EDEN IAS - GEOGRAPHY CLASS NOTES

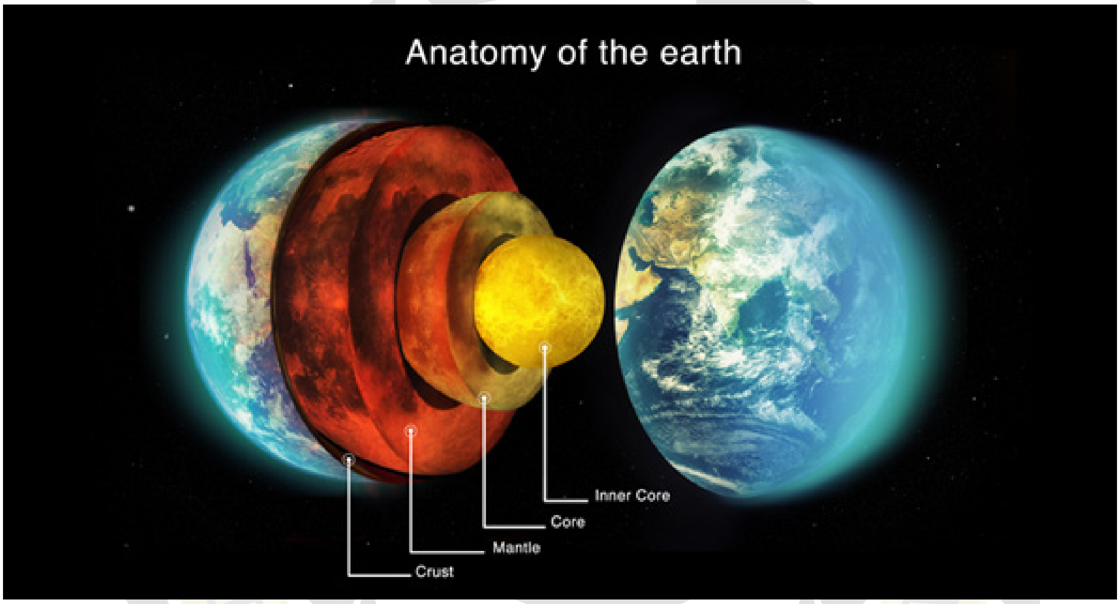
EDEN IAS MISSION PRELIMS 2021

GEOGRAPHY CLASS - 3

Structure of Earth

Starting at the centre, Earth is composed of three distinct layers. They are, from deepest to shallower, the core, (divided into two parts : the inner core, the outer core), the mantle and the crust.

Except for the crust, no one has ever explored these layers in person. In fact, the deepest humans have ever drilled is just over 12 km (7.6 miles)



The Crust:

- It is the outermost solid part of the earth
- It is brittle in nature.
- The thickness of the crust varies under the oceanic and continental areas.
- Oceanic crust is thinner as compared to the continental crust.
- Oceanic crust is denser as compared to the continental crust.
- Continental Crust is mainly composed of silicon and aluminium. Therefore, it is often termed as SIAL.
- The mean thickness of the continental crust is around 30 km. It is much thicker in the areas of major mountain ranges, extending up to 70 km in the Himalayan region.
- Continental crust has the mean density of 2.7 g/cm3.
- The mean density of material in oceanic crust is 2.9 g/cm3. It is mainly composed of basaltic rocks.

The Mantle:

- The portion of the interior beyond the crust is called the mantle.
- The mantle extends from Moho's discontinuity to a depth of 2,900 km
- The mantle is divided into upper and lower mantle.
- The upper portion of the mantle is called asthenosphere.

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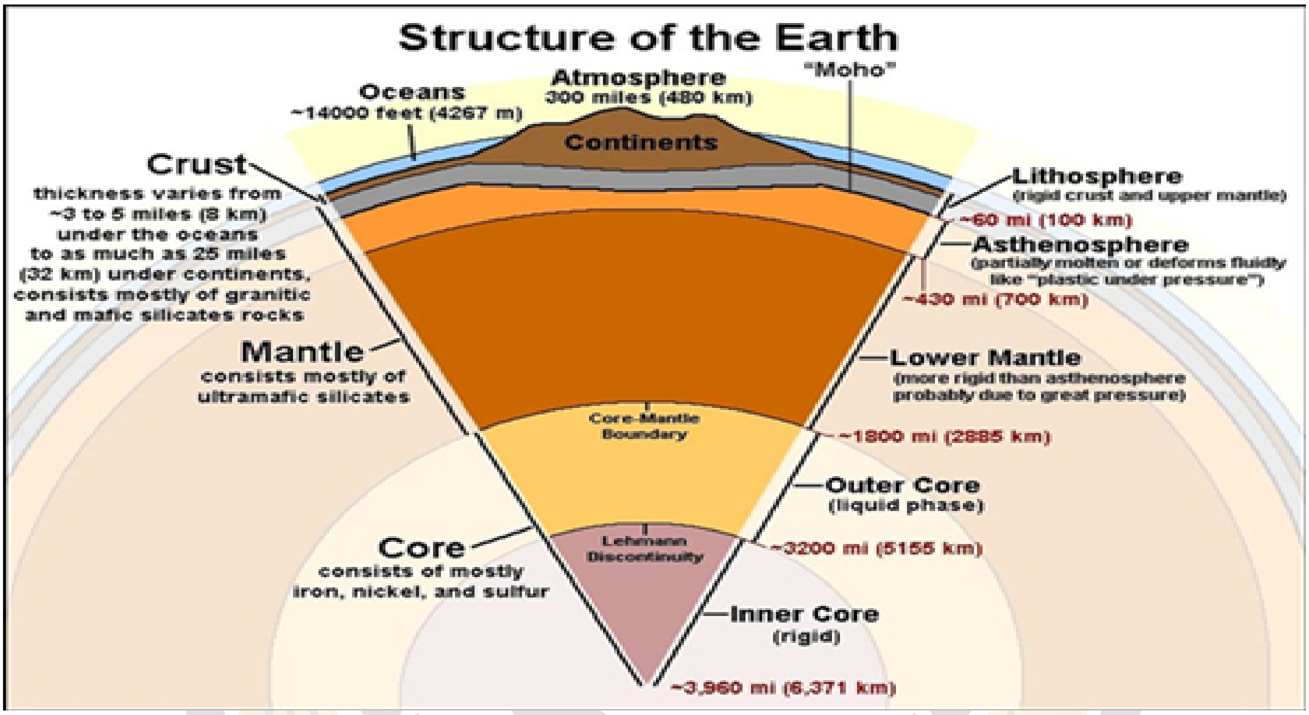
- o The word astheno means weak.
- o It is considered to be extending upto 400 km.
- o It is the main source of magma that finds its way to the surface during volcanic eruptions.

- The crust and the uppermost part of the mantle are called lithosphere. Its thickness ranges from 10-200 km.
- The lower mantle extends beyond the asthenosphere. It is in solid state.
- Major constituent elements of the mantle are magnesium and silicon. Hence, this layer is termed as SIMA.
- The mantle makes up about 84% of Earth's volume



The Core:

The Earth's core is the central inner part of our planet. It has a solid inner core and a liquid outer core.

The outer core of the Earth is a liquid layer about 2,260 km thick. It is made of iron and nickel.

Accounts for 16 per cent of the earth's volume.

Core has the heaviest mineral materials of highest density.

Its outer boundary is 2,890 km (1,800 mi) beneath the Earth's surface. The transition between the inner core and outer core is approximately 5,000 km (3,100 mi) beneath the Earth's surface.

The temperature of the outer core ranges from 4400 °C in the outer regions to 6100 °C near the inner core. Eddy currents in the nickel iron fluid of the outer core are believed to influence the Earth's magnetic field.

The average magnetic field strength in the Earth's outer core was measured to be 25 Gauss, 50 times stronger than the magnetic field at the surface

Without the outer core, life on Earth would be very different. Convection of liquid metals in the outer core creates the Earth's magnetic field. This magnetic field extends outward from the Earth for several thousand kms, and creates a protective bubble around the Earth that deflects the Sun's solar wind.

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The inner core of the Earth, as detected by seismology, is a solid sphere about 1,216 km (760 mi) in radius, or about 70% that of the Moon. It is believed to be an iron–nickel alloy, and may have a temperature similar to the Sun's surface, approximately 5778 K (5505 °C).

CONVECTIONAL CURRENT THEORY

English geologist Arthur Holmes made not one but two major contributions to our understanding of how the Earth works.

1) First earth scientist to grasp the mechanical and thermal implications of mantle convection,
2) He applied the newly-developed method of radioactive dating to minerals in the first attempt to quantitatively estimate the age of the Earth.

Convection currents and plate movement

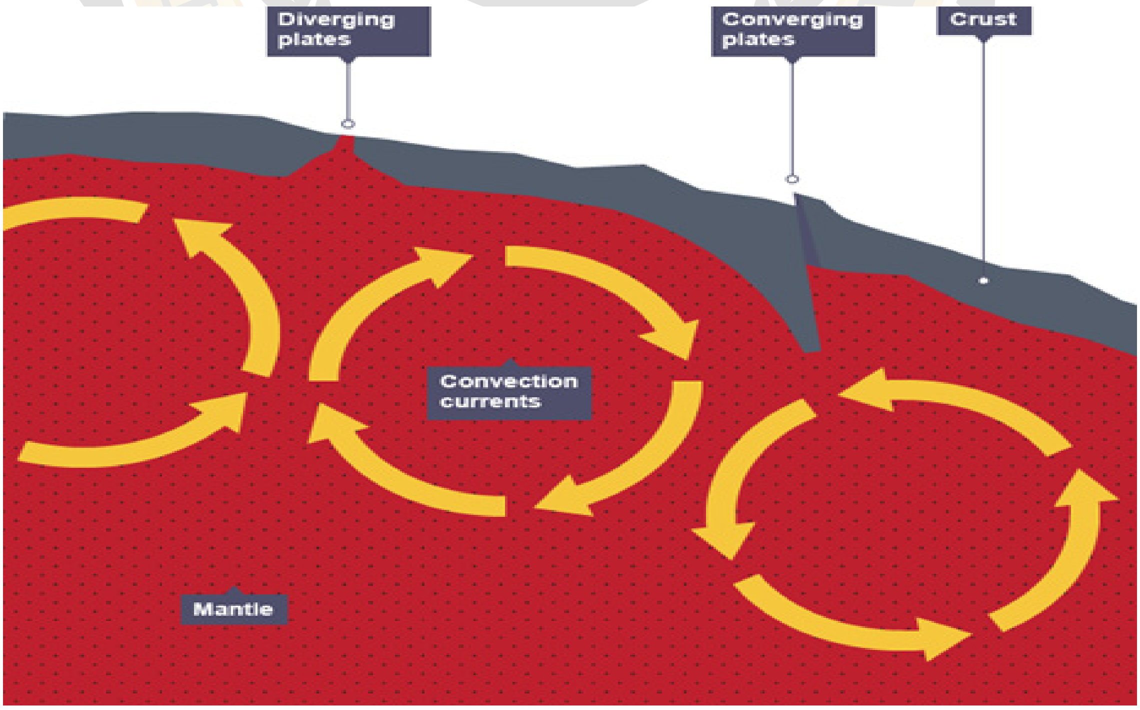
Holmes advised that Earth's mantle contained convection cells that dissipated radioactive heat and moved the crust at the surface.

- The Earth's crust is broken up into pieces called plates.
- The crust moves because of movements deep inside the earth.
- Heat rising and falling inside the mantle creates convection currents generated by radioactive decay in the core.
- The convection currents move the plates.
- Where convection currents diverge near the Earth's crust, plates move apart.
- Where convection currents converge, plates move towards each other.
- The movement of the plates, and the activity inside the Earth, is called plate tectonics.
- The point where two plates meet is called a plate boundary.
- Earthquakes and volcanoes are most likely to occur either on or near plate boundaries.

Convection Current:

Convection is a heat transfer process. When currents are produced, matter is moved from one location to another. So this is also a mass transfer process.

Convection that occurs naturally is called natural convection or free convection. If a fluid is circulated using a fan or a pump, it's called forced convection. The cell formed by convection currents is called a convection cell or Bénard cell.



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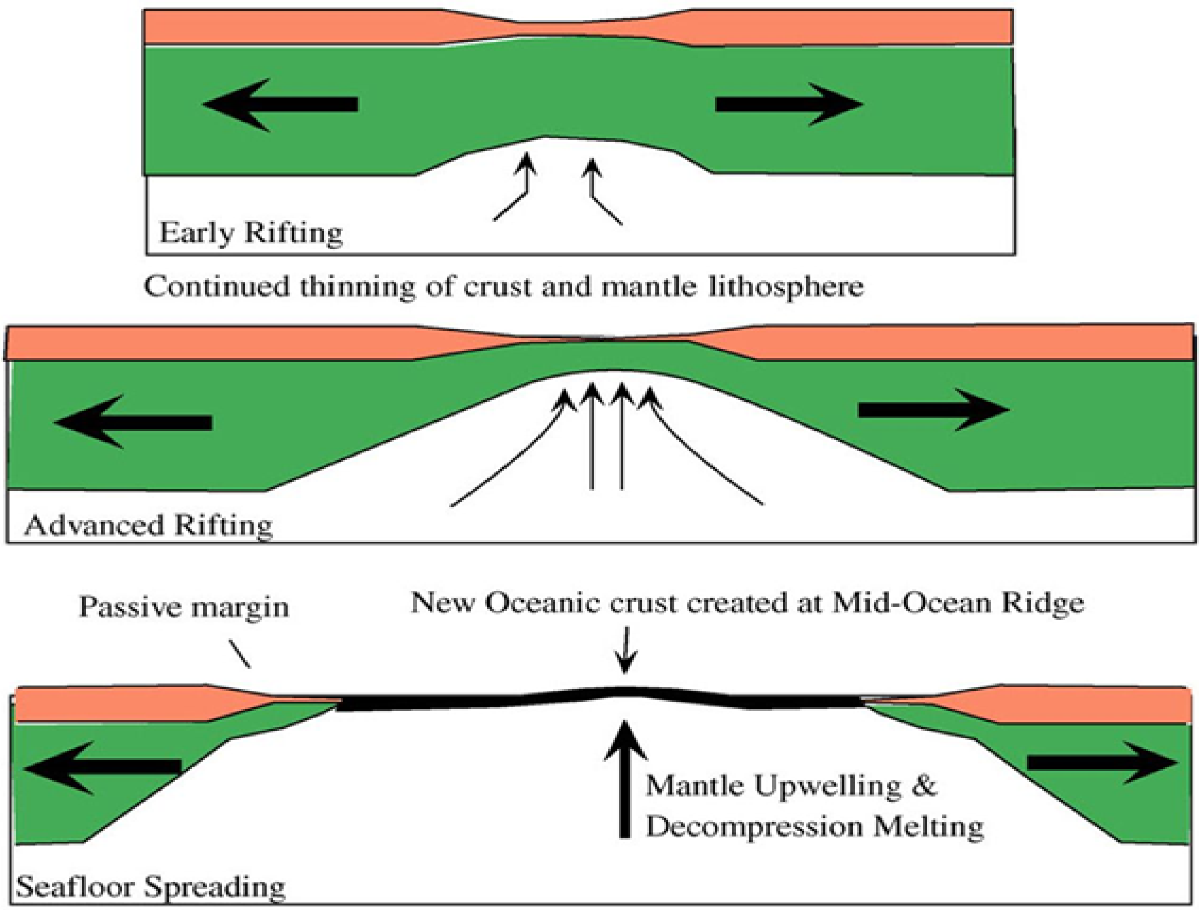
SEA FLOOR SPREADING

- Harry Hess proposed the idea of See Floor Spreading.
- The mapping of the ocean floor and Paleomagnetic studies of rocks from oceanic regions revealed the following facts
  - It was realised that all along the mid-oceanic ridges, volcanic eruptions are common and they bring huge amounts of lava to the surface in this area.
  - The rocks equidistant on either sides of the crest of mid-oceanic ridges show remarkable similarities in terms of period of formation, chemical compositions and magnetic properties. Rocks closer to the mid-oceanic ridges have normal polarity and are the youngest. The age of the rocks increases as one moves away from the crest.
  - The ocean crustal rocks are much younger than the continental rocks. The age of rocks in the oceanic crust is nowhere more than 200 million years old. Some of the continental rock formations are as old as 3,200 million years.
  - The sediments on the ocean floor are unexpectedly very thin. Scientists were expecting, if the ocean floors were as old as the continent, to have a complete sequence of sediments for a period of much longer duration. However, nowhere was the sediment column found to be older than 200 million years.
  - The deep trenches have deep-seated earthquake occurrences while in the midoceanic ridge areas; the quake foci have shallow depths.
- These facts and a detailed analysis of magnetic properties of the rocks on either sides of the mid oceanic ridge led Harry Hess (1961) to propose his hypothesis, known as the “sea floor spreading”.
- Seafloor spreading occurs at divergent plate boundaries.
- As tectonic plates slowly move away from each other, heat from the mantle’s convection currents makes the crust more plastic and less dense.
- The less-dense material rises, often forming a mountain or elevated area of the seafloor.
- Eventually, the crust cracks.



Hot magma fueled by mantle convection bubbles up to fill these fractures and spills onto the crust. This bubbled-up magma is cooled by frigid seawater to form igneous rock. This rock (basalt) becomes a new part of Earth's crust.

PLATE TECTONIC THEORY

A tectonic plate (also called lithospheric plate) is a massive, irregularly-shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.

- Plates move horizontally over the asthenosphere as rigid units.
- A plate may be referred to as the continental plate or oceanic plate depending on which of the two occupy a larger portion of the plate.
- The theory of plate tectonics proposes that the earth's lithosphere is divided into seven major and some minor plates.

The major plates are as follows:

- Antarctica and the surrounding oceanic plate
- North American (with western Atlantic floor separated from the South American plate along the Caribbean is- lands) plate
- South American (with western Atlantic floor separated from the North American plate along the Caribbean is-lands) plate Pacific plate
- India-Australia-New Zealand plate
- Africa with the eastern Atlantic floor plate
- Eurasia and the adjacent oceanic plate

Some important minor plates are listed below:

- **Cocos plate:** Between Central America and Pacific plate
- **Nazca plate:** Between South America and Pacific plate
- **Arabian plate:** "Mostly the Saudi Arabian landmass
- **Philippine plate:** Between the Asiatic and Pacific plate
- **Caroline plate:** Between the Philippine and Indian plate (North of New Guinea)
- **Fuji plate :** North-east of Australia

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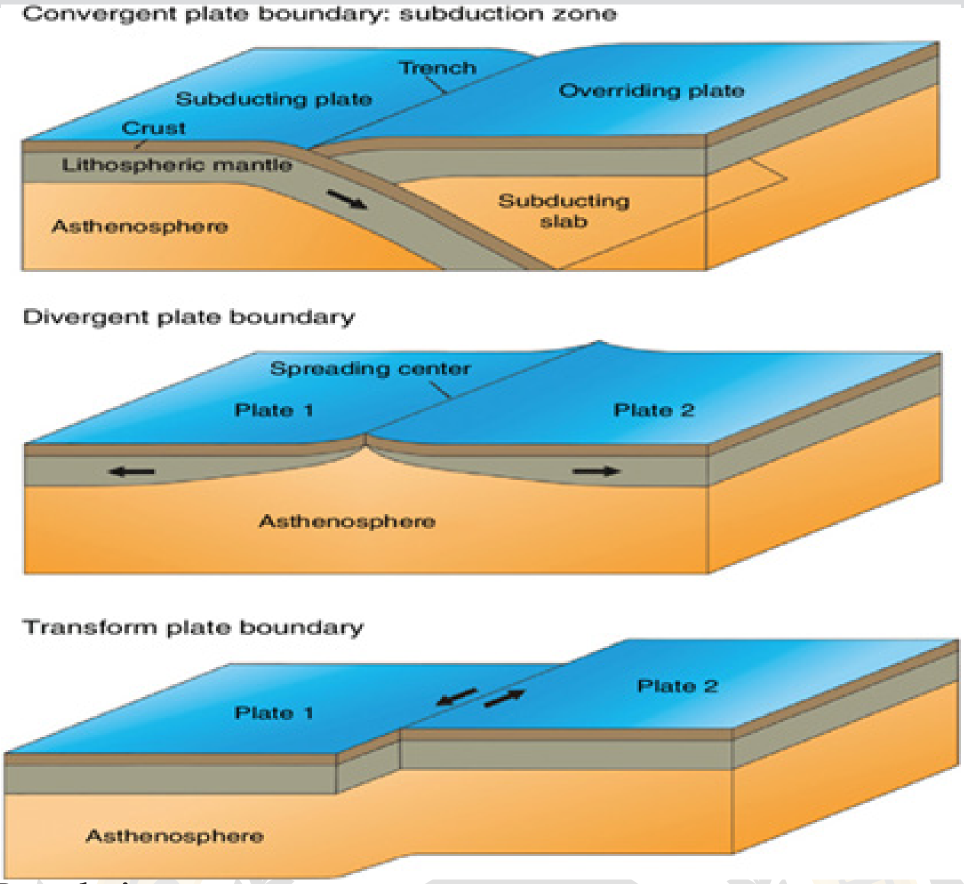
Types of Plate Boundaries

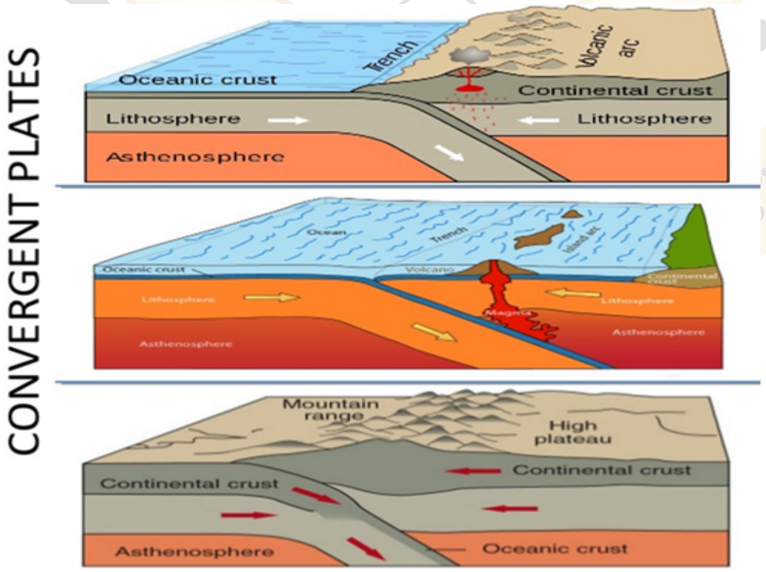


Divergent Boundaries

- Where new crust is generated as the plates pull away from each other.
- The sites where the plates move away from each other are called spreading sites.
- The best-known example of divergent boundaries is the Mid-Atlantic Ridge.
- At this, the American Plate(s) is/are separated from the Eurasian and African Plates.

Convergent Boundaries

- Where the crust is destroyed as one plate dived under another.
- The location where sinking of a plate occurs is called a subduction zone.
- There are three ways in which convergence can occur. These are :
  - o between an oceanic and continental plate;
  - o between two oceanic plates; and
  - o between two continental plates.



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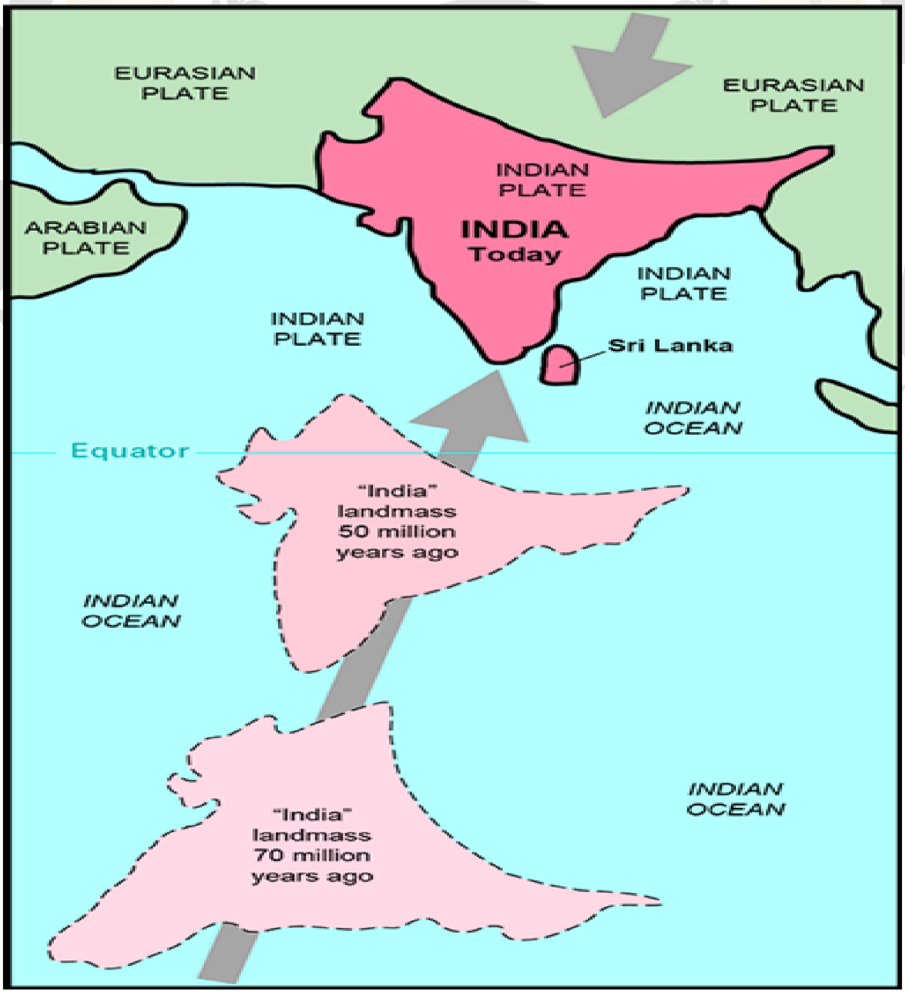
Transform Boundaries

- Where the crust is neither produced nor destroyed as the plates slide horizontally past each other.
- Transform faults are the planes of separation generally perpendicular to the mid-oceanic ridges.
- As the eruptions do not take all along the entire crest at the same time, there is a differential movement of a portion of the plate away from the axis of the earth.
- Also, the rotation of the earth has its effect on the separated blocks of the plate portions.

MOVEMENT OF THE INDIAN PLATE

- The Indian plate includes Peninsular India and the Australian continental portions. The subduction zone along the Himalayas forms the northern plate boundary in the form of continent— continent convergence.
- In the east, it extends through Rakinyoma Mountains of Myanmar towards the island arc along the Java Trench. The eastern margin is a spreading site lying to the east of Australia in the form of an oceanic ridge in SW Pacific. The Western margin follows Kirthar Mountain of Pakistan. It further extends along the Makrana coast and joins the spreading site from the Red Sea rift southeastward along the Chagos Archipelago.
- The boundary between India and the Antarctic plate is also marked by oceanic ridge (divergent boundary) running in roughly W-E direction and merging into the spreading site, a little south of New Zealand.
- India was a large island situated off the Australian coast, in a vast ocean.
- The Tethys Sea separated it from the Asian continent till about 225 million years ago. India is supposed to have started her northward journey about 200 million years ago at the time when Pangaea broke. India collided with Asia about 40-50 million years ago causing rapid uplift of the Himalayas.



Thankyou All the best for Prelims!!!!!!

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