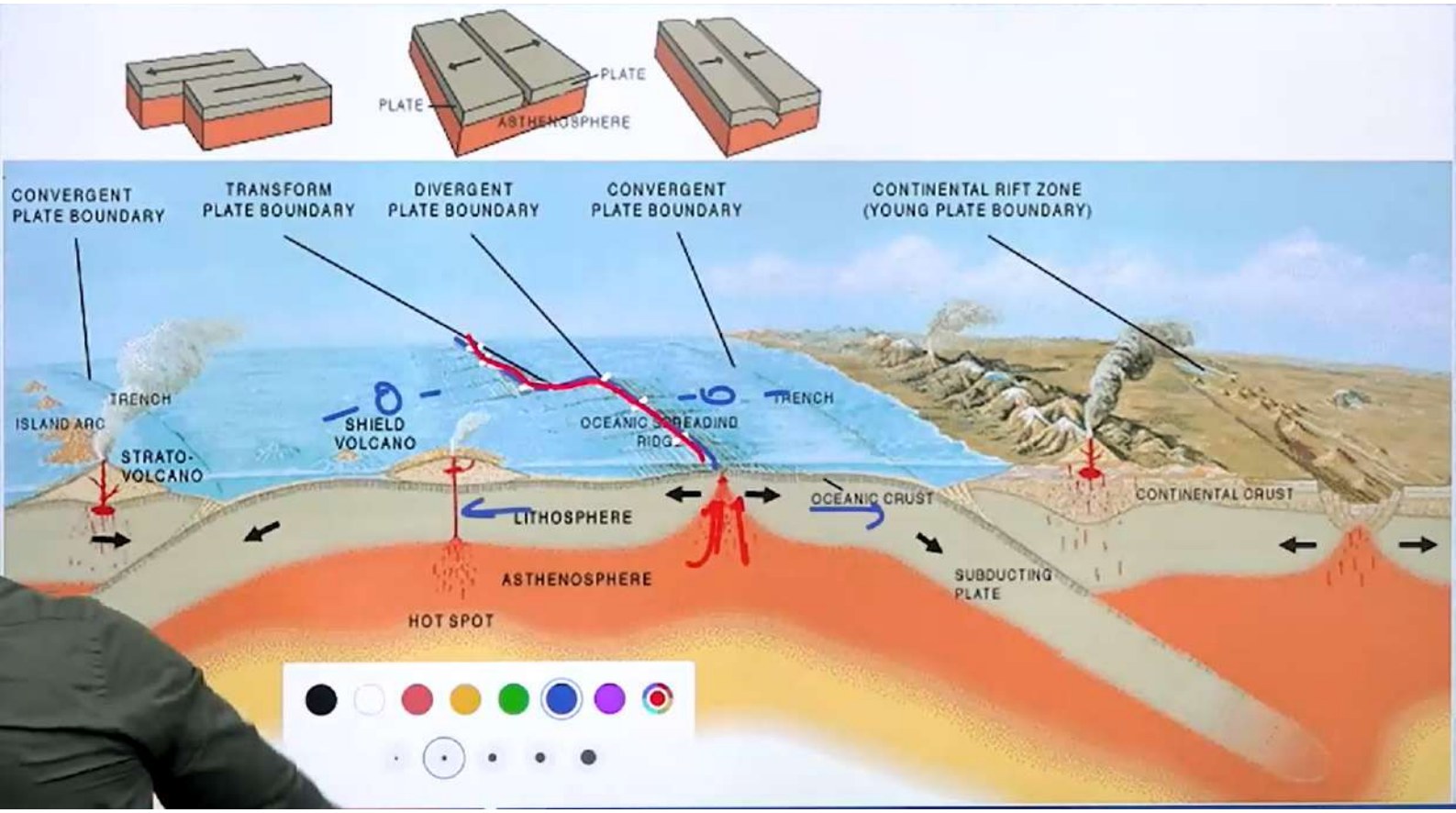
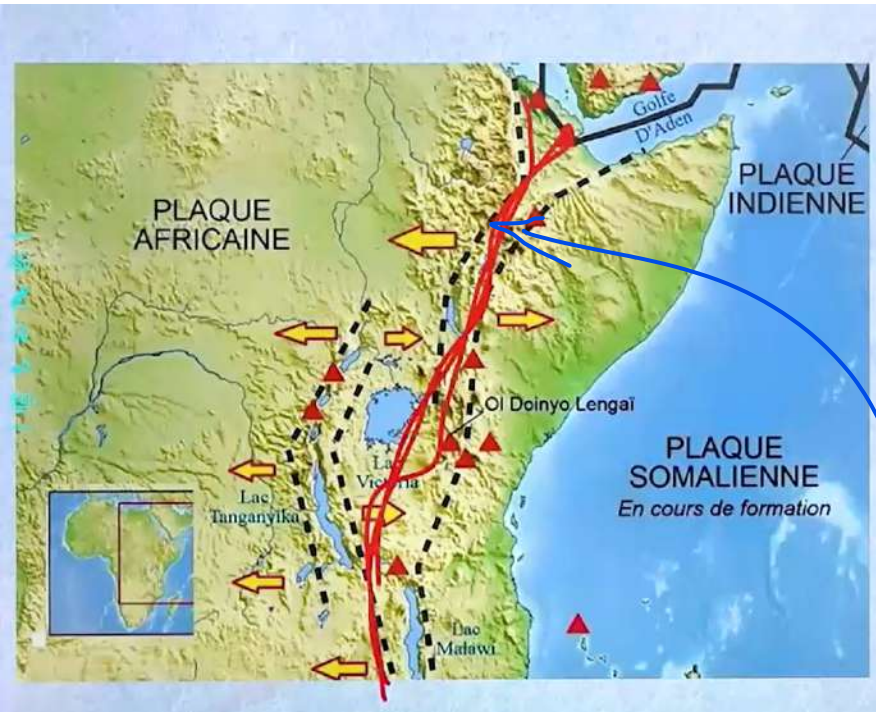


PLATE
PLATE
ASTHENOSPHERE
CONVERGENT PLATE BOUNDARY
TRANSFORM PLATE BOUNDARY
DIVERGENT PLATE BOUNDARY
CONVERGENT PLATE BOUNDARY
CONTINENTAL RIFT ZONE (YOUNG PLATE BOUNDARY)
TRENCH
ISLAND ARC
STRATO-VOLCANO
SHIELD VOLCANO
OCEANIC SPREADING RIDGE
TRENCH
LITHOSPHERE
ASTHENOSPHERE
HOT SPOT
OCEANIC CRUST
CONTINENTAL CRUST
SUBDUCTING PLATE



East African Rift Valley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