

## Geography Class 11

### STUDENTS MUST REMEMBER (9:10 AM):

- Students must try to minimize pendency and complete the daily tasks on the day itself.
- Studying according to the pace of the class is good enough but we need to maintain consistency.
- Maintaining balance with personal life & interactions along with reducing distractions is necessary to sustain consistency for a long time.
- For mapping we only need to focus on **two things**:
- (1) Where is the location?
- (2) Why is it in the news?
- We are not supposed to get into too much depth of any of the above two things.

### Revision of the previous class:

- The processes that bring about changes in the configuration on the surface of the earth are called **Geomorphic processes**.
- These processes can be endogenetic or exogenetic.
- Endogenetic processes can be Diastrophic (Tectonic, Isostatic & Eustatic)& Catastrophic(earthquakes, volcanoes).
- Exogenetic - Aggradation & Degradation( weathering, erosion & mass-movement).
- Tectonic activities can be either Epeirogenic & Orogenic.
- **Epeirogenic** movements are vertical movements that cause continent formation.
- These are characterized by large-scale upliftment, subsidence, emergence, or submergence of land areas.
- **Orogenic** movements are mountain-building movements.
- They act in a **tangential** direction.
- They involve intense folding and faulting of narrow belts.

## Isostasy:

- It refers to the concept that the lighter crust must be floating on the denser underlying mantle.
- The physical properties of the lithosphere are affected by the way the mantle and crust respond to internal and external factors.
- This depends upon the **buoyancy** principle by **Archimedes**.
- **Archimedes' Principle** is the fact that buoyant force is equal to the weight of the displaced fluid.
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Isostasy refers to the equilibrium that exists between the Earth's lithosphere (the rigid outer layer) and the asthenosphere (the semi-fluid layer beneath). It explains how the Earth's crust "floats" at an elevation dependent on its thickness and density, similar to how an iceberg floats in water.

### Key Concepts:

Principle: Thicker, less dense crust (like continental crust) "floats" higher, while thinner, denser crust (like oceanic crust) sinks lower.

### Isostatic Adjustment:

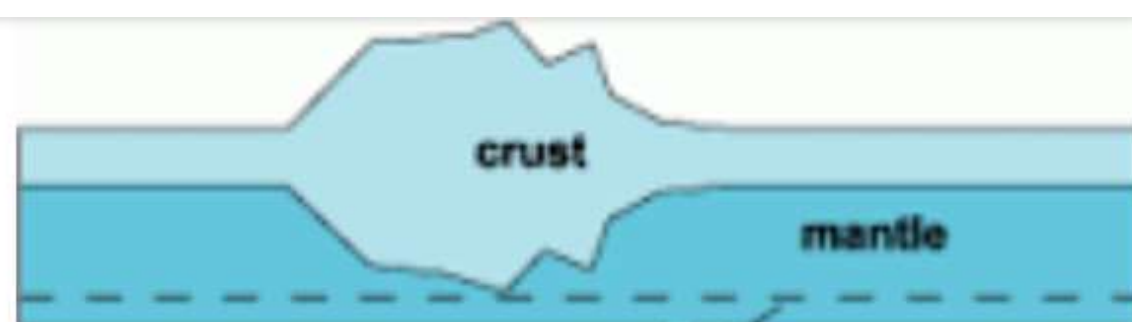
When weight is added (e.g., glaciers, sediments), the crust sinks into the mantle.

When weight is removed (e.g., glacial melting, erosion), the crust rises, a process called isostatic rebound.

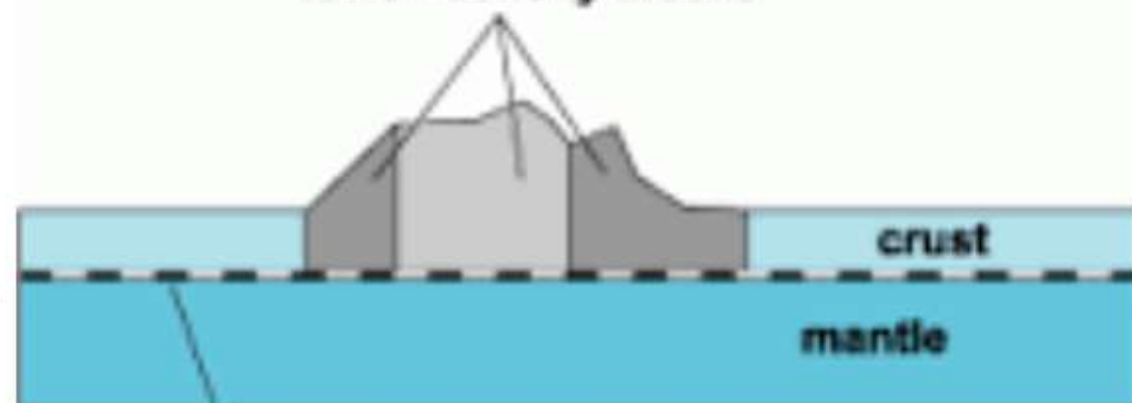
### Examples:

Glacial Isostasy: Regions like Scandinavia and Canada are rising slowly due to the melting of Ice Age glaciers.

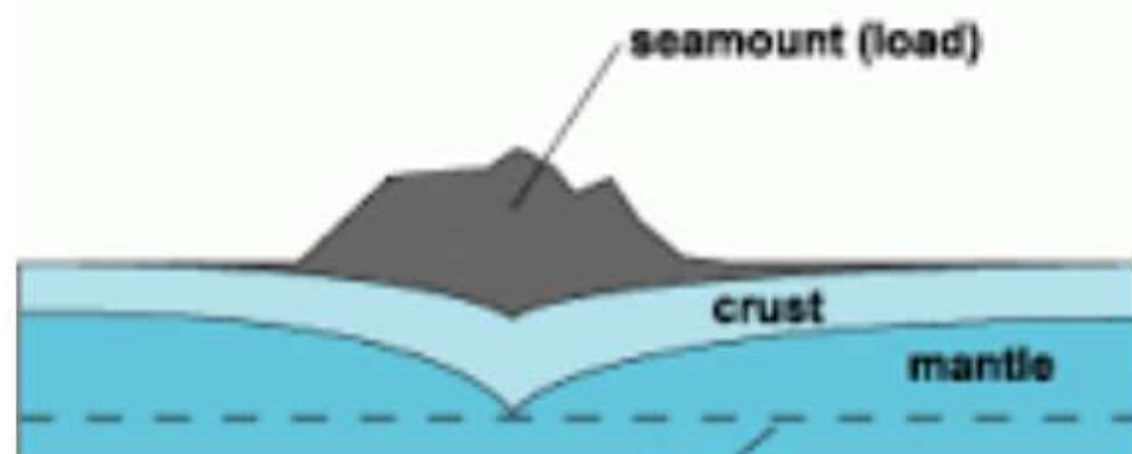
Sediment Loading: The Mississippi Delta region is sinking due to the weight of accumulating sediments.



(a) depth of compensation

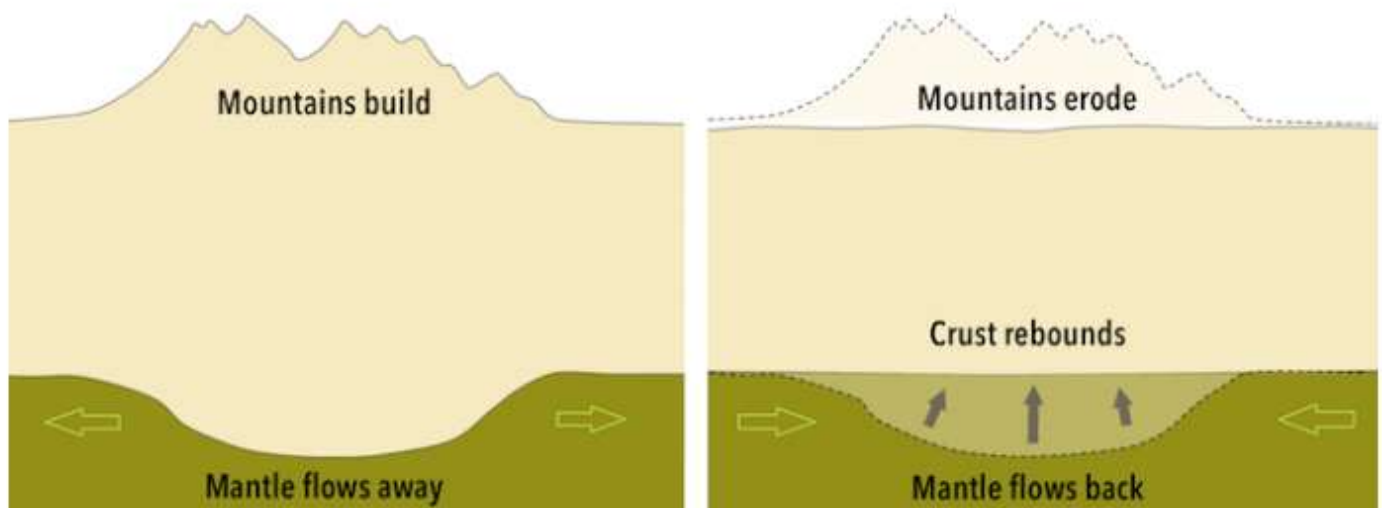


(b) depth of compensation



(c) depth of compensation

- They include vertical movements on the basis of **floatation displacement** between the rock layers differing densities to achieve balanced crustal columns of uniform mass above a level of compensation in which the topographic elevation is inversely related to the underlying rock density.
- **For example**, mountains have deeper roots.
- **Depth of compensation** is the depth below which the pressure (both upwards and downwards) is identical across any horizontal surface.
- As the mountains form and erode, the pressure they exert on the underlying layers of the earth change.
- When mountains form, the pressure increases downwards and when mountains erode, this pressure reduces.
- The earth's crustal column adjusts to changes in weight.



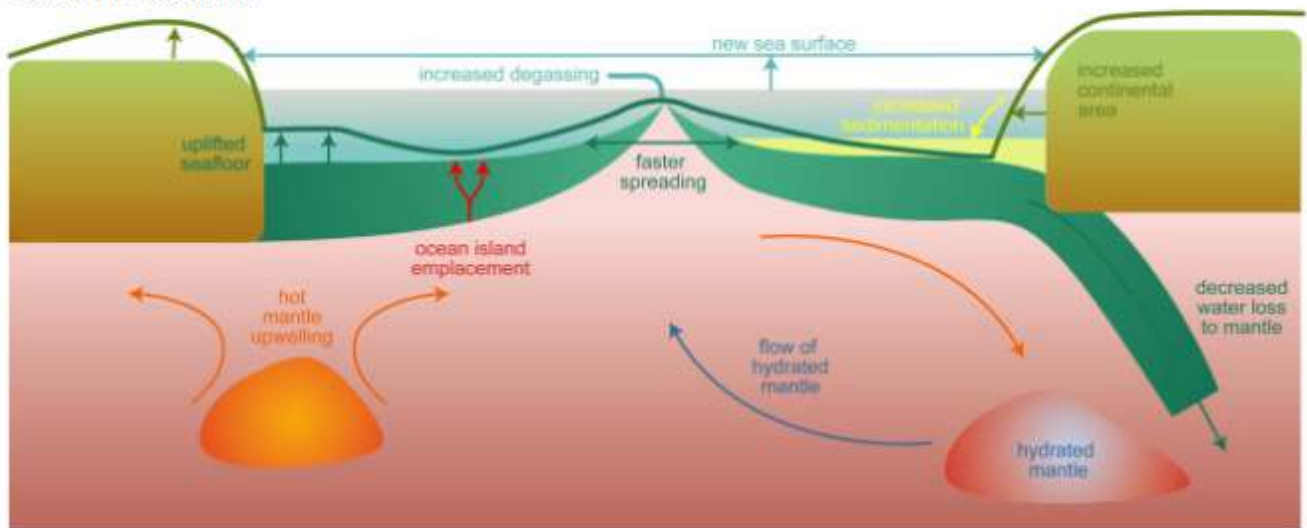
- This effect is prominently seen on the coast of **Norway (Scandinavia)**.
- Norway had remnants of the last ice age (which ended 11000 years ago) in the form of large glaciers.
- These large glaciers exerted large pressure on the mountains and land.
- As these glaciers started to melt, the exerted pressure started to decrease and the land started to rise.
- This rise is visible on the Norway coast.





## EUSTATIC CHANGES (9:40 AM):

- They involve worldwide sea levels which include the changes in the total volume of liquid seawater and the capacity of ocean basins.
- **For example-** Convections from the interior will arch up and displace water from oceanic basins.



### 2. Eustatic Changes:

Eustatic changes refer to global changes in sea level caused by variations in the volume of water in the oceans or changes in the shape of ocean basins.

#### Causes of Eustatic Changes:

##### Melting or Formation of Glaciers (Glacio-Eustasy):

During glacial periods, sea levels fall as water is stored in ice sheets.

During interglacial periods, melting glaciers increase sea levels.

##### Thermal Expansion (Thermo-Eustasy):

As the ocean warms, water expands, raising sea levels.

Cooling causes contraction and lower sea levels.

##### Tectonic Changes:

Alterations in the shape or capacity of ocean basins due to tectonic activity (e.g., seafloor spreading) can affect global sea levels.

#### Examples:

Rising sea levels due to global warming and glacier melting.

Falling sea levels during glacial periods when water is locked in ice caps.

#### Comparison Between Isostasy and Eustatic Changes:

Aspect	Isostasy	Eustatic Changes
Definition	Equilibrium between lithosphere and mantle	Global sea-level changes
Cause	Local changes in crust thickness/density	Changes in ocean volume or basin shape
Scale	Local or regional	Global
Examples	Glacial rebound, sediment loading	Glacial melting, thermal expansion

#### Summary:

Isostasy is about the balance and vertical movement of the Earth's crust in response to weight changes.

Eustatic changes are global shifts in sea level due to variations in water volume or basin capacity. Both processes are crucial in understanding Earth's dynamic surface and how land and sea levels evolve over time.

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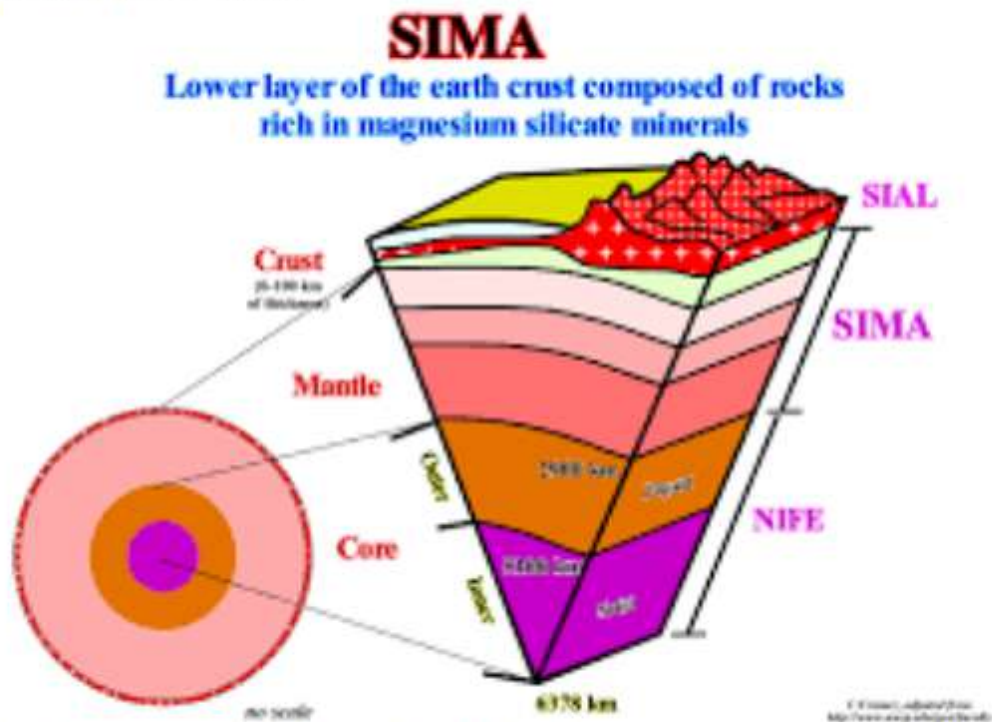
### Continental Drift Theory:

- **Alfred Wegner** was a German meteorologist that put forward his idea in the form of the Continental Drift Theory in 1912.
- **Meteorology** refers to the study of weather.
- He proposed the theory to explain major variations in the Earth's climate.



### Assumptions of the theory:

- He proposed that the earth is made up of three layers- Outer SiAl, Intermediate SiMa, and inner NiFe.

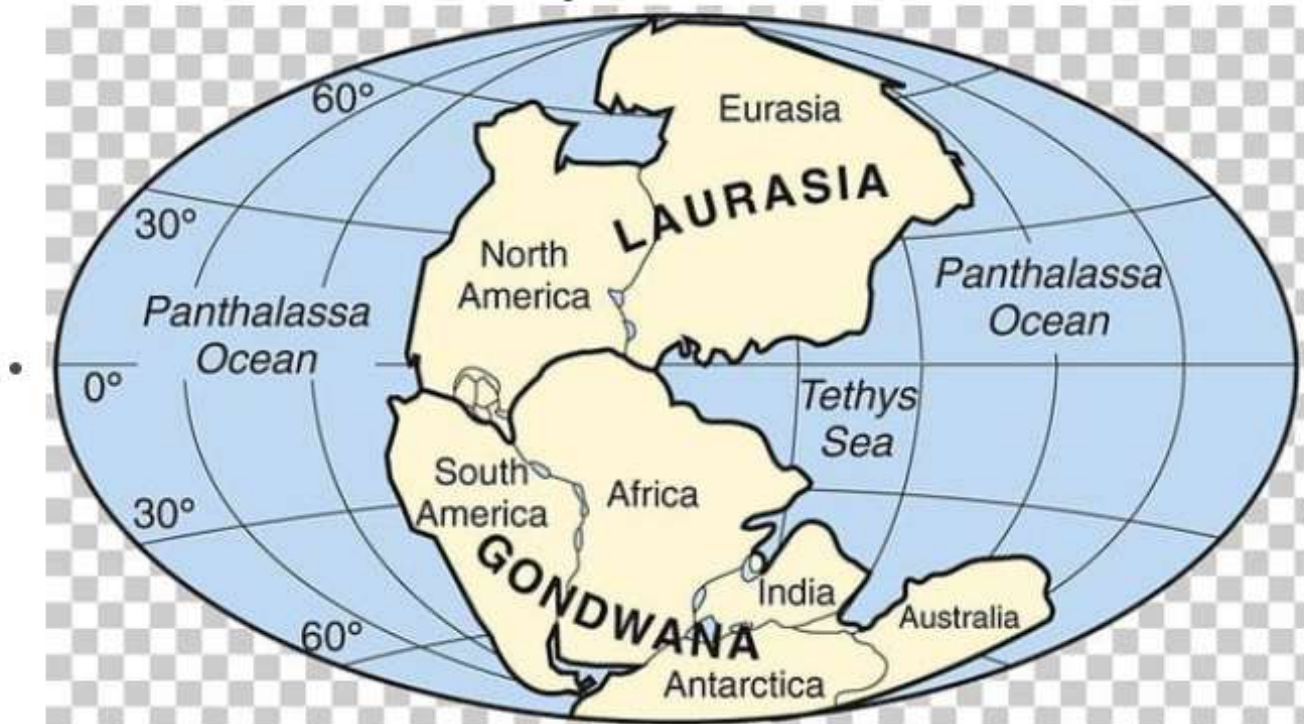


- SiAl is the continental mass, SiMa is the oceanic crust and Nife is the core.
- The continental masses are floating over the oceanic crust without any resistance.



### EXPLANATION (10:10 AM):

- 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 Southern **Gondwana** by a rift running from East to West.
- This rift was filled with the **Tethys Sea**.



- The northern part consisted of North America, Greenland, and Eurasia (without ~~Arabia~~ & India).
- The southern Gondwana land consisted of Africa with Arabia, Madagascar, India, Australia, Antarctica, and South America.
- A north-south rift separated North America from Eurasia and South America from Africa, which started to move towards the West.
- India started to move towards the north.
- Australia got separated from Antarctica and moved towards the east.
- Arabia got separated from Africa and merged with Asia.

Pole-fleeing force is a concept related to the centrifugal force caused by Earth's rotation. It is the force that pushes objects away from the poles toward the equator due to the Earth's spinning motion. The pole-fleeing force is a result of Earth's rotation, creating a centrifugal effect that pushes objects away from the poles toward the equator. This force plays a role in shaping the Earth, affecting weight distribution, and influencing natural phenomena like ocean and atmospheric circulation.

Wegener proposed two primary forces that he believed moved the continents:

Pole-fleeing force: Due to the Earth's rotation and centrifugal force, continents were pushed toward the equator.

Tidal forces: Exerted by the Moon and Sun, causing westward drift of continents.

These forces, however, would suggest a general, unified direction of motion (toward the equator or westward), not the complex patterns of separation observed in Pangaea's breakup.

Thus, his theory couldn't explain the diverse directions in which continents moved after Pangaea's breakup.

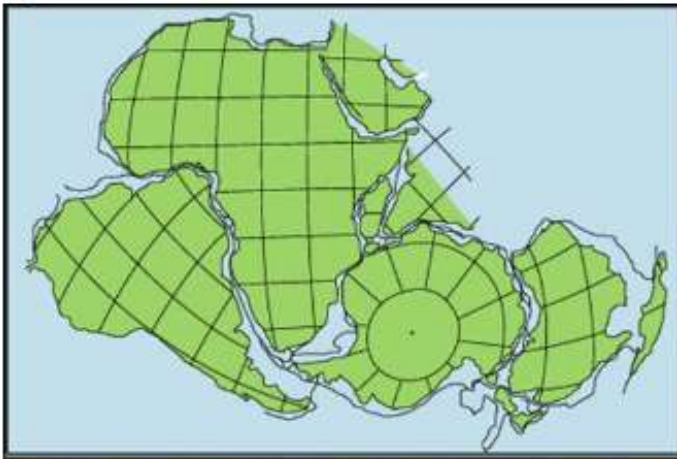
Wegener's concept of equatorward motion was based on incomplete and incorrect assumptions about the forces driving continental drift. While it helped initiate the idea that continents move, it could not explain the breakup of Pangaea or the observed patterns of continental separation. Modern plate tectonics, driven by mantle convection, seafloor spreading, and plate interactions, provides the correct explanation for why Pangaea fragmented and why continents moved apart in various directions.

## Forces responsible for the movements per Wegner:

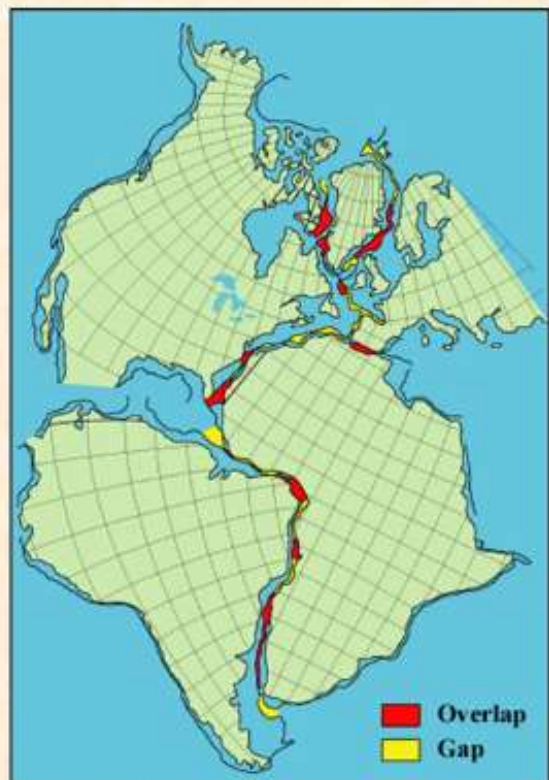
- **Equatorward Motion** which was caused by **pole-fleeing force**.
- This force was a result of gravitational differential force and the force of buoyancy to adjust the center of gravity and the center of buoyancy
- The **westward motion** was caused by the **tidal forces** of the sun and moon due to gravity.

## EVIDENCES GIVEN BY WEGNER(11:00 AM):

### I. Jigsaw Fit of the continents:



This “jigsaw” fit of continental margins is best when the outline is the edges of the continental shelves.



- Similarities in the coastlines on the opposite sides of the oceans were found.
- All the continents can be merged together to form one big continent.

## II. Structural evidence:

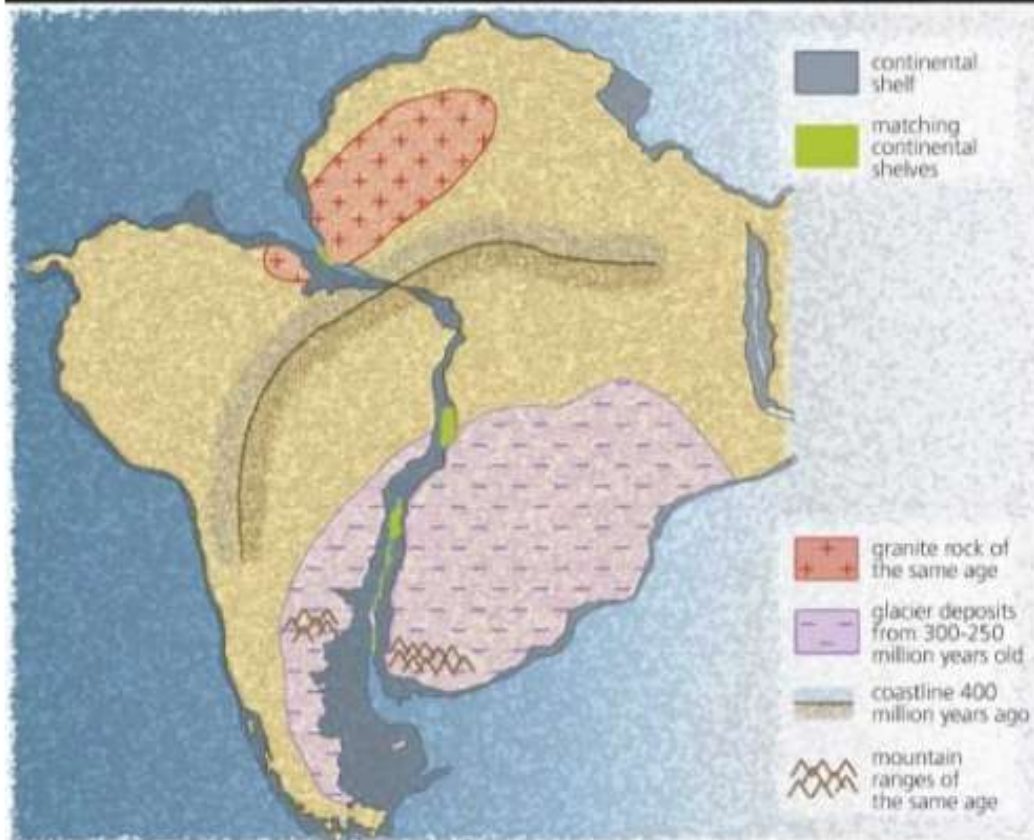
- This refers to the similarities in the age and structure of mountain belts in different parts of the world.
- **For example-** The mountain belts of Brazil terminate along the eastern coast of South America and the same type of mountains re-appear in Western Africa.
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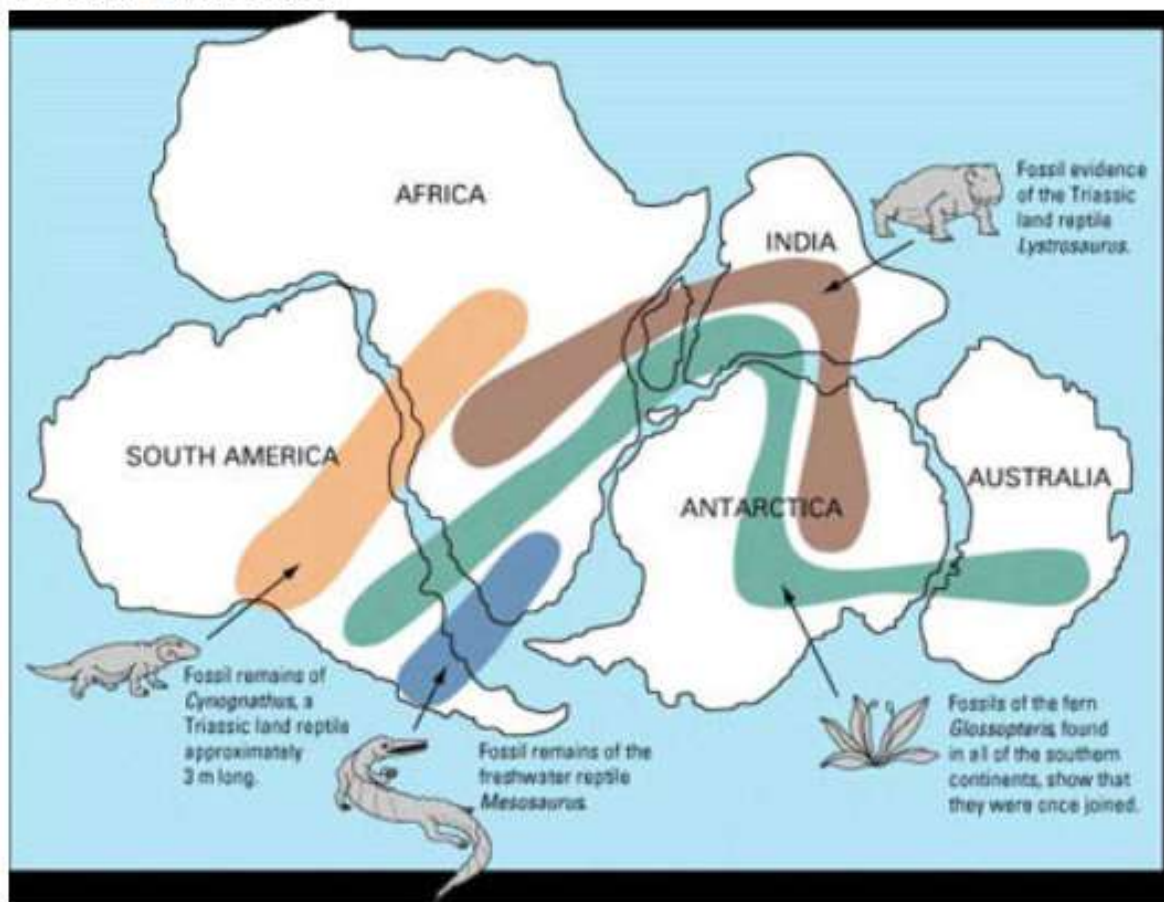
### III. Stratigraphic evidence:

- It refers to the similarities in the rock formations.
- **For example-** the Eastern coast of Brazil has the same type of rock formations observed on the western coast of Africa.



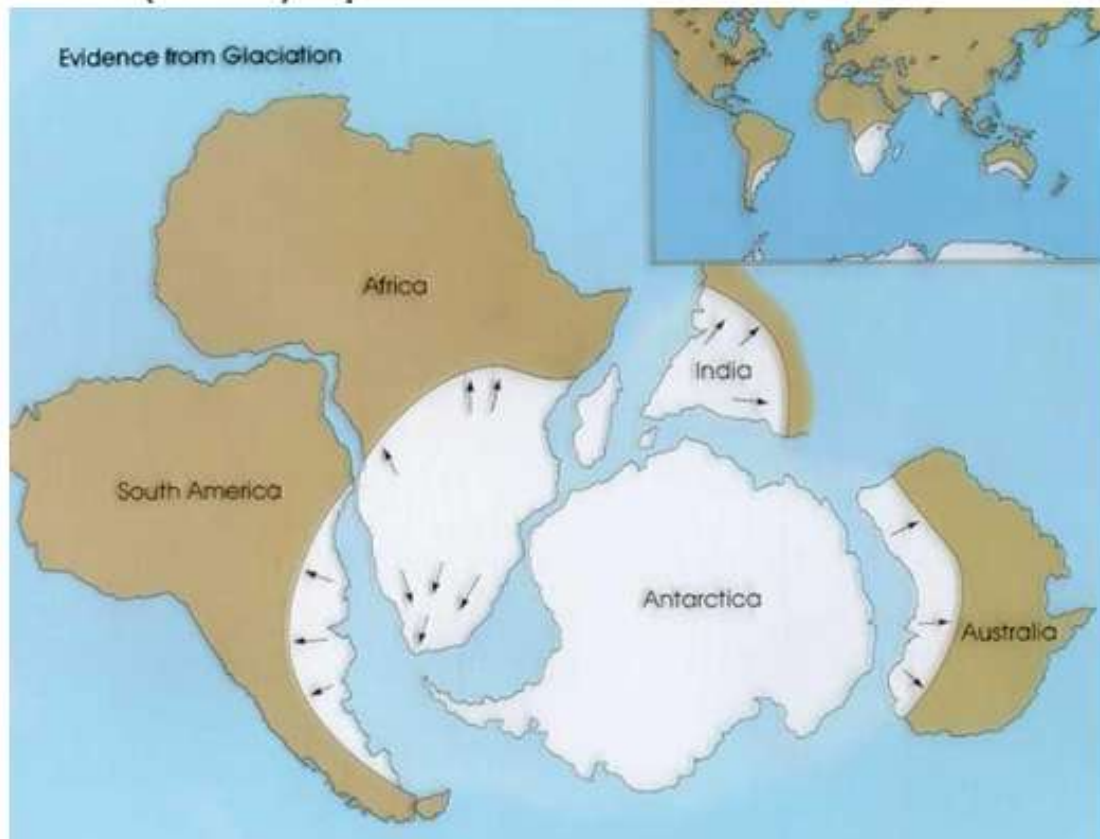


#### IV. Fossil Evidence:



- **Mesosaurus**- The freshwater reptiles whose fossils were found across South America and Africa which are separated by a wide ocean.
- **Glossopteris**- This floral evidence was found all across the Gondwanaland.

## V. Glacial (Tillites) Deposits:



- They are presently found in warm tropical regions like South America, South Africa, Australia, India, etc.

## VI. Placer Deposits:

- They are the sediments that have been deposited at a place different from their place of origin due to depositional forces.
- Rich deposits of gold placer deposits near the **Ghana Coast** without any source of gold nearby, but the source is found in Brazil.
- The **impurity analysis** of gold placer deposits is very accurate.
- This is because impurities from two places cannot be the same.
- This analysis told us the gold found in **Indus Valley Civilization** sites was sourced from the **Kolar Gold Field**.



## CRITICISMS OF THE THEORY (11:35 AM):

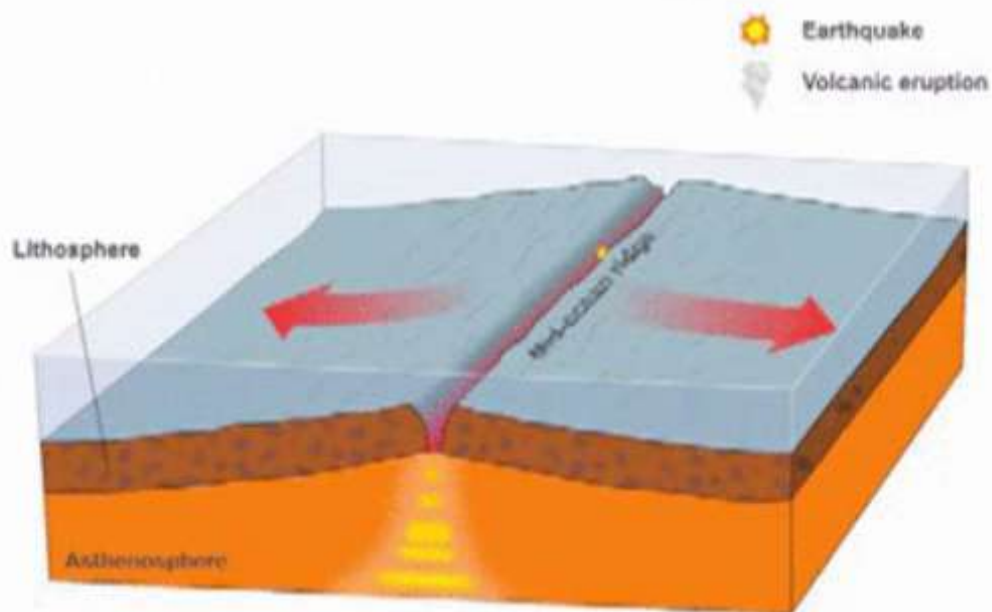
- The forces envisaged for the movement of the continents were considered to be inadequate. (bz that much small amount of forces can't affect location of continents)
- The rocks of continental and oceanic crusts are rigid and they would not permit easy drifting of continents over the oceanic crust.
- The theory did not describe the conditions of pre-carboniferous times.

it means that Alfred Wegner says that SIAL layer which is continental crust drifts over SIMA layer which is oceanic crust.

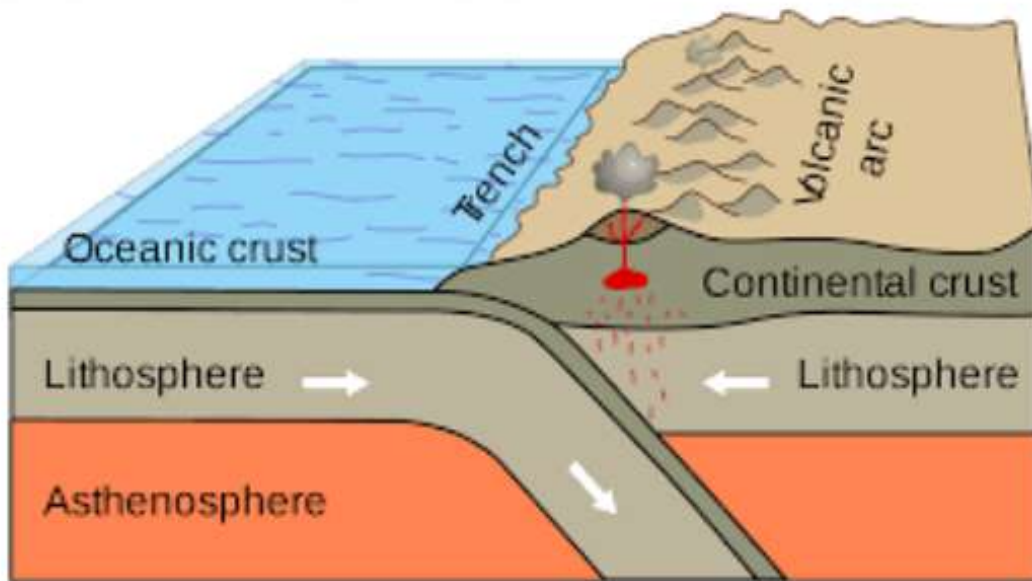
### Sea-Floor Spreading Theory:

- The theory was proposed by **Harry Hess** in 1961.
- Due to **SONAR( Sound Navigation And Ranging)** mapping of the ocean floor, we discovered many new facts.
- The oceanic crust was much thinner than the continental crust.
- No oceanic rock older the 150 million years were found, while we had many land rocks older than 4 billion years.
- Seafloor spreading is a geologic process in which tectonic plates—large slabs of Earth's lithosphere—split apart from each other.
- As per the theory, the new crust was being formed at Mid Oceanic ridges and the older crust was being destroyed at oceanic trenches.

### Mid-Ocean Ridge



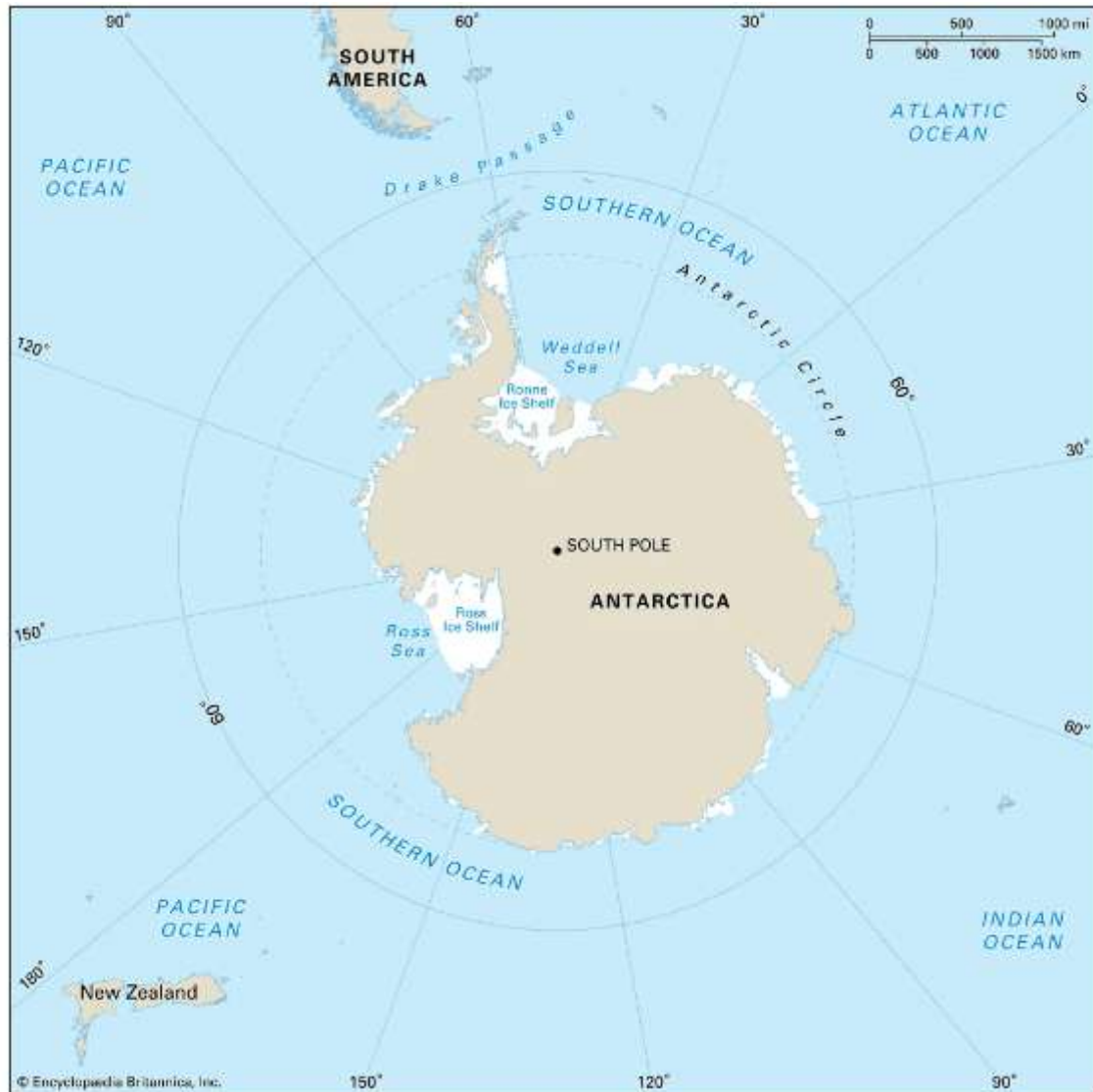




#### Mapping exercise:

- The Atlantic Ocean is the youngest ocean.
- The Indian Ocean is not connected with the Atlantic Ocean and this causes occurrences of monsoons and cyclones.
- The Arctic Ocean is the smallest ocean.
- A major part of the Arctic Ocean is covered with thick ice.
- The polar bear is the largest land carnivore, which is found only in the north pole.
- The penguins are found only in the south pole.
- In 2010, the **Southern Ocean** was demarcated by the **International Hydrographic Organization**.
- This is the ocean which consists of waters below 60 degrees south latitude.





- The demarcation is done at 60 degrees south because waters beyond this latitude do not get easily mixed with other waters.
- This is due to the presence of **oceanic currents** which can be understood as "rivers flowing in the ocean".

The topics for the next class are the dictation of the **Sea Floor Spreading theory** and the **Plate Tectonic Theory**.

## CONTINENTAL DRIFT OF PLATES



225 Million Years Ago



150 Million Years Ago



100 Million Years Ago



Earth Today