

Internal Structure of the Earth

Learning Outcomes

Students will be able to:

- 1) Label the internal structure of the Earth.
- 2) Describe the characteristics of the core, mantle and crust

Introduction

What do geologists know about the earth's interior? How do they obtain information about the parts of the earth beneath the surface?

We have found out about the Earth's structure by studying the paths of earthquake waves as they travel through the Earth's interior, and by studying evidence of volcanic eruptions which bring material from deep within the Earth's interior to the surface.

Deeper parts of the earth are studied indirectly by a branch of geology known as geophysics. One of the study of geophysics is the study of seismic waves.

Geologists are not able to sample rocks very far below the earth's surface. One direct way of looking at rocks from deeper levels is when mantle rock is brought to the surface by basalt flow.

Seismic waves are caused by events like earthquakes and human-made blasts. The waves pass along the surface and through Earth.

The study of seismic refraction and seismic reflection led scientists to plot the four main layers of the earth.

You will see from Figure 1.1 that the Earth's structure is divided into four zones.

The crust averages between 5km to 40km thick (up to 70km under mountain). The crust can be subdivided into two main parts:

- (i) continental/ upper crust/ sial
- (ii) oceanic/ lower crust/ sima

Both differ in thickness, density and composition. Seismic studies have shown that that crust is thinner beneath the oceans than beneath the continents. Because rock in the crust is cool, the crust is brittle (cracks and breaks easily). Shallow earthquakes occur in the crust.

Continental crust: - the upper rocky layer of the crust.

The thickness of the continental crust varies between 35 km - 40 km (up to 70km under continents). Seismic studies have shown that the continental crust is thickest under young fold mountain ranges. Continental crust is also less dense than oceanic crust. This is because it is made up of light rocks such as granitic, metamorphic and sedimentary rocks. The continental crust consists chiefly of the minerals silica and alumina, hence the continental crust is sometimes called SIAL.

Oceanic crust: - the lower layer of the crust that lies under the oceans.

Its thickness varies between 5 km - 10 km thick. Oceanic crust is primarily composed of silica, iron and magnesium, hence it is sometimes called SIMA. It is thinner than continental crust, or SIMA. It is generally about 7 kilometers thick. Oceanic crust is denser than the continental crust.

The Mohorovicic Discontinuity (Moho)

The boundary (transitional zone) that separates the crust from the mantle is called the Mohorovicic discontinuity (Moho). The Mohorovicic discontinuity was first identified in 1909 by Andrija Mohorovicic, a Croatian seismologist.

The Lithosphere

The earth's crust and the uppermost portion of the mantle together are known as the lithosphere. This section is strong and brittle. The lithosphere makes up the plates in plate tectonics theory. It averages about 100 kilometers thick. The lithosphere is also the zone where earthquakes, mountain building, volcanoes, and continental drift activity takes place.

THE MANTLE - the mantle is the layer between the crust and the core

The mantle is almost 2900 kilometers thick. The mantle is subdivided into an upper mantle and lower mantle.

The Upper mantle

The upper mantle is a lot thinner than the lower mantle. It can be found between 50 km and 410 km below the surface of the earth.

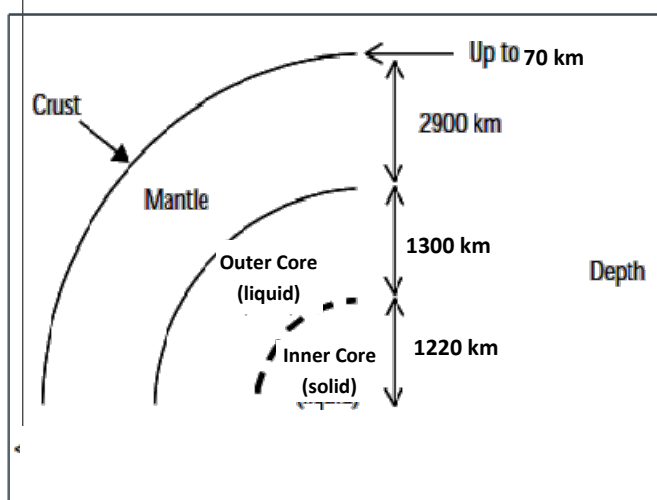


Figure 1.1: The structure of the Earth

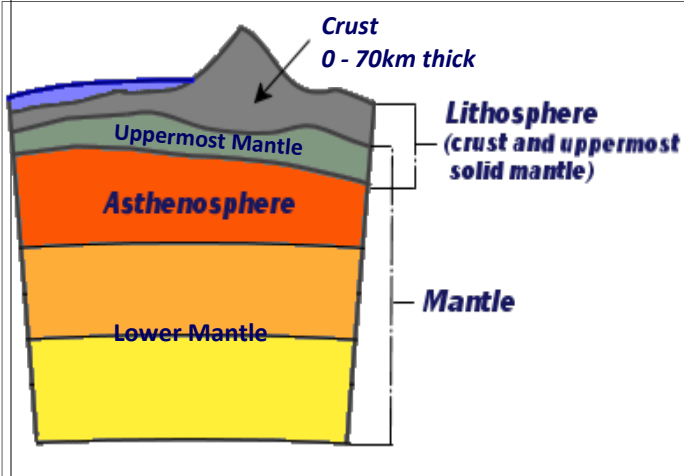
THE CRUST - outer layer of rock which forms a thin skin on the earth's surface

The thin, outermost layer of our planet is the Earth's crust. This skin consists of varied rocks and minerals and contains the continents and ocean basins. It is the source of soil on the lands, salts in the sea, gases in the atmosphere, and of all the water of the oceans, atmosphere, and lands.

Two main zones are distinguished in the upper mantle. These are

- the uppermost part of the mantle (the lower part of the lithosphere) composed of rigid rock about 50 to 120 km thick.
- the inner asthenosphere composed of plastic flowing rock of varying thickness, on average about 200 km thick;

The rocks in this zone may be close to their melting point and therefore may have the ability to flow. Most magmas (molten rock) are generated in this zone. The asthenosphere is believed to be the zone upon which the great rigid and brittle lithospheric plates of the Earth's crust move about .



Lower Mantle:

The lower mantle can be found between 410 km and 2,900 km below the earth's surface. The rock is solid because of the high pressures.

The Gutenberg Discontinuity

The border of transition zone between the mantle and the core. The Gutenberg discontinuity occurs within Earth's interior at a depth of about 2,900 km below the surface, where there is an abrupt change in the seismic waves that travel through Earth. The Gutenberg discontinuity was named after Beno Gutenberg (1889-1960) a seismologist who made several important contributions to the study and understanding of the Earth's interior.

THE CORE- The inner part of the earth is the core.

The core is a dense ball consisting mainly of the elements iron and a little silicon, sulfur and oxygen and nickel. It is an iron-rich sphere with a radius of 3,500 km.

It is divided into two layers, the inner core and the outer core

The Outer Core

The outer core of the Earth is a fluid layer about 2,300 km thick and composed of mostly iron and nickel. Seismic S-waves show that the outer core is liquid. Evidence for a fluid outer core includes observations from seismology which shows that seismic shear-waves are not transmitted through the outer core.

The Inner Core

The Earth's inner core is the Earth's innermost part. It is believed to be primarily a solid ball with a radius of about 1,220 km. It is composed of an iron and nickel and some light elements. It was discovered in 1936, by the Danish

seismologist Inge Lehmann.

N.B. Earth's Magnetic Field

Powerful electric currents are formed as the liquid outer core moves. These electric currents create Earth's magnetic field. This magnetic field protects the planet from harmful solar radiation. It also protects the atmosphere. Life on Earth would be in danger if the outer core cooled and stopped moving.

Basalt-flow - molten volcanic rock that spreads rapidly to form sheets hundreds of kilometers across.

Basalt - a dark coloured, fine-grained igneous rock that flows from volcano.

seismic refraction - the return of some of the energy of seismic waves to the earth's surface after the waves bounce off a rock boundary.

seismic reflection - the bending of seismic waves as they pass from one material to another.

Lithosphere - the crust and the upper layer of the mantle which lies above the asthenosphere.

Asthenosphere - the zone in the mantle which lies beneath the rigid lithosphere between 70 and 250 km.

A **seismologist** is a scientist who detects and interprets these vibrations at different locations on Earth's surface.

Shear wave, is a seismic body wave that shakes the ground back and forth . It does not pass through liquid.

DIAGRAM SHOWING STRUCTURE OF THE EARTH

