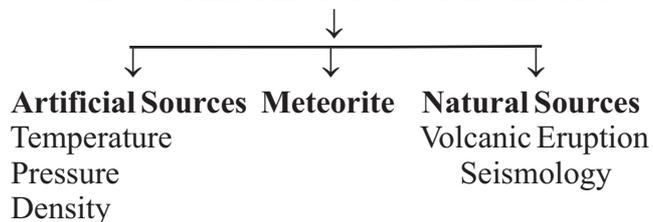


Lesson - 4

Interior of the Earth

The interior of the earth is invisible and inaccessible. Man has been able to know the interior part of the earth for few kilometers through the actions of drilling and mining. Due to the rapid increase in temperature along with depth, it becomes almost impossible to mine or drill deeply. The high temperature of the earth's interior can melt any device used for drilling therefore drilling is limited upto a certain depth therefore it becomes very difficult to know directly about the earth's interior; There are other sources of information about interior of the earth like eruption of lava from volcanoes and gases, but it is difficult to know about the depth at which this magma comes out. More scientific and authentic information about the structure of the earth is obtained from Seismology. The sources which provide information about the interior structure of the earth can be categorized into following classes -

Sources of information of earth's interior



1. Artificial Sources :

(a) Temperature :

It has been proved by geological surveys that there is constant increase of temperature of 1°C

at the depth of every 32 meters towards the centre of the earth. According to this rate of increase in temperature with increasing depth, all the substances should be found in the liquid state in the earth's core but this does not actually happens. With the increasing depth, due to rapid increase in pressure, the melting point of rocks also increases simultaneously and the rate of increase in temperature inside the earth's crust keeps on declining towards the centre of the earth. According to this calculation the temperature of the core of the earth is more than 2000°C.

(b) Pressure :

The increasing pressure of the thick layers of the earth's interior causes increase in density towards the centre of the earth. It is obvious that substances present at the core should be in liquid form because of high temperature, but due to excessive pressure the liquid substance behaves as solid. Therefore because of excessive heat and excessive pressure, rocks are like solid plastics.

(c) Density :

Due to constant pressure exerted towards the centre of the earth and due to heavy substances, the density of layers also increases. According to the gravitational theory of Newton, the calculated density of the earth is 5.5 (density of earth's surface 2.6-3.3 gcm³ and average density of the earth's centre 11gcm³)

2. Meteorite Shower :

Meteorites are part of our solar system. They

were scattered in the space during the origin of planets. Sometimes these meteorite falls on earth's surface. This process is called Meteorite Shower. The study of meteorite reveals that it contains Nickle and Iron. Earth is also a member of Solar System. The earth has magnetic property. This property has originated in earth due to the mix of Nickle-Iron in its interior part.

3. Natural Sources :

(a) Volcanic Eruption :

From the substances erupted from the volcano and magma, it is clear that the some part of the earth's interior is hot and is in the state of magma.

(b) Evidences of Seismology :

This is a science which studies the seismic waves by using seismograph. Earthquakes are sudden vibrations which are produced in the earths interior. Focus is the place in the earths interior from where it has been originated. Seismic waves are actually the path adopted by the earthquakes's vibrations during an earthquake. These seismic waves are of three types. Primary (P) waves are fastest. They can travel through solid liquid and gases. Secondary (S) waves can travel only through, solids material but they cannot pass through liquid. Surface (L) waves move mainly along the surface

that reaches near the focus of earthquake in the end. These waves are very destructive. The shadow zone is the area of the earth, from angular distances of 105° to 140° from the epicenter of the earthquake where no seismic wave is recorded. (Fig.4.1).

On the basis of the path and velocity of seismic waves the information about interior of the earth is obtained. It is observed at the Seismograph stations that these waves follow a curved path which proves that car vature is due to variation in density in interior of the earth.

As the density inside the earth crust increases, the waves (P and S) being carvature inside the core of the earth and disappear as they reach the surface of the earth (Fig. 4.1) As 'S waves do not pass through liquid and disappear from the depth of more than 2900 kms, it is proved that earth is in a liquid state beyond 2900 kms of depth which is extended near the core of the earth. As there is difference in density of rocks, so there is difference in the traveling speed of the seismic waves. On the basis of the above facts three layers of the earth's interior are recognised-

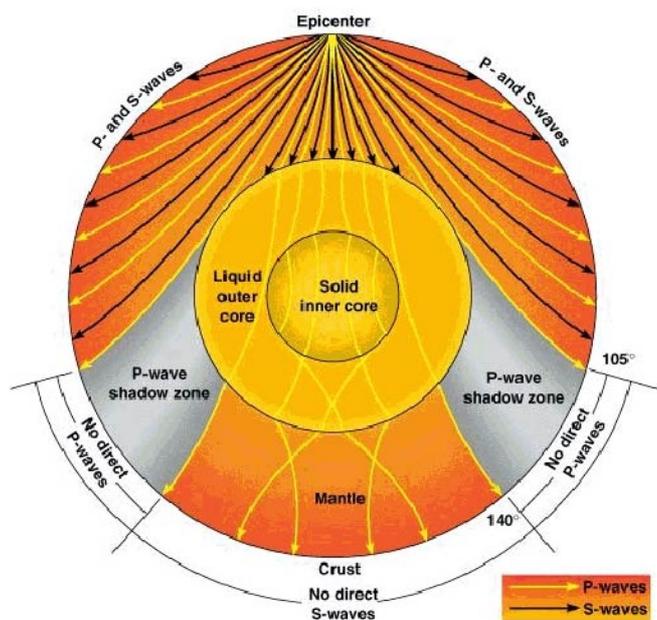


Fig. 4.1 : Paths of Seismic Ways

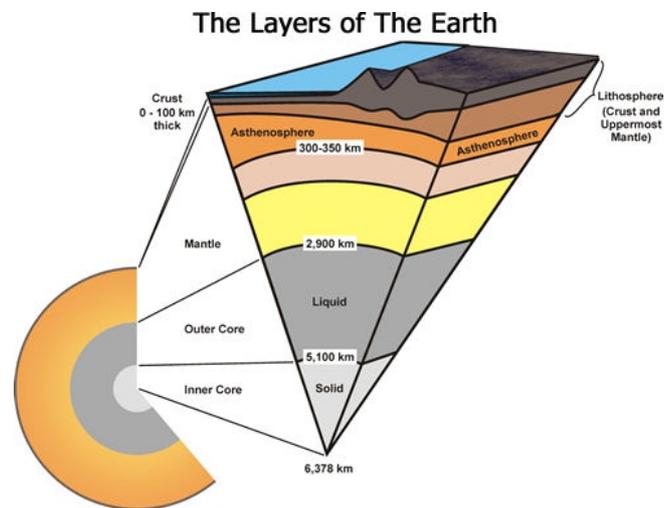


Fig. 4.2 - Interior structure of earth according to Seismology.

1. The Crust :

This the outer most layer of the earth and its average thickness is 30 kms. This layer is made of lighter rocks and its density is 3 gms per cubic centimeter.

2. The Mantle or substratum :

Mantle is extended upto the depth of 2900 kms from the crust of the earth. The upper part of Mantle is called Asthenosphere. The lava which reaches the earth's surface during volcanic eruptions has its source from this Mantle 'S' waves disappear after the depth of 2900 km, therefore Mantle is made up of solid rocks.

3. Core :

The part of the earth's interior which is extended between 2900 km to 6371 kms of depth is the most interior part of the earth. Its density is 11 gms per cubic centimeters 'S' waves can not reach to this region. This layer is divided into 2 parts - outer core which is in liquid form and extends from 2900 to 5150 kms, the second part is inner core which is much dense and extends from 5150 km to 6371 km of depth.

identified three layers under the crust.

1. Sial :

It refers to the earth's crust upper most layer and is made up of rocks abundant in (Silica) (Silica - Si) and Aluminum (al) therefore it is called Sial. Its average density is 2.9 and average depth ranges from 50 to 300 kms.

2. Sima :

This layer is mainly composed of rocks Silica (Si) and Magnesium (ma) therefore its called Sima (Si+ma=sima). Its density varies between 2.9 to 4.7. Its depth ranges from 1000 to 2000 kms.

3. Nife :

This layer has abundance of Nickel (ni) and Ferriun (Fe). Therefore it is called Nife (ni+fe=nife). Its density is about 11 and it extends till the core of the earth.

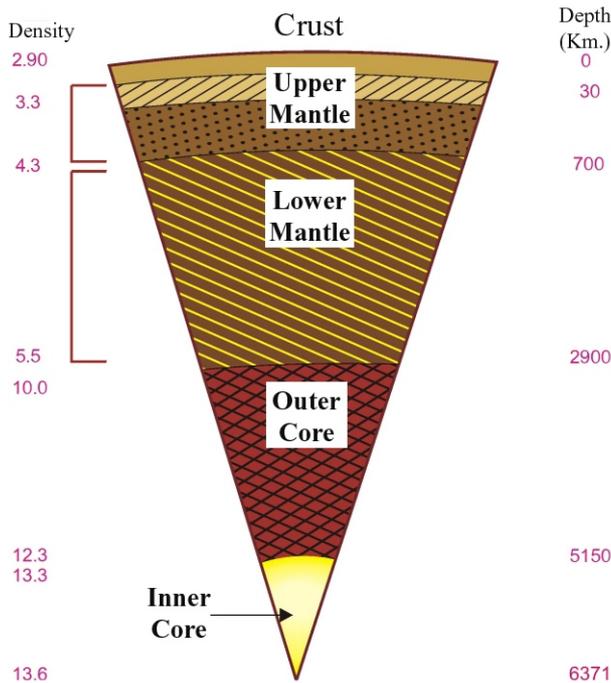


Fig. 4.3 : Depth & Density of Interior Layers of the earth

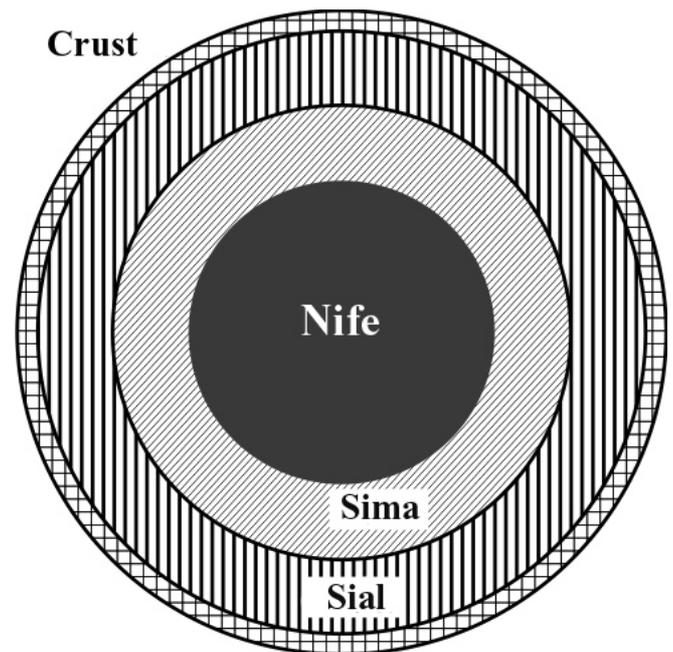


Fig. 4.4 : Interior Structure of the Earth according to Suess

Classification of Suess

According to Suess, the upper part of the earth is made up of sedimentary rocks. On the basis of chemical composition of rocks, Suess has

Van der Gracht's Classification

Van-der-Gracht has proposed 4 layers of the earths interior which can be categorized as follows :

1. Outer Silica Crust : The thickness of this layer beneath the continents is about 60 km, beneath Atlantic Ocean it is 20 kms. and beneath the Pacific

Ocean it is 10 kms. The density of this layer varies between 2.75 to 3.1. This layer is composed of Silica, Aluminium, Potassium and Sodium.

2. Inner Silicate layer and mantle :

The thickness of this layer is between 60 to 1200 km. Its density varies between 3.1 to 4.75. This layer is composed of Silica, Magnesium and Calcium.

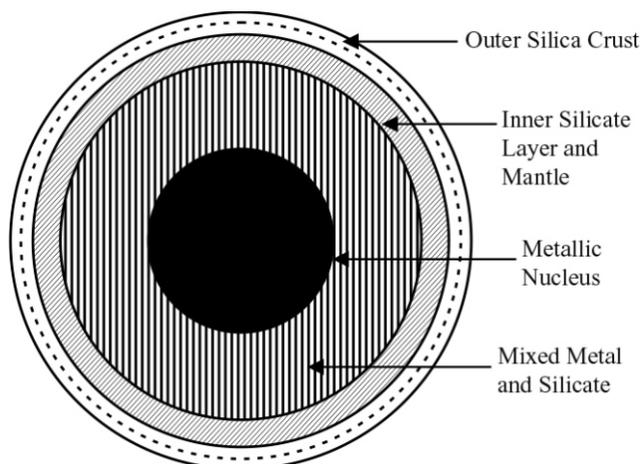


Fig. 4.5 : Interior Structure of the earth by Van der Gracht

3. Zone of mixed metals and silicate :

The thickness of this layer is between 1200 to 2900 km. Its density is from 4.75 to 7.8. This layer is formed of a mixture of Nickel, Iron, Silica, Magnesium.

4. Metallic nucleus :

This layer extends from 2900 km to the core of the earth. Its density is more than 11. This layer is formed of Nickel and Iron.

Important Points

1. The main reason for the limited information of the earth's interior is the limited access to it.
2. Main sources of information about earth's interior are temperature, density pressure, meteor shower, volcanic eruptions and evidences of seismology.
3. On the basis of scientific analysis of velocity and seismic paths of seismic ways, three

layers of earth's interior are determined :

- (a) Crust (b) Mantle (c) Core
4. Classification as given by Suess :
 (a) Sial (b) Sima (c) Nife
 5. Classification proposed by Van der Gracht :
 (a) Outer Silica Crust
 (b) Inner silicate layer and mantle
 (c) Zone of mixed metals and silicate
 (d) Metallic Nucleus

Exercise

Multiple Choice Questions

1. The components of Sial layer are :
 (A) Silica - Magnesium
 (B) Sodium - Aluminium
 (C) Silica - Aluminium
 (D) Silica - Iron
2. The maximum thickness of the outer most layer of the earth according to Vander & Gracht :
 (A) 1200 km
 (B) 60 km
 (C) 2900 km
 (D) 200 km
3. The statement which is wrong in reference to the classification given by Suess is :
 (A) Density of upper layer is 2.7
 (B) The density of Sima is less than 4.7
 (C) Nife consist of magnetic quality
 (D) Sial is floating on Nife
4. Interior of the earth is classified as Sial, Sima and Nife by :
 (A) Van der Gracht
 (B) Dally
 (C) Homes
 (D) Sues

5. Which of the following is the direct source of information of earth's interior?
(A) Seismic Waves
(B) Gravitational Force
(C) Volcanic Eruptions
(D) Magnetism of Earth

Very Short Type Questions :

6. Name the direct sources through which we can get the information about the earth's interior?
7. What is Seismology?
8. What are seismic waves?
9. Why our knowledge is so limited regarding the interior of the earth?
10. What are the major components of Nife?

Short Type Questions :

11. Name the layers of the earth's interior classified on the basis of seismological evidences.
12. What are the characteristics of Earth core?
13. Write the characteristics of 'Sial'.
14. What is 'Substratum'? Give its characteristics?
15. Name the different layers of earth's interior suggested by Van-der-Gracht.

Essay Type Questions :

16. Explain the views of vander Grachat regarding interior of the earth.
17. Explain the view of suess regarding interior of the earth.
18. Describe the earth's interior on the basis of evidences of Seismology.

Answer Key

1.C 2.B 3.D 4.D 5.C