



Structural Changes in Earth's Inner Core

[Source: DTE](#)

Why in News?

- A study published in **Nature Geoscience** reveals that [Earth's inner core](#) is undergoing **structural changes**.

What are the Key Findings of the Study?

- **Methodology:** Researchers analyzed [seismic waves](#) near Antarctica's South Sandwich Islands from 1991 to 2024. Repeating earthquakes revealed subtle changes in seismic waves, offering insights into Earth's inner structures.
- **Structural Changes in Inner Core:** The **near surface of Earth's inner core** is undergoing **structural changes**, challenging the earlier belief that **it is rigid and stable**.
 - The **inner core's rotation** appears to be **slowing down**, which could subtly **alter the length of a day** on Earth.
 - Researchers suggest **viscous deformation in the inner core** is caused by dynamic interactions between the **turbulent, molten outer core** and the **solid inner core**, similar to how [magma](#) flows under stress.

What are the Key Facts About Earth's Inner Core?

- **Structure:** The **inner core** is a **hot, dense ball** primarily made of **iron and nickel**. Unlike the **liquid outer core**, the inner core remains **solid due to immense pressure** from Earth's upper layers.
- **Depth and Size:** Located **5,150 km beneath** the surface, at Earth's center. It has a **radius of about 1,220 km**.
 - The boundary between the inner and outer core is called the **Lehmann Discontinuity**.
- **Magnetism:** The inner core influences [Earth's magnetic field](#), while the outer core's swirling liquid iron generates it through the **geodynamo effect** (magnetic field generation).
 - The inner core has **high thermal and electrical conductivity**.
- **Rotation:** The inner core rotates eastward slightly **faster than the Earth's surface**, completing an extra rotation every 1,000 years.
- **Growth:** The inner core grows by about **1 mm per year** as the liquid outer core solidifies.
 - Growth is uneven, occurring more around subduction zones and less near superplumes.
 - The core will never fully solidify due to slow crystallization and continuous radioactive decay.

Earth's Interior

- The Earth's interior is structured in concentric layers, similar to an onion. These layers are:
 - **Crust (Outermost Layer):** The **thinnest** layer, varying in thickness:
 - **Continental crust:** ~35 km thick, composed mainly of **silica (Si) and alumina (Al)**, referred to as "**sial**" for the continental crust.
 - **Oceanic crust:** ~5 km thick, oceanic crust contains **silica (Si) and magnesium**

(Mg), called "sima".

- **Mantle (Thickest Layer):** Extends up to **2900 km** below the crust. Composed of silicate minerals rich in **iron and magnesium**.
 - The upper part contains the **asthenosphere**, a semi-molten layer responsible for **plate movements**.
- **Core (Innermost Layer):** Extends up to **3500 km** in radius. Composed of **nickel (Ni) and iron (Fe)**, called "nife".
 - **Divided into Outer Core** (liquid state, generates Earth's magnetic field) and **Inner Core**.

INTERIOR OF THE EARTH

1 THE CRUST

- Thin, outermost layer
- Oceanic crust – thinner
 - Mean thickness - 5 km
 - Made up of Silica and Magnesium (SiMa)
- Continental crust – thicker
 - Mean thickness - 30 km
 - Made up of Silica and Aluminum (SiAl)
 - Thicker in the areas of major mountain systems.
 - Around 70 km thick in the Himalayan region.
- Temperature increases with depth (rises by up to 30° C for every km)

Lithosphere

- Rigid outer layer, thickness: 100 km
- Consists of the crust and the upper mantle
- Divided into tectonic plates responsible for large-scale changes in the earth's geological structure (folding, faulting)

3 THE CORE

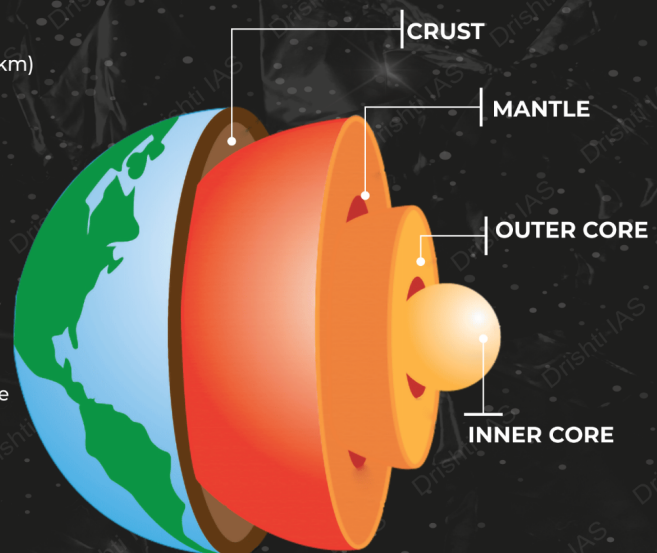
- Lies between 2900-6370 km below the earth's surface
- Made up of heavy materials, primarily nickel (Ni) and iron (Fe) - NiFe
- Outer core –
 - Between 2900-5100 kms
 - **Liquid** because of not enough pressure to solidify
- Inner core –
 - Between 5100-6370 kms
 - **Solid** – it can transmit **secondary waves** (earthquake) which outer core can't
- **Denser than Mantle**

Boundaries/discontinuities between Earth's layers

1. **Conorod Discontinuity**– between upper and lower crust
2. **Mohorovicic Discontinuity (Moho)** – separates the crust from the mantle, its average depth being about 35 km.
3. **Repiti Discontinuity** – between the upper and lower mantle
4. **Gutenberg Discontinuity** – lies between the mantle and the outer core.
5. **Lehman Discontinuity**- between inner and outer core

2 THE MANTLE

- Extends from Moho's discontinuity to a depth of 2,900 km
- Upper portion is called **asthenosphere**
 - Zone of weak rocks; in semi molten or jelly like state
 - Extends upto 400 kms
 - **Main source of magma** that comes out of volcanic eruptions



Prelims

Q. In the structure of planet Earth, below the mantle, the core is mainly made up of which one of the following? (2009)

- (a)** Aluminium
- (b)** Chromium
- (c)** Iron
- (d)** Silicon

Ans: (c)

PDF Refernece URL: <https://www.drishtiias.com/printpdf/structural-changes-in-earth-s-inner-core>

