7

MAJOR LANDFORMS AND THEIR ECONOMIC SIGNIFICANCE

You have learnt in the previous lesson that the landforms found on the earth's surface are the result of interplay between internal and external forces. The soft rocks are easily worn down by these forces. While the relatively harder rocks are not so easily worn down. Therefore, rocks have a great influence on the landforms developed in an area. The internal forces are perpetually elevating the earth's surface and the external forces about which you will study in the next lessons are constantly wearing down such elevations to make ,the surface level. This is how various landforms are formed by constant action of agents of gradation. These landforms are not only the physical features of the earth's surface but also the basis of human civilization. The major landforms found on the earth's surface are mountains, plateaus and plains. In this lesson, we will study the major landforms of the earth and their economic importance for us.

OBJECTIVES

After studying this lesson you will be able to :

- differentiate among the three major landforms found on the earth's surface;
- explain the process of formation of various landforms with the help of illustrations;
- classify mountains on the basis of their mode of formation;
- discuss the usefulness of mountains to man;
- list different types of plateaus and describe their economic significance;

- enumerate major types of plains and explain their influence on human life;
- locate major mountains, plateaus and plains on the outline map of the world.

7.1 MOUNTAINS

Mountain, plateau and plain are broad by present day land features of the earth's surface produced by the deformation of its crust. Among them, mountains are the most awe-inspiring landform. About 27% of the earth's surface is covered by the mountains. Generally, they are uplifted portions of the earth's surface which are much higher in contrast to the surrounding areas. But all uplifted or elevated areas are not mountains. In fact height and slope together give rise to a particular form of land which we identify as a landform. For example, the elevated portion in Tibet, which is about 4500 metres high above sea level, is called a plateau and not a mountain.

It may also be remembered that the formation of a mountain range takes millions of years. During these years, the internal forces of the earth uplifting the land are fighting against erosion wearing it down. In order to form one Mt. Everest, internal forces must push up the land faster than the external forces constantly eroding it. Therefore, mountains are those uplifted portions of the earth's surface which have steep slopes and small summit area rising more than thousand metres above the sea level. Mountains have the maximum difference of height between their high and low portions.

- The uplifted portions of the earth's surface with steep slopes and small summit area rising above 1000 metres and formed over a period of million of years are called mountains.

7.2 CLASSIFICATION OF MOUNTAINS

On the basis of their mode of formation, the mountains have been classified as:

(a) Fold Mountains
(b) Block Mountains
(c) Volcanic Mountains
(d) Residual Mountains

(a) Fold Mountains

We have studied in the last lesson how folds are formed in the rock strata by the internal earth movements. Mountain range mainly consisting of uplifted folded sedimentary rocks are called fold mountains. When these rocks are subjected to horizontal compressional forces for millions of years, they get

bent into up and down folds. This leads to the formation of anticlines and synclines. Such earth movements occur from time to time and lift the folds to a considerable height which result in the formation of fold mountains.

- The mountains which have been formed by the uplift of mainly the folded sedimentary rock strata under compressional forces are called fold mountains.

Fig. 7.1 Distribution of Important Fold Mountains of the World

The Himalayas in Asia, the Alps in Europe, the Rockies in North America and the Andes in South America are the most prominent fold mountains of the world, (See fig. 7.1). Since these mountain ranges were formed during the most recent mountain building period, they are known as young fold mountains. Some of these mountain ranges, for example, Himalayas, are still rising.

(b) Block Mountains

Block mountains are also formed by the internal earth movements. When the forces of tension act on the rocks, they create faults in them. When the land between the two almost parallel faults is raised above the adjoining areas, it forms a block mountain. It may also occur when land on the outer side of the faults slips down leaving a raised block between them. The rocks composing the fault levels may be flatlying or even folded. Block mountain is also called horst (see fig. 7.2). The Vosges in France, Black Forest Mountains in Germany and Sierra Nevada in North America are the typical examples of block mountains.

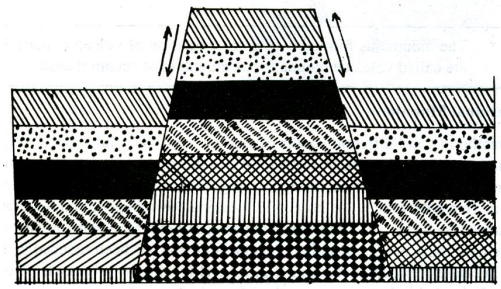

Fig. 7.2 Block Mountain or Horst

- The mountain formed by the uplift of land between faults or by the subsidence of land outside the faults is known as block mountain.

(c) Volcanic Mountains

We have learnt in the previous lesson that the interior of the earth is extremely hot. Due to high temperature deep inside the earth rocks turn into a molten magma. When this molten rock material is ejected to the earth's surface during volcanic eruption, it accumulates around the vent and may take the form of a cone. The height of the cone increases with each eruption and it takes the form of a mountain. As these mountains are formed by the accumulation of volcanic material, they are known as volcanic mountains or mountains of accumulation (see fig.7.3). Mount Mauna Loa in Hawaii Islands, Mount Popa in Myanmar, Vesuvius in Italy, Cotopaxi in Equador and Fuji Yama in Japan are examples of volcanic mountains.

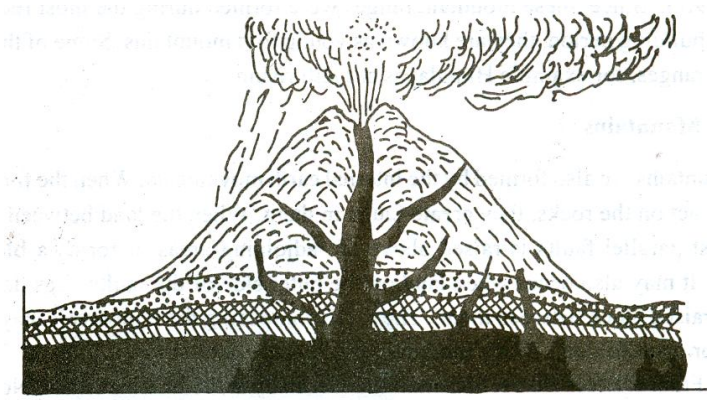

Fig. 7.3 Volcanic Mountains

- The mountains formed by the accumulation of volcanic material are called volcanic mountains or mountain of accumulation

(d) Residual Mountains

The weathering and different agents of erosion – rivers, winds, glaciers etc. are constantly acting on the earth's crust. As soon as an elevated mountain range appears on the earth's surface, the agents of gradation begin their work of leveling it down. To a large extent, the process of wearing down depends on the shape and structure of the rocks. After thousands of years, soft rocks are worn down into sand and the hard rocks are left standing up in the area that has been reduced in height. These are called residual mountains (fig.7.4). Hills like the Nilgiris, the Parasnath, the Rajmahal and the Aravalis in India are examples of residual mountains.

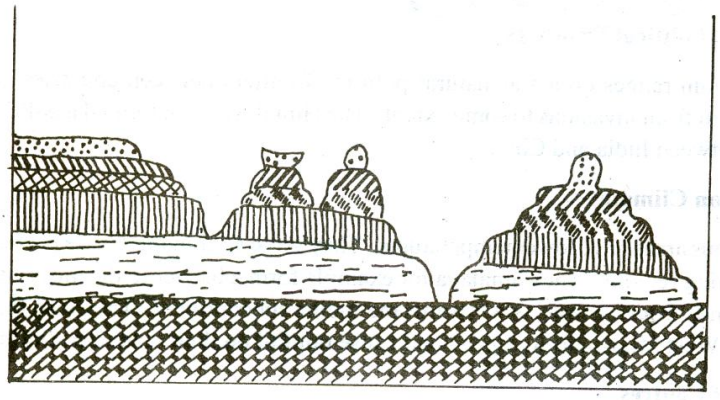

Fig. 7.4 Residual Mountains

- The elevated regions that have escaped weathering and erosion and appear in the form of mountains are called residual mountains.
- On the basis of their mode of formation, the mountains can be classified as Fold Mountains, Block Mountains, Volcanic Mountains and Residual Mountains.

7.3 THE ECONOMIC SIGNIFICANCE OF MOUNTAINS

Mountains are useful to us in the following ways :

(a) Storehouse of Resources

Mountains are the storehouse of natural resources. Large resources of minerals are found in mountains. The Appalachian range in the United States is well-known for coal and limestone deposits. We get timber, lac, medicinal herbs and wood for making pulp from the forests of the mountains. Tea and coffee plantations and some fruits orchards have been developed on mountain and hill slopes.

(b) Generation of Hydro-electricity

Hydro-electricity is generated from the waters of perennial rivers in the mountain regions. The mountainous countries like Japan, Italy and Switzerland, which suffer from the shortage of coal have developed hydro-electricity.

(c) Abundant Sources of Water

Perennial rivers rising in the snow fed or heavily rain fed mountains are the important source of water. They help in promoting the irrigation and provide water for many other uses.

(d) Formation of Fertile Plains

The rivers that originate in the high mountain region bring silt alongwith water to the lower valleys. This helps in the formation of fertile plains.

The great alluvial plain of northern India has been formed by the rivers Ganga, Sutlej and the Brahmaputra.

(e) Natural Political Frontiers

The mountain ranges do act as natural political frontiers between countries and protect them from invasions to some extent. The Himalaya have formed a political frontier between India and China.

(f) Effect on Climate

Mountainous areas have lower temperatures. They serve as climatic divide between two adjoining regions. The Himalaya for example form a barrier to the movement of cold winds from Central Asia towards the Indian subcontinent. They also force the South West Monsoons to ascend and cause rainfall on their southern slopes.

(g) Tourist Centres

The pleasant climate and the beautiful scenery of the mountains have led to their development as centres of tourist attraction. The tourist and hotel industries get an additional encouragement in such regions. Shimla, Nainital, Mussorie and Srinagar are some of the important hill stations of India which attract tourists all over the world.

INTEXT QUESTIONS 7.1

1. Name the three major landforms found on the earth's surface.

   (i)_____ (ii)_____ iii) _____

2. Answer in brief

   (a) From which rock type have the fold mountains been formed?

   _____

   (b) By which forces are the fold mountains formed?

   _____

   (c) Name the four important hill stations of India.

   (i) _____ (ii)_____

   (iii) _____ (iv) _____

3. Write the type of mountain in the brackets:

   (a) The Black forest ( )

   (b) The Nilgiris ( )

   (c) The Fuji Yama ( )

   (d) The Andes ( )

7.4 PLATEAUS

The plateaus cover about 18% of the earth's surface. This landform has a large elevated area on its top unlike a mountain and has nearly even surface out there.Very often rivers or streams cut out deep valleys and gorges in a plateau region. In place of its original smooth topography, it then changes into a disected plateau. A plateau, however remains much higher above the sea level of the nearby areas. Though normally 600 metres above sea level, there are plateau of Tibet and Bolivia, more than 3600 metres above sea level.

A plateau is an elevated area of more or less level land on its top. It has a large area on its top and steep slope on its side.

7.5 CLASSIFICATION OF PLATEAUS

On the basis of their geographical location and structure of rocks, the plateaus can be classified as:

(a) Intermontane Plateaus

(b) Piedmont Plateaus

(c) Continental Plateaus

(a) Intermontane Plateau

The plateau which are bordering the fold mountain range or are partly or fully enclosed within them are the intermontane plateaus (Fig 7.5). Vertical movements raise this extensive landforms of nearly horizontal rocks to thousands of metres above sea level. The extensive and over 4500 metres high plateau of Tibet is one such example. It is surrounded by folded mountains like Himalaya, Karakoram, Kunlun, Tien Shah on its two sides. The plateau of Colorado is another well known example, over one km high into which rivers have cut the Grand Canyon and a series of gorges. The plateau of Mexico, Bolivia and Iran are all other examples of this type.

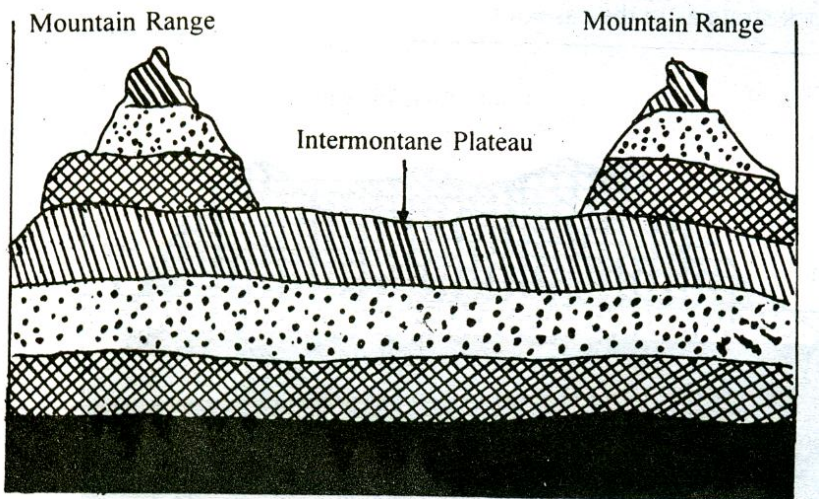

Fig. 7.5 Intermontane Plateau

(b) Piedmont Plateau

The plateaus that are situated at the foot of the mountains and are bounded on other sides by a plain or an ocean are called piedmount plateau Fig. 7.6. The plateau of Malwa in India, those of Patagonia facing the Atlantic ocean and the Appallachian situated between the Appalachian Mountain and the Atlantic Coastal Plain in U.S.A are their examples. In their case, the areas once high have now been reduced by various agents of erosion. For this reason, these are also called the plateaus of denudation.

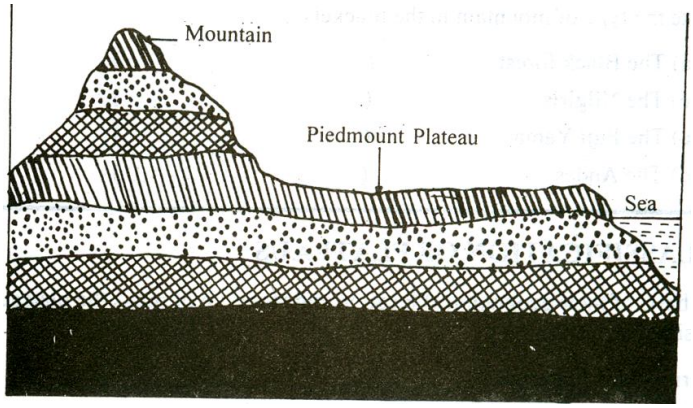

Fig. 7.6 Piedmont Plateau

(c) Continental plateau

These are formed either by an extensive continental uplift or by the spread of horizontal basic lava sheets completely covering the original topography to a great depth. The volcanic lava covered plateau of Maharashtra in India, Snake River Plateau in North West USA are the examples of this type. These are also, called the ptateau of accumulation.

All continental plateaus show an abrupt elevation in contrast to the nearby lowland or the sea (fig.7.7). As compared to other, these plateaus, cover a vast area like the Great Indian Plateau and those of Arabia, Spain, Greenland, Africa and Australia. They may be tilted on one side without any disturbance in the horizontal nature of underlying rock strata as in the case of Great Indian plateau.

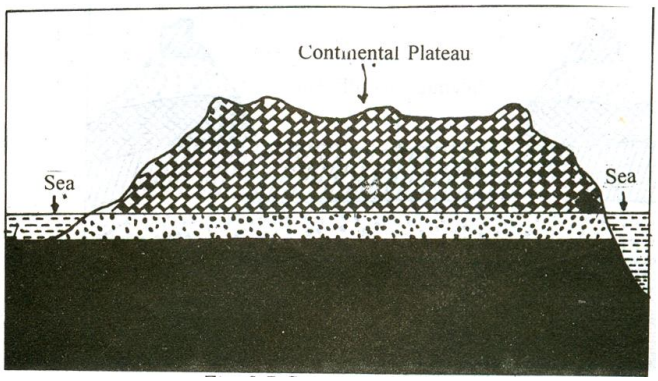

Fig. 7.7 Continental Plateau

- The plateau which are bordering or are enclosed within high mountain ranges are called intermontane plateau.
- The plateaus formed by the uplift of large areas or by the gradual spread and acumulation of basic lava sheets are called continental plateau.
- The plateaus which are situated at the foot of mountains and are bounded by a plain or an ocean on the other side are called piedmont plateaus.

[redacted] the prevalence of a patchy or the slow development of agriculture and building of roads on the plateaus. This factor also explains why the plateaus are sparsely populated. Nevertheless plateaus are extremely useful to mankind in the following ways:

(1) Storehouse of Minerals

Most of the minerals in the world are found in the plateaus. Besides, the extraction of minerals is relatively easier on plateaus. These minerals are indispensable as raw material for our industries. We get gold from the Plateau of Western Australia; copper, diamonds and gold from the Plateaus of Africa and coal, iron, manganese and mica from the Chota Nagpur Plateau in India.

(2) Generation of Hydel-power

Rivers falling down the edges of plateaus form water-falls. These water-falls provide ideal sites for generating hydel-power.

(3) Cool Climate.

The higher parts of the plateaus even in tropical and sub-tropical regions have cool climate. Hence they have attracted Europeans to settle there and develop their economy e.g. South and East Africa.

(4) Useful for Animal-rearing and Agriculture

Plateaus have large grassland areas suitable for animal-rearing specially sheep, goat and cattle. They provide a veriety of products such as wool, milk, meat and hides and skin. The lava plateaus as compared to all other plateau are richer in agriculture since their soil is very fertile.

- Plateaus are useful because of the presence and easier way of extracting minerals and favouring generation of hydro-power. Their suitable climate and sometimes fertile soils are helpful for developing animal-rearing and agriculture.

[redacted]

(a) Name the three types of plateaus.

(i) _____ (ii) _____ (iii) _____

(b) Name three natural resources for which plateaus are well known

(i) _____ (ii) _____ (iii) _____

(c) Write against each of the following the type of plateaus to which it belongs:

(i) The plateau of Patagonia _____

(ii) The plateau of Bolivia _____

(iii) The Decean plateau _____

[redacted]ost important landforms found on the earth's surface. A low-lying relatively flat or slightly rolling land surface with very gentle slope and minimum local relief is called a plain. Plains occupy about 55% of the earth's surface. Most of the plains have been formed by the deposition of sediments brought down by rivers. Besides rivers, some plains have also been formed by the action of wind, moving ice and tectonic activity. Plains have an average height of less than 200 metres.

- A low-lying relatively flat or slightly rolling land surface with very gentle slope and minimum local relief is called a plain.

[redacted], plains can be classified into the following types:

(a) Structural plains,

(b) Erosional plains and

(c) Depositional plains:

(a) Structural plains

These plains are mainly formed by the uplift of a part of the sea-floor or continental shelf. These are located on the borders of almost all the major continents. The south eastern plain of the United States formed

by the uplift of a part of the Gulf of Mexico is an example of this type of plain. The structural plains may also be formed by the subsidence of areas. One such plain is the central low-lands of Australia.

(b) Erosional Plains

These plains are formed by the continuous and a long time erosion of all sorts of upland. The surface of such plains is hardly smooth. These are therefore also called peneplains which means almost a plain. The Canadian shield and the West Siberian plain are examples of erosional plains.

- The plains formed by uplift or subsidence of an area are called structural plains.
- The plains formed by the continuous long term erosion of uplands are called erosional plains.

(c) Depositional plains

Fragments of soil, regolith, and bedrock that are removed from the parent rock mass are transported and deposited elsewhere to make on entirely different set of surface features–the depositional landforms. When plains are formed by river deposits, they are called riverine or alluvial plains. The Indo Gangetic plain of the Indian sub-continent, the Hwang-Ho Plain of North China, the Lombardy Plain of the Po river in Italy and the Ganga-Brahmaputra Delta Plain in Bangladesh are examples of alluvial plains.

The deposition of sediments in a lake gives rise to a lacustrine plain or a lake plain. The Valley of Kashmir and that of Manipur are examples of two most prominent lacustrine plains in India.

When plains are formed by glacial deposits they are called glacial or drift plains. Plains of Canada and North-Western Europe are examples of glacial plains.

When wind is the major agent of deposition, they are called loess plains. Loess plains of North- Western China are formed by the deposits of loess-air-borne fine dust particles.

- depositional plains are formed by the deposition of sediments brought down by rivers, glaciers and winds.
- depositional plains are sub-divided into alluvial, lacustrine, glacial and loess plains.

[redacted]owing ways:

(1) Fertile Soil

The plains generally have deep and fertile soil. Since the plains have a flat surface, the means of irrigation are easily developed. Both these factors have made the plains agriculturally so important that they are often called 'food baskets of the world'.

(2) Growth of Industries

The rich agricultural resources especially of alluvial plains have helped in the growth of agrobased industries. This has given employment to millions of people and has registered a marked increase in the national production and per capita income. Since the plains are thickly populated, plenty of labour is available for the intensive cultivation and for supplying work force for industries.

(3) Expansion of Means of Transport

Since the plains have an even surface it favours the building of roads, airports and laying down of railway lines.

(4) Centres of civilization

The plains have been the centres of many modern and ancient civilizations. The major river valley civilizations of the world have flourished in the plains only. Hencs, they are aptly referred to as the cradles of civilization. For example, there are the civilization of the Indus and the Nile Valley.

(5) Setting-up of Cities and Towns

Easy means of transport on land, the growth of agriculture and industries in plains have resulted in the setting-up and expansion of cities and towns. The most developed trade-centres and ports of the world are found in the plains only. Rome, Tokyo, Calcutta, Yangoon (Rangoon), Varanasi, Paris and other famous cities are situated in the plains. As much as 80% of the world's population lives in the plains.

- Plains are useful to man due to their fertile soils, growth of industries, development of transport, setting up of cities & towns and making them attractive as craddles of human civilisation.

[redacted]

(a) Name the three major types of plains.

(i) _____ (ii) _____ (iii) _____

(b) To which category do the following plains belong?

(i) Lombardy Plain of Italy _____

(ii) The Plain of North-Western China _____

(iii) The Plain of Northern Canada _____

2. Name two civilizations that flourished in the river valleys.

(i) _____(ii) _____.

3. Give two examples of lacustrine plains?

(i) _____ (ii)_____

[redacted]s surface are the mountains, the plateaus and the plains. Besides the structure of rocks, the external and internal forces acting on the earth's surface also play a significant role in the development of these landforms. The landforms on the earth's surface have influenced human life in different ways. Fertile plains have been formed by the rivers originating in the mountains. These rivers are our perennial source of water for irrigation and other purposes. The plateaus are often described as the storehouse of minerals. Many of our major industries are dependent on the constant supply of these minerals. Besides this, the density of population is also influenced by the landforms. The plains including some of the valleys located in the mountain are teeming with people. Compared to the plains, the mountains and the plateaus have an uneven surface that is why they are generally sparsely populated.

[redacted]f mountains found in the world and describe the formation of each type.

2. Describe how plateaus are useful to man.

3. Why are the plains called 'cradles of civilization'?

4. Describe the significance of mountains.

5. Distinguish between the following:

(i) The intermontane plateau and the continental plateau.

(ii) The block mountain and the volcanic mountain.

(iii) The structural plain and the depositional plain.

6. Locate and label the following on the outline map of the world.

   (a) Rockies and Alps mountain ranges;

   (b) Patagonia and Tibetan plateaus;

   (c) Central low land of Australia and Hwang-Ho plains.

1. (a) Mountain (b) Plateau (c) Plain

2. (a) Sedimentary rocks (b) Horizontal compressional force (c) (i) Shimla (ii) Nainital (iii) Mussorie (iv) Sri nagar.

3. (a) Block mountain (b) Residual mountain (c) Volcanic mountain (d) Fold mountain .

7.2

(a) (i) Intermontane plateau (ii) Piedmont plateau (iii) Continental plateau

(b) (i) Mineral resources, (ii) water & soils, (iii) grassland

(c) (i) Piedmont plateau (ii) Intermontane plateau (iii) continental plateau.

7.3

1. (a) (i) Structural, (ii) Erosional and (iii) Depositional

   (b) (i) Alluvial plain, (ii) Loess plain and (iii) Erosional plain

2. (i) The Indus valley civilization (ii) The Nile valley

3. (i) Valley of Kashmir (ii) Manipur plain

HINTS TO TERMINAL QUESTIONS

1. See para 7.2 - classification of Mountains. Give examples of each type of mountain and illustrate your answer with diagram.

2. See para 7.6

3. Expand on the following points-availability of fertile soil, development of means of transport, growth of industries, development of trading centre. Give examples of different civilization which flourished on plains.

4. See para 7.3.

5. (i) See para 7.5 (a) and (c)

   (ii) See para 7.2 (b) and (c)

   (iii) See para 7.8 (a) and (c)

6. See Maps.

4

EVOLUTION OF LANDFORMS DUE TO INTERNAL FORCES

We live on an unstable earth, the surface of which is uneven. While travelling, we come across a variety of landforms such as mountains, hills, plateaus, plains, cliffs and ravines. We also come across tilted, broken and twisted layers of rocks which are originally deposited in horizontal forms. You have already studied about different types of rocks, their formation and characteristics. There is a close relationship between rock types and the shape of landforms. But all deformation on the face of the earth are due to the continuous influence of internal and external forces. In this lesson, we will study about the internal forces deriving their strength from earth's interior and playing their role in shaping what we see on the earth's crust:

OBJECTIVES

After studying this lesson, you will be able to :

- explain the endogenetic forces and the landforms produced by them;
- distinguish between sudden and slow movements;
- differentiate between vertical and horizontal movement;
- differentiate between folding and faulting;
- explain the causes of volcanic activity;
- describe the different types of volcanoes ;
- locate on the outline map of the world, important volcanoes and areas affected by earthquakes;
- explain the causes of earthquakes and their effects.

4.1 INTERNAL FORCES

The variety in the types of land forms on the earth is the end result of two types of forces working simultaneously and continuously both inside and outside on its surface. The forces which originate from within the earth's crust or inside the earth are called internal or endogenetic forces. The sources providing them energy are the internal heat, chemical reactions taking place within the earth, and the transfer of rock materials on the earth's surface by external forces.

4.2 EARTH MOVEMENTS

Though we generally hear people using phrase like "as hard as rock" and "as stable as the earth", but these phrases are not true. Neither the earth is stable nor are the rocks of which its crust is made, are so hard. Since the origin of earth, there have been major changes in the distribution of continents and oceans, the land and the oceans.The earth has experienced innumerable earth movements which have brought about vast changes in its surface. Some of the examples of these movements are submergence of forest in Bombay harbour, the Mahabalipuran temple now standing on the sea and changes in the ground level in Rann of Kuchchh of India.

The forces working from inside the earth in turn cause movements in its crust.These movements are called earth movements. Since, these movements pertain to or rise from, the movements of the actual structure of the earth's crust, they are also called tectonic movements. The word tectonic is derived from the Greek word, "tekton" which means builders. This word is true to its meaning because these are the earth movements which are constructional and have been responsible for buildings of different types of land forms.

From Figures 4.1. (a) and 4.1. (b) it is quite evident that the physiography of India was entirely different about 60 million years ago. The vast Tethys sea existed in that area where the Himalayan ranges and Indo-Gangetic plain exist. The Tethys sea was gradually filled up by the sediments brought by rivers from the surrounding regions. Later, the sedimentary rocks formed in the beds of this sea gradually emerged in the form of the Himalayas in the north and Indo-Gangetic plain to its south.

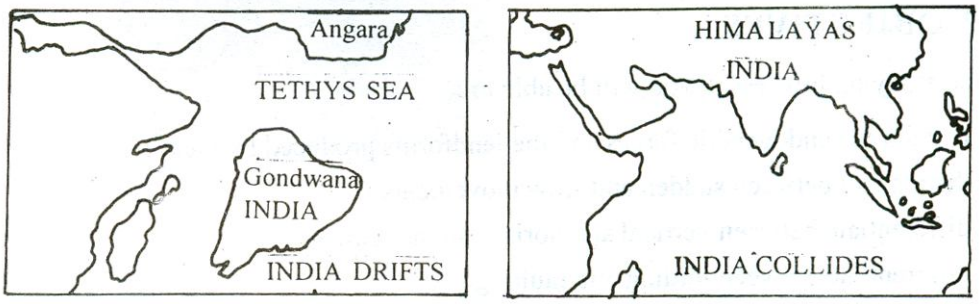

Fig. 4.1 (a) 60 Million Years ago Fig. 4.1 (b) Present configuration

The Malwa plateau and Deccan traps of India, Columbia and Snake Rivers Plateau of North America, Kimberlay Plateau of Australia and Parana and Patagonian Plateaus of South America were also formed by the solidification of molten lava which had escaped from the earth's interior to its surface at different geological times. The evidences clearly show that the surface of our earth never remained the same as it is today and neither it will be the same in future.

- Movements caused by internal or endogenetic forces affecting the earth's crust are known as Earth Movements.
- Earth movements are also called tectonic movements as they help in building the relief features on earth's crust through subsequently or simultaneously undergoing changes.

4.3 CLASSIFICATION OF EARTH MOVEMENTS

The earth movements are classified on various basis. On the basis of time taken by such movements, they are divided into:

(a) slow movement and

(b) sudden movement.

(a) Slow Movement

The movement which bring about changes on the Earth's crust very gradually or slowly taking hundreds or thousands of years and which cover a period much longer than a human life span are called slow movements. These movements act on the earth's crust either vertically or horizontally. Acting vertically, they cause uplift or subsidence of a part of the crust. The raised sea-beaches along the Kathiawar coast of India which contain the shells of marine life clearly point out that this coast was once below the sea level. Similar raised beaches are found In Orissa, Andhra Pradesh, and Tamil Nadu along the eastern coast of India as well. These beaches have been. uplifted to a height ranging between 15 to 30 metres above the mean sea level.

On the other hand there are numerous examples of submergence. Such as the presence of peat and lignite beds found below the sea-level in Sunderban Delta, the submerged forest in Tirunelveli in Tamil Nadu and the submerged forest on the east coast of Bombay Island.

(b) Sudden Movements

Contrary to the slow movements, there are certain movements which bring about abrupt changes in the crust. The examples of such movements are volcanic eruptions and earthquakes. The changes brought about by these two events are so sudden that the courses of rivers undergo a change,

and the lava flow result.in the formation of mountains, uplands and plateaus in a matter of days. Landslides occur in mountainous regions due to these movements.

- Sudden movements bring about abrupt changes on the earth's surface
- Volcanic eruptions and earthquakes are the result of sudden movements
- The movement which bring changes slowly and gradually over a long period of time are known as slow movements.
- Uplift, submergence and subsidence of the earth's crust are the result of slow movements.

INTEXT QUESTIONS 4.1

1. Give geographical term for internal forces

_____

2. What is Earth Movement?

_____

4.4 VERTICAL AND HORIZONTAL MOVEMENTS

The slow movements can further be divided into vertical and horizontal movements on the basis of the uplift or subsidence of a part of the Earth's surface.

(a) Vertical movements

Vertical movements originate from the centre of the earth and affect its surface. Consequently large scale uplift or subsidence of a part of the earth's surface takes place. These movements are slow and wide spread and do not bring changes in the horizontal rock strata. These movements are mainly associated with the formations of continents and plateaus, hence these are also known as continent building or plateau building movements. Besides, these movements are also called epeirogenetic movements. 'Epeiros' in Greek language means 'continent' In the previous lesson on rocks, you have studied that sedimentary rocks are deposited and formed in the oceans and seas. The presence of these sedimentary rocks is wide-spread in continents. This clearly shows that these were uplifted or raised to form continents.

Contrary to the above, there are countless evidences of submerged buildings, river -valleys and cities due to subsidence into the sea. Some of such examples include the submerged ancient buildings in Mediterranean in its Crete Island and the ancient city of Dwaraka in Saurashtra, India. These changes clearly point out the downward movement of the Earth's surface.

- Large scale uplift or subsidence create continents, plateaus and oceans.
- Vertical movements are also known as epeirogenetic movements.

(b) Horizontal Movements

There are forces which act on the earth's crust from side to side i.e. horzontally or tangentially. Naturally, they cause a lot of disruption in the horizontal layer of strata as they do involve a good deal of compression and tension of the preexisting rocks since these forces act horizontally or tangentially to the earth's spherical surface. These are known as horizontal or tangential movements.

We can divide them into two types:

(i) Forces of compression, and

(ii) Forces of tension.

(i) Forces of compression: involve pushing of the rock strata against a hard plane from one side or from both sides. To understand their working, let us take a piece of cloth and spread it on the table. Push the cloth with your both hands towards its centre, it will form wrinkles rising into up and down folds. Likewise rock strata also bend in the same fashion when forces of compression act on them from opposite directions. In this way, the compressional forces lead to the bending of rock layers and thus lead to the formation of fold mountains. In them the rock strata primarily of sedimentary rocks get folded, into wave like structure. This process of bending, sometimes warping and twisting of rock strata is referred to as their folding. The upfolds are called anticlines and downfold are called synclines.(Fig 4.2).

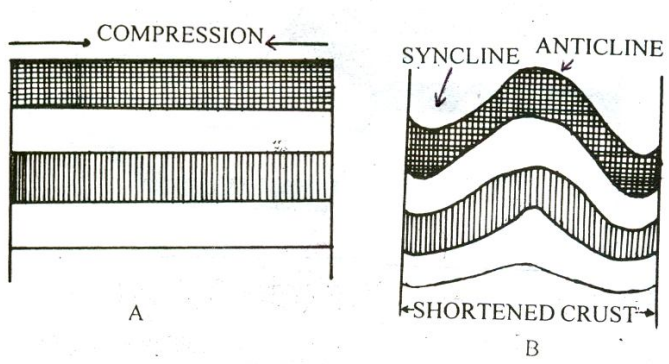

Fig. 4.2 The Earths crust before (A) and after folding (B)

When folding takes place on a gigantic scale, it represents the mountain building process. Most of the great mountain chains of the world viz, the

Himalaya, the Rockies, the Andes, the Alps and others of this sort have been formed by compressional forces resulting in mountain building on a large scale. These are also called Orogenetic Movements.

- Horizontal movements are produced by forces of compression and tension.
- Folding is the bending of rock strata due to compression.
- Upfolds are called anticlines and downfolds synclines.
- Folding on gigantic scale results in mountain building movement generally referred as orogeny.

(ii) Forces of tension: are produced when these forces are working horizontally in opposite directions i.e, away from a given plane or point. Under the operation of intense tensional forces, the rock strata is broken or fractured. As a result cracks and fractures develop. The displacement of rocks upward or downward from their original position along such a fracture is termed as faulting. The line along which displacement of the fractured rock strata takes place is called the fault line. Like wise the plane along which displacement of rock strata takes place is known as fault plane (Fig.4.3)

- Forces of tension produce faults.
- The plane along which displacement of fractured rock strata takes place is called its fault plane.

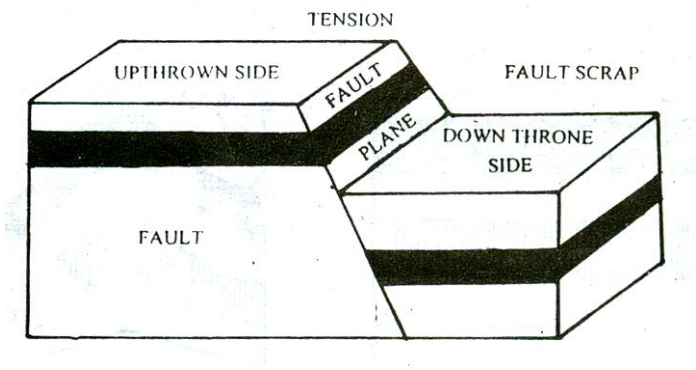

Fig.4.3 A Fault

Forces of compression give rise to the operation of the forces of tension. Thus faults are closely related to the formation and occurrence of folds. It implies that folding generally leads to or is accompanied by fracturing and faulting in rock strata.

Faulting results in the formation of well known relief features such as rift valleys and the block mountains. A rift valley is formed by sinking of rock strata lying between two almost parallel faults. (fig. 4.4). The classical

examples of rift valleys in the world include the Midland Valley of Scotland, the Rhine Valley, the Valley of Nile, the Dead Sea basin and the Great Rift Valley of East Africa comprising few lakes of this region. Some geographers are of the opinion that the Narmada and Tapti valleys are also rift valleys. The coal deposits of the Damodar valley are said to be originally laid in a synclinal trough resembling a rift valley.

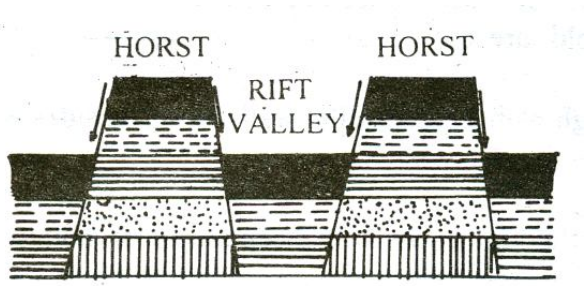

Fig. 4. 4 A Rift valley and Block mountain

A rift valley is a trough with steep parallel walls along the fault lines. Such a valley is also called a graben. A rift valley may also be formed by upliftment of two blocks along the fault line. These uplifted blocks are called horsts or block mountains. The well known examples of horsts are the Vosgesand the Black forest mountains on both sides of Rhine rift valley and the Plateaus of Palestine and Trans Jordan.

The escarpments (escarp/faces see Fig 4.3) are the characteristic features of rift valleys and horsts. They are very steep or have highly precipitous slopes in a continuous line facing one direction. The escarpments of Western Ghats ones looking the Arabian Sea are thought to be the result of faulting. The escarpments of Vindhyachal Mountain are also ascribed to the faulting and formation of narrow Narmada Valley.

- Faulting leads to the formation of rift valleys, horsts and escarpments.
- A rift valley is a trough with steep parallel walls along the fault line.
- A horst is a uplifted land mass with steep slopes on both the sides.
- An escarpment is a very steep slope in a continuous line along a fault.

INTEXT QUESTION 4.2

1. Name the earth movements caused by forces of compression.

2. Give geographical term for mountain building movements.

4.5 VOLCANOES

Have you ever seen an active volcano. Even if you have never seen a volcano, you have probably seen pictures or films of erupting volcanoes. These conical forms are one example of the land forms we will study in this chapter.

A volcano is a vent or an opening in the earth's crust through which molten rock material, rock fragments, ash, steam and other hot gases are emitted slowly or forcefully in the course of an eruption. These materials are thrown out from the hot interior of the earth to its surface. Such vents or openings occur in those parts of the earth's crust where rock strata are relatively weak.

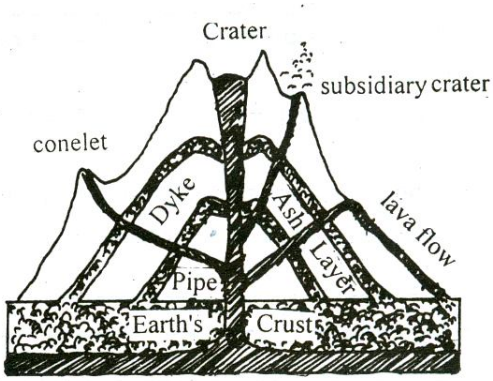

Fig. 4.5 A Volcanic Cone

You may be wondering why such eruptions take place. Actually, vo1canoes are evidence of the presence of the intense heat and pressure existing within the earth. Hot molten rock materials beneath the solid outer crust is known as magma. When this magma is thrown out from the magma chamber to the earth's surface it is known as lava (Fig 4.5). The magma and the gases stored within the earth's surface keep trying to come out to the surface through a line of weakness anywhere in the crust. The tremendous force created by magma and its gases creates a hole in the crust and the lava spreads out on the surface along with ash and fragmented rock material. The process by which solid liquid and gaseous materials escape from the earth's interior to the surface of the earth is called vulcanism.

- A volcano is an opening in the earth's crust through which molten rock material are thrown out slowly or forcefully depending upon the force of eruption.
- The cause of volcanic eruption is the excessive pressure exerted by the magma and hot gases on the earth's crust.

- The process by which solid, liquid and gaseous materials escape from the earth's interior to its surface is known as Vulcanism.

The volcanic materials accumulate around the opening or hole taking the form of a cone. The top of the cone has a funnel shaped depression which is called its crater (Fig 4.5).

(A) TYPES OF VOLCANOES

Volcanoes are classified on the basis of the nature of vulcanism. The basis include the frequency of eruption, mode of eruption or fluidity and the manner in which volcanic material escapes to the surface of the earth.

On the basis of the frequency of eruption, volcanoes are of three types:

(i) Active

(ii) Dormant and

(iii) Extinct.

The volcanoes which erupt frequently or have erupted recently or are in action currently are called active volcanoes. Important among these include Stromboli in Mediterranean, Krakatoa in Indonesia, Mayon in Philippines, Mauna loa in Hawai Islands and Barren Island in India. The volcanoes which have not erupted in recent times are known as dormant volcano. They are as such the 'sleeping volcanoes'. Important among these are Vesuvious of Italy, Cotopaxi in South America.

Contrary to these two, there are volcanoes which have not erupted in historical times. These are called extinct volcanoes. Mount Popa of Myanmar (Burma) and Kilimanjaro of Tanzania are important extinct volcanoes. It is not, always very simple to categorise a volcano as dormant or extinct. For example the Vesuvious and Krakatoa became suddenly active after lying dormant for hundreds of years.

- On the basis of the frequency of eruption, volcanoes are classified into active, dormant and extinct volcanoes.
- Active volcanoes are erupting currently or have erupted recently.
- Dormant are those volcanoes which have erupted at least once in human history and are not active now.
- Extinct volcanoes are those which have not erupted during long human history.

On the basis of mode of eruption, volcanoes are divided into two types:

(i) Central type of volcanoes and

(ii) Fissure type volcanoes

When the eruption in a volcanoe takes place from a vent or a hole, it is called a central type of volcano. Different types of domes or conical hills are formed by this type of erruption depending on the nature of erupted materials. Majority of volcanic eruptions in the world are of this type. The other characteristic of this mode of eruption is that it is marked by violent explosion due to sudden escape of gases and molten rocks through the hole. Visuvious and Fuji-yama belong to this group of volcanoes.

Sometimes, deep elongated cracks develop due to earthquakes or faulting. The magma starts flowing through them quietly. This mode of eruption is called fissure type of eruption. This eruption helps in the formation of thick horizontal sheets of lava or a low dome shaped volcano with broad base. It may also form what are identified as lava plateaus, and lava shields, Deccan Traps of India is one example of fissure type of eruption.

- Central type of volcanoes erupt from a vent or hole and result in the formation of a conical hill.
- Fissure type of volcanoes erupt through a crack or fissure and cause formation of plateaus and shields.

On the basis of the fluidity of lava there are two types of volcanoes :

(i) Volcanoes of basic lava and

(ii) Volcanoes of acid lava.

Since the basic lava is rich in metalic minerals and has a low melting point, it has greater fluidity. In this type of eruption, lava flows far and wide quietly with greater speed and spreads out in thin sheets over a large area. Thus, it leads to the formation of shields and lava domes. The shield volcano of Hawaian Island in Pacific ocean is one of these volcanoes.

Contrary to basic lava, acid lava is rich in silica and has a relatively high melting point. Therefore: it is highly viscous and solidifies quickly. Hence, the, acid lava volcanoes cause the formation of usually higher land features with steeper slopes. Acid lava cones are of steeper slopes than basic lava shields. (Fig. 4.6).

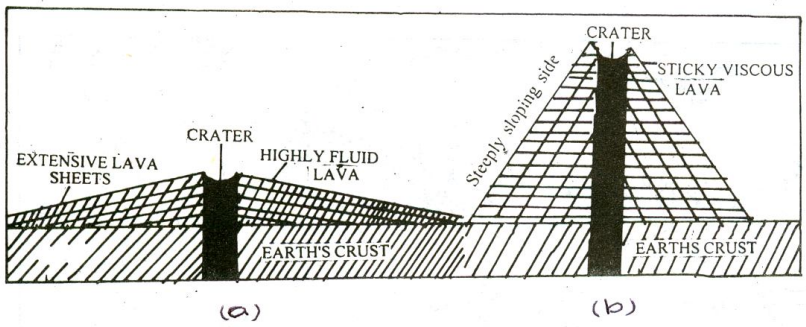

Fig. 4.6 (a) Basic lava shield (b) Acid lava cone

Notes

- Basic lava is highly fluid and flows readily and extensively. It causes the formation of shields.
- Acid lava is highly viscous. This type of eruption of steep sided cones.

(B) DISTRIBUTION OF VOLCANOES

There are about 500 volcanoes in the world. Most of these volcanoes are found in three well defined belts, The Circum-Pacific belt, the Mid-World Mountain belt and the African Rift Valley belt. Thus, volcanoes are closely related to the regions of intense folding and faulting. They occur along coastal' mountain ranges, on islands and in the mid-oceans. Interior parts of continents-are generally free from their activity. Most of the active volcanoes are found in the pacific region. About 83 active volcanoes are located in Mediterranean region (Fig. 4.7).

Circum-Pacific region has the greatest concentration of volcanoes, that is why, it is called 'Pacific Ring of Fire', This ring extends along Andes mountains of south America to Alaska and from the Aleutian Islands to Japan, Philippines, Indonesia to NewZealand.

The Mid-world mountain belt occupies the second position with regard to the numbers of volcanoes. It runs from Alps in Europe to Asia Minor and crossing through Himalayan region joins the Circum-Pacific belt. The African rift valley region ranks third. Most of the volcanoes are extinct here. Mt. Cameroon is the only active volcano which is situated in Central West Africa.

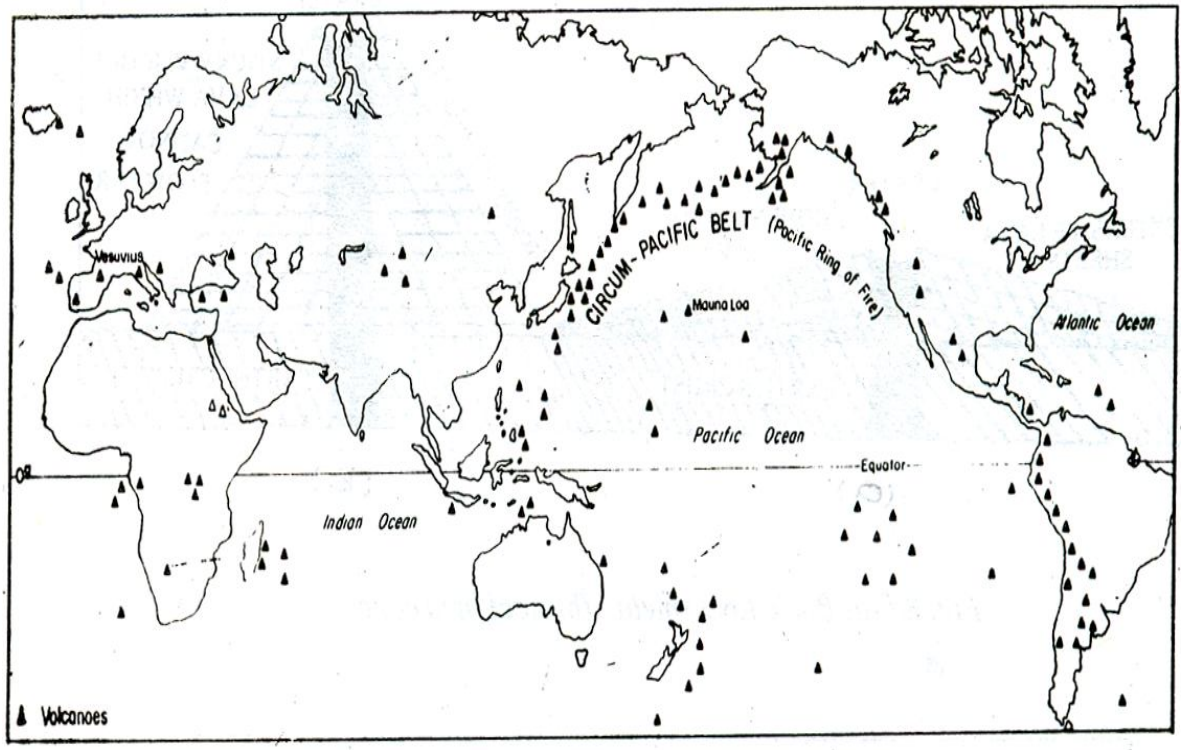

Fig. 4.7 The Distribution of Volcanoes

- There are about five hundred volcanoes in the world. They are located in three well defined belts namely the Circum-Pacific, the Mid World Mountain and East African Rift Valley belts.
- Most of the active volcanoes are located in Circum-Pacific belt which is known the Pacific Ring of Fire.

INTEXT QUESTIONS 4.3

1. Answer the following questions:-
   (i) Name the process by which magma is ejected out of the earth's interior
   _____
   (ii) Name three types of volcanoes on the basis of the frequency of eruption.
   (a) _____(b)_____(c)_____
   (iii) Name two types of volcanoes on the basis of the mode of eruption
   (a)_____ (b) _____
   (iv) State two types of lava on the basis of their fluidity
   (a)_____ (b) _____

4.8 EARTH QUAKE

You have probably seen television news accounts of disastrous earthquakes and destruction caused by them. An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking building apart. The earthquake is a form of energy of wave motion transmitted through the surface layer of the earth.

All the earthquakes are not of the same intensity. Some of them are very severe, others are very mild and still others are not even noticed. Major or strong earthquakes are only a few. Though our earth experiences many earthquakes everyday, however the frequency of earthquakes varies largely from place to place. The network of seismographic stations all over the world records dozens of earthquakes every day. But, occurrence of severe earthquakes is limited to a few regions. The instrument used for recording the earthquakes is known as seismograph. 'Sesamos' is a Greek word which means an earthquake.

The point within the earth's crust where an earthquake originates is called the focus. It is also referred as seismic focus. It generally lies within the depth of 60 kilometres in the earth crust.

The point vertically above the focus on the earth's surface is known as 'epicentre'. The impact of the earthquake is carried from the point of its origin by earthquake waves. These earthquake waves originating from the focus travel in all directions. But their intensity is the highest at the epicentre That is why the maximum destruction occurs at and around the epicentre. (Fig 4.8). The intensity of vibrations decreases as one moves away from the epicentre in all directions.

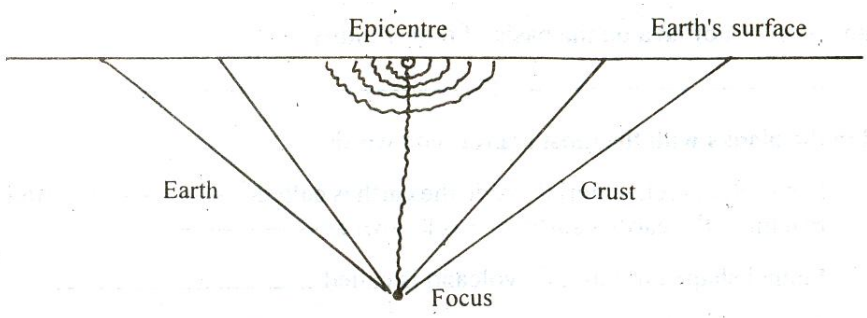

Fig 4.8 Focus and epicentre of an earthquake

- An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings apart.
- A seismograph is an instrument used for recording earthquakes.
- Focus is the point within the earth's crust where the earthquake originates.
- The epicentre is the point on the earth's surface vertically above the focus.

(A) CAUSES AND EFFECTS OF EARTHQUAKES

Folding, faulting and displacement of rock strata are the main causes of earthquakes. Some examples of this type of earthquakes are the San Francisco earthquakes of California in 1906, the Assam earthquakes of 1951, the Bihar earthquakes of 1935.

The second important cause lies in the plenomenon of volcanic eruption. The violent volcanic eruptions put even the solid rocks under great stress. It causes vibrations in the earth's crust. But, these earthquakes, are limited to the areas of volcanic activity. Its important example is the earthquake which continued for six days preceeding the eruption of Mauna Loa volcano of Hawaii Island in 1868.

Minor earthquakes often accompany or are the result of landslides, seepage of water causing the collapse of the rocks of cavern or underground mines and tunnel. These are least damaging earthquakes.

Violent earthquakes are generally very disastrous. They may themselves cause land-slides, damming of river course and occurance of floods, and sometimes, the depressions leading to the formation of lakes. An earthquake often forms cracks and fissures in the earth's crust. It changes the drainage system of an area as was witnessed in Assam after its 1951 earthquake. Earthquakes also

cause vertical and horizontal displacement of rock strata along fault line. They prove most catastrophic and devastating when they cause fires and seismic sea waves. Such tidal waves are called Tsunamis. These waves may wash away coastal cities. Buildings and bridges collapse causing death of the thousands of people. Lines of transport, communication and of electric transmission get disrupted. The after effect of earthquake is spread of epidemics like cholera.

(B) DISTRIBUTION OF EARTHQUAKES

The occurrence of earthquake is a phenomenon of almost every part of the world. But, there are two well-defined belts where they occur more frequently. These belts are the Circum-Pacific belt and the Mid-world mountain belt.

The first belt i.e., the Circum Pacific comprises the western coast of North and South America; Aleutian Islands and island groups along the eastern coasts of Asia such as Japan and Philippines. As it encircles the Pacific Ocean from end to end, it is named as such. The earthquakes in this belt are associated with the ring of mountains and volcanoes. It is estimated that about 68 percent of earthquakes of the world occur in this belt alone.

The second belt-extend from Alps with their extension into Mediterranean the Caucasus and the Himalayan region and continues into Indonesia. About 21, percent of total earthquakes of the world originate in this belt. Remaining 11 percent occur in the other parts of the world.

- Most of the earthquakes of the world occur in two belts namely the Circum Pacific and Mid world mountain belts.

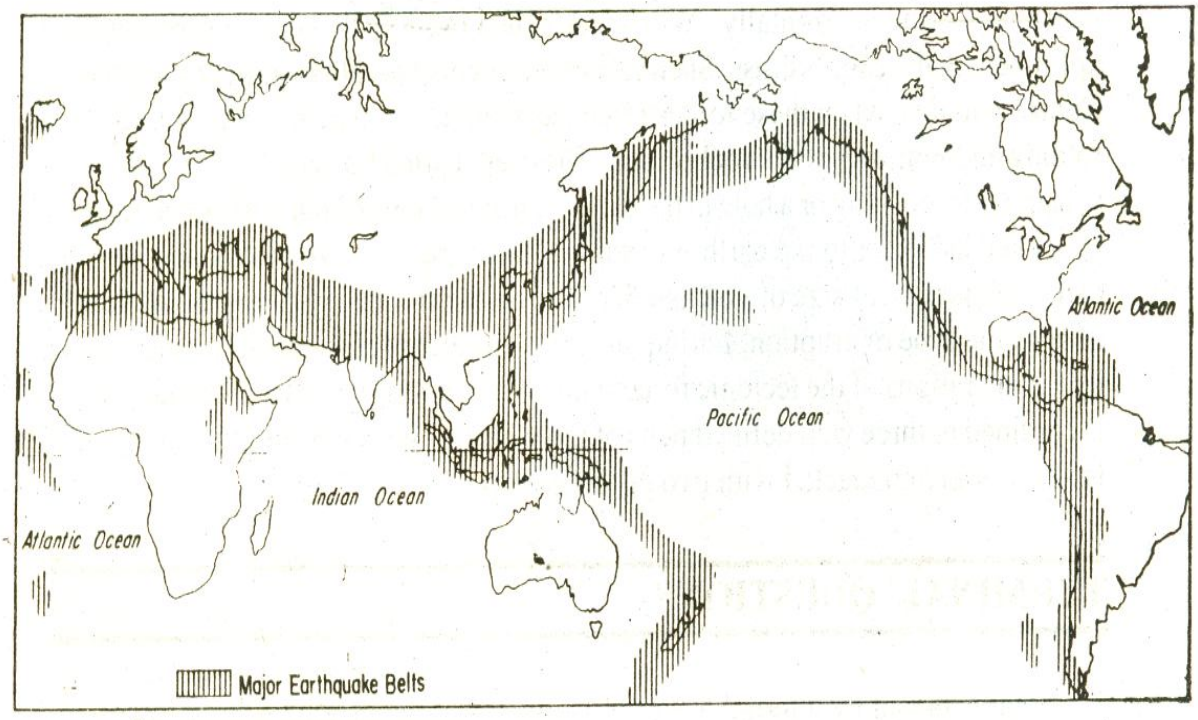

Fig. 4.9 Major Earthquake Belts

INTEXT QUESTIONS 4.4

1. Define is earthquake?

   _____

2. Which instrument record the earthquake waves?

   _____

3. Define 'Focus'.

   _____

4. How is 'Tsunami' caused ?

   _____

WHAT YOU HAVE LEARNT

Land forms of different types present on the earth's surface are the result of continuous work of both internal and external forces. Internal forces are responsible for creating inequalities in altitudes of different relief features. These forces originate in the interior of the earth. They are also known as endogenetic forces. These forces cause movements of the earth's crust which are called earth movements. Slow movements bring slow and gradual changes in the relief features while sudden movements bring abrupt and rapid changes. Internal forces affect the earth into two way radially and horizontally. When they affect radially they cause subsidence or upliftment of the earth's crust. Such earth movements are called vertical movements. Contrary to this; when these forces affect horizontally or side to side, they result in folding and faulting of the rock strata. These are called horizontal movements. Volcanoes are landforms marking the eruption of lava at the earth's surface. The shape and size of volcano depends on the frequency of eruption, fluidity of lava and type of eruption. Earthquakes are vibrations of the earth's crust cause by the operations of the tectonic forces and. volcanic activity. The volcanic activity is confined to three well defined belts of the world. The occurrence of earthquakes is also closely connected with two of these belts.

TERMINAL QUESTIONS

1. What is meant by internal forces? List causes of the origin of these forces.
2. Give four examples to prove that the earth's crust is unstable.
3. Draw diagrams to show
   (i) Displacement of rock strata along a fault plane,
   (ii) Anticline and synclines of rock strata.
4. Differentiate between vertical and horizontal movements.
5. Distinguish between folding and faulting.

6. What is a volcano? Describe different types of volcanoes with examples.
7. Distinguish between acid and basic lava and land forms developed by each of them.
8. What causes an earthquake?
9. List the effects of earthquakes on earth's surface.
10. Define the following terms:

    (a) Fault plane (b) Central type eruption (c) Fissure type eruption (d) Dormant volcano.

11. Locate and label the following in the outline map of the world :

    (a) An active volcano in India (b) A volcanic plateau in south America. (c) A rift valley in Europe (d) An extinct volcano in Myanmar (e) An extinct volcano in Africa (f) A volcano in Hawaii island.

ANSWER TO INTEXT QUESTIONS

4.1

1. Endogenetic forces
2. Movement caused by internal forces affecting the earth's crust are known as 'Earth Movement'.

4.2

1. Horizontal movements 2. Orogenetic movements

4.3

l. (i) Vulcanism (ii) (a) Active (b) Dormant (c) Extinct (iii) (a) Central type (b) Fissure type (iv) Basic lava (b) Acid lava

4.4

1. An earthquake is a motion of ground surface, ranging from a fain tremor to a wild motion capable of shaking building apart.
2. Seismograph
3. This point within the earth's crust originate of called the 'Focus'.
4. The seismic sea waves which originate due to earthquake in octaves, are called 'Tsunami'.

HINTS TO TERMINAL QUESTIONS

1. Refer to Section 4.1

2. Refer to Section 4.2
3. Refer to Figure 4.1
4. Refer to Section 4.4
5. Refer to Section 4.4 (b) (i) and (ii)
6. Refer to Section 4.5
7. Refer to Section 4.6
8. Refer to Section 4.6
9. Refer to Section 4.6 (A)
10. (a) The plane along which displacement of rock strata takes place is known as fault plane.

    (b) When the eruption in a volcano takes place from a vent or hole, it is called central type eruption

    (c) When the eruption takes place through deep elongated cracks, it is known as fissure type eruption

    (d) The volcanoes which have not erupted in recent times is known as dormant volcano.
11. Refer Maps.