STRUCTURE OF THE EARTH Module-2/3

On the basis of data assembled from studies of the travel habits of earthquake waves the earth has been divided into three major zones.

(i) Crust
(ii) Mantle
(iii) Core

The Crust

The outermost thin layer of the lithosphere is crust. Its thickness varies from 16 to 40 km.The crust contain the continental landmass and the ocean basins. In the continental areas, crust is about 40 km thick and in the ocean basin, the thickness of the crust is 5 to 10km.From seismic waves it seems that the surface layer of the continent is composed mainly of granite rocks with specific gravity 2.65 where the seismic velocity is 6km/sec.Because these rocks contain a large proportion of silica and aluminum they are collectively called **SIAL.** The basement layer is continuous which is exposed on the ocean floor or the ocean basin. The specific gravity is 3.0 and the earthquake waves travel at a speed of 6.7km/sec. The rocks contain silica and minerals rich in magnesium and iron. This layer of basic rocks is termed as **SIMA.**

The Mantle

Below the earth's crust is the second zone, themantle, having mean density of 4.6 gcm^{-3}extends to a depth of approximately 2900km, into the interior of the earth. The line of function between the earth crust and the mantle is called Moho discontinuity after the scientist Mohorovicic who discovered it in 1909.Moho discontinuity lying at a depth of up to 40kms beneath the continents and 6-10 km beneath the ocean floor.

At the Moho, the speed of P and S waves increases sharply as indication of the mantle material suddenly changes. (6.7km/sec in the crust to 8.2 km/sec). The change in speed suggests that it may contain more Ferro magnesium minerals.

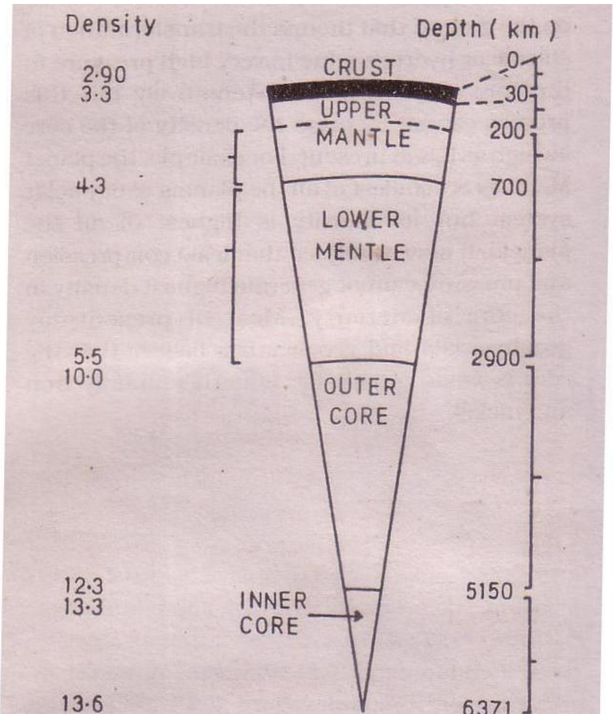

Fig. 3.5:Diagramatic presentation of different zones of the earth, their densities and thicknesses on the basis of the information of International Union of Geodesy and Geophysics.

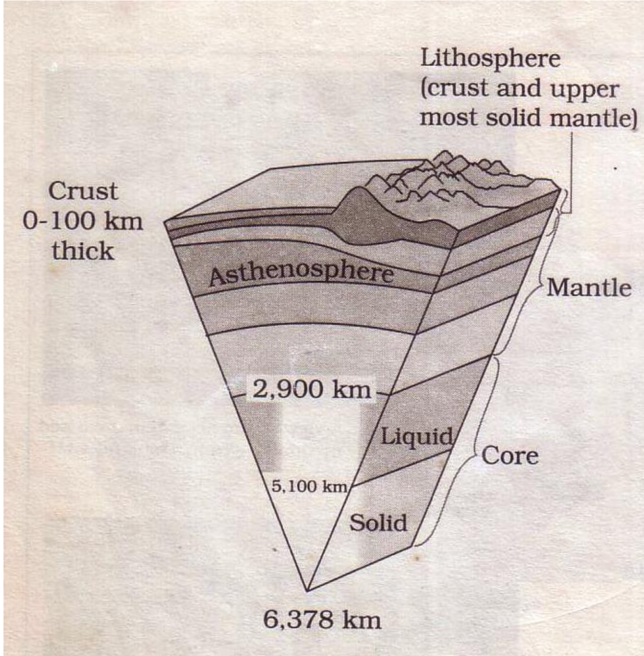

Figure 3.4 : The interior of the earth

The lithosphere mantle is not homogenous. Recent experimental seismological studies show some peculiar features. Just under the Moho an initial layer 10km thick transmit P waves at an average velocity of 8.1km/sec. Then a low velocity channel about 10km is observed in which the P waves are transmitted at 7.8-7.9 km/sec. This upper low velocity channel is the result of partial melting of mantle rocks. This portion is included within the lithosphere. An important feature of the mantle is the presence of a thin layer between 100 and 200km below its surface where the rocks appear to be less rigid and more plastic than those above and below. As a result the speed of propagation of earthquake waves is abruptly reduced. This layer is referred to as the asthenosphere or low velocity zone.

Within the asthenosphere the rocks are viscous and probably close to melting point, as a result the concentration of heat from radioactivedecay, where temperature is about 1400^{o}C.

With increasing depth in the mantle the velocity of seismic waves increases again. The rocks become more solid.

The Core

The zone next to mantle is core. This zone extends from 2900km to the centre of the earth at a depth of 6371km.The mantle is demarked from the core by the zone called Gutenberg discontinuity. The zone probably consisting of dense nickel, iron with a temperature estimated of about 2700K with an average density of about $10.5gcm^{-3}$.This sudden change in density is indicated by sudden increase in the velocity of P waves (13.6km per second) along the mantle-core boundary or Gutenberg Discontinuity. The density further increases from 12.3 to 13.3 and 13.6 with increasing depth of the core.

Seismographic record reveals that the core has two parts, an outer core 2200km thick and an inner zone with a radius of 1270km.The outer core is in liquid state while the inner core is in solid state.S waves disappear in this outer core. Thismeans that the outer core should be in molten state.P waves travel through this zone with the speed of 11.23 km per second.