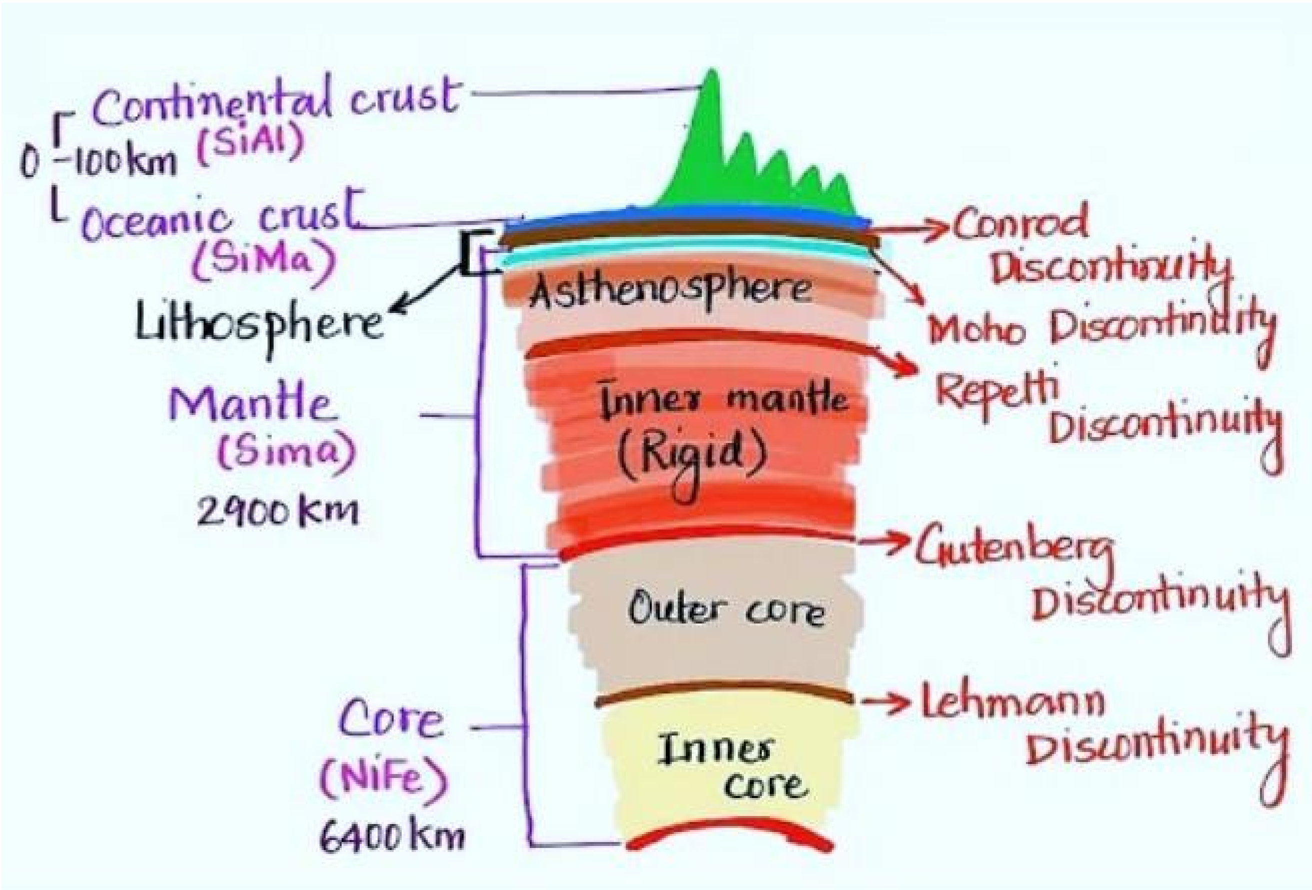
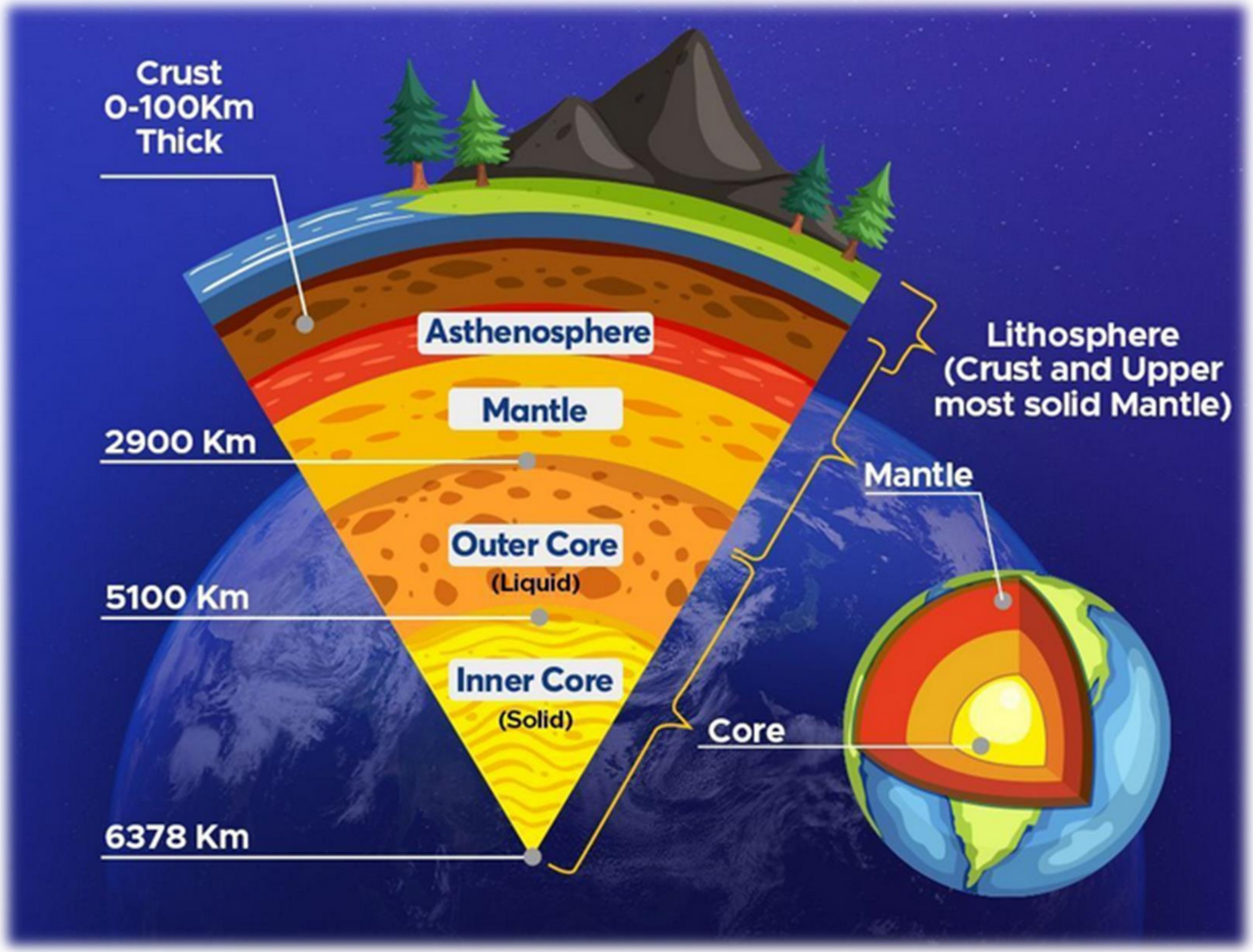
Earth’s Layers: Crust, Mantle & Core, Seismic Discontinuities

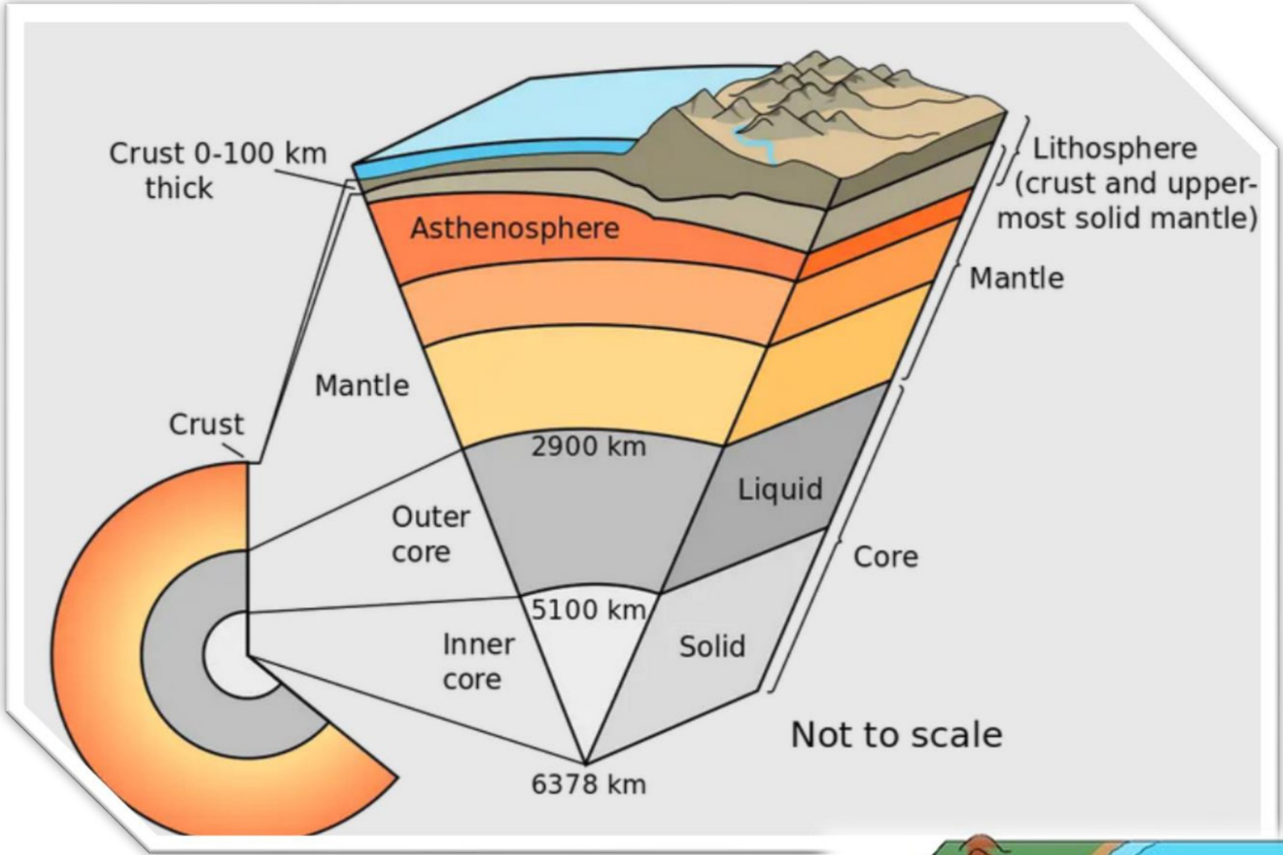


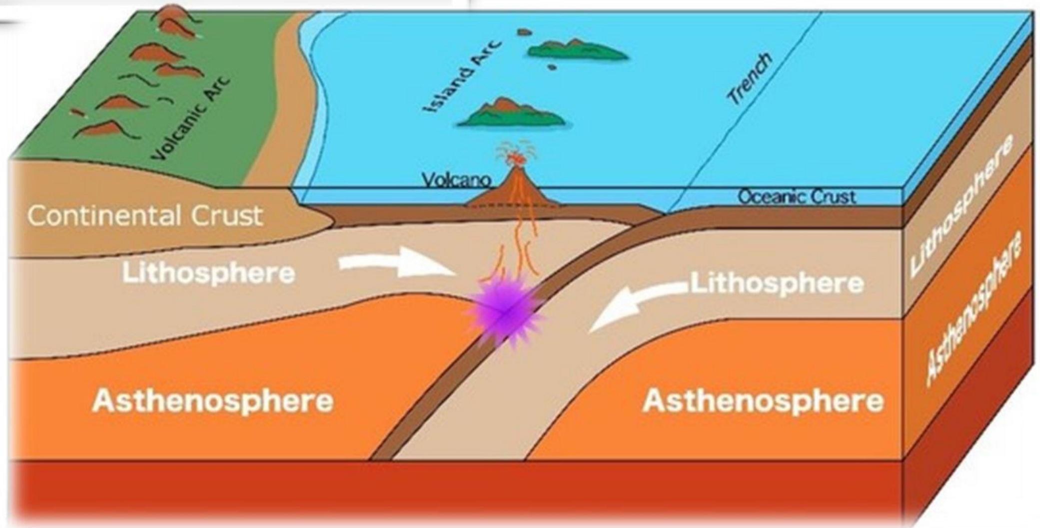
STRUCTURE OF EARTH



The Crust

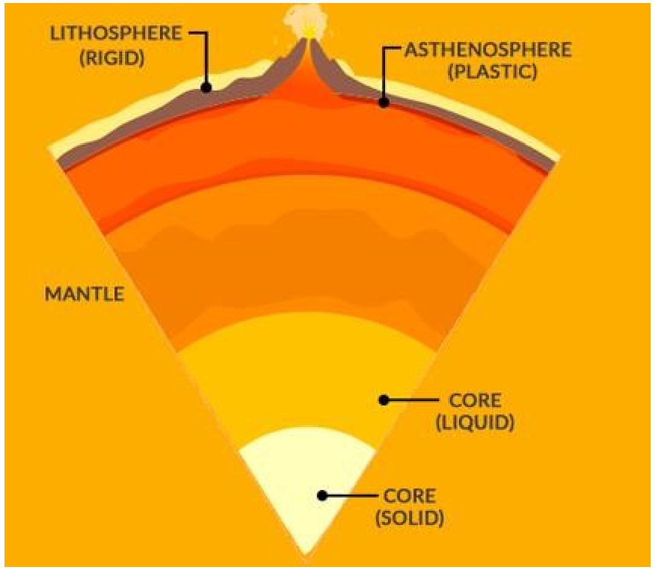
It is the earth's solid outermost layer, which is typically 8-40 kilometres thick.
The texture is **fragile**.
The earth's crust makes up almost 1% of its volume and 0.5 percent of its mass.
The thickness of the crust beneath marine and continental areas varies.
The continental crust is 5 kilometres thicker than the oceanic crust (about 30kms).
SIAL stands for ***Silica*** (Si) and ***Aluminum*** (Al), two key constituent elements of crust.
Sometimes ***SIAL*** is used to refer to the Lithosphere, which is the region comprising the crust ***SIMA*** **Slilica** and **Magnesiam** and uppermost solid mantle.
The density of the materials in the crust is 3g/cm3.
The border between the hydrosphere and the crust is known as the Conrad Discontinuity.


Crust 0-100 km
thick
Lithosphere
(crust and upper-
most solid mantle)
Asthenosphere
Mantle
Mantle
Crust
2900 km
Liquid
Outer
core
Core
5100 km
Inner
core
Solid
Not to scale
6378 km


Volcanic Arc
Island Arc
Trench
Volcano
Oceanic Crust
Continental Crust
Lithosphere
Lithosphere
Lithosphere
Asthenosphere
Asthenosphere
Asthenosphere

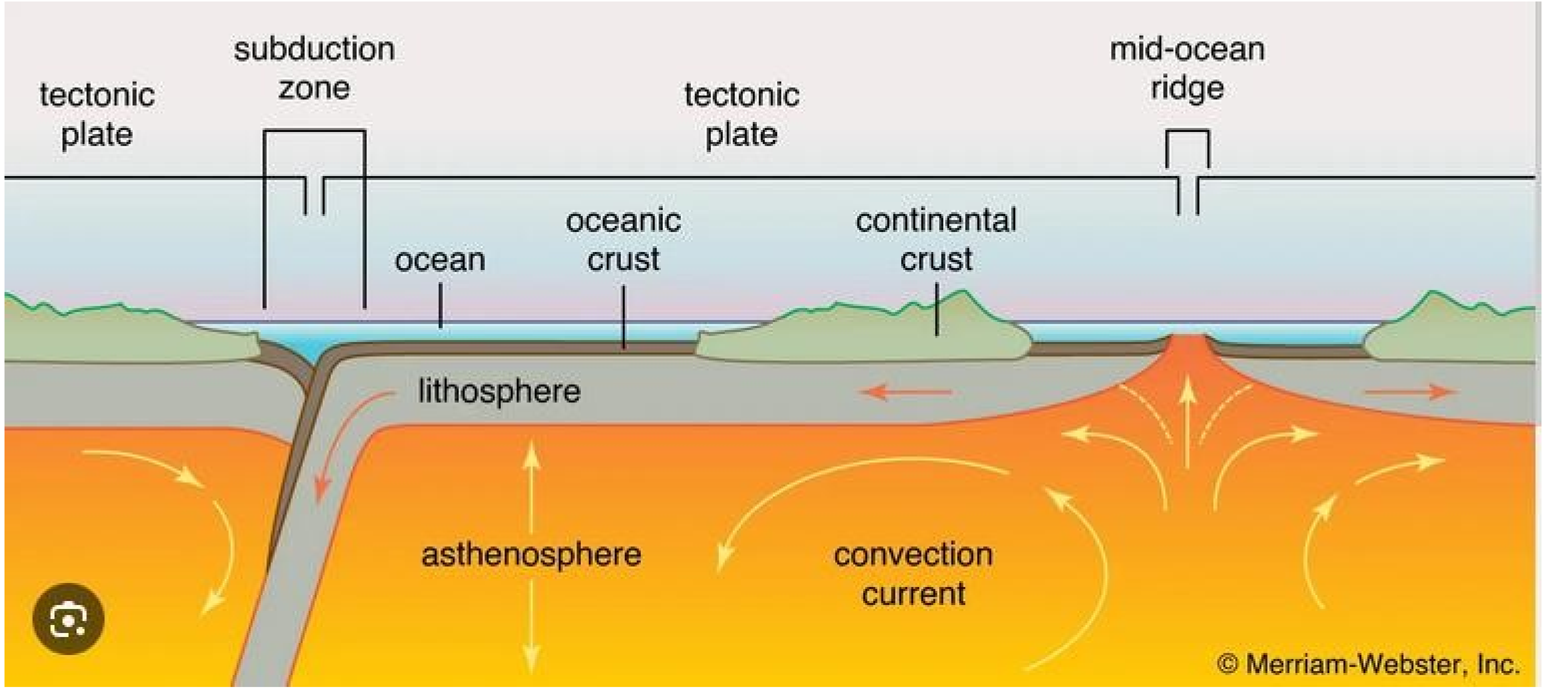
The Mantle

The interior region beyond the crust is known as the mantle.
The **Mohorovich Discontinuity**, or **Moho discontinuity**, is a transition between the crust and the mantle.
The thickness of the mantle is approximately 2900 kilometres.
The earth's mantle makes up around 84 percent of its volume and 67 percent of its mass.
Because silicon and magnesium are the primary component elements, the mantle is also known as **SIMA**.
The density of the layer is higher than that of the crust, ranging from 3.3 to 5.4 g/cm3.
The entire crust and the topmost solid component of the mantle make up the Lithosphere.



The **asthenosphere** is a viscous, mechanically weak, and ductile deforming layer of the upper mantle that lies between 80 and 200 kilometres below the lithosphere.
The principal source of magma and the layer through which lithospheric and continental plates move is the asthenosphere (plate tectonics).

The separation of the top and bottom mantles is known as **Repetti Discontinuity.**
The region of the mantle just below the lithosphere and asthenosphere but above the core is known as the mesosphere.



The Core

The layer that surrounds the earth's **core is the deepest.**

The core and the mantle are separated by **Guttenberg's Discontinuity**.

Because it is largely made up of **iron** (**Fe**) and **nickel**, it is also known as **NIFE** (**Ni**).

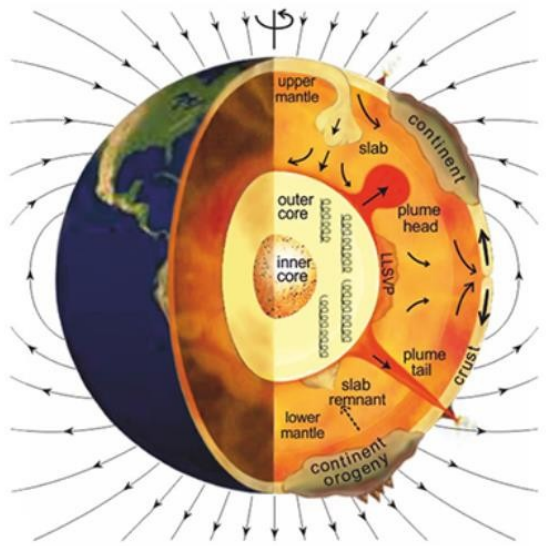
The planet's core accounts for around 15% of its volume and 32.5 percent of its mass.

With densities ranging from 9.5-14.5g/cm3, the earth's core is the densest layer.

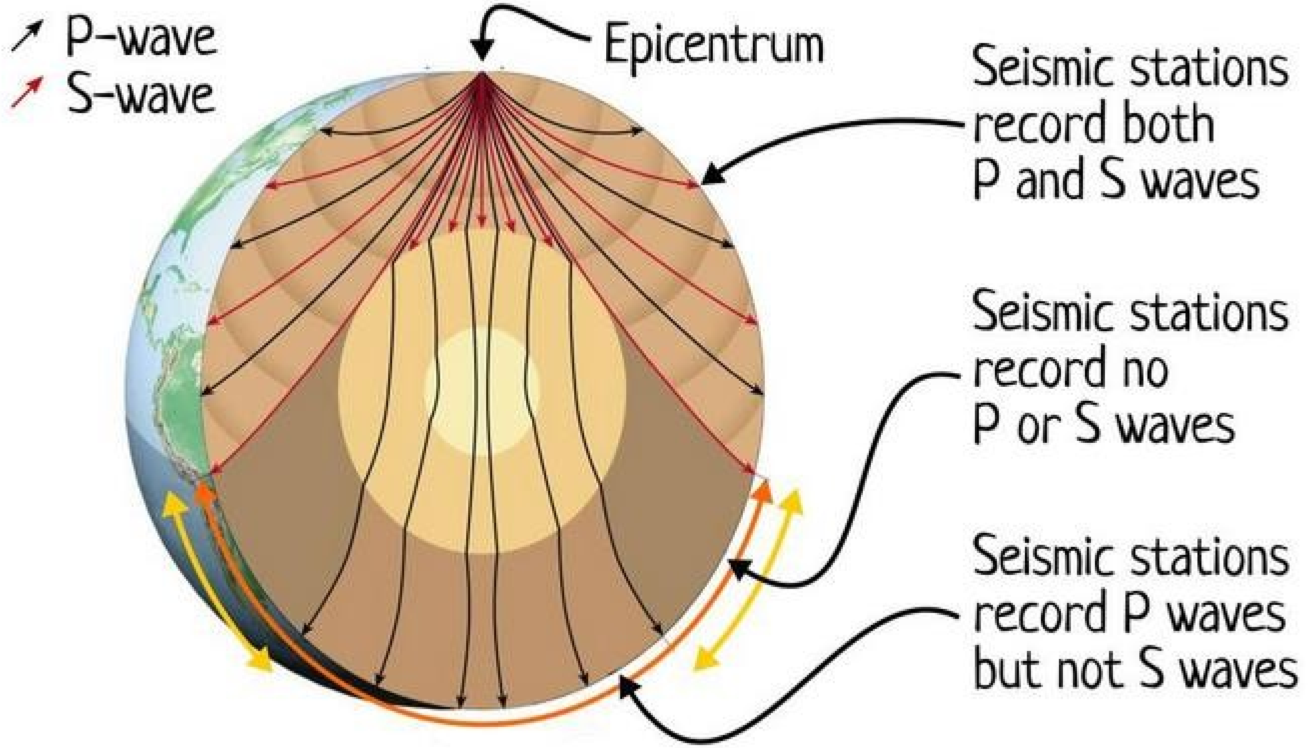
The Core is made up of **two sub-layers**: the inner core and the outer core.

The **interior core is solid**, whereas the **exterior** core is **liquid** (or **semi-liquid**).

A split between the upper and lower cores is known as the **Lehmann Discontinuity**.



An **earthquake** generates **seismic waves** that propagates throughout the Earth's interior. Earth's core is mapped by observing the characteristic of the **seismic waves** that reach the surface of the Earth.

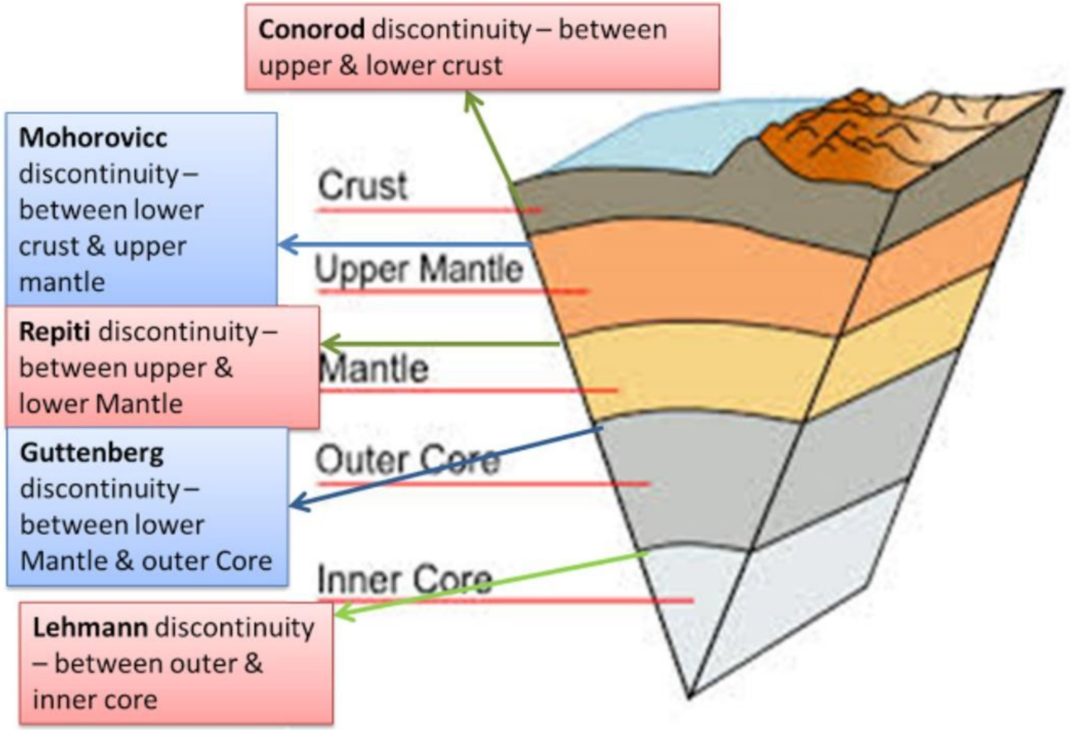


Flat-Earthers think it is impossible to determine Earth's interior as nobody has gone to the core before. They are wrong. **Seismology** provide a way for us to determine the **Earth's interior** without having to travel there physically.

Transition Zones

There are five discontinuities/ Transition Zones inside the earth:

1. **Conrad Discontinuity**: Transition zone between upper and lower Crust.
2. **Mohorovicic Discontinuity**: Transition zone between the Crust and Mantle.
3. **Repiti Discontinuity**: Transition zone between Outer mantle and Inner mantle.
4. **Gutenberg Discontinuity**: Transition zone between Mantle and Core.
5. **Lehman Discontinuity**: Transition zone between Outer core and Inner core.



Conrad Discontinuity:

The **transition zone between thee upper and lower part of the lithosphere, is called as Conrad discontinuity**. The name come from the Austrian geophysicist Vector Conrad.
Up to the middle 20thcentury the upper crust in the continental region was seen to consist of **felsic rock such as granite and the lower one consist of more magnesium rich mafic rocks such as basalt**.
Therefore, the seismologists of that time considered that Conrad discontinuity should correspond to a sharply defined contact between the chemically distinct layers of SIAL and SIMA.
In passing through the Conrad discontinuity the velocity of longitudinal seismic waves increases abruptly from approximately 6to6.5km/sec.

Mohorovicic Discontinuity:

The **transition zone between the crust and mantle is called as mohorovicic discontinuity.**
The mohorovicic discontinuity was discovered by Andrija Mohorovicic in the year of 1909.
The **Moho lies at the depth of 35km beneath the continents and 8km beneath the oceanic crust**.
The Moho separates both the continental crust and the oceanic crust from underlying mantle. The **Moho lies almost entirely within the lithosphere**, only beneath the Mid Oceanic Ridge does it define lithosphere and asthenosphere boundary.
Immediate above the Moho velocity of the P wave is 6km/sec and just below the Moho it becomes 8km/sec. Moho is characterised by up to 500km thick.

Repiti Discontinuity
It is the transition zone between **Outer mantle and Inner mantle.**
Gutenberg Discontinuity
The **mantle–core transition zone is called Gutenberg discontinuity**.
In the year of 1912 Weichert Gutenberg was discovered this discontinuity at the depth of 2900km beneath the earth surface. **In this zone the velocity of seismic waves changes suddenly**.

The **velocity of P wave decreases and S wave completely disappear at this depth**.
S wave shear material and cannot transmit through liquid. So, **it is believed that the part of above the discontinuity is solid and part of beneath then discontinuity is liquid or molten form.**

Lehmann discontinuity
It is the **transition zone between outer and inner core**.
The **Lehmann discontinuity** is an **abrupt increase of *P*-wave and *S*-wave velocities at the depth of 220±30 km**, discovered by seismologist Inge Lehmann.
It appears beneath continents, but not usually beneath oceans, and does not readily appear in globally averaged studies.
Several explanations have been proposed: a lower limit to the pliable asthenosphere, a phase transition, and most plausibly, depth variation in the shear wave anisotropy.