CHAPTER 6 STRUCTURE OF THE EARTH

Objectives

After studying this chapter, students should be able to:

(i) idenify the major components of the earth.

(ii) identify the various layers of the inner part of the earth.

(iii) describe the characteristic of each layer.

(iv) describe the relationship between the outer components of the earth.

The Earth as a planet is made up of two major zones or structures, namely:

(a) Outer structure

(b) Inner structure

6.1 The Inner or Internal Structure of the Earth

The internal or inner structure of the Earth is made up of three layers. These layers are concentric in nature and are made up of:

(i) Crust

(ii) Mantle

(iii) Core

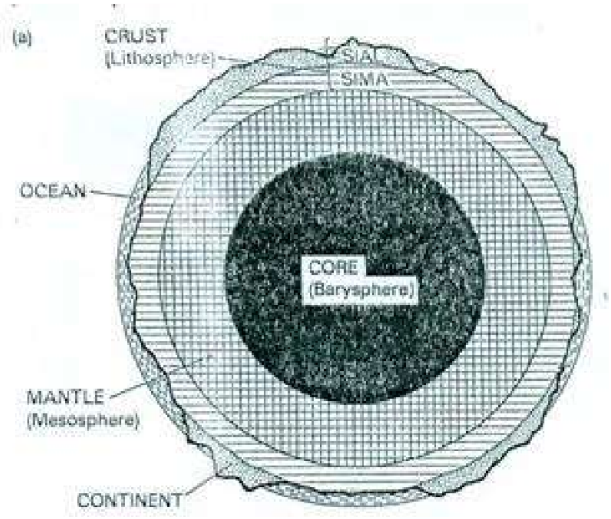

Fig. 6.1: Cross-section of the Earth

Crust or Lithosphere

This is the solid portion of the Earth and is made up of rock materials. It is divided into upper and lower parts. The upper part consists of granite rocks and serves as the platform on which the continents of the world are formed. It is made up of minerals such as silica and alumina. It is collectively known as the SIAL and has an average density of 2.7.

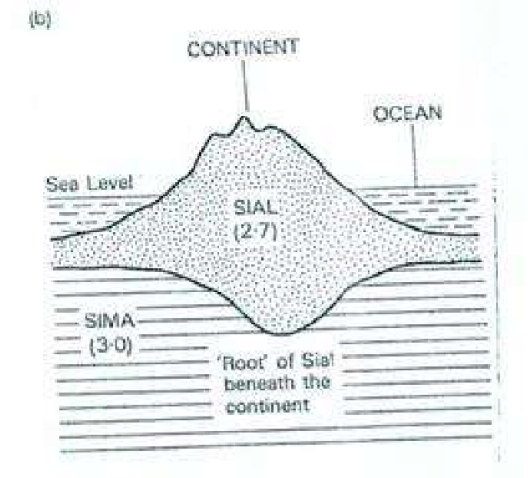

Fig 6.2: Cross Section of the Earth Crust

The lower part of the crust consists of silica, iron and magnesium which is collectively known as the SIMA. It is heavy and has an average density of 3.0. The SIAL is lighter than the SIMA. Both the SIAL and SIMA collectively form the earth crust and vary in thickness from 5km to 6km below the oceans to as much as 48km below the surface of the continents.

The lithosphere lies above the mantle and consists of soils and stones which sustain plants and animals.

Mantle or Mesosphere

This layer is found beneath the Earth's crust. It is about 2900 km in thickness and surrounds the barysphere or the core. It consists of dark-coloured igneous rocks that are rich in iron and magnesium. Its density varies between 3.0 and 3.3. It is very dense and heavy and it also contains minerals such as olivine. It is in a fluid state.

Core or Barysphere

This is the interior layer and is about 3,476km in radius. It is made up mainly of iron and nickel. It is otherwise known as Nife. The temperature of the core is extremely hot and estimated to be as high as 1930^0C (3500^0F). As a result of this, it is subject to high pressure. Hence, under this state the core is always in a liquid state. However, recent developments have suggested that it is very likely that the core is probably in a crystalline or solid state. The density of this zone is estimated to be 10.0.

6.2 The Outer Structure of the Earth

The outer structure of the Earth is that part which is exposed and in which human beings interact and can directly observe. The outer structure largely consists of the physical and biological constituents. The physical constituents are those entities and materials that exist naturally and are in the three states of matter (gas, liquid and solid) and are largely non-living. The biological constituents are those made up of living things such as man, plants, animals and micro-organisms. The outer structure consists of four domains or spheres namely:

(i) The Lithosphere
(ii) The Hydrosphere
(iii) The Atmosphere
(iv) The Biosphere

(a) Lithosphere

This is the outer skin of the Earth. As mentioned earlier on, it is the solid portion of the Earth beginning from the surface down to the rocky part. The solid part is made up of different rocks, soils and minerals. They produce

the basic materials from which the land masses are formed and they serve as platform in which landform features and soils are based. The lithosphere is important because of the following reasons:

(i) It forms the platform in which human settlements and all forms of building are found;

(ii) It is the major source of mineral resources.

(iii) It aids the movement of people and goods through the various modes of transport.

(iv) It allows the performance of several human activities such as mining, agriculture, lumbering trading, *etc.*

(v) It allows man to interact actively with his immediate (close) and remote (far) environment.

(b) Hydrosphere

This is the liquid portion of the Earth and consists of all forms of water on the Earth's surface. Such water exists in the form of surface water such as oceans, seas, lakes, rivers, ice sheets or as water vapour and cloud in the sky. A large portion of the earth is covered by water (about 70%) while the remaining 30% constitute the earth. Some water is also found beneath the earth's surface and is collectively known as underground water, *e.g.* wells and boreholes. Water found in oceans and seas account for over 96% of the total water bodies on the Earth's surface while the remaining 4% belongs to surface water, ground water, lakes and streams which are the major sources of fresh water which is very vital to the existence and sustenance of life. The water found in oceans and seas are saline (contain salt) and not safe for human consumption. The water existing in the atmosphere contains water vapour which later falls as rain which is far more than fresh water held in streams, rivers, lakes, *etc.* Indeed, water vapour constitutes the main source of all fresh water as it supplies water to the existing water bodies on the Earth's surface. The hydrosphere is very important because of the following reasons:

(i) It is a source of fresh water supplies for domestic uses such as drinking, washing, cooking, *etc.*

(ii) It is a medium for the transportation of people and goods.

(iii) It is a habitat to aquatic life such as fish, prawns, crabs, cray fish, lobsters, oysters, *etc.*

(iv) It is an important ingredient in the cultivation of crops and rearing of animals.

(c) Atmosphere

This is the gaseous portion of the Earth and it is an envelope (bag) of air that surrounds the Earth. It is vast as it extends upwards from the surface of the Earth to a height or altitude of more than 1,000km. The atmosphere is made up of two layers; the inner atmosphere known as the erTROPOSPHERE which extends for about 10km from the Earth's surface. The upper part which extends far more is known as the STRATOSPHERE. The atmosphere is a significant component of the Earth's outer structure as it provides the platform for the operation of climatic elements such as temperature, humidity, clouds, pressure, *etc.* The density of the atmosphere decreases with altitude (increasing height). It is composed of several gases such as Nitrogen (78%), Oxygen (21%), Carbon(IV) oxide (0.03%) and rare or inert gases (0.97%). Also the atmosphere is made up of water vapour, dust particles and smoke.

The atmosphere like other components is important because of the following reasons:

(i) It controls the distribution and spread of sun's rays in that the stratosphere contains a special bag of air known as the OZONE LAYER which absorbs harmful ultra violet rays from the sun by preventing it from reaching the Earth's rays where it can damage the tissue of living organisms.

(ii) It provides a platform for weather elements to operate especially the formation of rain.

(iii) It is the habitat of some living organisms especially micro-organisms.

(iv) It is the source of carbon dioxide which is essential in the process of photosynthesis.

(v) It is the source of air needed for respiration of plants and animals.

(d) Biosphere

This is that portion of the Earth which supports all forms of life. It is the cone where all living things on the Earth's surface are found. It is formed out of the interaction and interplay of the other physical constituents or zones such as lithosphere, atmosphere and hydrosphere. Living things consist of all forms of life such as plants, animals, man and micro-organisms. They live largely in land, water and the air. Indeed, the biosphere is fundamental to human life and all types of activities on the Earth's surface. It provides man with all sources of support that sustain and aid his existence. Such support includes air, water, food, energy and shelter (habitation).

The various living organisms relate and influence one another in one form or the other. Man depends on plants for food, while the decomposition of plants provide an opportunity for micro-organisms to thrive and grow where in the plants decay and the decayed material serves as nutrients for plant by nourishing the soil content. The biosphere exists between the lower atmosphere and the upper lithosphere. It extends from the upper air to the ground surface or top soil and the ocean surface where several forms of life exist. It has a thickness of about 5km where complex biological and chemical activities occur.

Like other outer components, the biosphere is important because of the following reasons:

(i) It aids the balancing and purification of atmospheric gases such as carbon(IV) oxide during respiration and oxygen during photosynthesis.

(ii) It allows the existence of life forms *e.g.* plants and animals.

(iii) It provides a formidable platform for man to interact with the physical environment.

Importance of the Components of the Earth's Outer Structure to Man

(a) The Atmosphere: This zone is important to man in the following ways:

(i) It provides oxygen for man to breathe and respirate.

(ii) It acts as a green house for purifying the environment for man's use.

(iii) It is a medium of transport for people and goods e,g., air transport.

(iv) It is a source of energy to man *e.g.* wind.

(b) The Hydrosphere: This is equally beneficial to man in the following ways:

(i) It is the major source of water to man and other living organisms especially for domestic, industrial and agricultural uses.

(ii) It provides a medium of transport in form of rivers, oceans, *etc.*

(iii) It is a source of employment *e.g.* fisherman, sailors, *etc.*

(iv) It is a major source of food to man *e.g.* fish, prawn, lobsters, *etc.*

(v) It is a medium for sport *e.g.* swimming, diving, *etc.*

(vi) It can be used as a source of power *e.g.* hydroelectric power.

(vii) It also serves as tourist centres and attraction *e.g.* river and beaches.

(viii) It is used in agriculture *e.g.* rainfall for irrigation farming.

(c) The Lithosphere: This component of the Earth's outer structure is useful to man in the following ways:

(i) It aids the transport of goods and services over long distance *e.g.* road transport.

(ii) It supports the practice of agriculture, mining, industrialization, *etc.*

(iii) It provides the platform for the growth of human settlements.

(d) The Biosphere: This is important to man for the following reasons:

(i) It is a source of food to man especially through plant and animals.

(ii) It provides energy for man through firewood, charcoal, *etc.*

(iii) It provides raw materials for industries such as fibre, timber, hides and skins, cotton, *etc.*

(iv) It is a source of employment to man as herdsman, fisherman, lumbers, *etc.*

(v) It provides resources for making shelter and building construction *e.g.* timber, soil, sand, *etc.*

6.4 Relationship between the Outer Zones of the Earth

There is a close relationship between the four zones of the Earth. This relationship is expressed in so many ways, some of which are:

1. Plants and animals that form a major part of the biosphere exist and live within the other three zones: lithosphere, atmosphere and hydrosphere from where they derive their food and which also serve as habitats.
2. Plants in the biosphere derive their food and nutrients from the soil which is a part of the lithosphere.
3. Human beings carry out their activities and means of livelihood within the lithosphere and hydrosphere.
4. Gases such as oxygen and carbon(IV) oxide are stabilized and made constant in the atmosphere through the processes of respiration and photosynthesis which involve the exchange and use of these gases by plants and animals.
5. Sunlight that passes through the atmosphere is required by plants to carry out the process of photosynthesis.
6. Water vapours within the atmosphere help in the formation of rain which is the principal source of water for the hydrosphere.

Summary

- The Earth is made up of two structures or components: inner structure and outer structure.
- The inner structure of the Earth consists of the core (barysphere), mantle (mesosphere) and crust (lithosphere).
- The outer structure or zones of the Earth are composed of four constituents or components: the atmosphere, the lithosphere, the hydrosphere and the biosphere.
- Each of the zone have peculiar attributes that can be used to describe the nature and forms of the Earth's surface.
- Each of the zones are unique and of immense benefits to the various life forms on the Earth's surface. They provide several resources such as energy, food, shelter and support to all living organisms. The further existence of living organisms especially man depend on these resources.
- All the zones interact fully with each other and directly influence one another to bring about remarkable changes on the Earth's surface.

Revision Questions

Objective Questions

1. The Earth is made of _____ structures.
   A. 1
   B. 2
   C. 3
   D. 4
2. The inner structure of the Earth is made up of all but one of the following:
   A. Core.
   B. Mantle.

C. Crust.

D. Stratosphere.

3. Which of the following outer structure is not physical in its characteristics?

A. Biosphere

B. Hydrosphere

C. Atmosphere

D. Lithosphere

4. Which of the following gases is the least abundant in total volume within the atmosphere?

A. carbon(IV) oxide

B. oxygen

C. Nitrogen

D. Argon

5. Which of the following is not a source of fresh water in the hydrosphere?

A. Glacier

B. Rain

C. Seas

D. Groundwater

6. The biosphere is important to life as a source of primary support for each of the following except

A. water.

B. food.

C. shelter.

D. energy.

7. Which of the following is not a constituent material of the biosphere?

A. Man

B. plants

C. Animals

D. Rocks

8. The portion of the Earth that contains life is the

A. atmosphere.

B. hydrosphere.

C. lithosphere.

D. biosphere.

9. The earth is enveloped by a mixture of gases referred to as the

A. biosphere.

B. lithosphere.

C. mesosphere.

D. atmosphere.

10. Another name for the core of the Earth is

A. lithosphere.

B. biosphere.

C. barysphere.

D. mesosphere.

Answers

1. B 2. D 3. A 4. D 5. C 6. A 7. D 8. D 9. D 10. C

Essay Questions

1a. State the zones in the outer structure of the Earth.

b. Describe the importance of any two of the zones.

2a. Describe the various ways in which plants are beneficial to man.

b. Identify the major sources of water in the hydrosphere.

3a. With the aid of a well-labelled diagram, describe the outer structure of the Earth.

b. List five importance of water to man.

4a. Describe the major characteristics of each of the following:

(i) Atmosphere (ii) Biosphere (iii) Lithosphere

b. Describe the importance of the atmosphere to living organisms.

5a. Describe the interaction within the outer zones of the Earth.

b. List four possible interactions betweens the four zones.