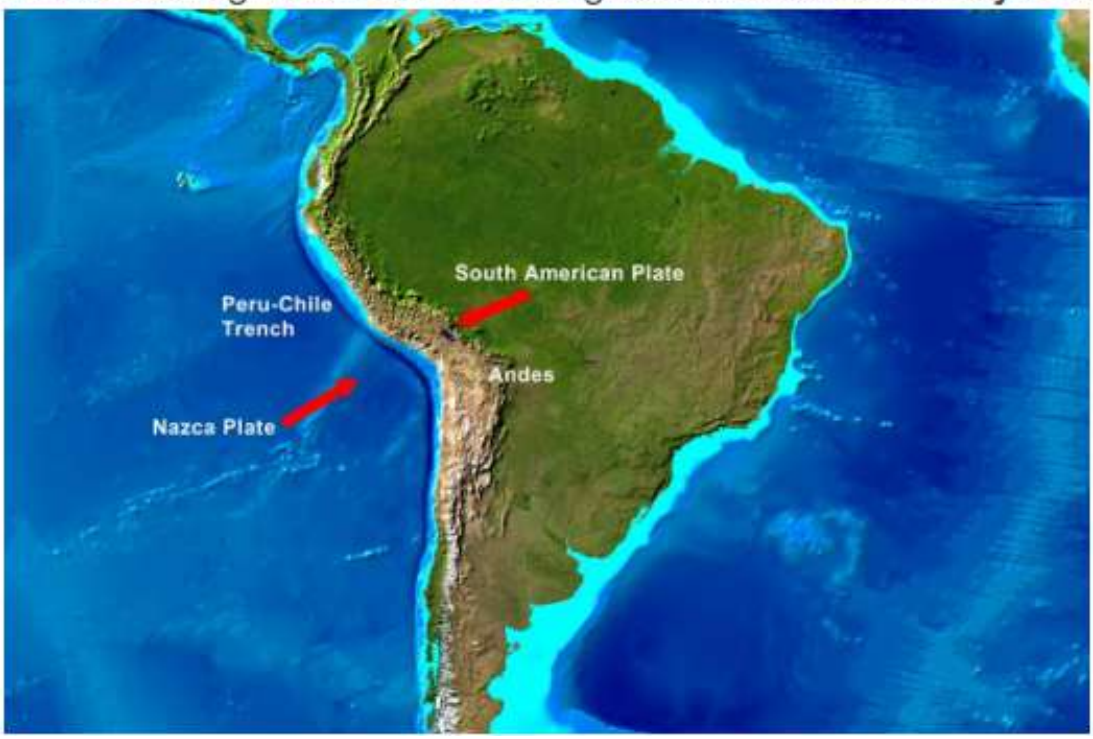
Geography Class 13

REVISION OF THE PREVIOUS CLASS(9:09 AM):

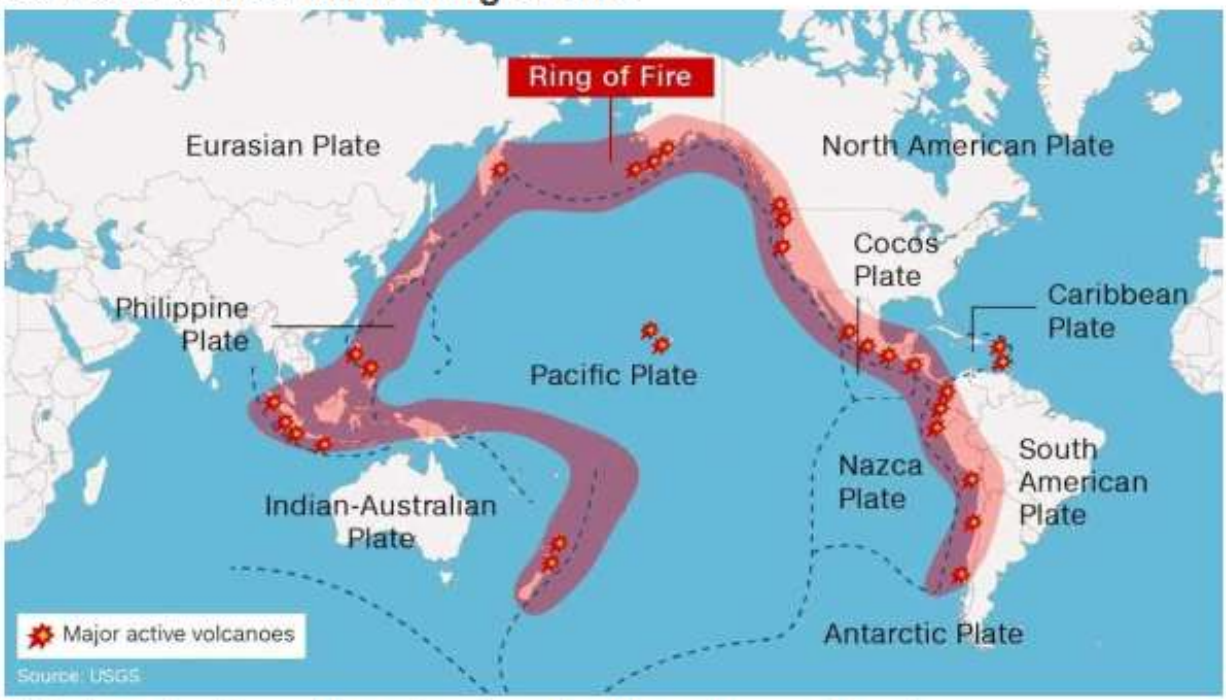
- The theory was first proposed by Mckenzie, Parker & Morgan in 1967.
- Plates are the broad and rigid segments of the lithosphere which include the rigid upper part of the upper mantle and crust.
- The plates are in motion on the underlying asthenosphere.
- There are 7 major plates and many minor plates.
- Plates are constantly in motion but with different speeds and different directions.
- This results in three types of plate boundaries: Divergent, Convergent, and Transform.
- Plate interactions give us various landforms such as ridges, island arcs, etc.
- In the cases of convergence, it is always the heavier plate that gets subducted below.

Oceanic-Continental convergence:

- When a plate with an oceanic margin collides with a plate of the continental margin, the continental crust being more buoyant ,forces the denser oceanic plate into the mantle.
- The oceanic plate will get subducted because it is denser and heavier.
- **For example-**Nazca plate subducting below South American Plate.
- The interaction between continental and oceanic plates shall compress, deform and fold the sediments at the continental margin to form fold mountain chains.
- **For Example-** Andes and Rockies.
- Convergent boundaries are also called **destructive plate boundaries** because the tectonic plate is destroyed at the plate margins due to subduction.

- As the oceanic plate subducts, it creates trenches, earthquakes are generated at shallow intermediate and deep locations, Benioff zones are formed, etc.
- As the oceanic plate plunges deeper, it melts and starts to rise.
- This rising magma will accumulate within the continental crust, and eventually move to the surface leading to the formation of volcanoes.
- **For Example-** The subduction of the Nazca Plate below the South American plate has resulted in a series of volcanoes in the Andes.
- This is the region of the world's highest active Volcano- **Ojos del Salado.**
- 

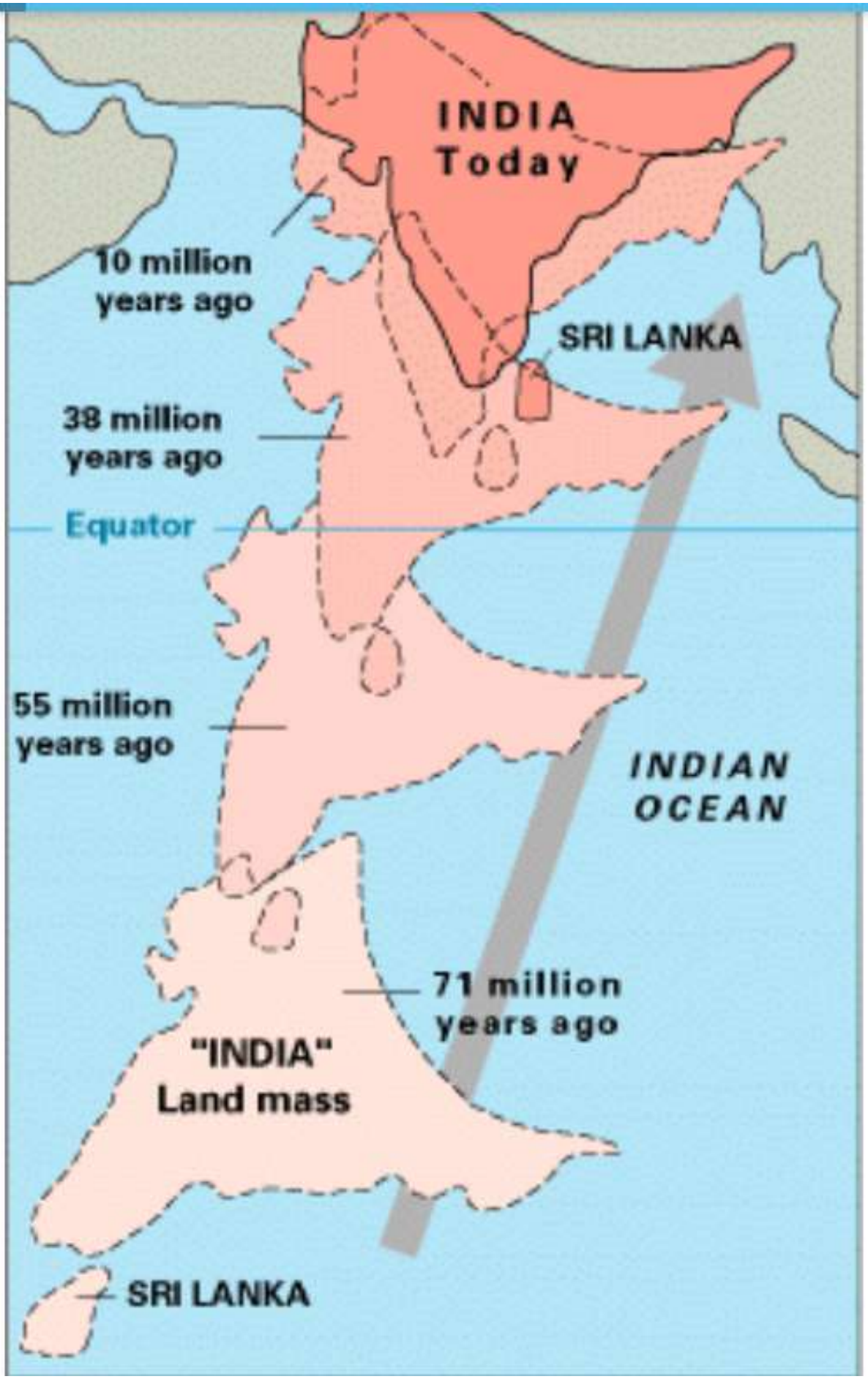
MISCELLANEOUS INFORMATION (9:43 AM):

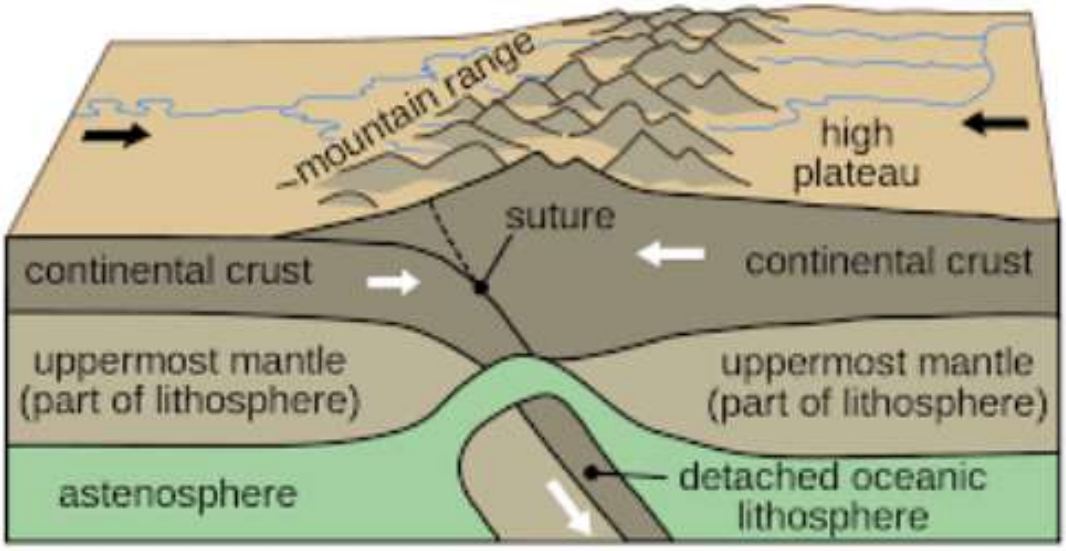
- It is always the oceanic plate that gets created and destroyed and not the continental plate.
- Continental drift is hence a continuous process, and we expect that at some point in the future, we expect to get a supercontinent.
- Pangea is the fifth supercontinent.
- This making-breaking-making of supercontinents is a continuous cycle called the **Wilson cycle.**
- The **Pacific Ocean** is surrounded by trenches on all sides which are the zones of intense volcanic activities and earthquakes.
- So we have the **Pacific Ring of Fire.**
- 

- This is actually not in a ring form but in a horse-shoe form.
- The Mediterranean Sea, Black Sea, etc, are the leftover parts of the Tethys Sea.

Continental- Continental Convergence:

- Before the convergence of continental margins, the landmasses are usually separated by oceanic crust.
- As two plates converge, the intervening sea encloses, and the sea floor subducts beneath one of the plates.
- The continued convergence result in the complete subduction of the oceanic crust and the two continental masses start to converge.
- The low density of continental material doesn't permit its subduction.
- The oceanic material completely breaks from the continental block and gets completely assimilated in the mantle.
- Since there is no subduction, so no melting of rocks due to friction to form magma, volcanoes are absent in the region.
- At this point in time, volcanic activity ceases.
- The continued convergence forces the continental crust to partially get under another one.
- This creates an unusually thick layer of landmass.
- The two continental landmasses get stitched together at a zone called **the Suture zone.**
- The sediments deposited in the basin between the continental margin undergo continuous and intense compression resulting in the formation of tall fold mountains.


INDIA
Today
10 million
years ago
SRI LANKA
38 million
years ago
Equator
55 million
years ago
INDIAN
OCEAN
71 million
years ago
"INDIA"
Land mass
SRI LANKA

- **For example-** the Himalayas.
- Even the Aravallis are folded mountains.
- Shallow and intermediate earthquakes are observed in this region.
    - 

- Continent-Continent convergence stops after a certain time when the two plates will merge into a single plate.
- Oceanic-Oceanic convergence and Oceanic-Continental convergence can continue forever because oceanic plates can get both destroyed and created.

TRANSFORM/CONSERVATIVE BOUNDARIES (10:30 AM):

- The plates slide past each other without the construction of a new plate or the destruction of the new plate.
- At this margin, transform faults roughly move parallel to the direction of plate movement.

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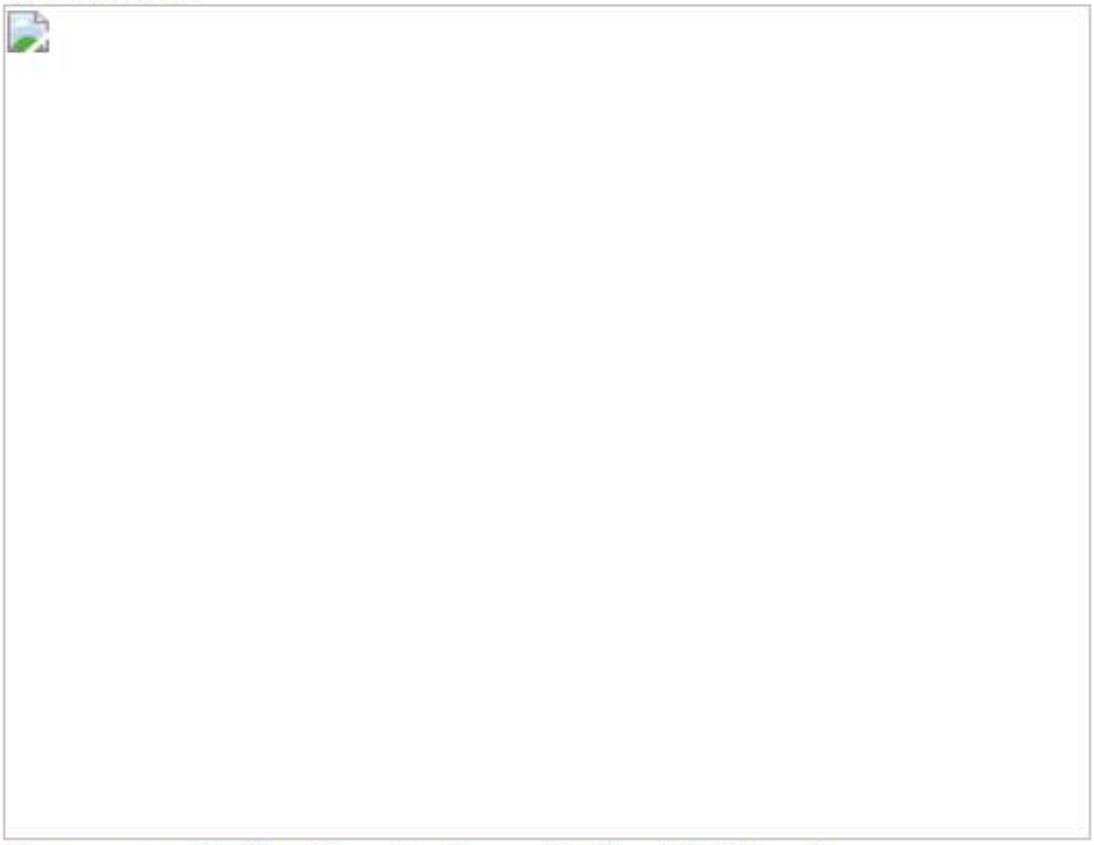
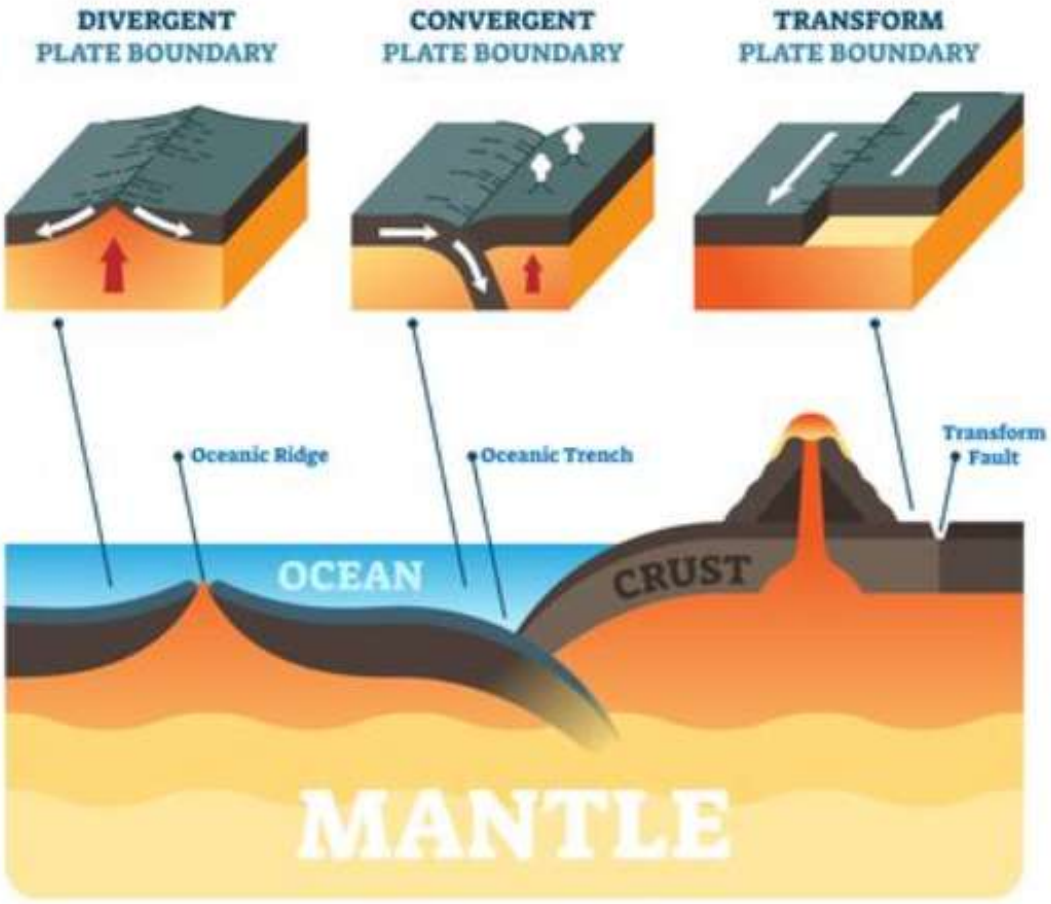
- 
- **For example the** San Andreas fault of California.
- Such series of transform faults are also found on the oceanic crust where they offset the oceanic ridges throughout their length.
- Such regions can see strong earthquakes as we saw recently in **Turkey.**
- The Anatolian transform fault system is probably the most active in the world.
- It separates the Eurasian plate from the Anatolian plate in northern Turkey.


Eurasian Plate
North Anatolian fault
Anatolian Plate
TURKEY
Aegean Plate
Earthquake activity
Feb 6th 2023
East Anatolian
fault
Arabian Plate
SYRIA
African Plate

PLATE BOUNDARIES



REVISION OF THE PLATE TECTONICS (11:05 AM):

Parameter	Ocean-Ocean Divergence	Continent-Continent Divergence	Ocean-Ocean Convergence	Ocean-Continent Convergence	Continent-Continent Convergence	Co /P bo
Feature	Mid oceanic ridge, transform faults	Rift Valley, shallow sea, Mid oceanic ridge	Trench, subduction zone, volcanic mountains and islands, island arcs, Benioff zone	Trench, subduction zone, Benioff zone, fold mountains, volcanoes	High fold mountains, Suture zones, Nappes	Tra fau
Earthquake	Shallow	Shallow	Shallow, intermediate, and deep	Shallow, intermediate, and deep	Shallow and intermediate	Sh
Volcanism	Yes	Yes	Yes	Yes	No	No
Examples	Mid-Atlantic ridge, East Pacific Rise, Carlsberg ridge	East African rift valley, Red Sea, Mid Atlantic ridge	Japan, Aleutian	Andes, Rockies	Himalayas	Sa

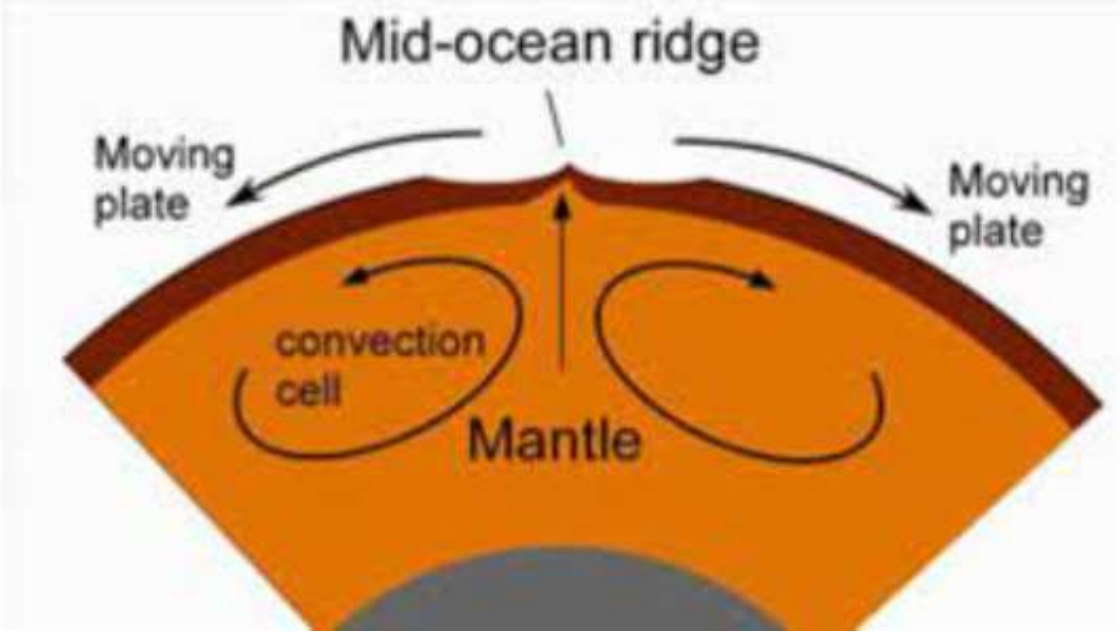
We do not see Continent-Ocean divergence because:

- For divergence to happen, the rising of magma is necessary.
- This rising can happen anywhere, but it is very rare that such a rise of magma happens exactly at the ocean-continent plate boundary.
- Even if we see such a rise, very soon it will get converted into ocean-ocean divergence.
- This is because magma will accumulate on both sides, and the formation of a new oceanic crust will begin.

Causes of the plate motion:

- Convection Currents.
- Mantle Plumes.
- Ridge Push.
- Gravity sliding.
- Slab pull

1. **Convection Currents11:30 AM):**
   - The theory was given by **Arthur Holmes.**
   - They are generated due to the intense heat released in the interior of the earth.
   - The currents are of two types:
   - I.Involving the whole of the mantle.
   - II. Involving only the Asthenosphere.
   - The convection currents as they rise from below, diverge and spread laterally.
   - This causes the lithosphere to split, resulting in the formation of cracks.
   - As the plates move laterally, the currents carry the slab of the lithosphere along with them.
   - When these currents encounter a similar current from the opposite direction, they both descend into deeper parts of the mantle.
   - In this process, the lithosphere is dragged down to the mantle along trenches.

- 
Mid-ocean ridge
Moving plate
Moving plate
convection cell
Mantle

2. **Mantle Plumes:**

- It is a type of mantle convection that involve jetlike plumes of low-density material from the core-mantle boundary.
- It happens only at isolated locations, unlike across the plate boundaries like in convectional currents.
- It causes continuous heating of the plates.
- As the plume reaches the lithosphere, it spreads laterally, doming at the surface and moving along the direction of mantle plumes.
- They are the source of energy that keeps the plates active.
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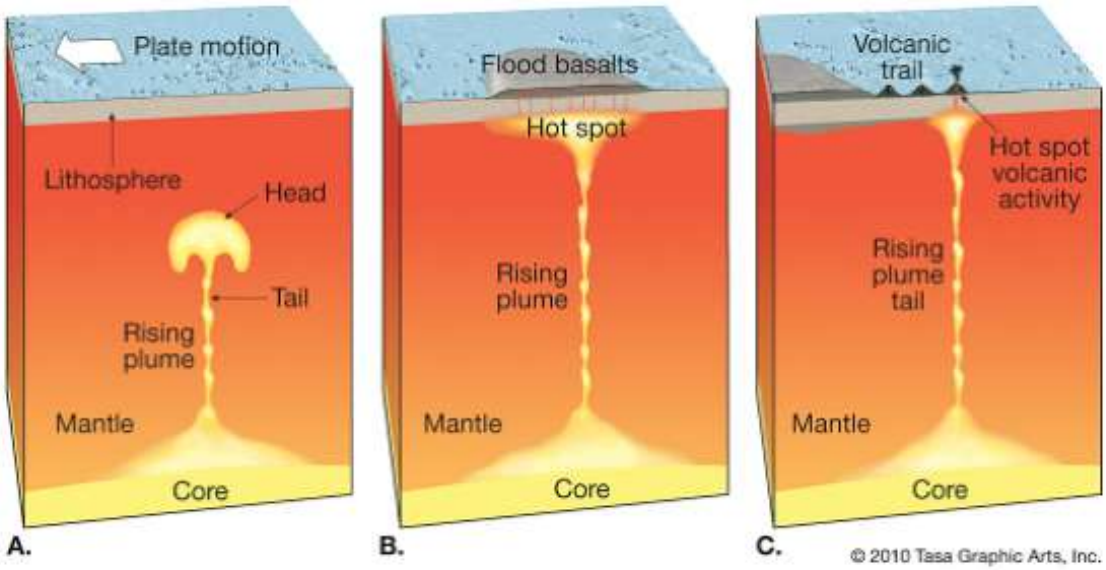
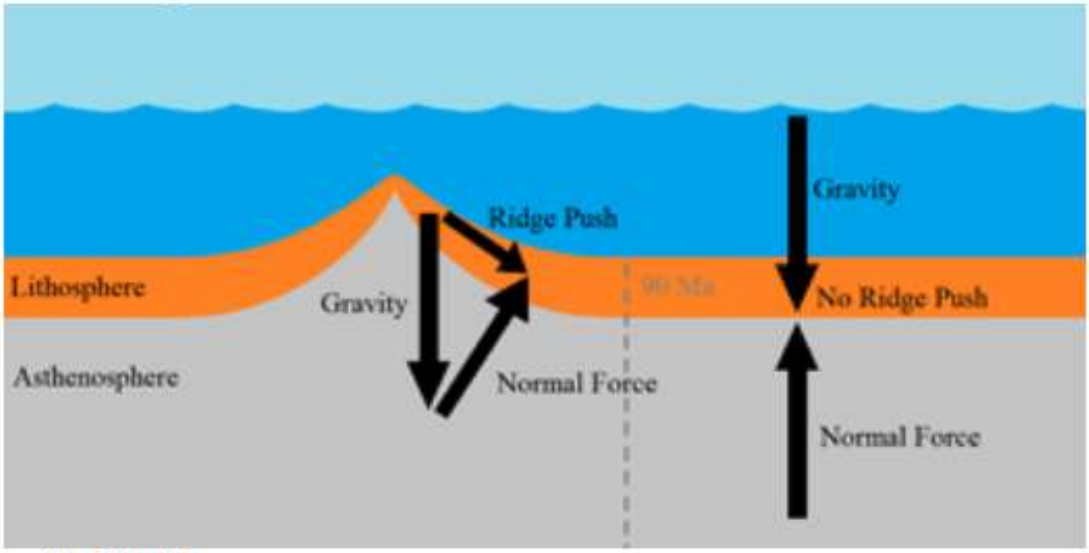


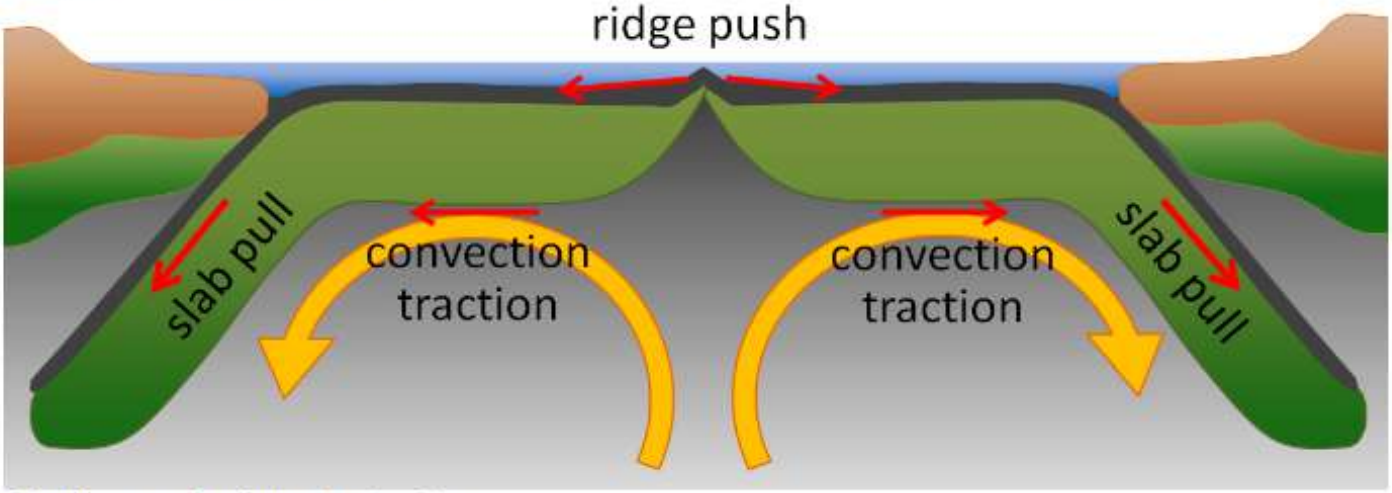
- Mantle plumes are the cause of differential plate motions causing **intra-plate movements**.
- That particular spot on the lithosphere where the mantle plumes are rising is called a **hotspot.**
- They are the causes of the formation of **Volcanic Hotspots** like Hawaiin, and Reunion.

Near Madagascar in Indian ocean.

3. **Ridge Push:**
   - Magma rising along the mid-oceanic ridges accumulates on both sides of the oceanic plate resulting in the pushing apart of the plates.
   - It can be understood as the pressure exerted by the excess height of the mid-ocean ridge.
   -


4. **Gravity Sliding:**
   - The spreading centers of the ridges stand high on the oceanic floor.
   - This results in gravitational sliding of the lithospheric slabs away from the oceanic ridge.
   - It can be understood as the movement of rock bodies in response to gravitational instability along particular planes.

4. **Slab Pull:**
   - They are considered to be along the subduction zones where the subducting plate pulls the rest of the slab along.
   - It can be understood as the force exerted by the weight of the subducted slab on the plate it is attached to.



Limitations of plate tectonics:

Plate tectonics in the past:

- It cannot fully explain the formation of old fold mountains (older than 200 million years). like Ural, Aravallis, and Appalachians.
- It cannot fully explain the older movement of different plates.
- Also how they are different from the present ones.
- **Africa** is totally surrounded by ridges except by a small trench along the Mediterranean.
- It means Africa is continuously growing.
- Similarly, the **Antarctica plate** is also surrounded by ridges.
- Both plates continue to grow and have no subduction zones to accommodate the new lithosphere generated.
- What are the future of this process and both plates?
- When will the process stop?

The topic for the next class is volcanism.

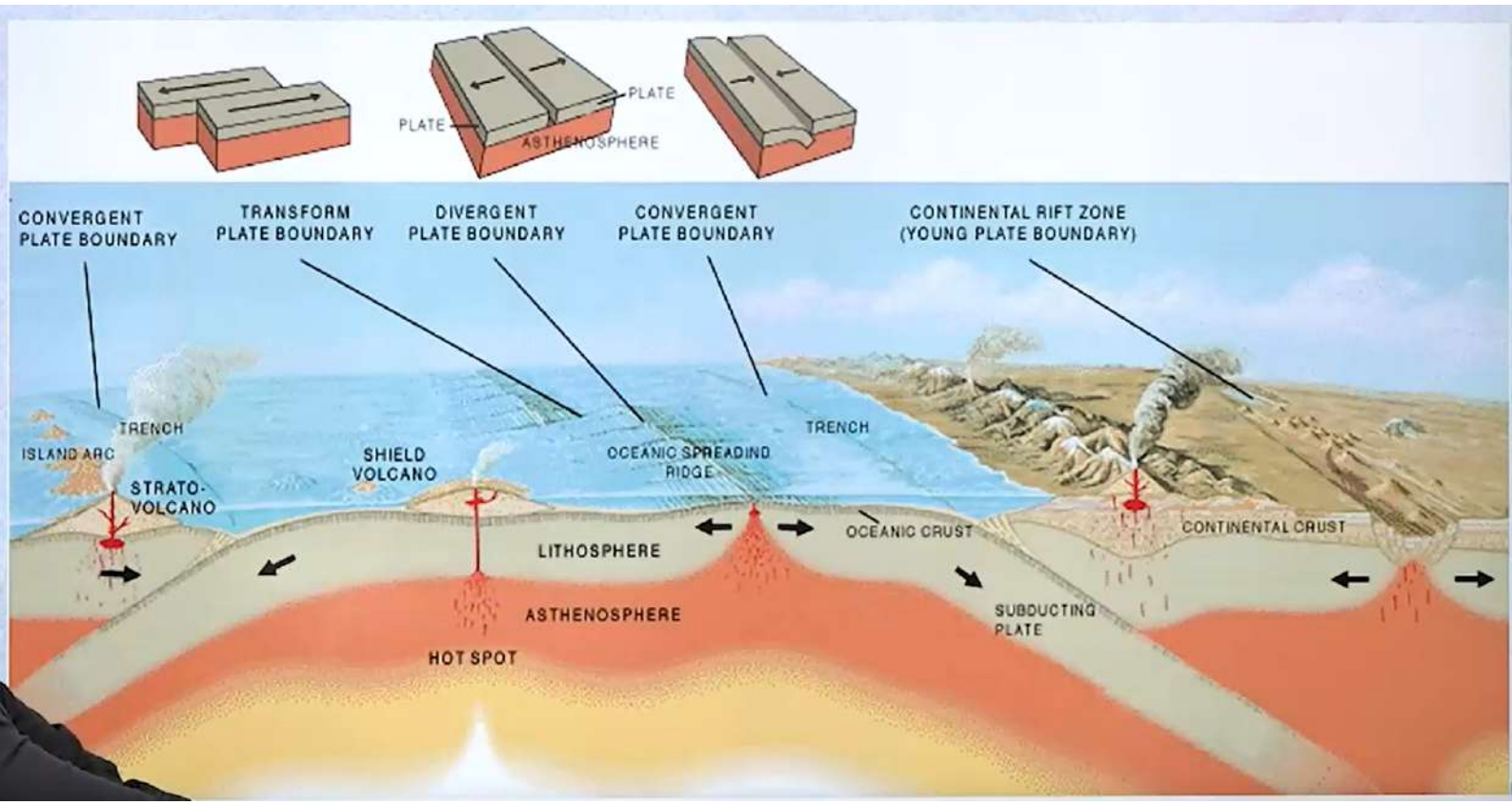
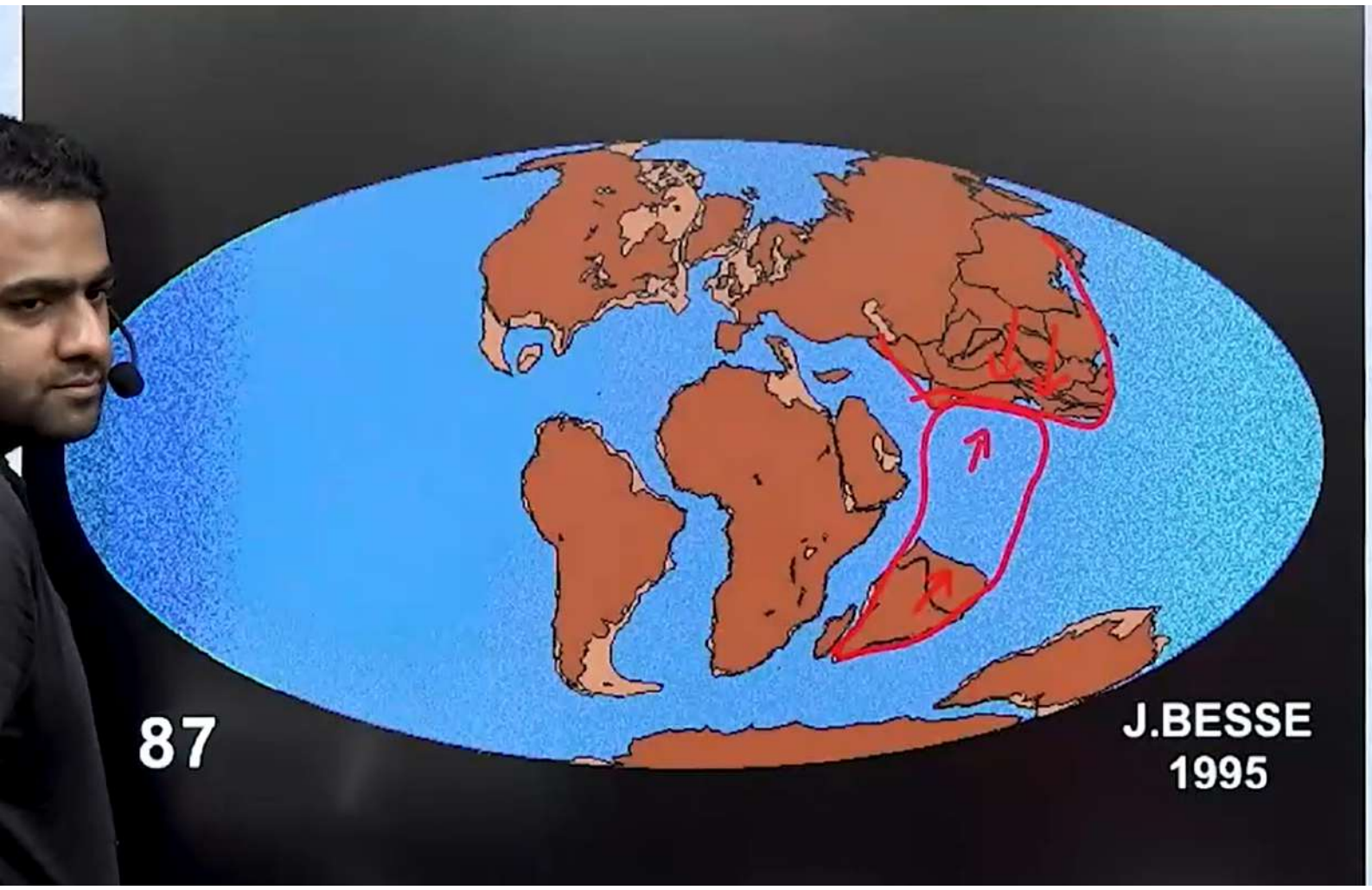


PLATE
PLATE
ASTHENOSPHERE
CONVERGENT PLATE BOUNDARY
TRANSFORM PLATE BOUNDARY
DIVERGENT PLATE BOUNDARY
CONVERGENT PLATE BOUNDARY
CONTINENTAL RIFT ZONE (YOUNG PLATE BOUNDARY)
TRENCH
ISLAND ARC
STRATO-VOLCANO
SHIELD VOLCANO
OCEANIC SPREADING RIDGE
TRENCH
OCEANIC CRUST
CONTINENTAL CRUST
LITHOSPHERE
ASTHENOSPHERE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



Indian plate colliding with Eurasian plate and will cause c-c convergence.

San Andreas fault near California.

Transform fault.