EWCE 203: Geology and Geomorphology

Geology

What we discussed in previous class?

- **What is Geology?**
- **Requirement of studying Geology.**
- **Definition**
- **Branches of Geology**
- **Theory of Uniformitarianism**
- **Continental drift**

What we are going to learn today?

- **Some Chronological Events of the Earth Development**
- **Mid ocean ridges**
- **Sea-floor Spreading**
- **Significance of sea-floor spreading**
- **Theory of plate tectonics**

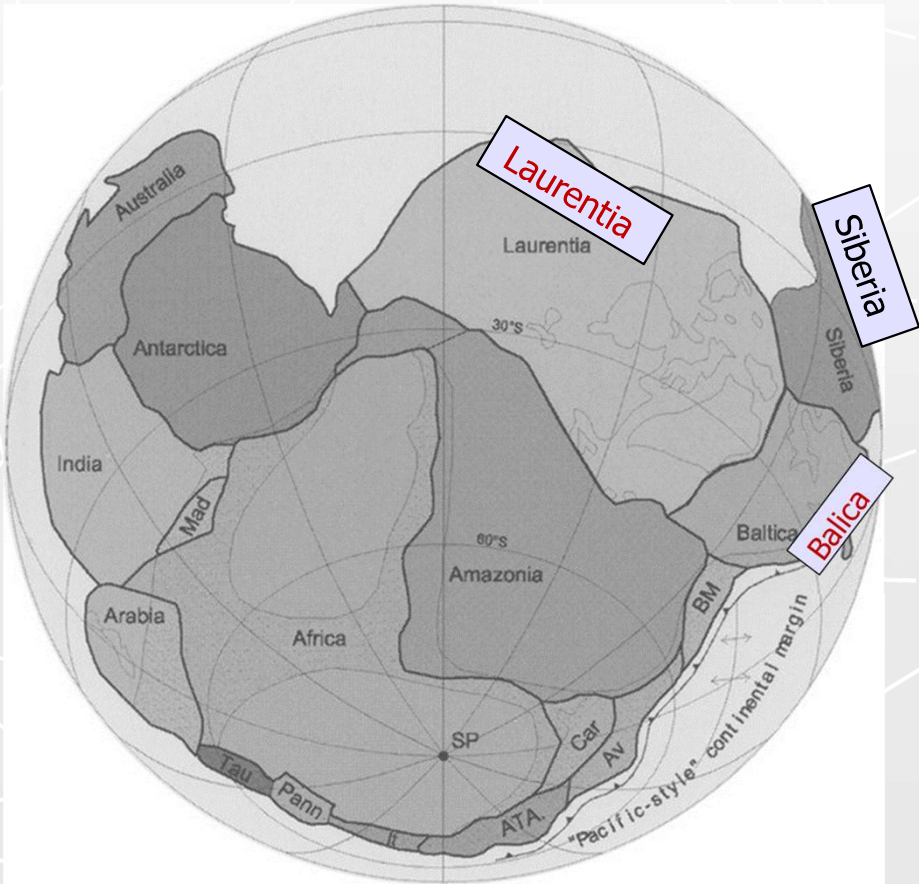
Chronological Events of the Development of the Earth

500 Million Years Ago - Pannotia

- **500 million years ago** a **chunk** of the **supercontinent Pannotia** drifted north and split into three masses, forming:

  -**Laurentia** (present-day North America), **Baltica** (present-day northern Europe), and **Siberia**.

In shallow waters, the first multicellular **animals with exoskeletons appeared**, and an explosion of life began.



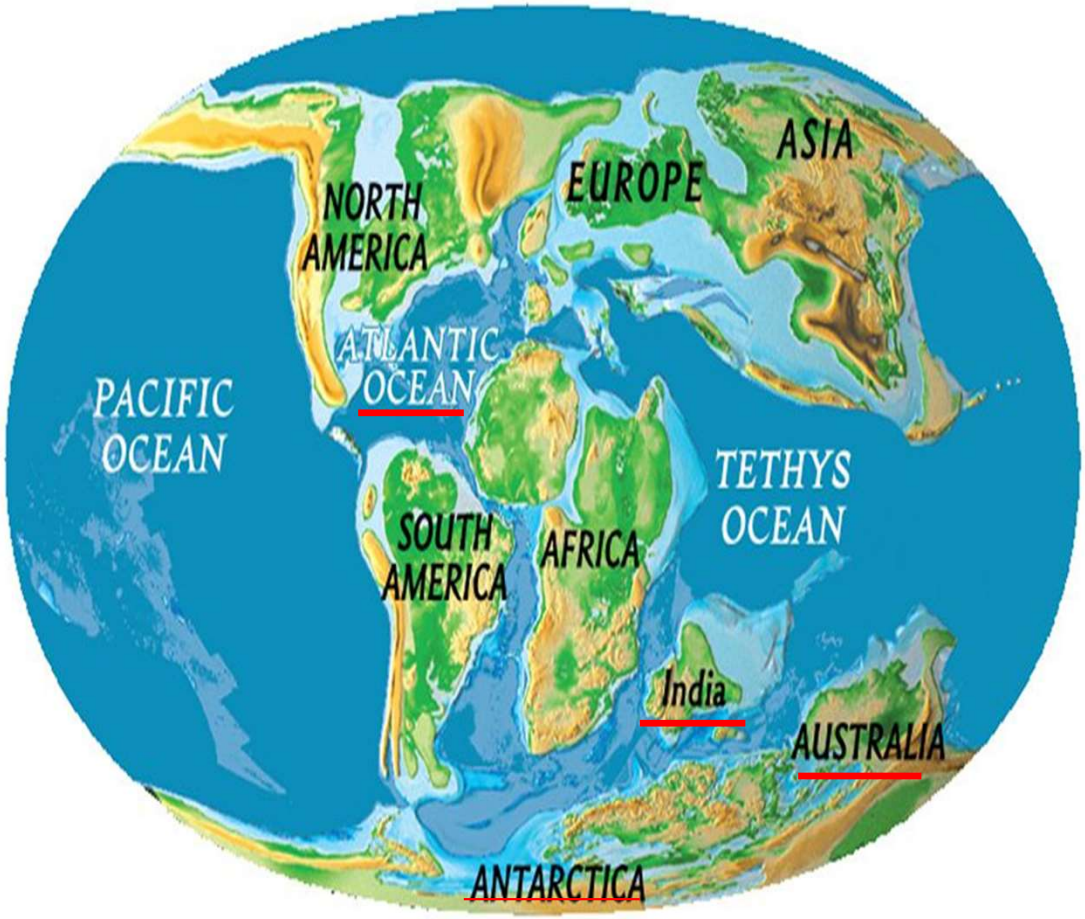
200 Million Years Ago - Pangea

200 million years ago, dinosaurs roamed the **supercontinent, Pangea**, surrounded by the **Panthalassic Ocean**, the oceanic ancestor of the Pacific Ocean and **Tethys Ocean**, ancestor of Atlantic Ocean .



100 Million Years Ago

- **100 million years ago**, **Pangea broke apart**.
- **Atlantic Ocean poured** in between Africa and the America.
- **India broke away** from the African continent, and
- **Antarctica and Australia**, still connected above sea level, were stranded near the South Pole.



50 Million years ago:

- **Dinosaurs were extinct** from the Earth.
- **Continental fragments collided**, pushing up mountain ranges still existing today.
- Collision of **Africa into Europe** gave rise to the **Alps** in Europe, and
- Collision of **India into Asia** formed the **Himalaya**.
- **Birds and mammals** began to expand in number and diversity.



Forming Mountain Ranges





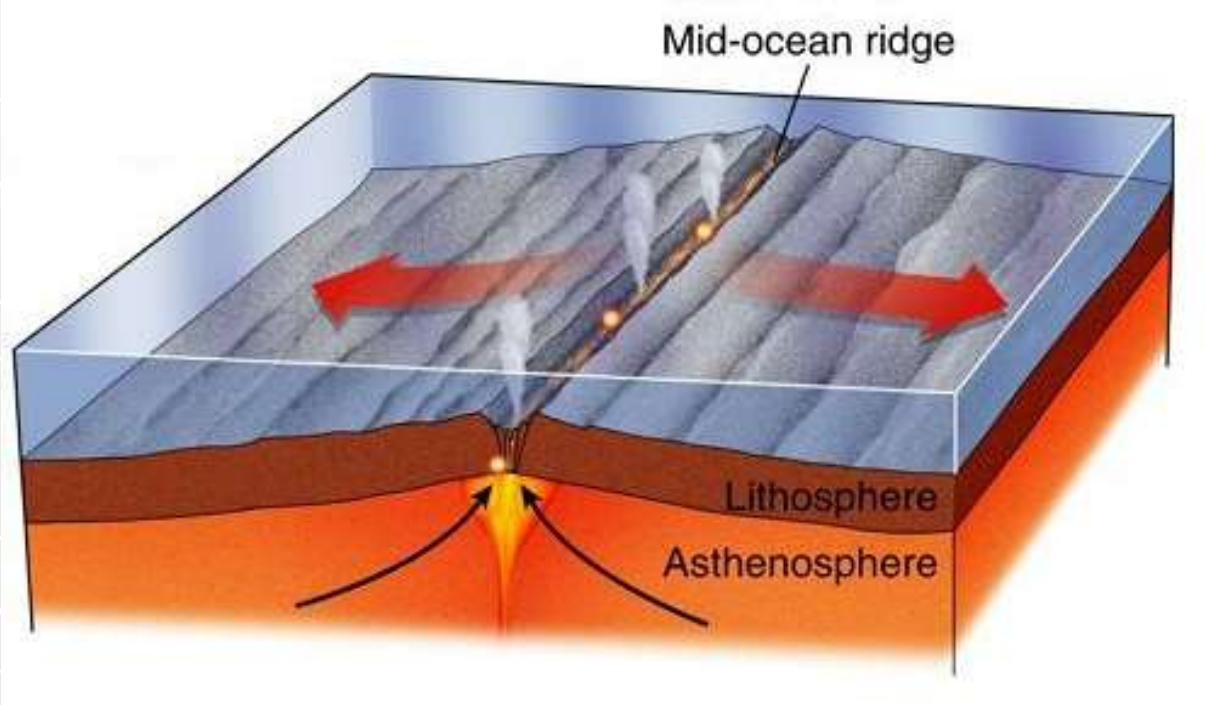
Mid-Ocean Ridges

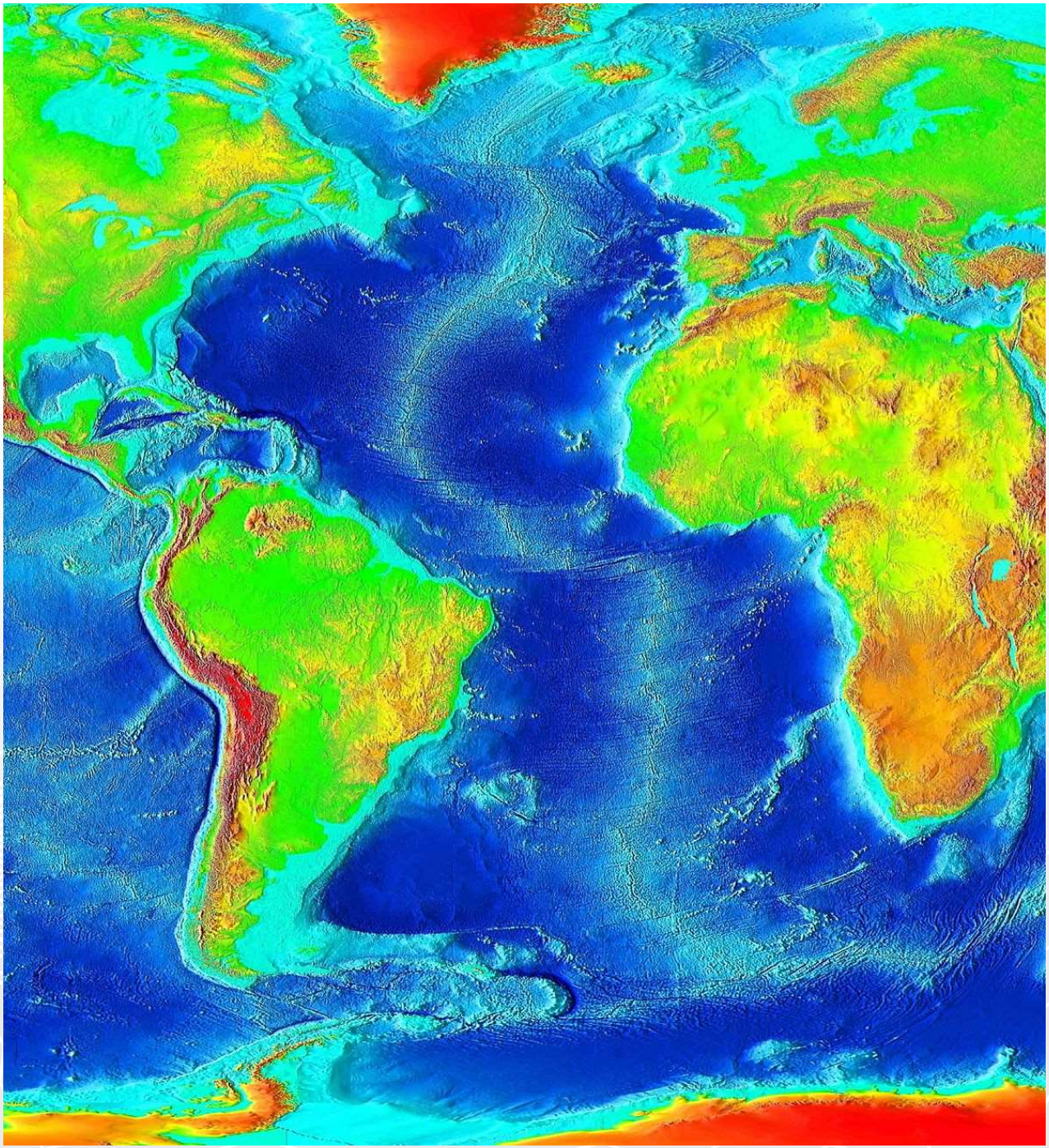
Concept - Mid-ocean Ridges

- **Alfred suggested** that **continents 'floated' or 'drifted'** to **their positions**.
- **Could not explain how this happened** and scientific community rejected his theory until the 1940s.
- Technology boom associated with WWII brought advances in **sonar and radar**.
- **In 1947**, **two geologists mapped the ocean floor,** which revealed evidence that **oceanic crust is created at mid-ocean ridges**.

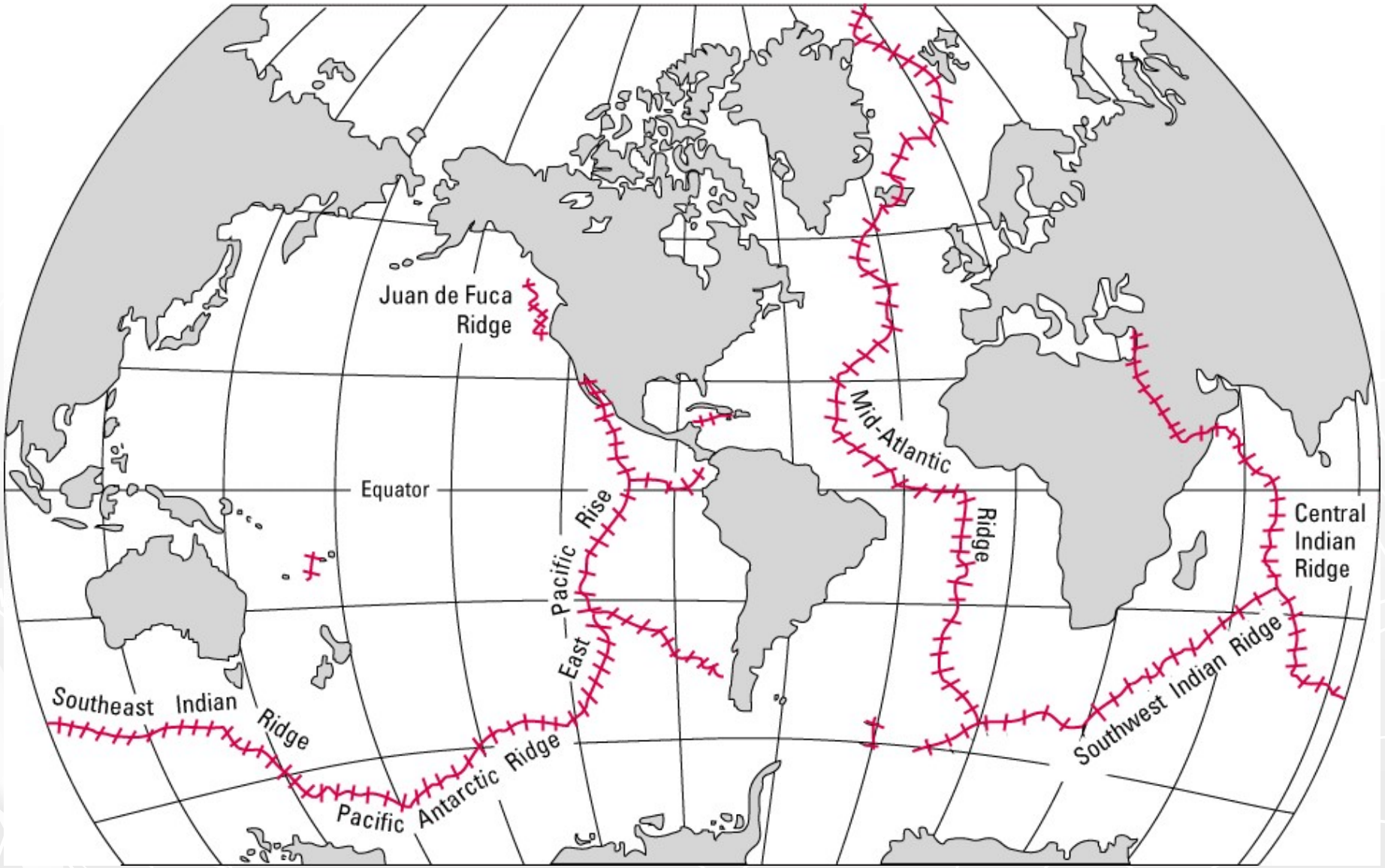
Mid-ocean ridge (MOR):

- A **seafloor mountain system** formed by **plate tectonics**.
- It typically has a **depth of 2,600 meters** (8,500 ft) and rises about **two kilometers** above the deepest portion of an ocean basin.
- Mid Ocean ridge is where sea-floor spreading takes place along a **divergent plate boundary**.





Mid-Atlantic Ocean Ridge

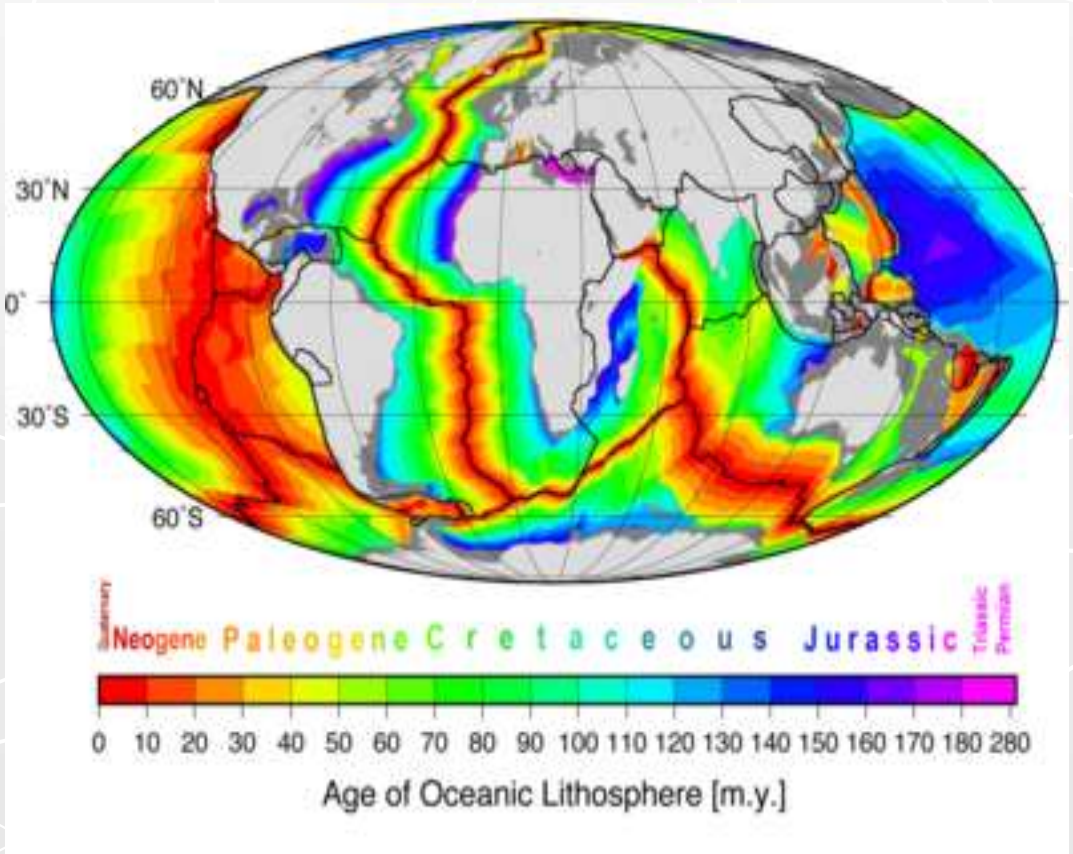


World distribution of mid-oceanic ridges

Seafloor spreading:

- **Process that occurs at mid-ocean ridges**, where **new oceanic crust** is formed **through volcanic activity** and then **gradually moves away** from the ridge.

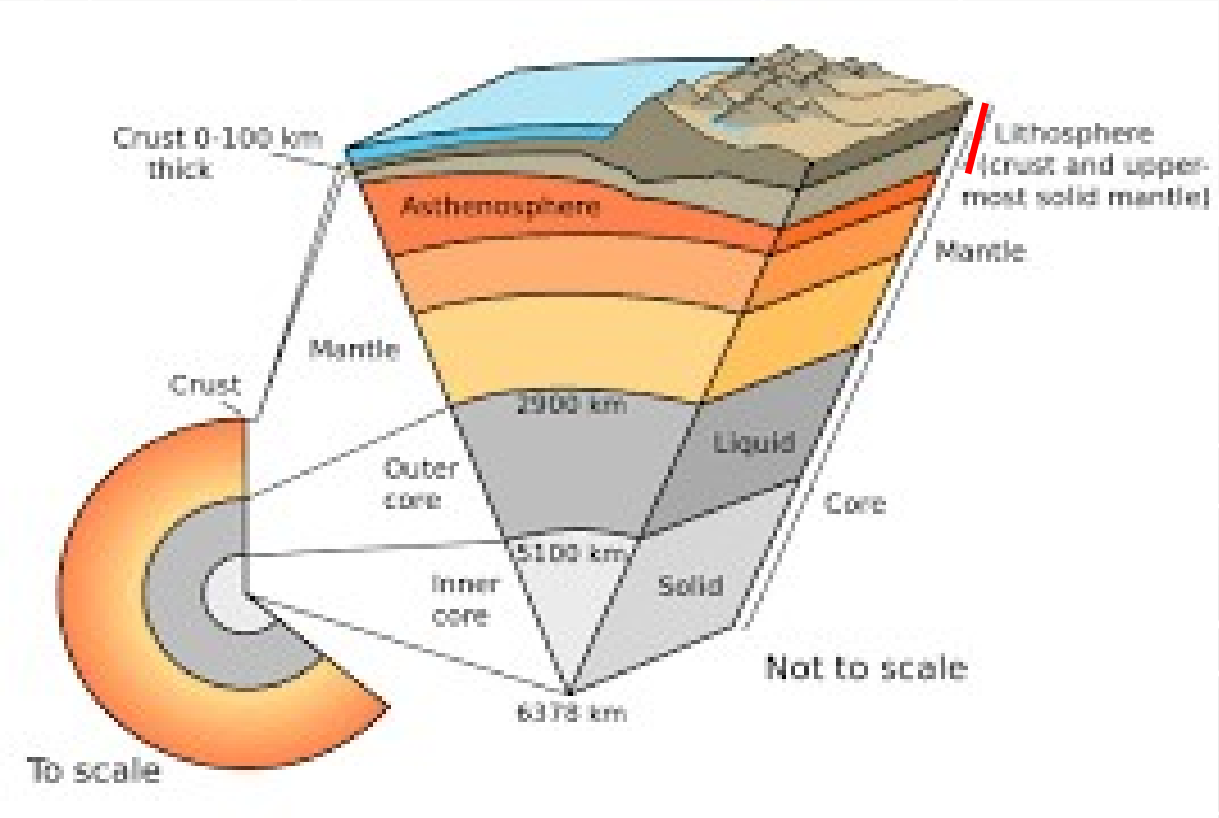
Spreading rate is more than **90 mm/year** and less than **40 mm/year**.

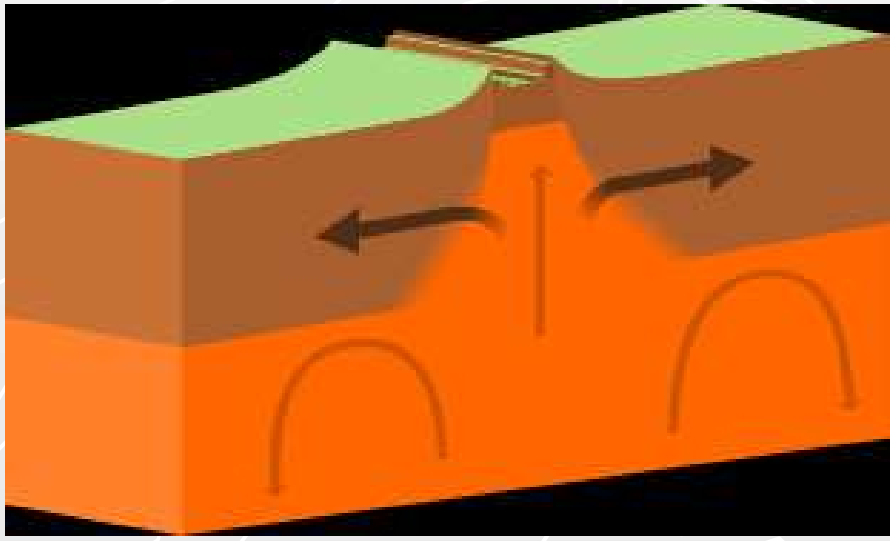


Significance of Sea floor spreading

- Helps to **explain continental drift** in the theory of plate tectonics.

- When **oceanic plates diverge**, tensional stress causes **fractures to occur in the lithosphere.**





Continental-continental divergent/constructive boundary

Causes of Sea Floor Spreading

Slab Pull

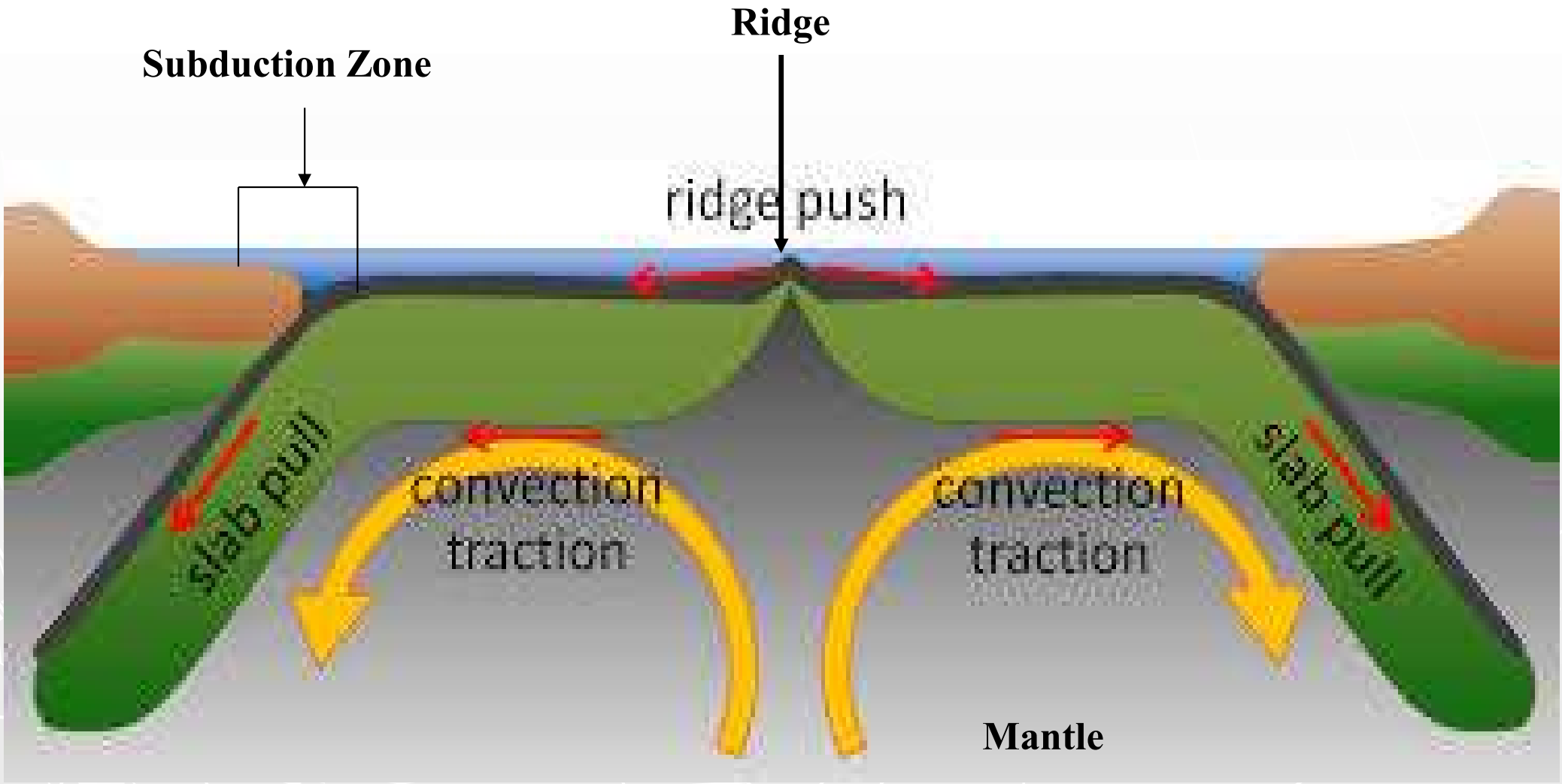
- **Motivating force** for is **tectonic plate to move slab pull at subduction zone,** rather than magma pressure.

Convection Traction

- There is typically significant **magma activity,** producing **convection currents** at spreading ridges cause **convection traction.**

Ridge Push

- Plates that are **not subducting** are driven by **gravity sliding** off the elevated mid-ocean ridges a process called **ridge push.**

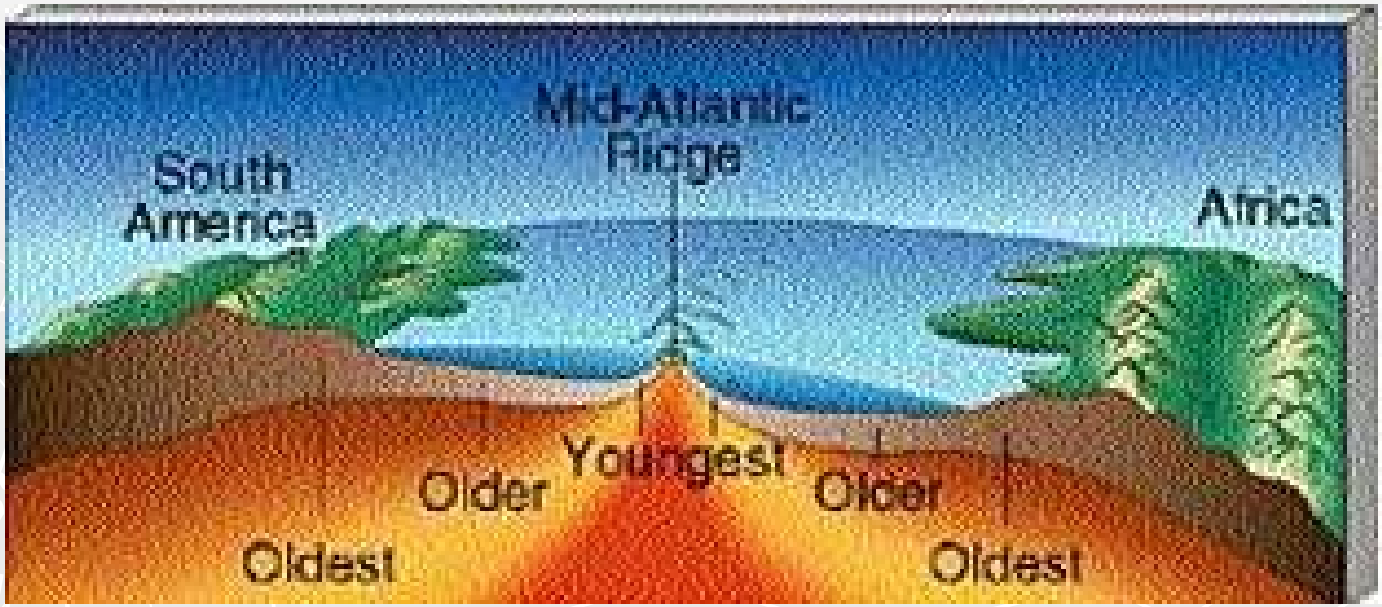

Ridge
Subduction Zone
ridge push
slab pull
convection
traction
convection
traction
slab pull
Mantle

New Sea Bed

- At a **spreading center**, basaltic **magma rises up the fractures and cools on the ocean floor to form new sea bed.**

Younger Rocks

- **Older rocks will be found farther away** from the spreading zone while **younger rocks** will be found nearer to the spreading zone.





- **Mid-ocean ridges**, are found on the bottom of the oceans and are **major cracks or vents in oceanic crust**.

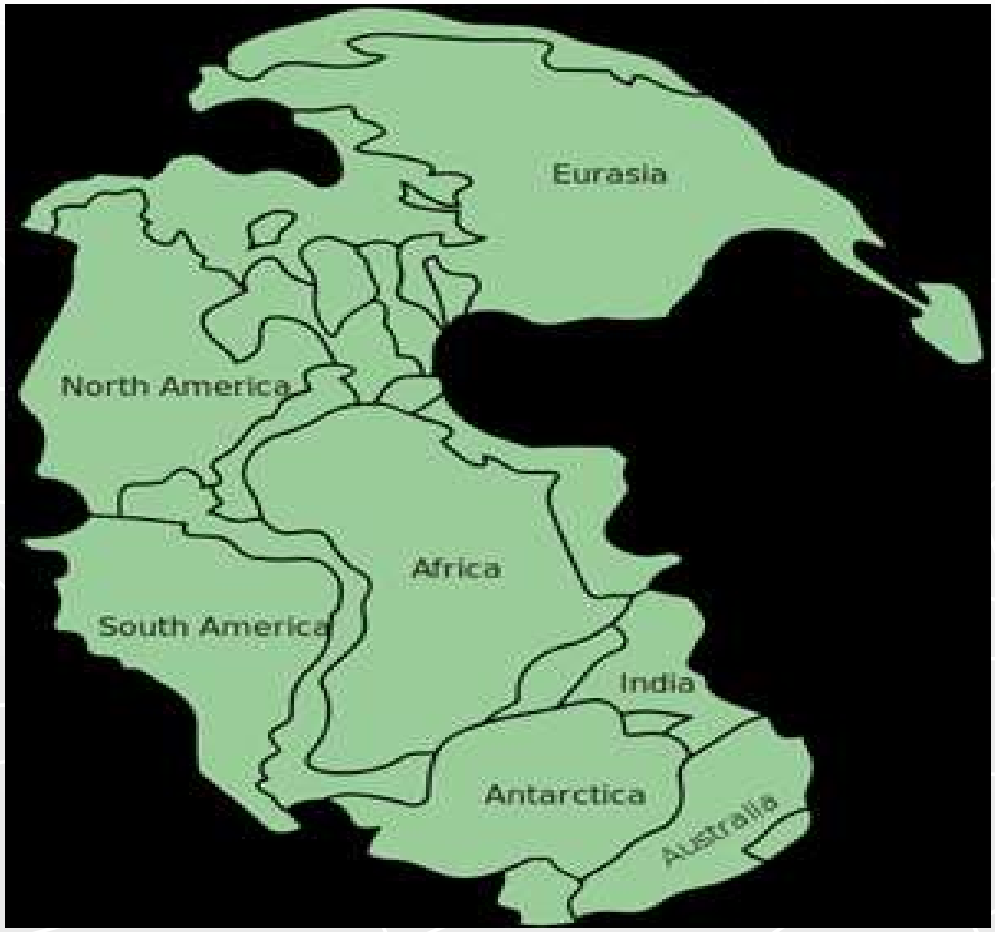
- **Magma from the mantle pushes** its way up through the cracks (think of squeezing toothpaste from its tube).

- As it does this, it **pushes the existing crust causing continents to move around.**

How the continents to move around?

Theory of Plate Tectonics

Theory is **based on the idea** that **Earth is broken into tectonic plates** and these **plates move in response to seafloor spreading.**



Supercontinent, Pangea.
Can be seen, how the continents fit together like puzzle pieces.

Plate tectonics:

It is a scientific theory **describing the large-scale motion** of **seven large plates and more smaller plates** of the **earth's lithosphere**, since tectonic processes began on Earth between 3.3 and 3.5 billion years ago.



What we so far have discussed today?

- **Some Chronological Events of the Earth Development**
- **Mid ocean ridges**
- **Sea-floor Spreading**
- **Significance of sea-floor spreading**
- **Theory of plate tectonics**

Thanks