



New Insights in Geology

For Prelims: Fundamentals of Physical Geography, Geology, Volcano, Composition of Earth, Tectonic Plates

For Mains: Role of magma in creation of Volcano, Different layers in earth composition, Effects of tectonic plates movement, Important Geophysical Phenomena

Why in News?

A recent study by a team of scientists at Goa-based [National Centre for Polar and Ocean Research \(NCPOR\)](#) has brought new insights into the critical processes involved in the **movement of the earth's tectonic plates**.

What is NCPOR?

- NCPOR was established as an **autonomous Research and Development Institution** of the **Ministry of Earth Sciences** (formerly Department of Ocean Development) on the 25th May 1998.
- It is designated as the **nodal organization** for the co-ordination and implementation of the [Indian Antarctic Programme](#), including the maintenance of India's permanent station in Antarctica.
- Year-round maintenance of the two Indian stations ([Maitri & Bharati](#)) in Antarctica is the primary responsibility of the Centre.
 - Maitri (1989) and Bharati (2011) were established, for carrying out research by the Indian scientists in all disciplines of polar research.

What do we need to know about the Study by NCPOR?

- **Background:**
 - The buoyant rising of **hot and low-density magma or plumes** from the Earth's interior towards the surface **leads to extensive volcanism** and the **creation of seamounts and volcanic chains above** the ocean floor.
 - However, many times, the magma's buoyant force is **not sufficient to pierce through the lithosphere**.
 - In such cases, plumes tend to dump the material at **sub-lithospheric depths**. When the tectonic plates that lie over the lithosphere move, **they tend to drag the ponded materials along with them**.
 - A fundamental question that remains outstanding in understanding earth's processes is **how far a tectonic plate can drag the plume material** at its base after its initial impact with the plume.
- **About Study:**
 - Scientists studied samples of **igneous rocks collected from near the Ninety East**

Ridge in the **Indian Ocean** during an expedition under the **International Ocean Discovery Program (IODP)**.

- The Ninety East Ridge is an **aseismic ridge located almost parallel** to 90 degrees east longitude in the Indian Ocean. It is approximately 5,000 km in length and has an average width of 200 km.
- Igneous rock, or magmatic rock, is one of the three main rock types, the others being sedimentary and metamorphic.
 - It is formed through the cooling and solidification of magma or lava.
- Investigation revealed that some **basaltic samples were highly alkaline** and had very **similar composition to those released by the Kerguelen hotspot** (volcanic hotspot at the Kerguelen Plateau in the Southern Indian Ocean).
 - In addition, **the minimum age of alkaline samples was about 58 million years**, much younger than the adjacent oceanic crust surrounding Ninety East Ridge (around 82-78 million years old)
- This study proposes that the Indian Tectonic Plate, which was **contemporaneously moving northward at a very high speed**, had dragged a considerable amount of Kerguelen plume material **for more than 2,000 km underneath the Indian lithosphere**.
- **Subsequent reactivation of deep fractures** may have triggered decompression melting of the underlying plume material and emplaced as **magmatic sills** and lava flows near the Ninety East Region around 58 million years ago.

What do we know about Earth's Crust?

▪ Crust:

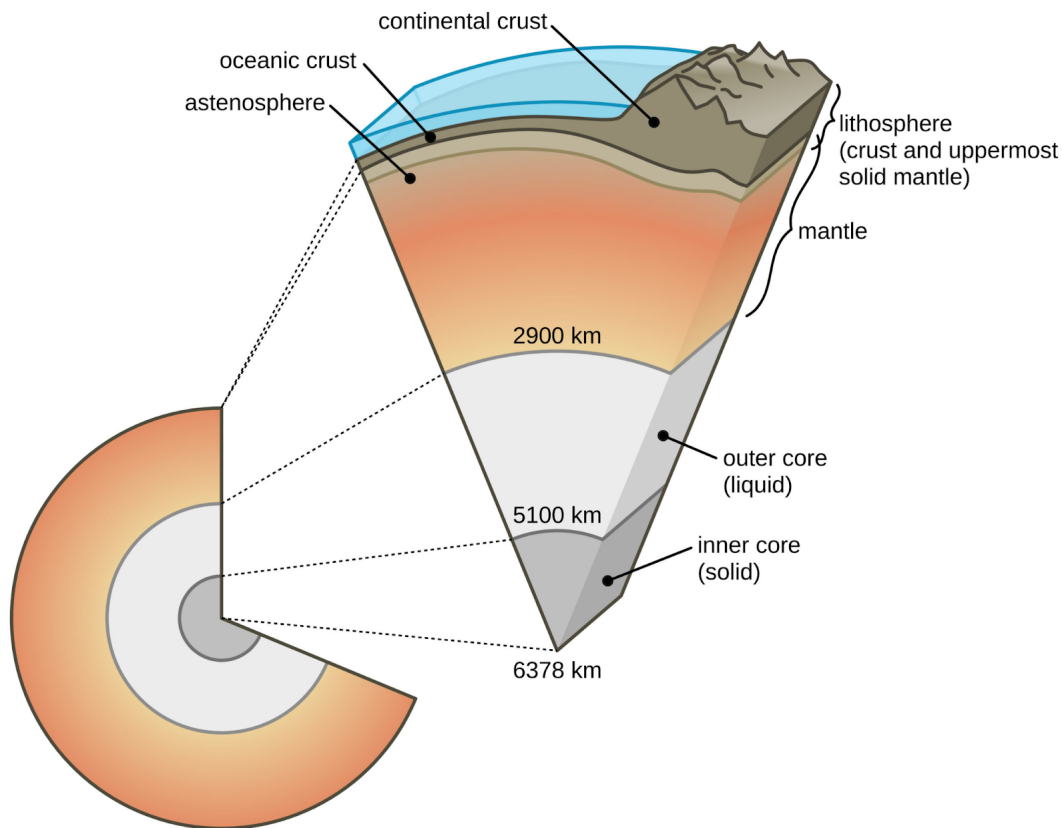
- The **outer superficial layer of the earth is called the "crust"**. In continental regions, the crust can be **divided into two layers**.
 - The **upper layer** which is less dense and granitic in character, is known as "**sial**", while the **lower layer** which is basaltic in character is known as "**sima**".
- It extends down to **30 or 40 kilometer beneath continents and to about 10 km beneath ocean basins**

▪ Mantle:

- The **mantle** is located **beneath the earth's crust** and has a thickness of about 2900 km.
- It has been divided into two layers: **(i) upper mantle, and (ii) lower mantle**.
- The boundary between these is at about 700 km depth.
- The upper mantle contains a most important zone called the "**asthenosphere**". It is located at depths between 50 to 100 km.
- This zone **provides lava for volcanic eruptions**.

▪ Core:

- The **core** (inner core and the outer core) accounts for just about **16%** of the earth's volume but **33% of earth's mass**.
- Like Mantle, core can also be distinguished into two layers namely **outer core and inner core**.
- The outer core is composed of **iron** mixed with **nickel** and trace amounts of lighter elements.
- The outer core is **not under enough pressure to be solid**, so it is **liquid** even though it has a composition similar to the inner core.



UPSC Civil Services Previous Year Question (PYQ)

Q. Consider the following statements: (2018)

1. The Barren Island volcano is an active volcano located in the Indian territory.
2. Barren Island lies about 140 km east of Great Nicobar.
3. The last time the Barren Island volcano erupted was in 1991 and it has remained inactive since then.

Which of the statements given above is/are correct?

- (a) 1 only
 (b) 2 and 3
 (c) 3 only
 (d) 1 and 3

Ans: (a)

Explanation:

- Barren Island is India's only active volcano which is located in the Andaman and Nicobar Islands. **Hence, statement 1 is correct.**
- It is located at about 140 km from Port Blair, southern part of Andaman Island in Andaman Sea. The distance between Barren Island to Great Nicobar is more than the given distance. **Hence, statement 2 is not correct.**
- First recorded eruption of the volcano dates back to 1787. In the past 100 years, it has erupted at least five times. Then for the next 100 years, it remained silent. It re-erupted massively in 1991. Since then, the eruption has been recorded every two-three years, the latest in the series was

February 2016. Hence, statement 3 is not correct.

- Therefore, option (a) is the correct answer.

Source: [DTE](#)

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