



Tectonic Evolution of Greater Maldive Ridge

For Prelims: Greater Maldive Ridge, Tectonic Plate, Moho Discontinuity, Isostasy, Transform Fault, seismic waves.

For Mains: Important Geophysical Phenomena, Earthquakes, Volcanoes, Geographical Features and their Location, Evolution of Continents and Plate Tectonics.

Why in News?

In a recent study, an Indian researcher **traced the [tectonic evolution](#) and the nature of the Greater Maldive Ridge (GMR).**

- It is a **very crucial geodynamic feature in the western Indian Ocean** whose origin has been the centre of many a scientific debate.
- The study was conducted by the **Indian Institute of Geomagnetism**, Mumbai, an autonomous institute of the [Department of Science & Technology](#), Govt. of India.

What is a Tectonic Plate?

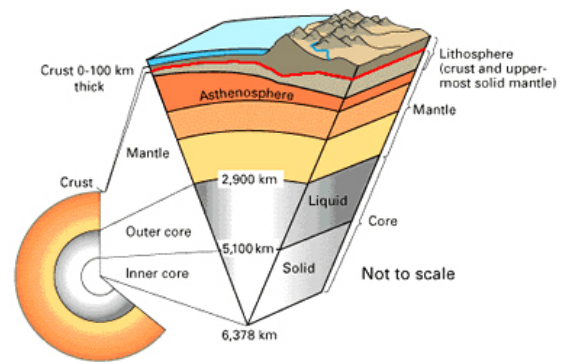
- A tectonic plate (also called lithospheric plate) **is a massive, irregularly-shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.**
 - The lithosphere **includes the crust and top mantle** with its thickness range varying between 5-100 km in oceanic parts and about 200 km in the continental areas.
 - The concept of Tectonic Plates was **first introduced in 1967.**
- A tectonic plate may be a continental plate or an oceanic plate, depending on which of the two occupies the larger portion of the plate.
 - The **Pacific plate is largely an oceanic plate whereas the Eurasian plate is a continental plate.**
- The **tectonic plates are not fixed but constantly move horizontally over the Asthenosphere** as rigid units.
 - Sometimes these plates collide, move apart, or slide next to each other which leads to Earthquakes or Volcanic Eruptions.

What is a Mid-Ocean Ridge?

- A mid-ocean ridge or mid-oceanic ridge is an **underwater mountain range**, formed by plate tectonics.

What is the Mohorovičić Discontinuity?

- The Mohorovicic Discontinuity, or "Moho," **is the boundary between the crust and the mantle.** The red line in the diagram shows its location. [//](#)



- In geology the word "**discontinuity**" is used for a surface at which seismic waves change **velocity**.
- One of these surfaces exists at an average depth of **8 kilometres beneath the ocean basin** and at an average depth of about **32 kilometres beneath the continents**.
- At this discontinuity, [seismic waves accelerate](#). This surface is known as the Mohorovicic Discontinuity or often simply referred to as the "Moho."
- The Mohorovicic Discontinuity was **discovered in 1909 by Andrija Mohorovicic**, a Croatian seismologist.

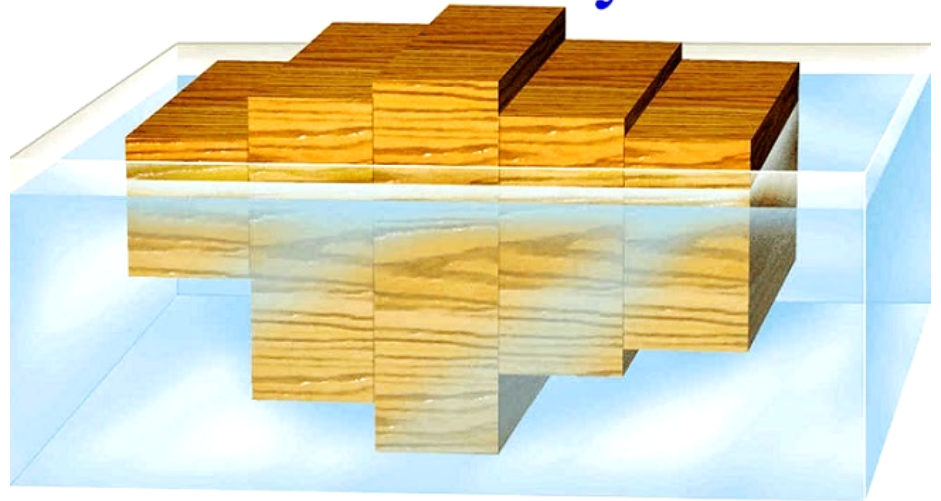
What is the Greater Maldivé Ridge?

- The Maldivé Ridge is an **aseismic ridge that is not associated with earthquake activities**. This ridge, located in the western Indian Ocean, southwest of India, is not well investigated.
- It is of **paramount importance to gain knowledge on the structure and geodynamics** of aseismic ridges (as it provides valuable inputs towards understanding the evolution of ocean basins).

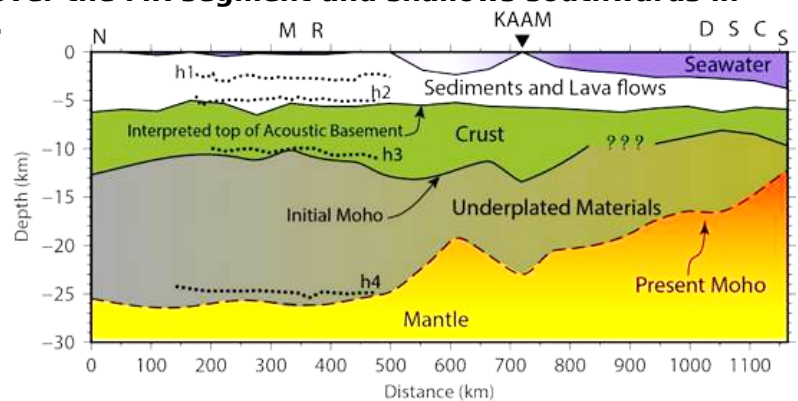
What is the Study About?

- It has **chalked the possible geological cross-sections along the GMR for the first time** with the help of satellite-derived high-resolution gravity data.
 - Satellite-derived gravity anomalies are very **helpful in deciphering the crustal architecture** where traditional shipborne geophysical data are either not available or scanty.
- The researchers postulated that the **GMR may be underlain by an oceanic crust**.
- It **provides the crustal architecture and the state of gravitational equilibrium** between Earth's crust and mantle (**isostasy**) of the Greater Maldivé Ridge segment of the larger Chagos-Laccadive Ridge (CLR) system.
 - **Isostasy** is the **rising or settling of a portion of the Earth's lithosphere** that occurs **when weight is removed or added in order to maintain equilibrium** between buoyancy forces that push the lithosphere upward and gravity forces that pull the lithosphere downward.

Isostasy



- Their study, **based mainly on the interpretation of gravity anomalies** (small differences in the pull of gravity caused by the lateral variations of density within the subsurface) with broadband seismic and refraction seismic data, **provided for the first time a three-dimensional picture of the variation of Moho** along the Greater Maldive Ridge and the adjoining ocean basins.
- The depth to the boundary between the earth's crust and the mantle or the **Mohorovicic discontinuity** (Moho) over the GMR was systematically mapped along with the finer variation of effective elastic thickness (T_e) at the place.
- The study found that **Moho is deeper over the MR segment and shallows southwards in the Deep Sea Channel region (DSC).**



- However, **the effective elastic thickness** (a proxy for the strength of the lithosphere) **values were lower over the MR compared to the DSC region.**
- The MR and DSC region may probably be oceanic in nature with the presence of underplated materials associated with the **Reunion hotspot volcanism.**
 - Most of the volcanic activities are concentrated along or adjacent to plate boundaries, but there are **some important exceptions in which this activity occurs within plates**, called the **Hotspots.**
 - There are about **40 to 50 hot spots estimated** to be around the world.
- The research **suggests that MR might have formed in the close vicinity of the Mid-Oceanic Ridge** (where creation of a new ocean floor occurs due to divergent motion of lithospheric plates or spreading centre).
- Meanwhile, the **DSC region was under a long transform fault** (offset between the spreading centres, which neither create nor destroy lithosphere), which hindered melt production and gave rise to the gap between Chagos and MR during the **Plume-ridge interaction.**
 - A mantle **plume** is an area under the crust of Earth, **where magma is hotter than surrounding magma.**
 - A **transform fault**, in geology and oceanography, is a type of fault in which two tectonic plates slide past one another.

What is the Significance of the Study?

- The study **can help reconstruct the original Gondwanaland break up and dispersal that led to present-day configuration of continents**, continental fragments, and formation of ocean basins in the Indian Ocean.
- The results from their study **can provide additional constraints in understanding the plate-tectonic evolution** of the Indian Ocean, better.

Source: PIB

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