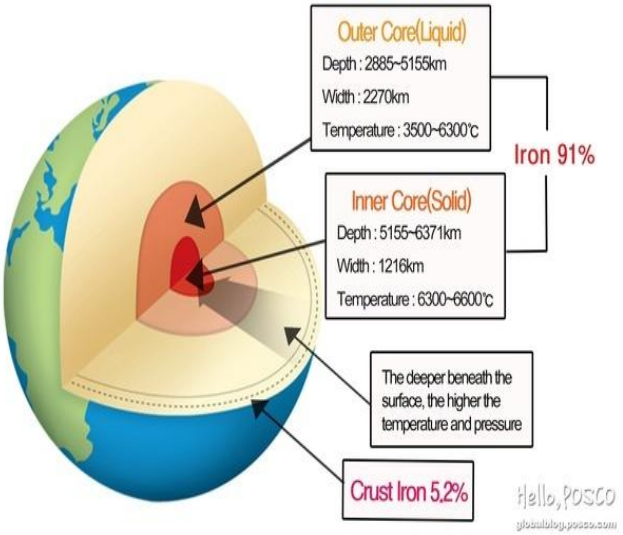
Internal Structure of Earth: (Interior of the Earth: Crust, Mantle and Core):

We should note that

- **It is not possible to know about the earth's interior by direct observations because of the huge size and the changing nature of its interior composition.**
- **It is an almost impossible distance for the humans to reach till the centre of the earth**
- **Through mining and drilling operations we have been able to observe the earth's interior directly only up to a depth of few kilometres.**
- **The rapid increase in temperature below the earth's surface is mainly responsible for setting a limit to direct observations inside the earth.**



- **But still, through some direct and indirect sources, the scientists have a fair idea about how the earth's interior look like.**

In spite of all these serious problems we have the sources from which we can get the information about the interior of the earth:

Direct Sources:

1. **Rocks from mining area**
2. **Volcanic eruptions**

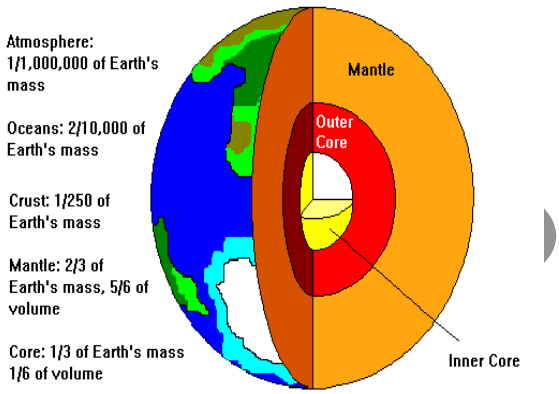
Indirect Sources:

1. **By analyzing the rate of change of temperature and pressure from the surface towards the interior.**
2. **Gravitation, which is greater near poles and less at the equator.**
3. **Gravity anomaly, which is the change in gravity value according to the mass of material, gives us information about the materials in the earth's interior.**
4. **Magnetic sources.**
5. **Seismic Waves: the shadow zones of body waves give us information about the state of materials in the interior.**

Structure of the earth's interior:

Crust

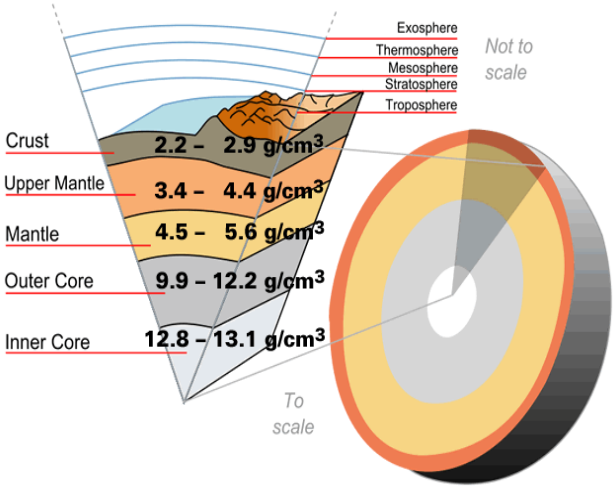
- It is the outermost solid part of the earth, normally about 8-40 kms thick.
- It is brittle in nature.
- Nearly 1% of the earth's volume and 0.5% of earth's mass are made of the crust.
- The thicknesses of the crust under the oceanic and continental areas are different. Oceanic crust is thinner (about 5kms) as compared to the continental crust (about 30kms).



- This crust is basically made by Silica (Si) and Aluminium (Al) and thus, it is often termed as SIAL (Sometimes SIAL is used to refer Lithosphere, which is the region comprising the crust and uppermost solid mantle, also).
- The air region over the crust is called hydrosphere
- The mean density of the materials in the crust is 3g/cc.
- The discontinuity between the hydrosphere and crust is termed as the Conrad Discontinuity.

Mantle

- The portion of the interior beyond the crust is called as the mantle.
- The discontinuity between the crust and mantle is called as the Mohorovich Discontinuity or Moho discontinuity.
- The mantle is about 2900 kms in thickness.
- Nearly 84% of the earth's volume and 67% of the earth's mass is occupied by the mantle.
- The major elements of this mantle are Silicon and Magnesium and hence it is also termed as SIMA.
- The density of this mantle is higher than that of the crust and varies from 3.3 – 5.4g/cc.
- The uppermost solid part of the mantle and the entire crust constitute the Lithosphere.
- Below this lithosphere, the middle portion of this mantle is called asthenosphere
- This astheno sphere i.e. lower part of mantle has average width between 80-200 km and it is a highly viscous, mechanically



weak and ductile deforming region of the upper mantle which lies just below the lithosphere.

- The astheno sphere is the main source of magma and it is the layer over which the lithospheric plates/ continental plates moves at the time of earth quake and it is then called "plate tectonics".
- The discontinuity between the upper mantle i.e. lithosphere and this middle mantle i.e. asthenosphere is known as Repetti Discontinuity.
- The lower portion of the mantle which is just below the asthenosphere, but above the core is called as Mesosphere.

Core

- It is the innermost layer around the earth's centre.
- The core is separated from the mantle by Guttenberg's Discontinuity.
- It is composed mainly of iron (Fe) and nickel (Ni) and that is why it is also called as NIFE.
- The core constitutes nearly 15% of earth's volume and 32.5% of earth's mass.
- The core is the densest layer of the earth with its density ranges between 9.5-14.5g/cm^3.
- The Core consists of two sub-layers: the inner core and the outer core.
- The inner core is in solid state and the outer core is in the liquid state (or semi-liquid).
- The discontinuity between the upper core and the lower core is called as Lehmann Discontinuity.
- This core region of earth and sometimes whole interior of earth is known as Barysphere

Temperature, Pressure and Density of the Earth's Interior

Temperature

- The different observations show that the rate of increase of temperature is not uniform from the surface towards the earth's centre. It is faster at some places and slower at other places.
- In the beginning, this rate of increase of temperature is at an average rate of 1^{0}C for every 32m increase in depth.
- While in the upper 100kms, the increase in temperature is at the rate of 12^{0}C per km and in the next 300kms, it is 20^{0}C per km. But going further deep, this rate reduces to mere 10^{0}C per km.
- Temperature is always increasing from the earth's surface towards the centre.
- The temperature at the centre of earth as estimated lies between 3000^{0}C and 5000^{0}C
- Even in such a high temperature also, the materials at the centre of the earth are in solid state because of the heavy pressure of the overlying materials.

Pressure

- **Just like the temperature, the pressure is also increasing from the surface towards the centre of the earth.**
- **It is due to the huge weight of the overlying materials like rocks.**
- **It is estimated that in the deeper portions, the pressure is tremendously high which will be nearly 3 to 4 million times more than the pressure of the atmosphere at sea level.**
- **At high temperature, the materials beneath will melt towards the centre part of the earth but due to heavy pressure, these molten materials acquire the properties of a solid and are probably in a plastic state.**

Density

- **Due to increase in pressure and presence of heavier materials like Nickel and Iron towards the centre, the density of earth's layers also increases towards the centre.**
- **The average density of the layers gets on increasing from crust to core and it is nearly 14.5g/cc**