# FYBA

# GEOGRAPHY PAPER - I

# SEMESTER - I

# PHYSICAL GEOGRAPHY

# SUBJECT CODE : UBA 1.27

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**December 2020, F.Y.B.A. Geography, Paper - I, Physical Geography**

**Published by** : **Director Incharge**
Institute of Distance and Open Learning ,
University of Mumbai,
Vidyanagari, Mumbai - 400 098.

DTP composed by : Ashwini Art's
Guru Krupa Chawl, M.C.Chagla Marg, Bamanwada,
Vile Parle (East), Mumbai - 400 099.

**Printed by** :

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# Unit - 1

## UNDERSTANDING GEOGRAPHY

**Unit Structure:**



## 1.0 OBJECTIVES :

Module 1 is on Understanding of Geography will help the student:

- Will help them to understand through various definitions how different scholars have perceived geography.
- To realize the scope and importance of the Physical and Human Geography.
- To study various branches of physical, human and interface geography.
- To understand the spatial distribution of physical and human phenomenon on the earth's surface.
- To study various aspects of earth's interior.
- To know about earthquake and its waves.
- To understand how and where the land and water is distributed on the earth's surface in the world.

## 1.1. INTRODUCTION:

Geography is a fundamental science that helps us to understand our physical environment with its elements and

components forming a complex structure of the earth which is the only habitable planet in the solar system. Geographers study the factors responsible for spatial distribution and variation of people, places with their locations. Physical geographers explain the phenomenon of evolution of landforms, tectonic movements, weather and climate, ocean characteristics and properties, flora and fauna. Human geographers explain the interrelationship between man and his physical environment. Interface geographers study various physical and human aspects in the form of their interaction and interrelation. The study of the earth system with specific approaches by geographers has therefore developed specialized branches of geography.

## 1.2. **DEFINING GEOGRAPHY:**

Geography is related to the distribution of various features natural or man-made on the surface of the earth. A Greek scholar Eratosthenes was the first to coin the term Geography derived from the two Greek words i.e. 'Geo' means 'earth' and 'graphe' means description. Geography is thus a description of earth's surface and the entire phenomenon appearing on it. However different scholars have defined geography as per their view point. Some of these are as follows:

i) According to Richard Hartshorne 'Geography is a discipline that seeks to describe and interpret the variable character from place to place of the earth as the world of man'.

ii) According to Bowman 'Geography tells what is where, why and what it is made of'.

iii) Vidal de la Blache defines Geography as the science of places.

iv) As per Griffith Taylor opinion 'Geography is the correlative science'.

v) According to David Harvey 'Geography is concerned with the description and explanation of the areal differentiation of the earth's surface'.

**Check your progress:**

Q.1) How is geography viewed by different geographers?

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## 1.3. NATURE AND SCOPE OF GEOGRAPHY:

Geography is one of the important subjects of understanding the spatial science of the earth in relation with the components of physical and human aspects. Physical Geography as a science studies the earth's surface and its characteristics representing spatial relationships and varying regional patterns. It thus includes:

- The land surface and its features (Lithosphere)
- The water surface and its characteristics (Hydrosphere)
- Gaseous envelop surrounding the earth (Atmosphere)
- Living organisms in the environment (Biosphere)

Scope of Geography: Maps form an important aspect of explaining the spatial phenomenon of the earth. Geographical Information System (GIS) is an advanced Computer Software programme useful in almost all disciplines in the economy of the world. Geography covers many of the physical and human branches in General knowledge and is one of the compulsory paper in any competitive examination like MPSC, UPSC. Nearly 50-60% graduates, prefer Geography as special subject for these exams because Geography it deals with physical and human phenomenon of day to day to life and so relatively easy to understand and score marks in these competitive examinations. Besides, Geography is one of the popular subjects at B.Ed. Colleges. Geography students can get better opportunities in Tourism, town planning, teaching etc. Geography as a subject therefore offers wide and diverse employment opportunities in their career.

Human geography studies the patterns of human activities in an environment. It includes human, political, cultural, economic aspects of social sciences. Human geography studies various activities in relation to its physical components and involves quantitative and qualitative data for analysis. Human geography is studied with the help of thematic maps giving location and other attributes of the phenomena under study. For example distribution and pattern of rural and urban settlements transport and communication lines etc. in any area (Figure 1.1)

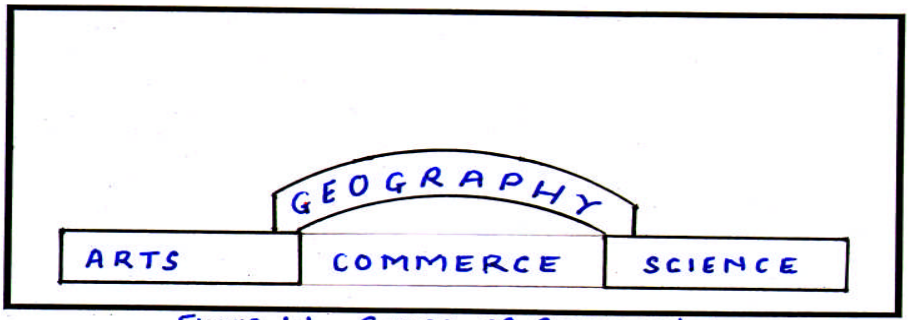



**Figure 1.1 Scope of Geography**

**Check your progress:**

Q.2) Explain in brief the nature and scope of geography?

Physical geography undertakes the study of the earth with its four major components viz:

a) Lithosphere,
b) Hydrosphere,
c) Atmosphere, and
d) Biosphere.

All these four components with their varying spatial and temporal aspects have produced different characteristics features on the earth. This is well identified / observed by spatial distribution of different phenomenon on the surface of the earth. For example distribution of relief features natural vegetation, birds and animals, human population etc. However all these phenomenon are unevenly distributed on the earth surface.

## 1.4. BRANCHES OF GEOGRAPHY

Branches of Geography

| A. Physical Geography | B. Human Geography | C. Interface Geography |
|---|---|---|
| 1) Astronomical Geog. | 1) Population Geog. | 1) Thematic Cartography |
| 2) Geomorphology | 2) Settlement Geog | 2) Computer cartography |
| 3) Climatology | 3) Economic Geog | 3) Remote Sensing |
| 4) Oceanography | 4) Regional Geog | 4) Quantitative Geog |
| 5) Hydrology | 5) Cultural Geog | 5) Geography of Health |
| 6) Biogeography | 6) Historical Geog | 6) Environmental Geog. |
| 7) Soil Geog | 7) Political Geog | 7) G.I.S.(Geographical Information System |

**A. Physical Geography**: Following are the branches of physical geography.

1) **Astronomical Geography**: is the part of mathematical geography that treats the earth in its relation to the other celestial bodies in the solar system. Astronomical geography

thus studies the earth as a planet with its shape, size, imaginary lines of latitude and longitude, time zones, and the earth's diurnal and annual motions (yearly calendar and seasons) (Figure 1.1.a)

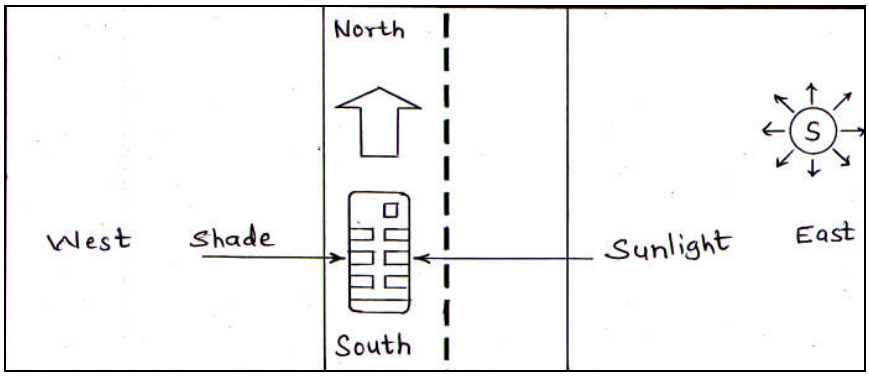



**Figure 1.1a Importance / Relevance of Geography**

2) **Geomorphology**: According to Bloom 'Geomorphology is a systematic description and analysis of landscapes and the processes that change them (Figure 1.2)

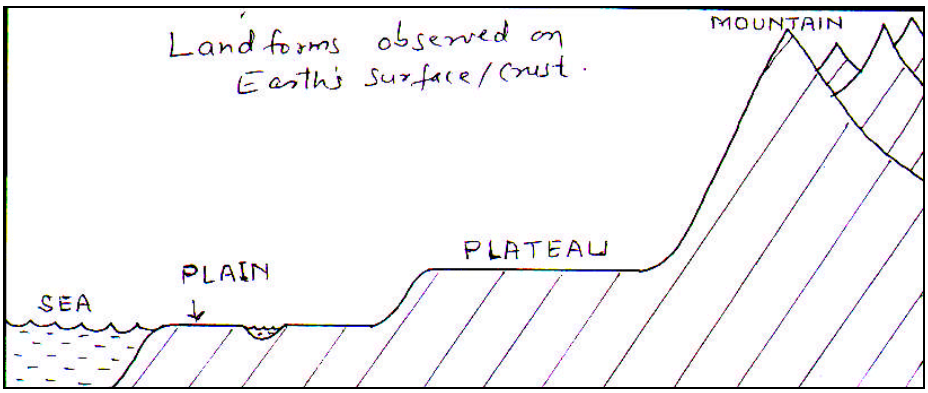



**Figure 1.2 Geomorphology**

3) **Climatology:** According to Miller 'Climatology is the aggregate study and analysis of climatic conditions with long term keen observations'. Climatology is thus a e science which deals with the atmosphere various changes that take place in the atmosphere due to temperature, humidity and atmospheric pressure and so the formation of various climatic zones on the earth and their influence on the natural environment (Figure 1.3.)

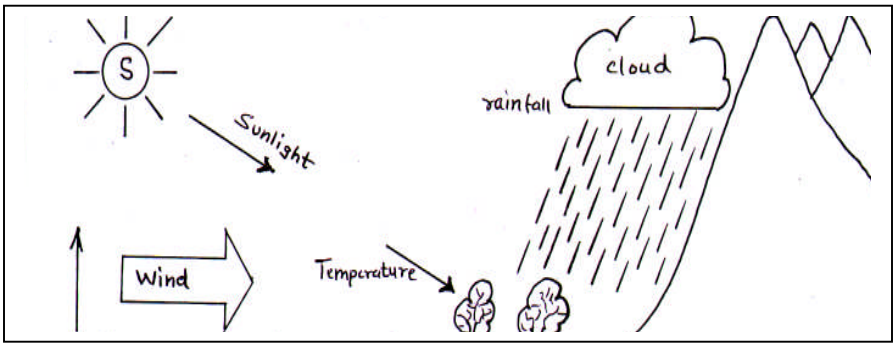



**Figure 1.3**

4) **Oceanography**: According to J. Proudman Oceanography studies the fundamental principle of dynamics and thermodynamics in relation to the physical and biological properties of the sea water. It is related to the study of oceans i.e. temperature, salinity of the ocean water, relief of the ocean floor, movements of the ocean water, tides, ocean currents etc. ( Figure 1.4.)

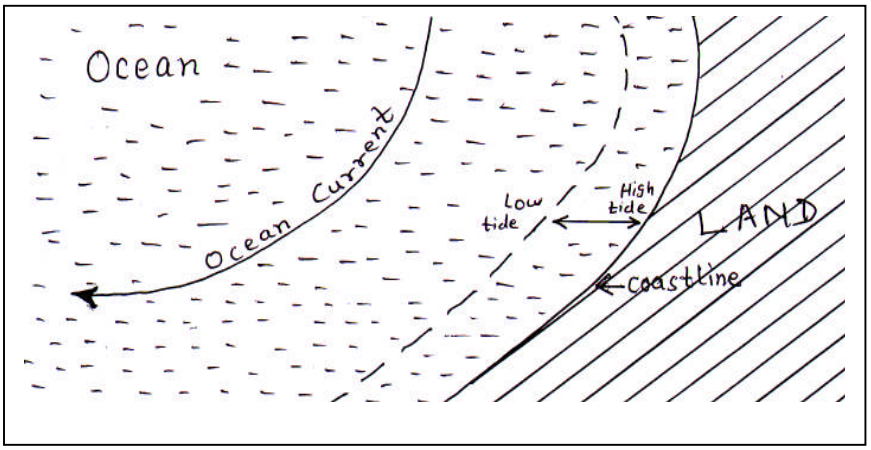



**Figure 1.4 : Oceanography**

5) **Hydrology**: It is a study of earth's surface and subsurface water bodies found in the form of oceans, rivers, glaciers, lakes and seas, underground water, water vapour in the atmosphere.

6) **Biogeography:** It is a study of factors responsible for evolution and spatial uneven distribution of various species (plants and animals / flora and fauna) found on the earth.(Figure 1.5.)

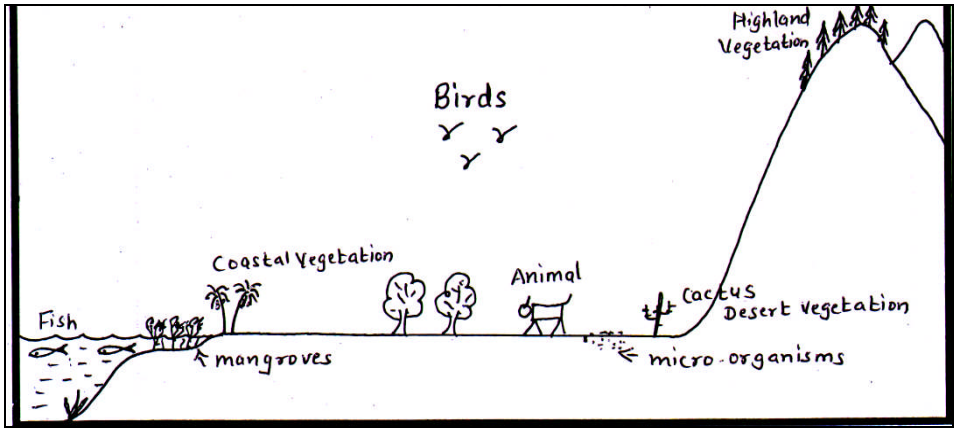



**Figure 1.5 : Bio-geography**

7) **Soil Geography**: It helps to understand the formation, its nature (structure and texture), types and distribution on the earth. Soil is the most important component of the earth that determines the growth and distribution of natural vegetation and thus the species associated with it (Figure 1.6.)

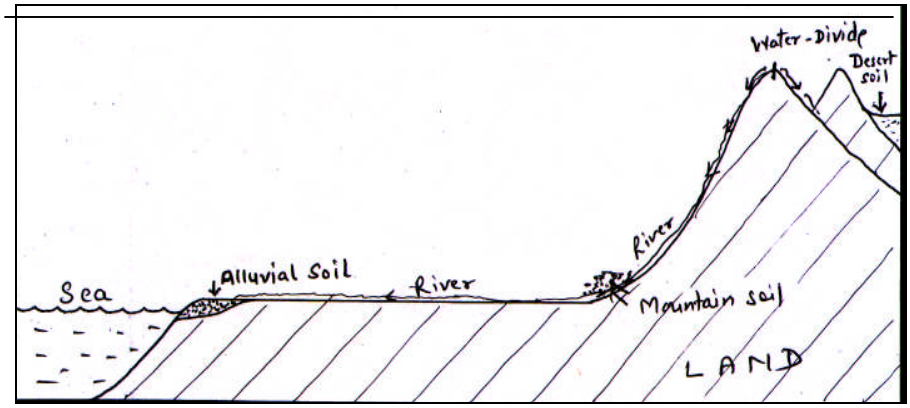



**Figure 1.6 : Soil Geography**

**B. Human Geography**: Following are the branches of Human Geography:

**1) Population Geography:** is a branch of geography that studies factors responsible for various patterns of spatial distribution and location of population on the earth's surface. It studies various demographic aspects of human population explaining growth of population, structure and occupation of population and other socio-socio cultural aspects.

**2) Settlement Geography:** Settlement geography explains the evolution and growth of rural and urban settlements in relation to

their site and situation; their structure and pattern, nature of functions. (Figure 1.7)

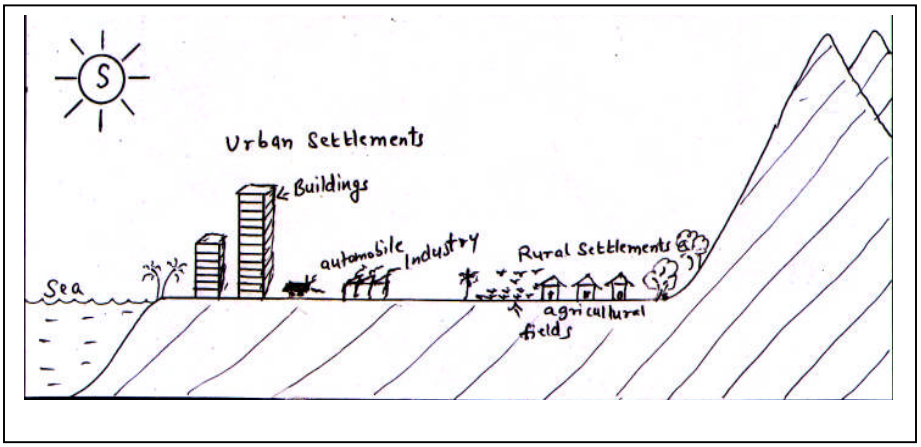



**Figure 1.7 : Settlement Geography**

**3) Economic Geography:** This branch explains us about spatial distribution and concentration of different types of economic activities influenced by physical factors and practiced by man based on their locational attributes. Accordingly they can be classified as:

i) **Primary activities**: e.g. Food gathering and hunting, agriculture, fishing, mining and quarrying.

ii) Secondary activities: e.g. Manufacturing and construction activity.

iii) Tertiary activities: e.g. Trade, Transport and Communication.

iv) Quaternary activities: e.g. activities related to specialist service providers such as banking and insurance, administrative and educational, defense and security, legal and medical.

It is noticed that large population engaged in primary activities are concentrated in underdeveloped countries while in developed countries they are concentrated more in secondary and tertiary activities, quaternary services.

**4) Regional Geography:** is a branch of geography that takes into account the homogeneous physical characteristics of an area to designate it as a region. Thus various regions are formed by taking into consideration its climate, relief, drainage, natural vegetation and population that determines unique characteristics for forming a particular region. For example Monsoon region based on climate, Himalayan mountainous region based on relief, coastal region based on coastal location, river plain of Indus and Ganga river basin, savanna region based on grassland, Amazon region based

on forest, demographic regions based on population characteristics for example density of population etc.

**5) Cultural Geography:** studies various traditional customs and traits of a community which is reflected in their life-style, dressing pattern, food- habits, religious rituals and ceremonies, fairs and festivals, arts and architecture, language, and the type of occupation practiced by them and the nature of governance over the space. For example in terms of festivals it can be said that Christmas of Christian community, Diwali of Hindus, Id of Muslims, Buddha Jayanti of Buddhists, Mahavir jayanti of Jains etc. In case of architecture Moghul architecture of Moghuls, Gothic architecture of Britishers, Dravidian architectural style of south Indian, Hoysala architectural style of Indo-aryan, Stupas and Pagodas architecture of Buddhist etc. This spatial distribution and variation of different cultures are studied as cultural regions in this branch of geography which have evolved over a period of time due to different experiences, need and interactions. The culture of man has thus changed with changing time and technology that can be identified as a nomadic primitive man practicing hunting and food-gathering, to a cultivator developing permanent rural settlements; manufacturer, trader, transporter that developed urban settlements. All this has influenced to some extent the traditional culture of each society.

**6) Historical Geography:** is a branch of geography that takes into account the geographical and human factors and processes responsible for the happening of different historical acts and events in the space over a period of time.

**7) Political Geography:** is a branch of geography that studies the organization of political system in a country. It mainly deals with its jurisdiction (boundaries and frontiers) and nature of relationship with neighboring and other countries in the world. The functioning of the political system determines the stability/ instability of the government and its power within and outside the country in the world.

**C. Interface Geography**: Following are the branches of Interface Geography:

1) **Thematic Cartography**: is a science of preparing maps and diagrams involving field survey with specific themes representing the spatial distribution of the phenomenon under study; for example spatial distribution of population density in the world, distribution of rainfall etc.

2) **Computer Cartography**: Thematic maps and graphs prepared by adopting quantitative and qualitative data analysis using specialized software's in a computer are called as computer

cartography. Computer cartography has provided ease by saving time, cost and energy while producing different spatial dimension of maps / diagrams.

3) **Remote Sensing**: Remote sensing may be defined a collection of data bout an object from a distance. For example aircraft provides with aerial photographs, space satellites provide with satellite imagery. These have specific uses such as information about weather phenomenon, security purpose, identified the areas affected with flood/ drought/ earthquake, landslide, landuse, study of natural resource etc.

4) **Quantitative Geography**: The application of mathematical and statistical concepts and methods to the study of geography. Quantitative Geography is thus an empirical study of spatial phenomenon found on the earth surface that helps in determining certain scientific principles and laws.

5) **Geography of Health**: Health geography is the application of geographical information with spatial perspectives and methods to the study of health, disease, and health care of any area.

6) **Environmental Geography**: Is a branch of geography that studies how physical and human environment are interacting with each other to produce different landuse and its effect on the nature environment and on living species (Figure 1.8)

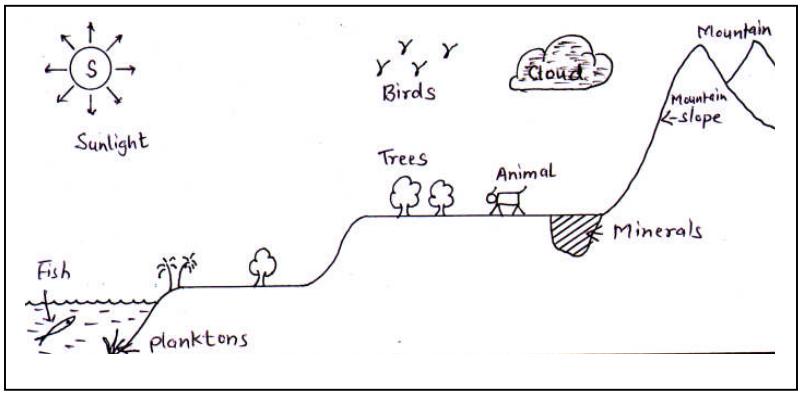



**Figure 1.8 : Environmental Geography**

7) **Geographical Information System (G.I.S.):** G.I.S. is defined as a system that facilitates storage and intelligent use of data about land and water resources and human activities. An essential feature of G.I.S. is the use of sophisticated computer hardware and software to collect, store, operate and process the geographic data. G.I.S. technology today is highly utilized in the field of integrated development planning such as, water resource management, water-shed management, environmental monitoring and assessment, landscape conservation,

telecommunication and network analysis, defence and military planning operations.

**Check your progress :**

1) Discuss various branches of Physical Geography
2) Discuss various branches of Human Geography
3) Discuss various branches of Interface Geography

## 1.5. SPATIAL DISTRIBUTION OF PHENOMENON

All things or objects are not evenly distributed on the surface of the earth. They are concentrated in some areas and absent in the other areas for e.g. sand-dunes are found in hot deserts, sand beaches near sea-coast, coal is sedimentary rocks, higher educational institutions and medical services in urban areas glaciers/snow in areas in minus degree temperatures, agriculture and forest in area with favourable physical factors, mining in mineralized zones etc.

Geographers study the pattern of distribution of a particular phenomenon under study for e.g. population, where population is concentrated and why? This geographical approach is also termed as Spatial Analysis. Spatial means related to space.

Geographers use maps for representing various features found on the earth. This pattern of distribution helps geographers to understand the areas of concentration and dispersion. It is a geographer who finds the reasons for this uneven distribution of various natural and man- made resources on the earth surface.

Maps help to understand the distribution of various phenomenons at a glance.

The ability to analyse information given in the map provides spatial analysis of the phenomena represented by the expertise of the Geographer.

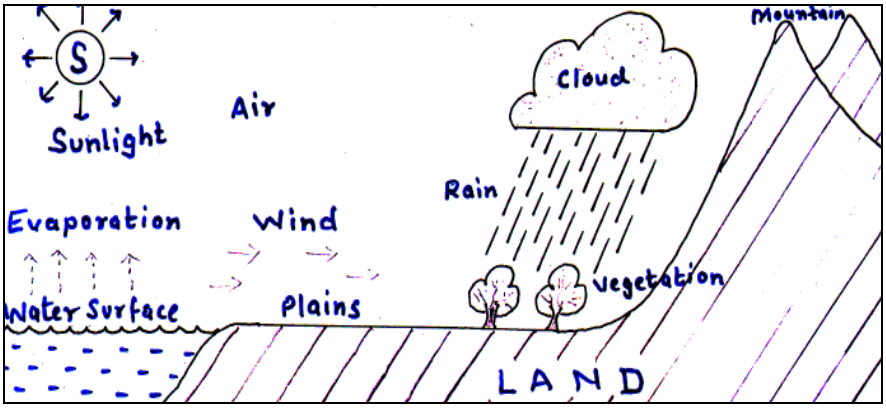
Our earth was formed about 4600 million years ago. Almost all natural living features like plants, animals, birds, fish, and insects

appeared on the earth much before the emergence of man. Radius of the Earth is 6371 Kms.

Man appeared on the earth just about 2 million years ago. Man has well developed thinking and reasoning ability. Hence he developed science and technology and modified natural landscape. Natural features modified by the man are known as Cultural features. All the features found on the earth are therefore classified as:

i) Natural features e.g. Mountains, rivers, trees, animals, plains, oceans etc. ( Figure 1.9.)

ii) Cultural/man-made features. e.g. production of primary goods, rural and urban settlements, transport and communication, manufacturing industries, trading houses, administration and security etc.( Figure 1.10.)




**S:SUN Figure 1.10 Natural features**

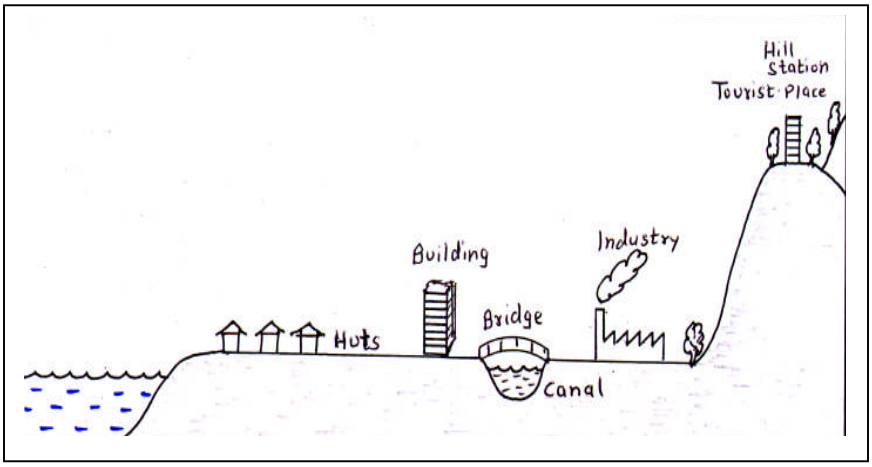



**Figure 1.11 Cultural / Man-made/Anthropogenic Features**

## 1.6. IMPORTANCE OF PHYSICAL GEOGRAPHY:

Physical geography is that branch of natural science which deals with the study of processes and patterns in the natural environment like the atmosphere, hydrosphere, biosphere, and geosphere that shapes the Earth's surface, the animals and plants that inhabit it, and the spatial patterns they exhibit. The study of Physical geography is well done with the help of field survey and field visits for understanding various natural features .

## 1.7. INTERIOR OF THE EARTH:

**INTERIOR OF THE EARTH:** The changes that occur over the earth's surface are related with the deep existing internal forces operating from within the earth. The interior parts of the earth can be divided into 3-4 zones as: a) crust b) mantle and c) Core (Figure 1.12). It is important to study the structure of the earth's interior as explained below:

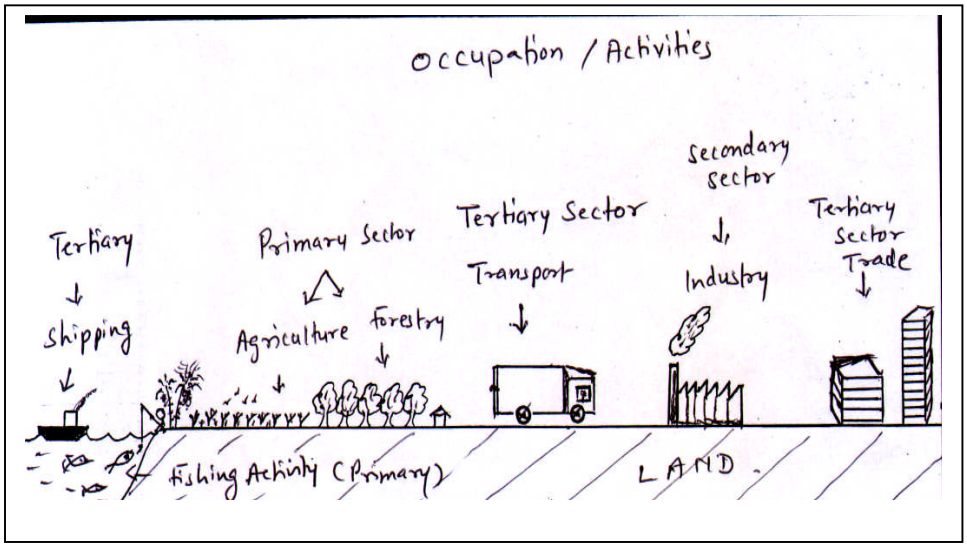



**Figure 1.12**

a) **Crust:** This is the outermost layer of the earth. Various landform features like mountains, plateau and plains, rivers, lakes, sea, oceans and human settlements are found on the crust. It is the most significant zone of the solid earth with an average thickness of 17 kilometer. The base of the crust is sharply defined where it contacts the mantle. This surface of separation between the crust and mantle is called '*Moho' (*Mohorovicic discontinuity). The crust varies greatly in thickness which is as small as 5 km. thick in some places beneath the ocean and up to 70 km. depth under the mountain ranges. It is composed of silicon (27.7 %), aluminum (8.1%), Iron (5%), Calcium (3.6%) and other elements (Figure 1.13).

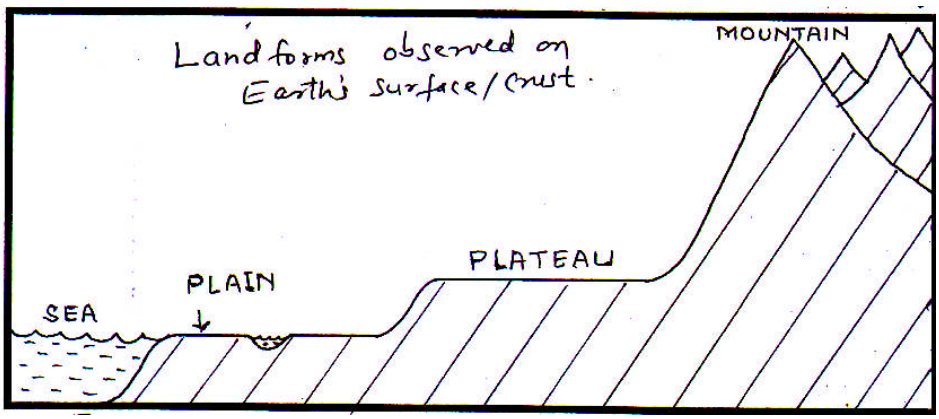



**Figure 1.13 : Geomorphology**

The layer of SIMA is found below the layer of SIAL. The density of this layer is about 3.09/cm$^3$. The silicates of magnesium, calcium and iron are found in SIMA. SIMA (SI – Silica + MA – Magnesium). The bottoms of ocean are composed of denser material termed as SIMA (Figure 1.14).

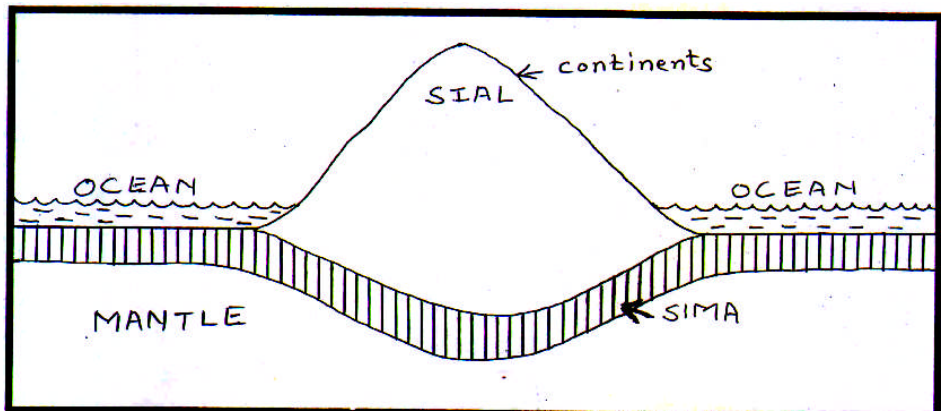



**Figure 1.14 : Earths Crust**

Magma is found in this layer which comes out on the earth's surface as lava during volcanic eruption.

**a)** The rocks of this layer are subdivided into:

**i)** Basaltic rocks underlying the ocean basins containing much of iron and magnesium, and

**ii)** Granite rock: The rock that make the continents which are rich in silicon and aluminum and are lighter in colour and density.

Boundary between the crust and next layer Mantle is termed as Moho discontinuity or Mohorovicic discontinuity.

**b) Mantle:** The mantle is a thick layer which lies below the crust of the earth and extends up to a depth of 2900 km. and above the core. Temperature and density increase with increase in depth in this layer. The average density is 5.6 g $cm^3$. It is mainly of solid olivine rocks made up of silicates of magnesium and iron. Silicate minerals rich in iron and magnesium are found in this zone. Boundary between Mantle and core is termed as Gutenberg discontinuity (Figure 1.15).

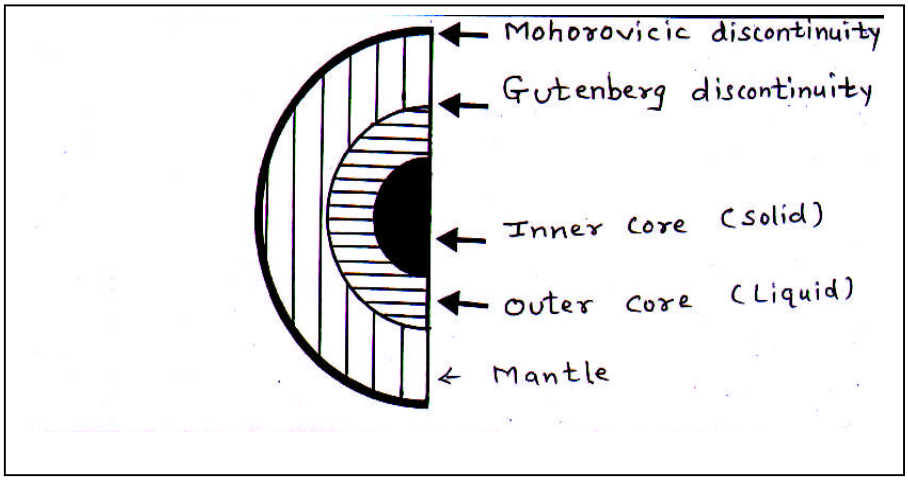



**Figure 1.15 : Lines of Discontinuity and Core**

**c) Core:** is the centre of the earth beyond a depth of 2900 km and reaches up to 6371 km with a spherical zone and a radius of 3475 km. It is assumed that the core is subdivided into two parts. Outer core and Inner core. The outer core extends from mantle up to the depth of 5100 km. and the inner core extends from 5100 km. to 6371 km. i.e. centre of the earth. Due to extreme pressure the inner core is assumed to be in the solid state. Temperature of the core is very high. As we move from surface of the earth towards it's centre, there is a rise in temperature i.e. $1^0$c per 32 metres of depth. The temperature of the core is between $2200^0$ Celsius and $2750^0$C with atmospheric pressure as high as three to four million times found at sea level and a density of 13.5 g $cm^3$. It is named as Barysphere and also *Nife.* The central part is a liquid core consisting of small proportion of nickel, ferrous (80%) and other elements. The earth has a magnetic field. We are able to find out north direction due to the earth's magnetic field. This is possible due to the presence of iron-rich core. The core of the earth is composed of Nickel and Ferrous material. Hence it is termed as NiFe. (Ni = Nickel and Fe=Ferrous)

From the diagram it is clear that the temperature at the centre will be more than $5000^0$C. Metals such as iron, aluminium, copper and even tungstone have lower melting points than $5000^0$C. Hence we assume that the core is in liquid state (Figure 1.16).

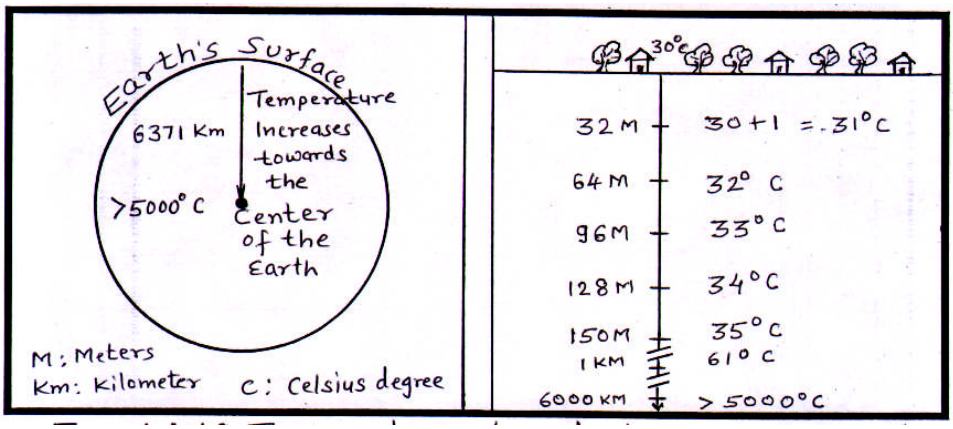



**Figure 1.16 : Temperature towards the Core of the Earth**

**Check your progress:**

Q.6) Explain with the help of suitable diagram various sections of the earth's interior.

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## 1.8. EARTHQUAKE WAVES:

Earthquake waves provide useful information about interior of the earth. Different types of waves are generated at the time of earthquake i.e. 'P' Waves, 'S' Waves, 'L' Waves etc. These waves have different wave motions, and so have different properties. e.g. 'P' waves are able to pass through liquid material but 'S' waves are absorbed in the liquid material. These are:

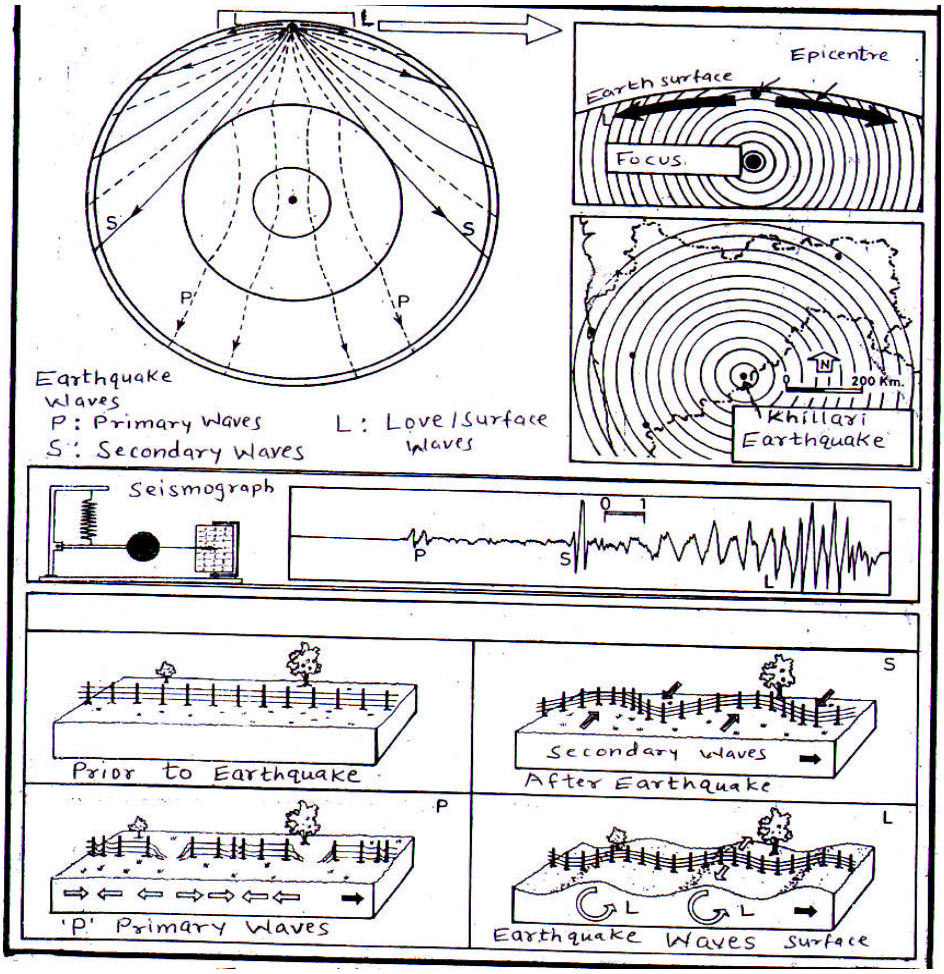


**Figure 1.17: Earthquake waves**

**i) P-Wave or Primary/ Longitudinal wave**: These waves travel in straight line and their speed is maximum i.e. up to 12 km. per second. These waves can travel through solid as well as liquid part of the interior of the earth.

**ii) S-Wave / Secondary Wave or Transverse Wave**. They move with 60 % velocity of the 'P' waves. Theses waves are slower than the P-Waves due to their zigzag wave motion. These can travel through solid part but are absorbed in the liquid part of the earth.

**iii) L-Waves :** Also known as Surface Waves or Love Waves (Love is the name of the scientist who discovered these waves). These waves cannot travel to a long distance and are restricted to the surrounding surface region where earthquake occurs. These are the most destructive waves.

These earthquake waves are recorded all over the world through the instrument called seismograph. Scientists used this data/ information and on the basis of this data they visualised internal structure of the earth. (Figure 1.17)

**Check your progress:**

1) Explain different types of earthquake waves.

## 1.8. DISTRIBUTION OF LAND AND WATER:

1) The distribution of landmasses and water-bodies on the surface of the Earth is not uniform. The landmasses or continents occupy 29 percent, while water-bodies or oceans cover 71 percent surface area of the earth. The surface area of the Earth is 510 million $km^2$ which has land surface of 149 million $km^2$ and water surface with 361 million $km^2$ (Figure 1.18).

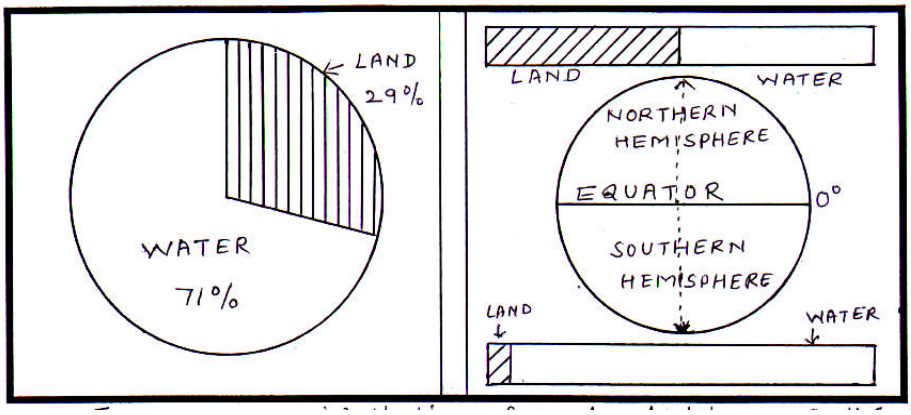


**Figure 1.18: Distribution of land and water on the earth**

2) The distribution of land and water in the northern hemisphere is nearly equal but it is highly uneven in the southern hemisphere. Of the total earth surface in the northern hemisphere 61 % is land and 39 % is water, while in southern hemisphere it is 19 % land and 81 % water surface. The proportion of water in the southern hemisphere is nearly 15 times more than the amount of land in the southern hemisphere is given in table 1.

| I. Land masses / continents | Area in million sq. km. approximately |
|---|---|
| 1. North America | 24 |
| 2. South and Central America | 18 |
| 3. Europe | 10 |
| 4. Africa | 30 |
| 5. Asia (including C.I.S. Common wealth of Independent States) | 44 |
| 6. Australia | 7.8 |
| 7. Antarctica | 13 |
| **II. Water bodies /Oceans** | |
| 1. Pacific Ocean | 165 |
| 2. Atlantic | 82 |
| 3. Indian | 73 |
| 4. Arctic | 14 |

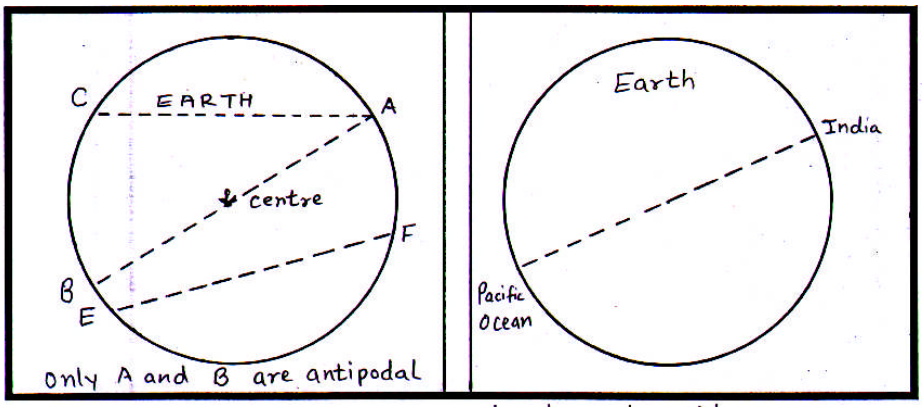


**Figure 1.19: Antipodal locations**

3) **Water-bodies or oceans/seas are found at the antipodal locations of landmasses or continents.** (Figure 1.19)

4) Land area is almost continuous in the temperate belt (23 ½ $^0$N. to 66 ½$^0$N.) of the northern hemisphere.

5) Water bodies or oceans form complete circle in the southern hemisphere at 55$^0$ South latitude i.e. between the southern continents and the continent of Antarctica.

6) Continents or land masses become narrow in the southern hemisphere.
7) East-West trade and transport routes are more important in the northern hemisphere while north – south routes are more important in the southern hemisphere.

Major transport routes in the northern hemispheres like Trans-Siberian railway, North Pacific routes, Trans-continental American

railways, North Atlantic route form complete of Transport network around globe.

8) The landmass of Antarctica has three extended areas one towards Australia second towards South Africa and third towards south America.
9) Australia is isolated from other major landmasses in the world.

10) About 90% of the world population is concentrated in the northern hemisphere and hence transport and communication network has developed more in the northern hemisphere.

11) Due to extensive landmasses in the northern hemisphere the interior parts of the continents like Asia experience extreme variation in summer and winter temperatures.

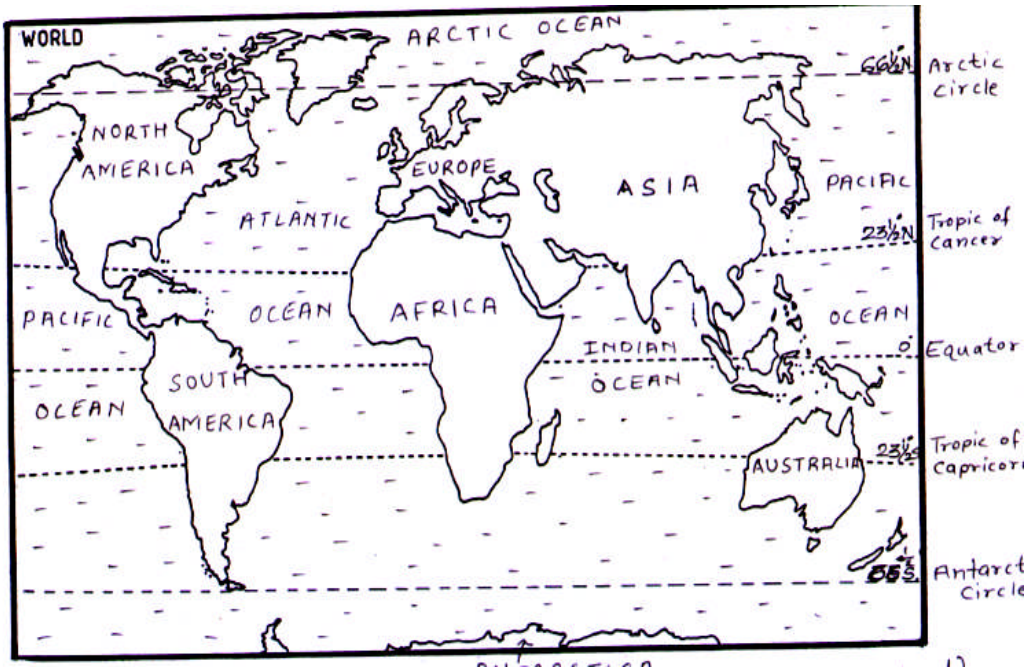


**Figure:1.20:WORLD:Distribution of Continents (land) and Oceans( Water)**

The range of temperature (i.e. difference between maximum and minimum temperature) increases as we move away from the sea-coastal areas towards inside of the continents. This phenomenon is termed as continentality of temperature is less in these areas.

12) Landmasses in the southern hemisphere i.e. South America, South Africa, part of Asia etc. have tapering southern tips so the land area is narrow surrounded by the oceans and hence the range of temperature is less. (Figure 1.20)

**Check your** progress:

1) Account for the distribution and location of landmasses and water-bodies on the earth's surface.

## 1.9. CONCLUSION

This module has thus explained the meaning, nature, scope, importance and various branches with respect to physical, human and interface geography. Various processes, features, facts, locations and their distribution on the earth's surface and subsurface are well explained with supporting maps and diagrams.

## 1.10 QUESTIONS

1) Define and explain the nature and scope of Geography.
2) Describe various branches of geography.
3) With the help of suitable diagram explain the interior of the earth.
4) Give an account of distribution of land and water on the earth's surface.

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# Unit - 2

## ROCKS AND MINERALS

**Unit Structure:**



## 2.0 OBJECTIVES :

- To understand different types of rocks and minerals and their importance in human life.
- To study different types of folds and faults and their impact on determining the landform features.
- To understand the factors responsible for weathering and its types.
- To understand the mass movement of weathered materials by different agents and the resultant landforms.

## 2.1. INTRODUCTION :

The hard solid surface of the earth is called as lithosphere. ‘Lithos’ means rocks. Rock material may be soft or hard constituting mud, clay, sand or stones and boulders. Rocks contain different types of minerals and elements that play an important role in the cycling movement of different geo-bio-chemical cycles enabling ecosystem to function. These ecosystems thus supply different food elements to living species of the earth making it a habitable (living) planet. The settlements, building structures, different types of economic activities, transport and communication, defense services etc. are developed only because of the presence and utilization of these rocks and minerals in various forms.

## 2.2. ROCKS AND MINERALS :

Rocks and Minerals are found on the earth’s surface, and in the crust of theearth below the earth’s surface.

- **Rocks:**According to the geographer or geologists the term rock is applied to any naturally occurring agglomeration of minerals particles can be termed as rock. It can be soft materials as clay, mud or sand as well as hard, massive boulders of stone.

- **Mineral**s are the chemical compounds of different elements. for e.g. Silica ( $SiO_2$ ).

Some minerals contain only one element e.g. sulphur and carbon (diamond).

Some minerals are crystalline because the atoms forming the crystals are arranged in a definite manner e.g. quartz.

Some minerals are non-crystalline as the atoms forming these minerals are not arranged in definite manner.

Rocks are formed due to the combination of minerals. Some rocks may contain only one mineral but many rocks are composed of different minerals.

Rocks are known by different names which are related to the combination of minerals.

Some common minerals are found everywhere on the earth and hence are termed as 'Rock forming minerals', while some minerals are scarce and are found only at particular location. These minerals are costly and are termed as Economic minerals.

Metals are extracted from some minerals which are known as 'Ore' of that metal e.g. Bauxite is an ore of Aluminum (Figure 2.1).

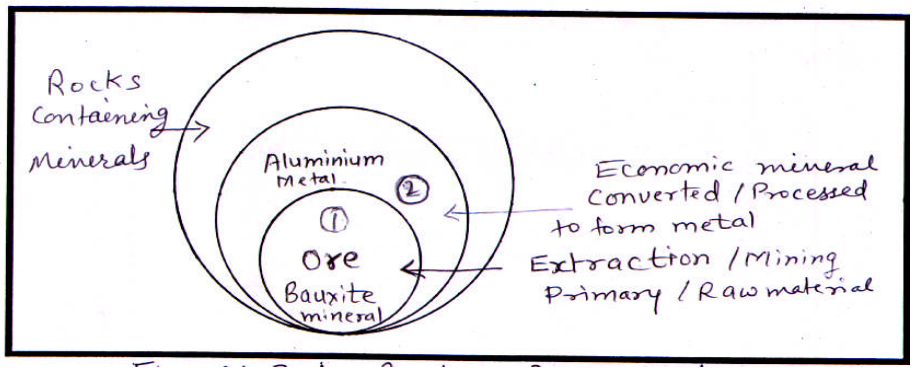


**Figure 2.1: Rocks: Ore: Mineral**

**a) The Rock forming minerals:**

Most of the rocks found on the earth are composed of following major minerals.
(1) Feldspar (2) Quartz (3) Pyroxenes (4) Amphiboles (5) Mica (6) Olivine

**b) Economic minerals:**Some of the important economic minerals and their uses are as follows.

**i) Apatite:**It is red, brown or yellow phosphorous and Fluorine is obtained from it.

**ii) Barite:**It is white or brown. It is used in glass, rubber, chemical and other industries.

**iii) Dolomite:**It is white. It is used in cement and iron and steel industries.

**iv) Gypsum:**It is soft, white. Used for the preparation of objects of art, idols etc.

**v) Pyrite:**It is yellow. Sulphuric acid is obtained from it.

**vi) Talc:**It is white or brown. It is used in making paints, rubber, crockery, paper, plastic, insecticides.

**C) Ores:**An economic mineral from which metal is extracted is termed as **an ore**. Some of the metals extracted from ore are as follows:

| **Ore** | **Metal** |
|---|---|
| Bauxite | Aluminum |
| Cinnabar | Mercury |
| Galena | Lead |
| Haematite | Iron |
| Magnetite | Iron |

**Check your Progress:**

1. Define mineral.
2. What is an ore?
3. State any four uses of rocks.
4. How is mineral different from the rock?
5. Which type of rock is associated with crude oil?

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- **Rock Cycle:**

Rocks are classified according to their mode of formation. Rocks which are formed due to solidification of molten lava/magma are termed as the Igneous Rocks. These rocks are disintegrated due to various agencies and processes on the earth's surface.

The weathered pieces of rocks are carried pieces of rocks are carried by different agencies of erosion like river, glacier, wind, sea waves etc. Which are deposited in sea, lake or desert? These weathered pieces of rocks are cemented together to form sedimentary rocks.

Sedimentary rocks change their structure due to crustal movements and heat and pressure inside the earth. The changed rock is known as the metamorphic rock.

Metamorphic rocks go deep towards interior part of the earth due to crustal movements and melt and become part of magam-molten material inside earth. When magma comes out on the earth's surface it is termed as lava. Thus the rock cycle continues. (Figure 2.2)

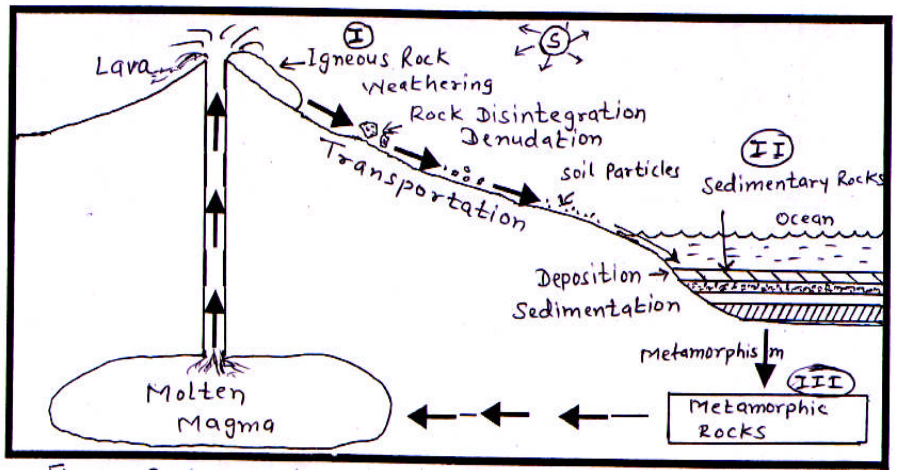


**Figure 2.2: Rock Cycle**

**A) Igneous Rocks:**

'Magma' is the molten material found below the crust. When magma comes out on the earth's, surface, it is termed as 'Lava'. (Figure 2.3). The rocks which are formed due to solidification of 'lava' or 'magma' are termed as Igneous Rocks. (derived from the Latin word 'ignis' means fire) Igneous rocks are formed first in the Rock cycle and hence these rocks are also termed as primary rocks.

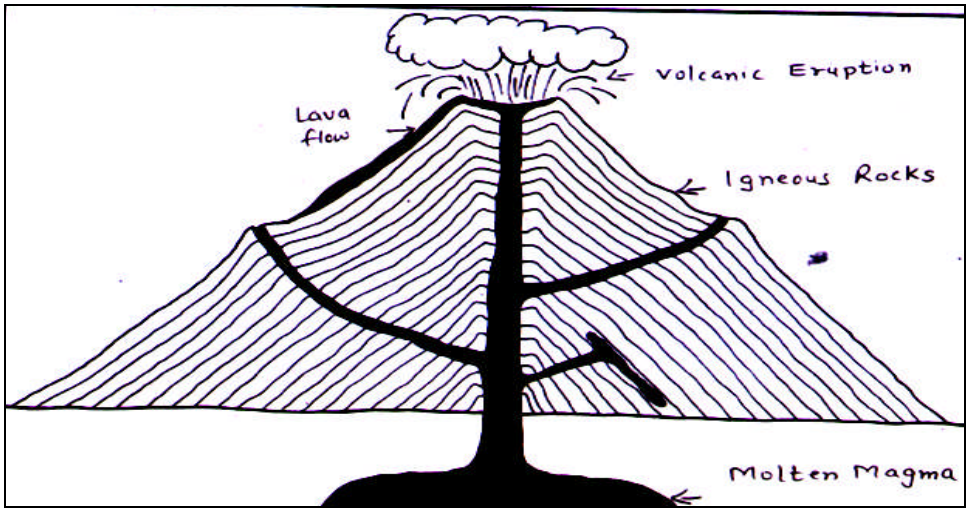


**Figure 2.3: Volcanic Eruption and formation of igneous rocks**

Igneous rocks are formed due to solidification of magma and hence these rocks are also termed as 'Magmatic rocks' Igneous rocks are classified according to the:

A) Place of formation
B) Composition

**Classification of Igneous Rocks**

A] According to the place of formation
- 1) Intrusive
  - **a) Hypabyssal**
    - i) Sill
    - ii) Dyke
    - iii) Lacolith
    - iv) Stock
    - v) Phacolith
  - **b) Plutonic**
    - i) Batholith
- 2) Extrusive
  - a) **Volcanic**

B] According to the composition
- 1) Acidic
  - More Percentage of Silica-Sticky
  - forms domes
- 2) Basic
  - More Percentage of Iron group of minerals
  - -Fluid
  - Forms plateau

## 1) Classification of the Igneous rocks according to their place of formation (Location):

The igneous rocks which are formed on the earth's surface are termed as 'Volcanic' or '**Extrusive' igneous rocks**. The cooling process of lava is more rapid on the earth's surface and hence different minerals in lava do not get opportunity to come together.

So we do not find large size crystals in the volcanic or extrusive rocks. These are termed as ‘find grained’ rocks.

On the other hand cooling process of magma below earth’s surface is very slow hence different minerals in magma get sufficient time to come together so we get large size crystals in the **intrusive igneous rocks**. These rocks are also known as ‘course grain’ rock.

- **Intrusive igneous** rocks are known by different shapes formed by the solidification of magma into the cracks of the existing rocks. These are:

a) Stock : Thick vertical formation like huge pillar.
b) Dyke : Vertical wall like formation.
c) Lacolith : Dome shaped formation.
d) Sill : Horizontal sheet like formation
e) Lapolith : Saucer type formation.
f) Phacolith : Wave like formation.

All these types of intrusive rocks are formed below earth’s surface but not at very great depth. These are called as Hypabasal rock.

The rocks which are formed at great depth e.g. Batholith are known as Plutonic rock. These are coarse grained rocks. (Figure 2.4)

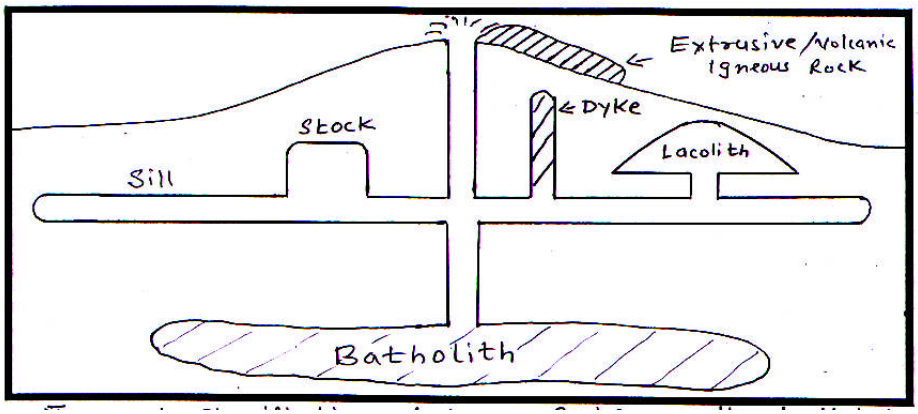


**Figure.2.4:Classificaiton of igneous rocks according to their location**

**2) <u>Classification of the igneous rocks according to the composition.</u>**

Igneous rocks are classified according to their composition i.e. the type of magma/ lava. If lava/ magma contain more proportion of silica it is termed as Acidic. Acidic lava being stickier

(viscose) is not spread over large area, it forms domes. The igneous rocks formed due to solidification of acidic lava have light colours.

On the other hand if the lava contains more percentage of iron group of minerals it is termed as basic lava. It is more fluid and so it spreads over large area and forms plateau e.g. The Deccan Plateau. The igneous rocks formed due to solidification of basic lava are dark in colour. (Figure 2.5)

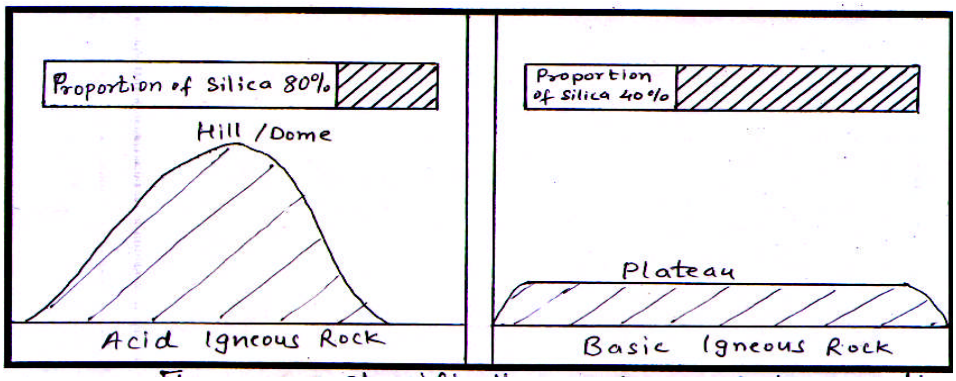


**Figure.2.5: Classification of igneous rocks according to their composition**

**Check your progress:**

1. What are igneous rocks? How are they formed? Give examples.
2. Give a classification of igneous rocks.
3. Draw a neat diagram to represent intrusive igneous rocks.

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**B. Sedimentary Rocks:**

Sedimentary rocks are also termed as ‘secondary rocks’ because these are formed after the formation of primary rocks (i.e. igneous rocks). Igneous and other types of rocks are weathered and eroded by the denudation processes and agents of erosion such as river, glacier, wind, etc.) The particles of these rocks are transported and deposited in parallel layers, one upon the other. Over a period of time, these layers become compact and cemented together due to the Weight of the overlying layers and gradual process of cementation develops hard, stratified layers termed as sedimentary rocks. Of all the rocks that are found in the Earth’s

crust up to the depth of 16 kms from the surface; about 95% are non-sedimentary rocks.

However, on the surface of the Earth, about 80 per cent rocks are sedimentary. These rocks are also known as stratified or layered rocks.

**Bedding plane:**

The plane of separation between two layers of the sedimentary rocks is termed as the Bedding plane. Sedimentary rock can break easily along the bedding plane.

**Characteristics of the Sedimentary Rocks:**

These rocks are termed as layered or stratified rocks as they display many layers in them.

Fossils of plants and animals are found in these rocks. As the process of formation of sedimentary rock is long and slow (i.e. heat or excessive pressure is not required), the imprints of the dead organisms remain on the rock. Such remains are termed as fossils. These fossils help us to identify the age or geological period of the organisms through the process of carbon dating.

Mostly sedimentary rocks are porous.

About 80% of the rocks on the surface of the Earth are sedimentary rocks.

Sedimentary rocks contain fossil fuels such as coal, crude oil etc.

Generally, these rocks are not crystalline as these are formed due to compaction of the weathered material.

The sedimentary rocks are formed in extensive horizontal layers. Therefore they form extensive horizontal landforms. (Figure 2.6)

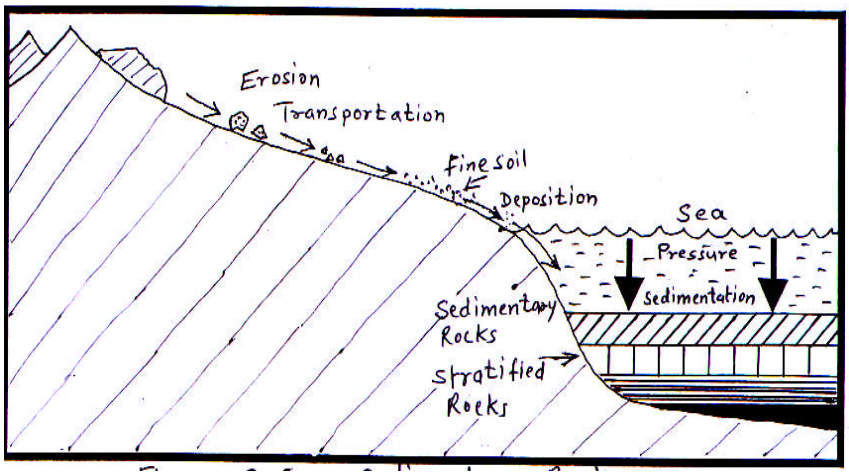


**Figure 2.6. Sedimentary Rocks**

**Classification of Sedimentary Rocks:** Sedimentary rocks can be classified according to their components (composition) or according to the place of formation.

1) **Classification of sedimentary rocks according to the composition:** Sedimentary rocks have different chemical composition, colour and size of particles.

a) **Clastic rocks and their types**: These sedimentary rocks are composed of rock fragments. Clastic rocks are classified according to the size of particles or grains of the sedimentary rocks.

*** Types of clastic sedimentary rocks**

- **Clayey or argillaceous rocks:** These rocks are composed of very fine sediments, e.g. shale, mudstone, etc.

- **Sandy or arenaceous rocks:** These rocks are composed of sand particles, e.g. sandstone.

- **Conglomerate:** The sedimentary rock composed of large rounded pebbles is known as conglomerate.

- **Breccia:** This sedimentary rock is com-posed of large angular fragments of rocks.

b**) Non-clastic rocks and their types:** These sedimentary rocks are composed of the remains of plants and animals.

*** Types of Non-clastic Rocks:**

- **Carbonaceous rocks:**The sedimentary rocks formed of the remains of plants are known as carbonaceous rocks. This is because these rocks contain carbon, e.g. lignite, coal, etc.

**Formation of coal:**

- **Calcareous rocks:**The rocks formed of the remains of animals are known as calcareous rocks. Calcium Carbonate ($CaCO_3$) is the main component of calcareous rocks. When fish and other aquatic animals die their bodies are decomposed. The two main components- (i) Bones and (ii) Flesh – are separately decomposed. Bones contain calcium. The bones get disintegrated into powder. This powder, which is deposited at the bottom of the ocean, gradually becomes compact to form layers of limestone.

**Formation of limestone:**

Limestone and dolomite are examples of calcareous sedimentary rocks.

**Formation of crude oil:**

2) **Classification of Sedimentary Rocks According to the Place of Formation:**

The process of sedimentation can take place at different locations. Therefore sedimentary rocks are also classified according to the place of formation.

Marine sedimentary rocks – These are formed on the seabed.

**i) Lacustrine sedimentary rocks –** When the sedimentary rocks are formed in a lake, they are termed as the Lacustrine sedimentary rocks.

**ii) Riverine or Fluviatile sedimentary rocks -** Alluvium, i.e. the disintegrated particles of rock with decomposed organic matter, is deposited either on river bed or on flood plains during floods. These layers of alluvium become compact to form the riverine sedimentary rocks. The plains of North India, the Nile Delta of Egypt, the Mississippi Delta, etc. are well known for such sedimentary rocks.

**iii) Aeolian sedimentary rocks –** These rocks are formed in the arid and semi-arid areas (i.e. desert areas) where the action of wind is strong. These winds carry loose particles of the rocks and deposit them elsewhere. Aeolian (related to wind) rocks are formed due to compaction of these particles.

**iv) Glacial sedimentary rocks:** The weathered/ eroded material carried down by the glacier is termed as moraine. When glaciers

melt, the material brought by the glaciers is deposited on the bed or in the surrounding region, which becomes compact to form glacial sedimentary rocks. Many places in North America and North Europe are known for such rocks.

**Check your progress:**

1. What are sedimentary rocks. Give examples.
2. Which agents of erosion are responsible for the formation of sedimentary rocks?
3. Name three types of sedimentary rocks according to their place of formation.

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**C. Metamorphic Rocks:**

The primary igneous rock or secondary sedimentary rock are changed in their appearance or change in their mineral composition and texture due to intense heat from below and pressure from above. This process of change due to intense heat and pressure in original rock structure and composition is called as metamorphism. The word 'Metamorphism' means change of form. The process of metamorphism brings change in the form of rocks in two ways :

a) **Physical metamorphism** causing changes in textural composition of rocks, and
b) **Chemical composition** that changes chemical composition of rocks.

**v) Agents of Metamorphism:** Three agents contribute to the process of metamorphism:

1. **Heat:** is the fundamental agent that brings changes in the parent rock to form metamorphic rocks. Intense heat that is received during the process when hot and molten magma from the core tries to come out (vulcanicity) through the crustal rocks beneath the earth surface changes entirely the composition of minerals in the rock.
2. **Compression**: The endogenetic forces cause convergent horizontal movement causing folding in rock beds. As a result pressure from compressive forces and consequent folding is

responsible for changing the form and composition of original rock. This feature is mainly observed during mountain building process.

3. **Solution:** During vulcanicity the chemically active hot gases and water act as solution while moving out from the core through the crustal rocks beneath the earth that changes the chemical composition of the rock.
( Figure 2.7).

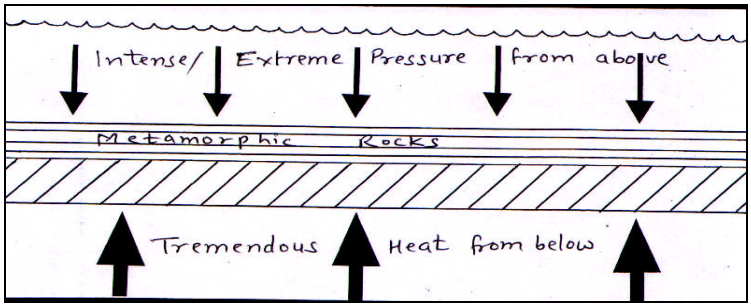



**Figure 2.7. Formation of Metamorphic rocks**

**vi) Types of metamorphism:** is based on their process that is characterized by the nature of the agent and the place and area involved in metamorphism.

**a) On the basis of the nature of agents:**

- **Thermal metamorphism (due to intense heat):** In this case, the structure of rocks is changed due to heat caused by magma, hot gases, geothermal energy, etc. Clay which changes into shale is the best example of thermal metamorphism.
- **Dynamic metamorphism: (due to intense pressure):** High pressure due to crustal movements generates great heat and pressure. This causes dynamic metamorphism.
- **Hydro-metamorphism (due to hydro-static pressure):**Hydro-static pressure is caused by a column of water. In the upper crust of the Earth, there are enough fractures, cracks, and porosity that the fluid within these voids is under hydrostatic pressure.
- **Hydro-thermal pressure (due to pressure of water and heat):** Rocks that are altered at high temperatures and moderate pressures by hydrothermal fluids are hydrothermally metamorphosed. This is common in basaltic rocks that generally lack hydrous minerals. Rich ore deposits are often formed as a result of hydrothermal metamorphism.

❖ **Effect of high pressure and high temperature:**

The interior of the Earth is very hot. Due to crustal movements such as mountain building, rocks are subjected to high

temperature and high pressure. As a result the structure of rocks is altered, e.g. limestone is converted into marble.

❖ **Effects of basic change in the structure of rocks**

Rocks are disintegrated due to chemical and mechanical actions. These disintegrated pieces of rock are again assembled to form hard rock, i.e. metamorphic rock.

**b) On the basis of place or area:**

- **Contact metamorphism (localized in area):** The rocks which come in contact with the hot molten magma are metamorphosed and are converted into metamorphic rocks.
- **Regional metamorphism ( large area is involved):**The layers of sedimentary rocks covering large areas below the surface are crumbled and compressed due to the pressure developed by crustal movements. Metamorphic rocks formed by regional metamorphism are found in the Himalayas, the Alps etc.

**v) Formation of metamorphic rocks**

Examples of the metamorphic rocks are given below:

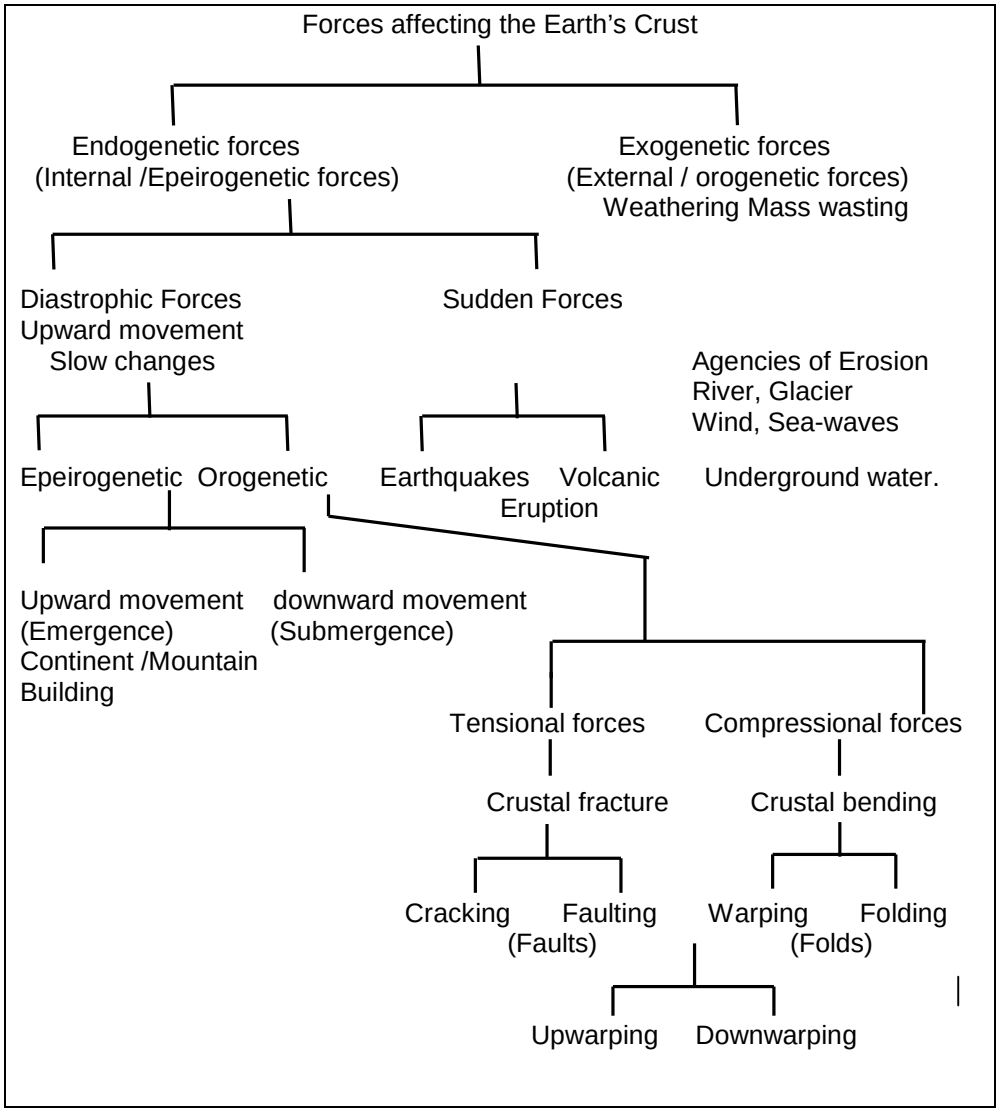
| **Type** | **Original rock** | **Metamorphic rock** |
|---|---|---|
| Igneous rocks | Basalt → | Schist |
| | Granite → | Gneiss |
| Sedimentary rocks | Limestone → | Marble |
| | Sandstone → | Quartzite |
| | Shale → | Slate |

**Check Your Progress:**

1. What are metamorphic rocks? Give examples.
2. Explain the process and agents of metamorphism.
3. Write a note on types of metamorphism.

## 2.3 FOLDS AND FAULTS- TYPES

**1. Introduction**: It is a well known fact that our earth is dynamic nature and undergoes constant changes caused by internal forces that are sometimes sudden and some are very slow requiring hundreds of years to view any significant changes in the earth.




'Endogenic' forces are the internal forces that produce sudden movements in earth that are easily felt by man during his existence. For example volcanic eruption and tremors produced by earthquakes. (Figure 2.8 and Figure 2.9. figure 2.10).

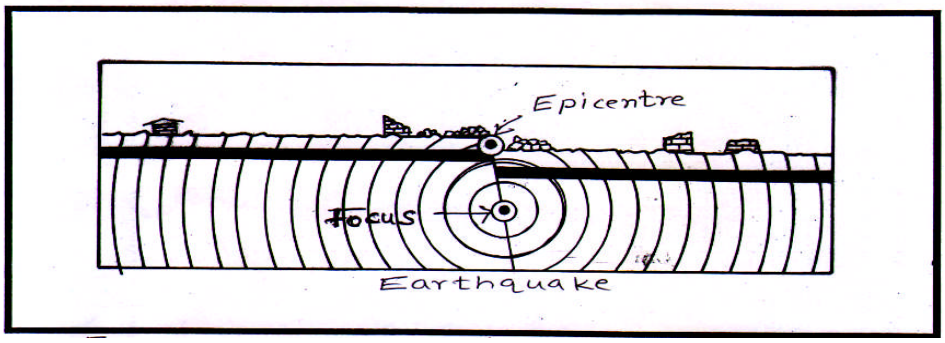



**Figure 2.8: Earthquake**

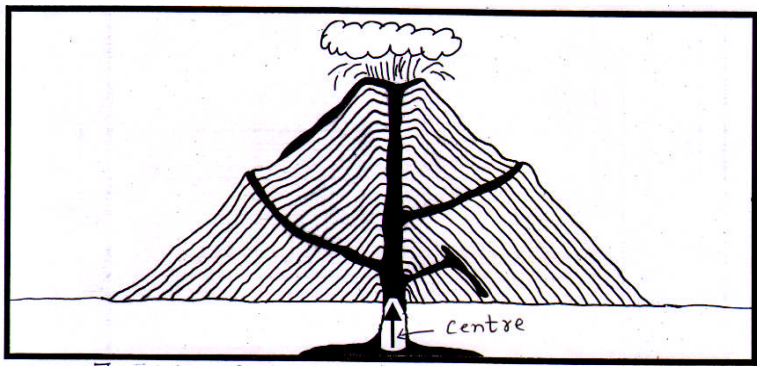



**Figure 2.9: Volcanic Eruption**

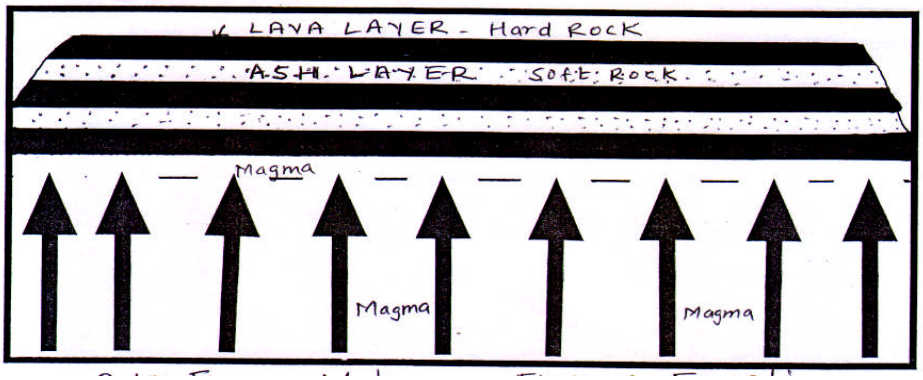



**Figure 2.10: Volcano – Fissure eruption**

This dynamism in earth through Endogenetic and Exogenetic forces are explained as under:

a) **Endogenic (Internal): These are diastrophic forces classified as:**

**i) Epeirogenetic) Forces:** The force coming from beneath the earth is called as endogenetic force. These can be experienced into two types:

- Sudden movement in the form of volcanic eruption or earthquake.
- Slow development that may be horizontal (compressional and tensional) and vertical (upward – uplift or downward-subsidence).

As the submergence or emergence of the region affects very large areas, these are also termed as the continent-building forces.

**ii) Orogenic (Tensional and compressional) Forces:** 'Oros' means mountain and genesis means to form. Hence, these forces are termed as Orogenic or mountain forming forces. Orogenic forces consist of fold and faults. Fault is caused by tensional forces while fold is caused due to Compressional forces of the Earth. Faults block mountains or rift valleys are formed due to the horizontal tensional forces.

a) **Exogenic (external) Forces:** The force coming from outside the earth is called as exogenic force. They consist of all forces that are actively engaged in levelling the relief of Earth. They are doing all kind of erosional transportational and depositional work. Exogenic forces on the Earth are water (sea, river and underground), wind, glaciers and cosmic forces.

**Check Your Progress:**

1. Differentiate between "vertical movement" and "horizontal movement".
2. Mention exogenetic forces.
3. State Endogenetic forces.

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- **FOLDS:**

Folds on the Earth's surface are wave-like bends formed due to tangential compressive force caused by the internal deep force from within the earth to form folds. These forces acting on crustal rocks give rise to a series of bends called as folds. The up-folds are called as **Anticlines** and the down-folds as **Synclines.**

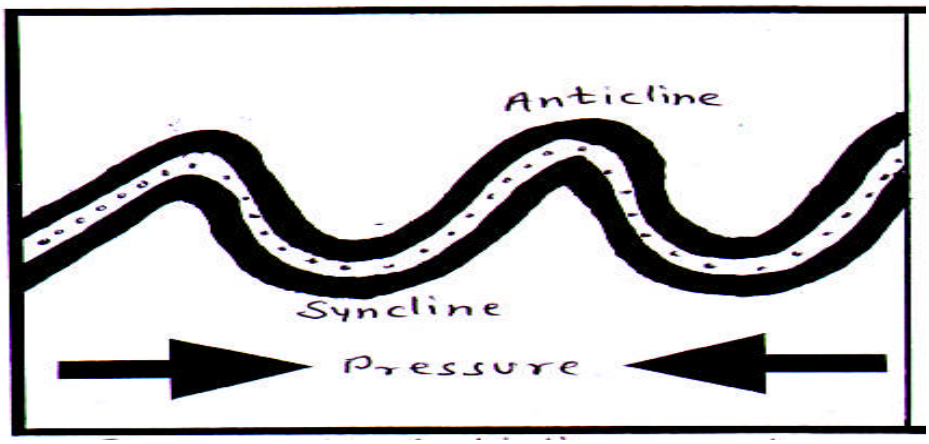


**FIGURE: 2.11. Anticlines and Synclines:**

The sides of a fold are termed as 'limbs'. Folding mostly occurs at the margins of the continental plates. Fold Mountains are developed due to a series of parallel folds, e.g. the Alps or the Himalayas. Different types of folds can be observed. These are:

**a) Types of Folds:**

The horizontal compressional forces acting towards each other are sometimes equal but are unequal in most of the cases. This inequality of the forces gives rise to various types of folds. These are:

i) **Symmetrical folds:** These are simple folds in which both the limbs of the fold incline uniformly. This is because the forces exerted on both the sides of the limbs are equal.

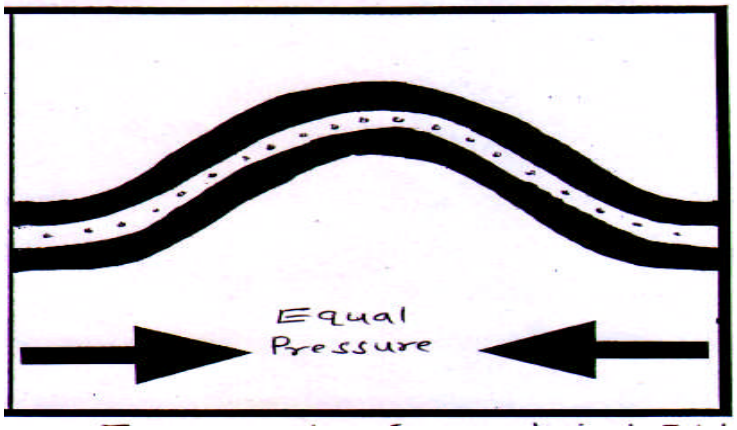


**FIGURE: 2.12.Symmetrical fold**

ii) **Asymmetrical folds:** Asymmetrical folds are produced due to exertion of unequal force on both the sides of the limbs.

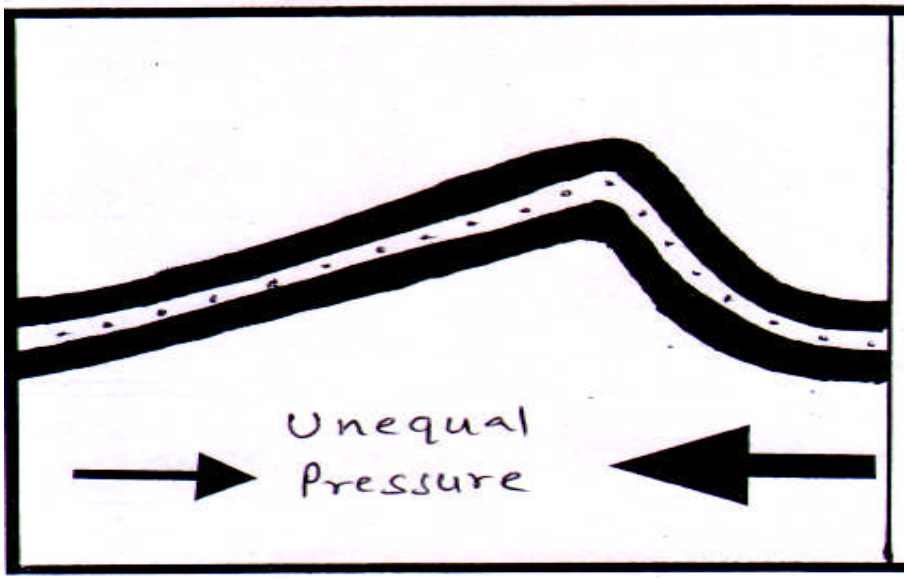


**FIGURE: 2.13.Assymmetrical fold**

iii) **Monoclinal / Vertical folds:** In this case, one of the limbs is moderately inclined and the other limb has a steeply inclined slope at right angle indicating application of greater force in that direction so as to develop monoclonal or vertical folds.

iv) **Isoclinal folds:** Here compressive forces are so strong that both the limbs of the fold become parallel to each other but are not horizontal.

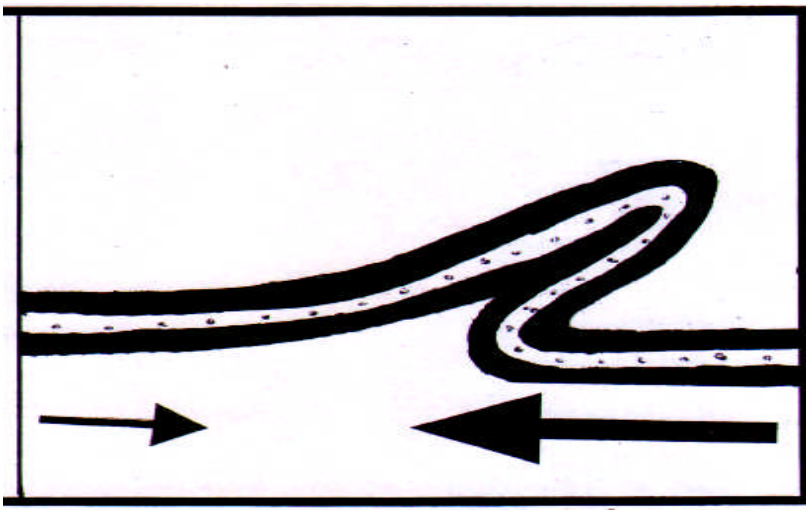

**FIGURE: 2.14 Isoclinal fold**

v) **Recumbent folds:** Here compressive forces are so strong that both the limbs of the fold become parallel as well as horizontal.

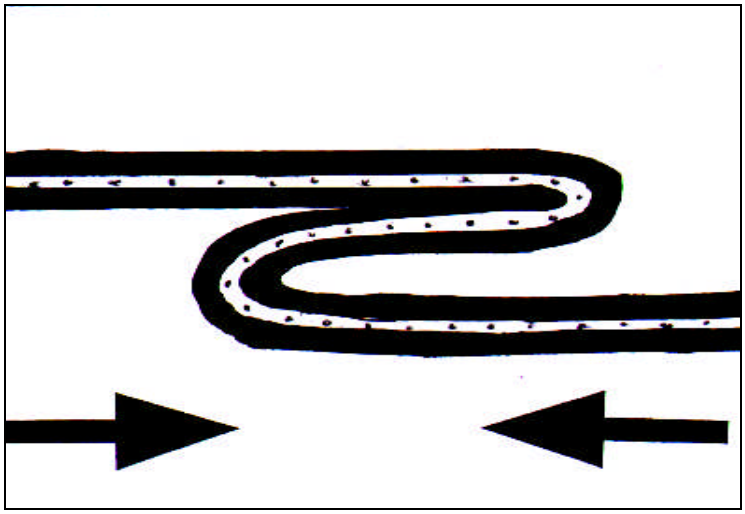

**FIGURE: 2.15 Recumbent fold**

vi) **Overturned / thrust folds:** In this case, as the force on one side is extreme, the fold breaks and the upper part slides over the lower part. Thus one limb of the fold is thrust upon another fold due to intense compressive forces. Limbs her are seldom horizontal.

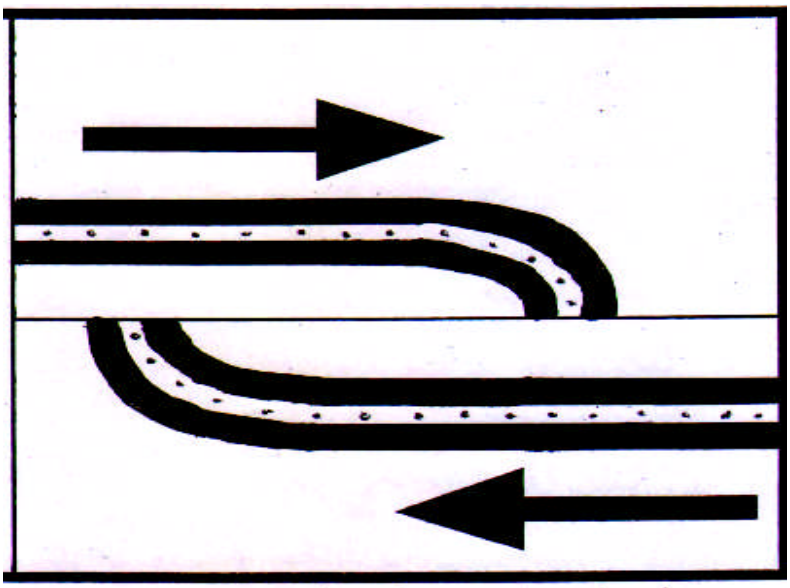

**FIGURE: 2.16 Overturned / thrust folds**

I. **FAULTS:** A fracture in the crustal rock where the rocks get displaced along a plane is called as a fault. In other words displacement of crustal rocks caused tensional movement due to internal force develops a fracture is called as a fault **FIGURE: 2.16.1**.

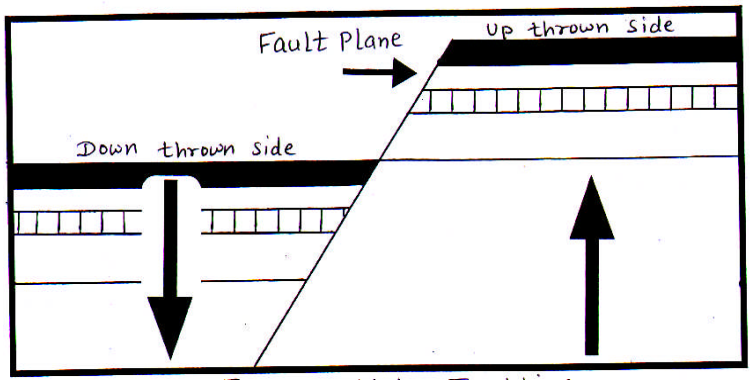


**FIGURE: 2.16.1.Faulting**

Horizontal tensional forces often develop cracks in the rock strata. These cracks are called joints. The crustal blocks move upward or in downward direction that develop faults. Faults also developed in the horizontal direction.

**FIGURE: 2.**

**a) Types of Faults Related to Gravitational Force. These are:**

**i) Normal faults:** Here the rock strata move in the downward direction due to the gravitational force. Hence, such faults are also termed as gravity / normal faults' **FIGURE: 2.17**. For example 'Rift' or 'Graben' Valley is formed due to the normal fault. Rivers Tapti, Purna and Narmada of central part of India flow through the rift valleys. Rift valleys generally have steep sides or steep banks **FIGURE: 2.18**. Other examples of rift valley are:

- Rhine rift valley in Europe;
- Jordan River valley from Syria through Red Sea basin to Zambezi valley is the longest rift valley with 6440 km.
- Dead Sea in Asia
- Narmada, Tapti rift valleys in India.

**ii) Reverse / thrust faults:** Here the rock strata are forced in the upward direction due to the horizontal compressional forces. Hence, the rock strata move up against the force of gravity. Here the vertical stress is minimum and horizontal stress is maximum. Therefore it is termed as reverse fault. Block mountains or horsts are formed due to reverse fault. **FIGURE: 2.17**

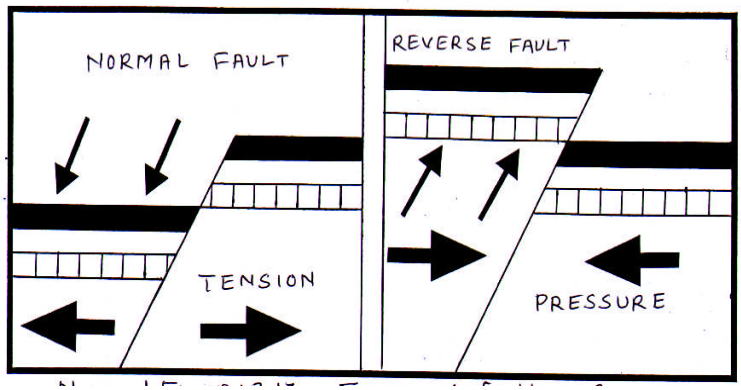


**FIGURE: 2.17** Normal Faults and Reverse Fault

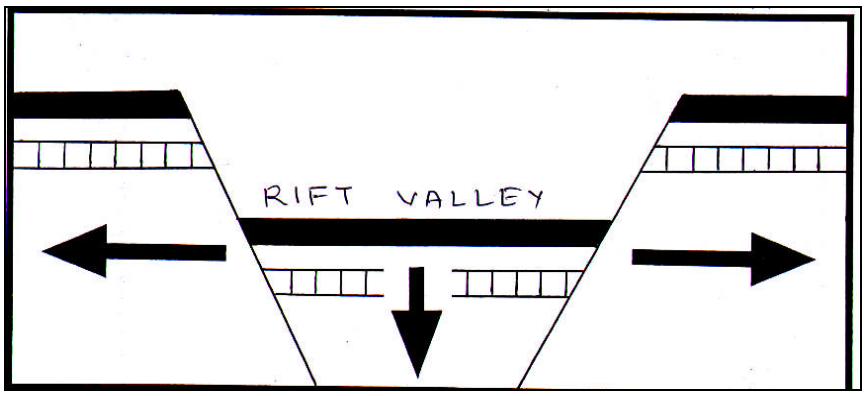


**FIGURE: 2.18 Rift Valley**

**Block Mountain:**

Faults also develop due to the horizontal displacement of the rock blocks. This is termed as the 'lateral' or 'strike-slip faults' **FIGURE: 2.19**.

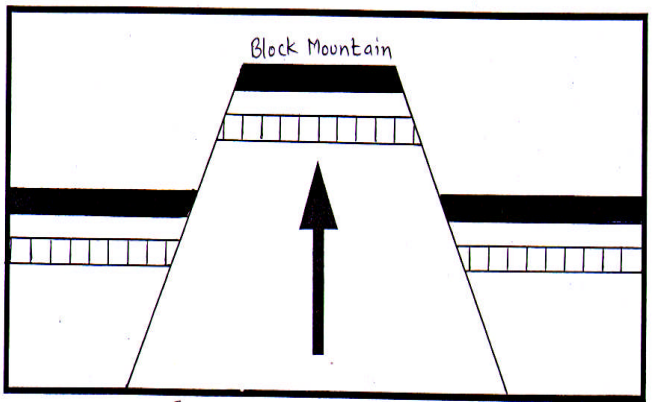


**FIGURE: 2.19**. **Block Mountains or Horsts**

**Block mountains or horsts:** Block Mountains/'horsts' are formed due to faulting and so they are also associated with rift valleys. Block Mountains normally have steep sides and flat tops that are developed due to faulting process. For example:

- The Black Forest Mountain of Germany.
- The Vosges in France.
- The salt range in Pakistan.
- The Flinders Mountains in Australia.

**Check Your Progress:**

1. What do you mean by “folding”?
2. Mention different types of folds.
3. What do you understand by the term “Faulting”?

## 2.4 CONCLUSIONS:

The present chapter has helped us to understand various processes responsible for the formation of different types of rocks, their location; structure; and physical and chemical composition. These various processes involved in formation and change of parent rock thus provide us with different types of rocks and minerals. Different types of human settlements and his activities are dependent upon the availability of these rocks and minerals.

## 2.5. QUESTIONS.

1. Explain any three differences between rocks and minerals.
2. How is igneous rock formed?
3. With the help of a neat diagram explain rock cycle.
4. Give major characteristics of the igneous rocks?
5. Give broad classifications of igneous rocks on the basis of their place of formation? Give two examples for each.
6. Give a classification of igneous rocks according to their composition?
7. What are the four important characteristics of sedimentary rocks?
8. Give a classification of sedimentary rocks?
9. How is metamorphic rock formed? Give four examples of metamorphic rocks.

10. Explain with the help of suitable diagram the formation of crude oil.
11. Explain the different types of folds with the help of suitable diagrams.
12. Describe the major types of faults with suitable diagrams.
13. Discuss the different types of forces affecting the earth's crust.

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# Unit - 3

## WORK OF RIVER

**Unit Structure :**



## 3.0 OBJECTIVES

- To know the origin/formation of river
- To study the importance of river
- To understand the work done by a river
- To observe the erosional landforms developed by a river and the underlying processes for its formation.
- To observe the depositional landforms developed by a river and the underlying processes for its formation.

## 3.1 INTRODUCTION

Rain water that falls on the earth's surface through hydrological cycle starts running /flowing in the form of a river is the most important agent of erosion (**Figure: 3.1).** It is manifested by the flow streams from uplands/highlands down the slope in the lowlands as a main river that merge into a lake/inland sea or into the sea in coastal areas. The main river receives water from various streams that forms its tributaries in its catchment area. The flow of water of Main River in the lowland is slowed down and at times distributes its water through different channels as distributaries before meeting the sea. These features are common in the delta region of a river **(Figure 3.2.)** River action consisting of weathering and mass wasting is responsible process for fluvial denudation. It is most marked in semi-arid regions because they

have little or no vegetation and the rains, though infrequent, are torrential.

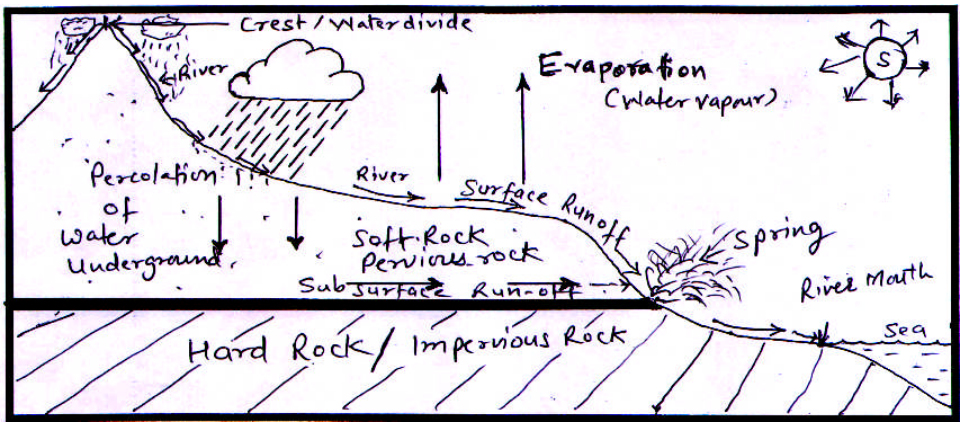



**Figure: 3.1. Hydrological Cycle.**

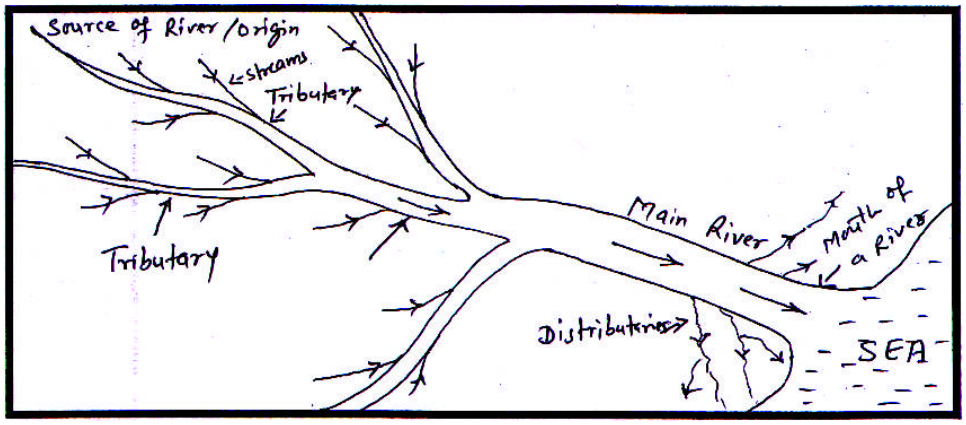



**Figure: 3.2. Main River with its streams, tributaries and distributaries.**

## 3.2 IMPORTANCE OF RIVER

Availability of fresh water almost throughout the year from the surface flow in the form of river, lake, pond or from the subsurface through wells, springs captured through rain is possible only because of these water flows from highland to lowlands through river basins. They are the source of living for all living organisms that sustains the ecosystem and our only living planet 'the earth' of this solar system.

## 3.3 PROCESSES OF EROSIONAL WORK BY RIVER :

There are four processes of erosion through rivers or streams water (**Figure: 3.3)** such as:

**1) Solution:** It is a type of chemical weathering in which most of the salts are removed from the bedrocks through process of chemical action i.e. corrosion.

**2) Abrasion:** It involves the removal of loosened materials of the valley walls and valley floors with the help of erosional tools.
**3) Attrition:** The wear and tear of the transported material themselves when they roll and collide with each other.

**4) Hydrolic Action:** It involves the breakdown of the rocks of valley sides due to the impact of water currents of the river channel.

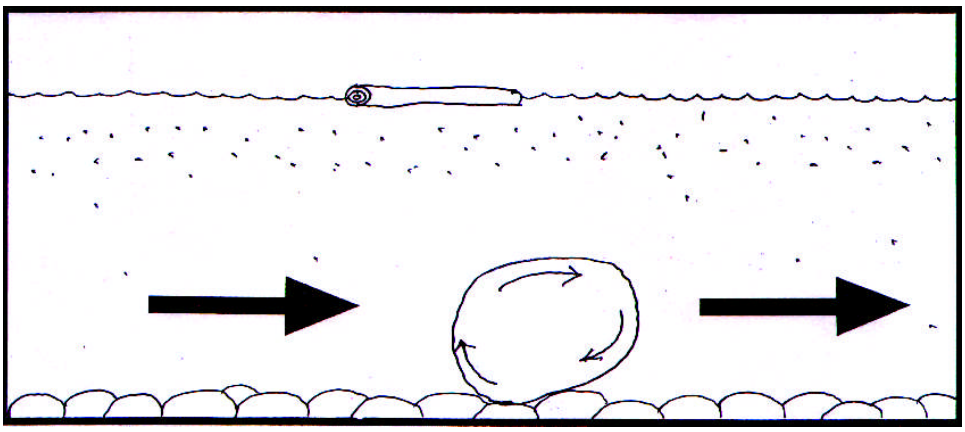


**Figure: 3.3. Transportation of material by river**

**<u>The river as an Energy system:</u>**

Energy of the river is the ability to do the work. The amount of river energy to do the work determines whether the river can effectively erode its valley and transport the material in the form of deposition.

**1) Three section of River:** A well developed mature river can be divided into the following three sections.

**2) The upper course:** The upper course of the river is that section where most of the erosion takes place since the gradient of the river channel is steep and river flow is very swift.

**3) Middle course:** In the middle course of river transportation of weathered material is the dominant process.

**4) Lower Course:** This section of the river gradient low and hence the river becomes sluggish. Therefore, deposition of weathered material is deposited on the bed of the river.

A river's energy increases with its volume (eroded material) with its velocity and with its regime i.e. seasonal flow. It means a

large, fast-flowing will have more power to erode and when its flow becomes sluggish with little water.

One should not forget that all the energy in a river is used for erosion. Some of it is necessary to overcome frictional resistance along the bed and banks and internal turbulence and roll against each other Energy is also necessary to transport the bolders, pebbles, sand, silt and dissolved chemicals and minerals in the water.

## The Development of a River valley

Energy of the river to erode, transport and deposit the load (weathered material depends up on its size and its gradient and the distance it has to travel before it reaches its base level. Base level is the level or altitude, at which a river reaches the lake or sea or another river. The river erodes down to this level.

The upper part of the river i.e. above the base level, because it is high above the base level, will be able to deepen its channel rapidly. However, a river cannot erode below its base level.

**Life cycle of River:** Like human beings the life cycle of a river is divided into the following three parts (**Figure 3.4)**.

**1) Stage of youth :** In this stage the river flow is swift, in a narrow, steep sided valley, whose floor is broken by pot holes, rapids and water falls, and lowers its valley.

**2) Mature stage :** In this stage of the river denudation widens the river valley, gradient is reduced, the river has less energy to erode and the river begins to take the initial curves because of the nature of its valley floor.

**3) Old stage** : At this stage gradient is further reduced, the river becomes sluggish and deposition becomes the major work of the river. Sediments brought down by the river are dropped by the river and slowly spread over the entire floor of its valley, where it build up a gently sloping plain known as a floor plain. Slowly river develops great meanders across the plain. Deposition of very fine sediments at the month of some rivers at the old stage, sometimes develop triangular shaped land, is known as a delta.

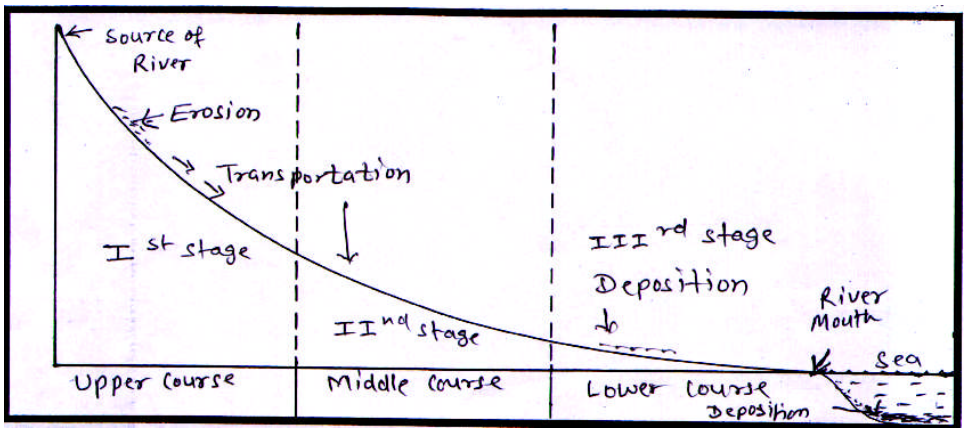



**Figure: 3.4. Stages of River and its work in different stages**

A river valley is deepened by vertical erosion and widen by lateral erosion. When river gradient is steep i.e. young stage or youth stage vertical erosion is dominant. When the river's gradient is very gentle i.e. old stage there is very little erosion but deposition dominant. However, in a mature stage lateral erosion is dominant.

**Check Your Progress:**

1. Explain the importance of a river.
2. Which are the processes of erosion by river?
3. Explain the cycle of erosion of a river.

## 3.4 EROSIONAL LANDFORMS PRODUCED BY WORK OF A RIVER

Different types of landforms features can be identified produced because of erosion carried by the running water of a river during its different stages from its source to its mouth. These features are developed in the upper course (1st stage) of a river.

**i) 'V' shaped valleys:** Rivers flowing with strong water force in the regions of heavy rainfall often leads to mass wasting that erodes its bank and bed rapidly forming steeper slopes on its sides to develop 'V' shaped valley **Figure 3.5.**

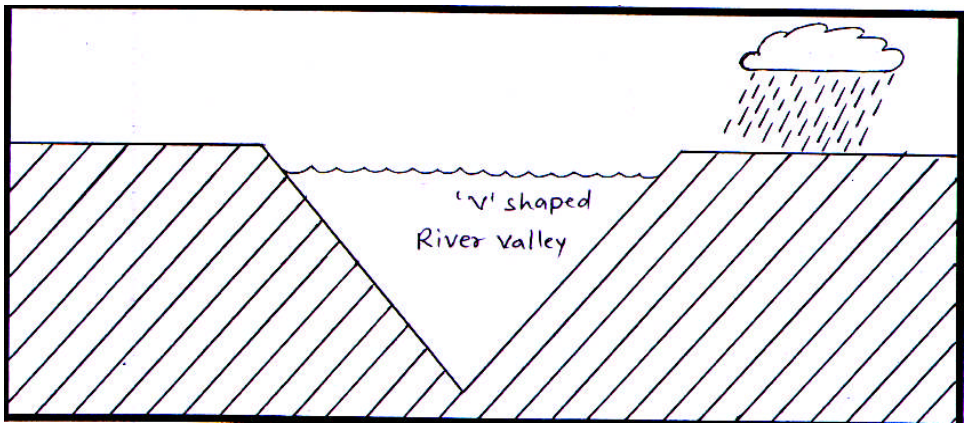



**Figure: 3.5. 'V' shaped Valley.**

**ii) Gorge:** It often forms when a waterfall retreats up stream. Gorge is formed in the mountains where vertical cutting is more rapid and strong than lateral cutting to develop very steep and deep valley, for example Ganga, Brahmaputra, Narmada. When they are large in size they are called as **Canyons** for example Colorado of U.S.A., figure 3.6.

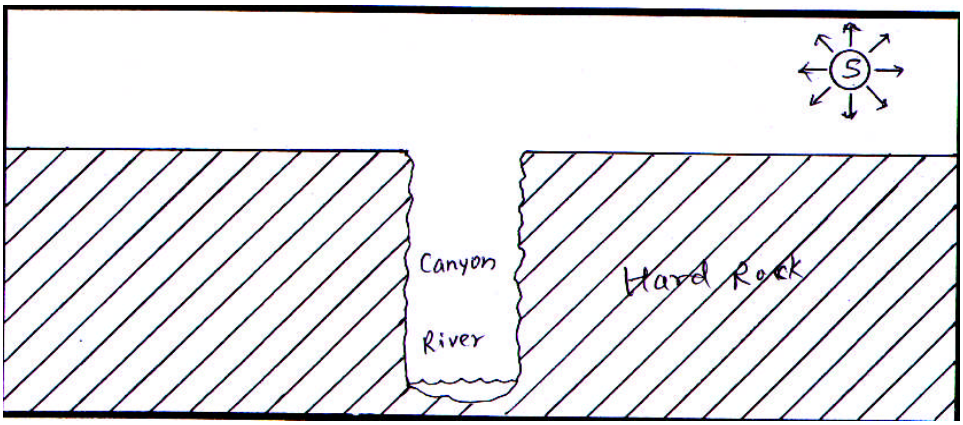



**Figure: 3.6. Canyon**

**iii) Pot Holes:** Pot Holes are commonly found along the upper couse of the river, where flows directly over solid bed rocks. Here, the water of a fast flowing river swirls if the bed of the river is uneven. The large and small pebbles carried by a swirling river cut circular depression on the bed of the river. These depressions gradully deepen the bed and are called pot holes, **Figure: 3.6.1** Much larger than such depressions of pot holes some times from at the base of a waterfall, known as Plunge pools.

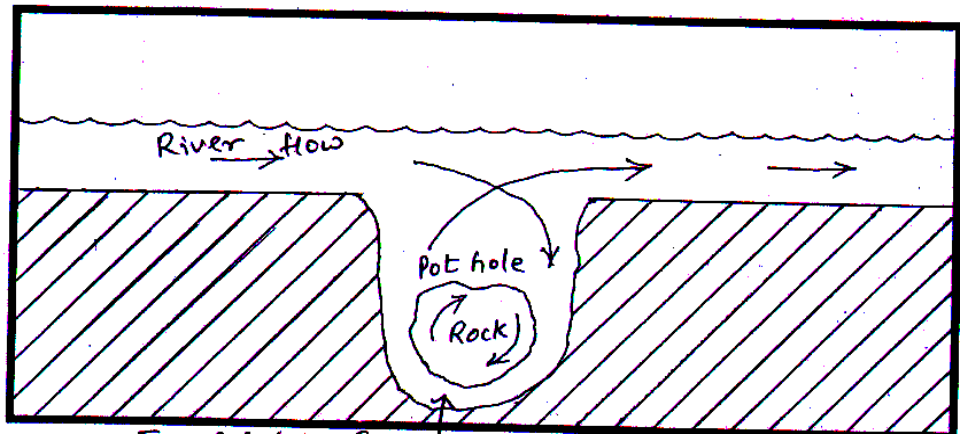



**Figure: 3.6.1. Pot Holes**

**iv) Interlocking Spurs :** When the river is in its youthful stage vertical erosion rapidly deepens the river channel. The river twists and turns around obstacles of hard rocks. There will be move erosion on the concave banks of bends of the river and this ultimately results into the formation of spurs, which are alternate on each side of the river to interlock. On the other hand, to the opposite convex bank there is very little erosion. Thus, interlocking spurs are one of a series of tapering ridges which alternately project into a river valley and around which the river winds its course **Figure: 3.7**.

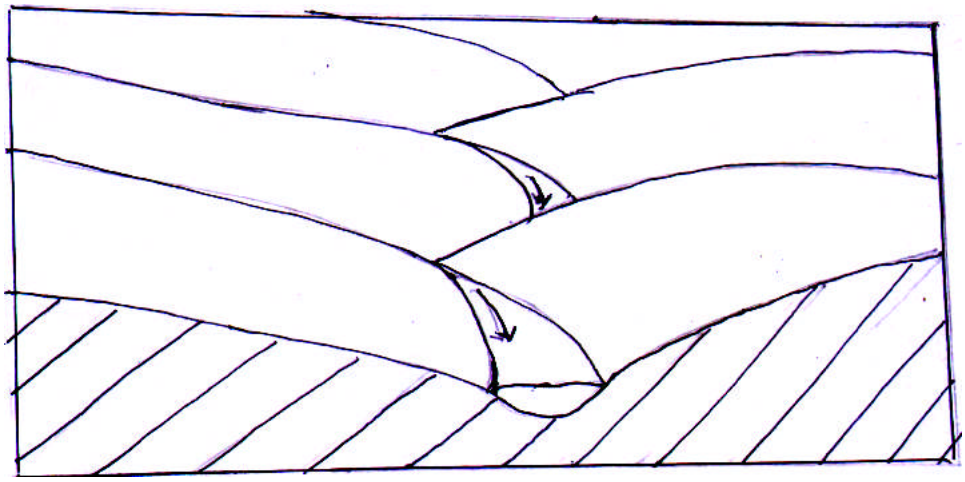


**Figure: 3.7. Interlocking Spurs**

**iii) Waterfalls:** When a layer of hard and soft rock lies across a bed of a river, the soft rocks on the down-stream side are more quickly eroded than soft rocks. The river bed thus steepened where it crosses and thus waterfall is developed. A waterfall develops when the hard rock layer is horizontal, dips gently upstream or is vertical. Continuous erosion causes waterfall to retreat upstream forming a deep valley **Figure: 3.8.**

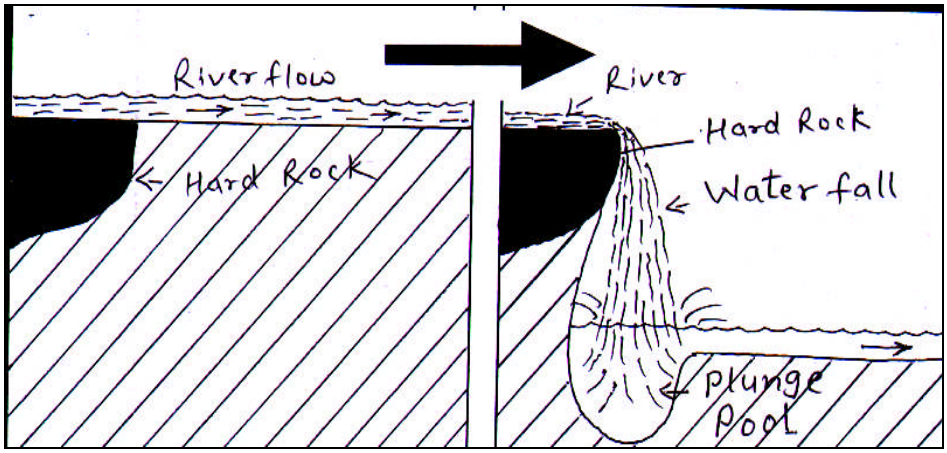



**Figure: 3.8. Waterfall**

**iv) Rapids:** These features are found in the mountain areas where the underlying rock structure is composed of alternately hard and soft composition. Thus the soft rock is eroded easily while the hard resistant rock remains at its place to develop rapids that appear as step like structure **Figure 3.9**.

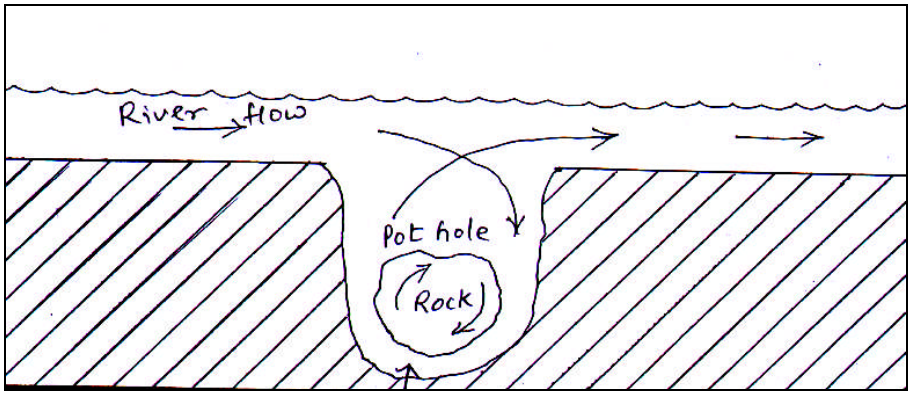



**Figure: 3.9. Rapids**

## 3.5. THE DEPOSITIONAL FEATURES DEVELOPED BY THE RIVER WORK IN ITS MATURITY (2ND STAGE) ARE :

**i) Alluvial fan**: The force of the river slightly reduces due to decrease in slope that causes deposition of large materials in the bed of a river. As a result its flow further slows down due to obstruction causing more deposition. The river tries to find its way by developing channels in its bed to flow downward. The shape thus created appears like a fan and since the deposited is fine soil it is termed as alluvial fan **figure 3.10.**

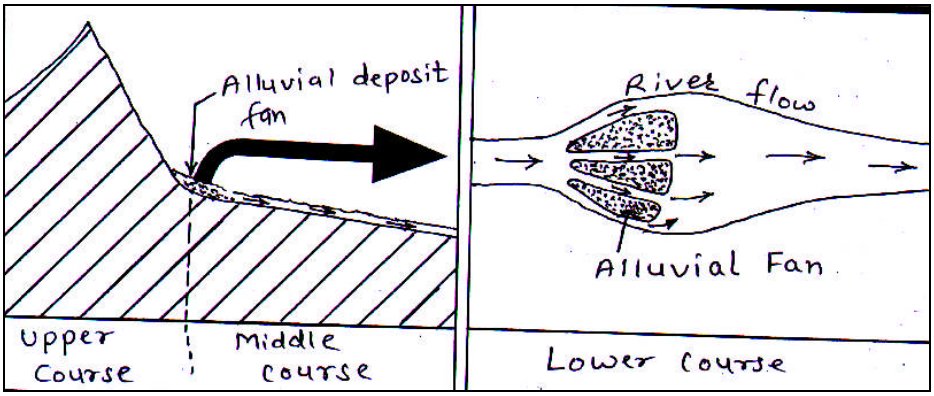
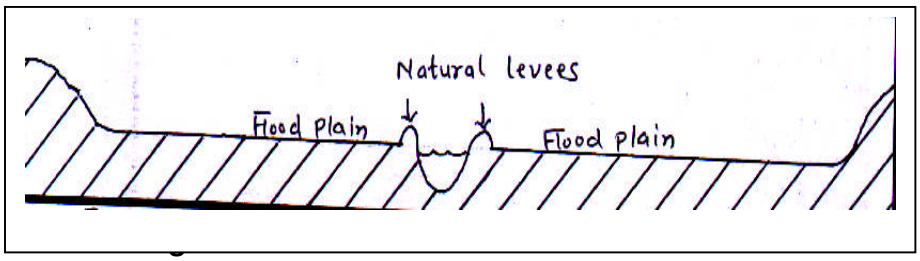



**Figure 3.10.Alluvial Fan**

**ii) Flood Plain and Natural Levee:** Flood plain area of periodic flooding that occurs inland along the course of river valleys. When the river discharge exceeds the capacity of channel, water rises over the channel banks and floods the adjacent low-lying area. As water spills out of the channel some alluvium will be deposited on the banks to form levees **figure 3.11.** This water will slowly seep into flood plain, depositing a new layer of rich fertile alluvium. Many important flood plains such as Ganga, Brahamaputra, Nile, Mississippi are found in different parts of the world.

**Levee** is a naturally formed raised bank along the side of a river channel. When river overflows its banks, the rate of in the flood area is less than that in the channel and silt is deposited. After water have withdrawn the sit is left on bank of the river, which grows during successive floods. Slowly the height of levee increases above the surrounding flood plain. Notable levees are found on the lower reaches of the Mississippi river in U.S.A. and Po river in Italy.

In times of sever floods, sometime, levees burst, through which water spreads out over surrounding flood plains; and produce disastrous floods.



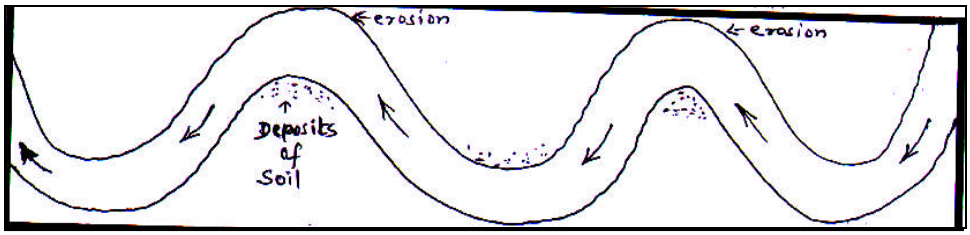



**Figure 11 A : Meandering River**

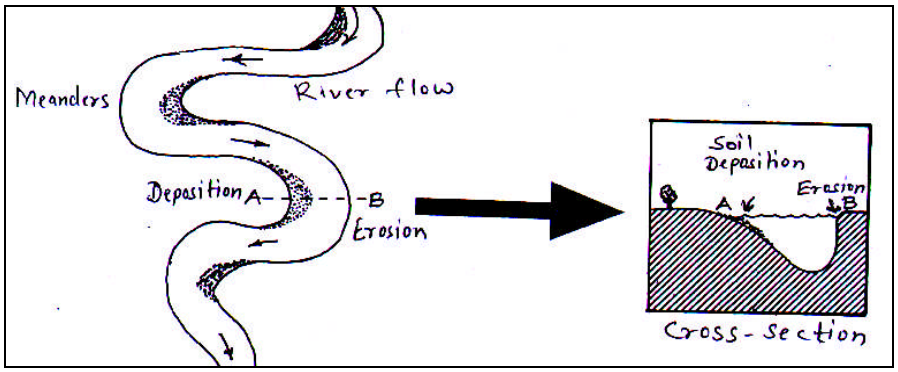



**Figure 11 B : Meandering River & Cross Section**

## 3.6. DEPOSITIONAL LANDFORMS DEVELOPED DUE TO WORK OF A RIVER:

As flow of water becomes relatively slow and wide due to the gently sloping land or lowland the large amount of material carried and transported by a river from the uplands is thus deposited in its different parts. This obstructs the flow of water and over the time this continuous process gives rise to the formation of different types of depositonal landforms. These are:

**i) Meander and Oxbow Lake:** A sweeping course of a river is known as meander or the curves formed in the course of a river are known as **meanders**. A meander usually has a steep slope on its outer curve, where the velocity of the river is high and therefore, erosion is greatest and a gentle on the inner curve, where the velocity is slowest. Generally, meanders the gradient is gentle, discharge is fairly high steady and material carried is fine.

**Oxbow lakes** are curved lakes found on the flood plain of a river. Oxbow lakes are cused by the loops of meanders being cut off at times of flood and a river subsequently adopting a shorter course **figure 3.12**

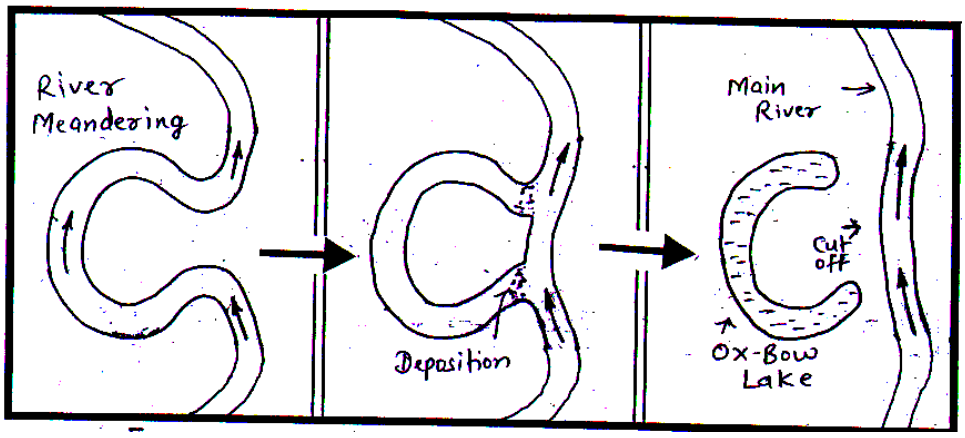



**Figure 3.12. Meander and Oxbow Lake**

**iii) Deltas:** A large, roughly triangular shape body of sediments deposited at the mouth of a river is known as Delta **figure 3.13**

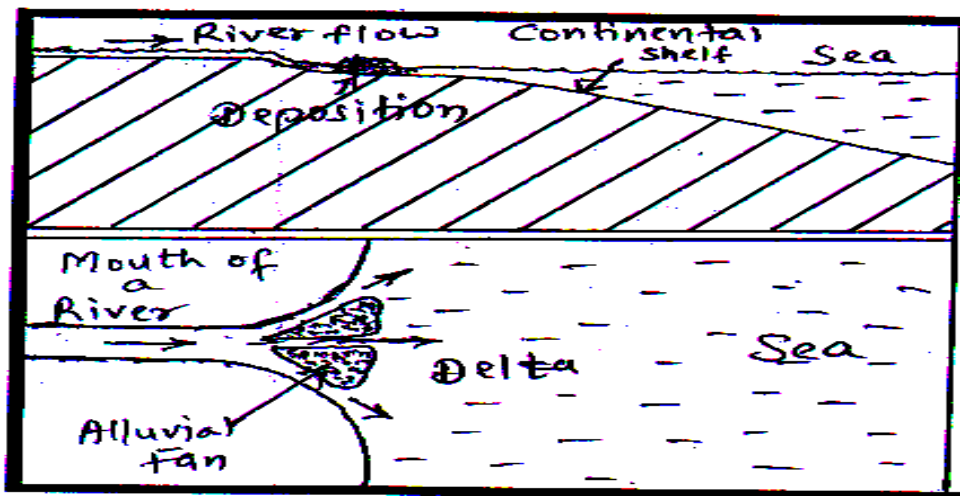



**Figure: 3.13 Deltas**

Most of the eroded material is carried by a river is ultimately deposited into the sea or a lake into which it flows. Such eroded material sometimes is collected in the mouth of a river. This material builds up into low lying swampy or marshy plain. Such plain is called delta.

As deposition of the material brough by the river goes on increasing in the mouth of the river, the river is forced to divide into number of channels. Each channel is further divided into more and more channels. All these channels are called **distributaries.**

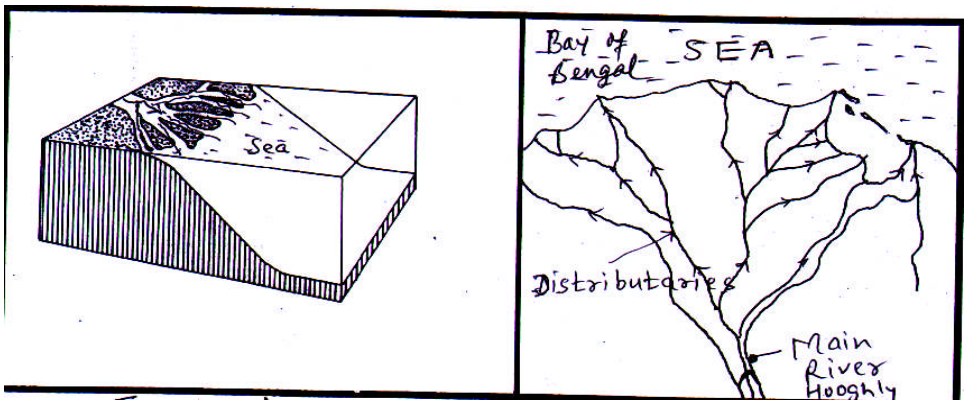



**Figure: 3.14. shaped Delta**

- **Types of Delts : There are three types of deltas :**

a) Arcuate Delta b) Birds Foot Delta c) Estuarine Delta.

**a) Arcute Delta:** This is very common type of delta. This type of delta is composed by course sediments, such as sand and gravels. eg. Nile Delta. Such delta has a number of distributaries other examples of this type of delta are Ganga, Indus, Irrawddy, Mekong etc.

**b) Bird's Foot Delta:** This type of delta is made up of very fine sediments called silt. The river channels are divided into few distributaries, clearly defined channels across the delta. The best example of this type of delta is the delta of Mississippi river in U.S.A. This type of delta develops in seas which have few ocean currents and tides to disturb the deposited sediments. **Delta figure 3.14**

**c) Estuarine Delta :** This type of delta develops in the mouth of a submerged river such delta takes the shape of estuary **figure 3.15**. The best examples of this type of delta are Elbe river in Germany, ob in Russia and Vistula river in Poland.

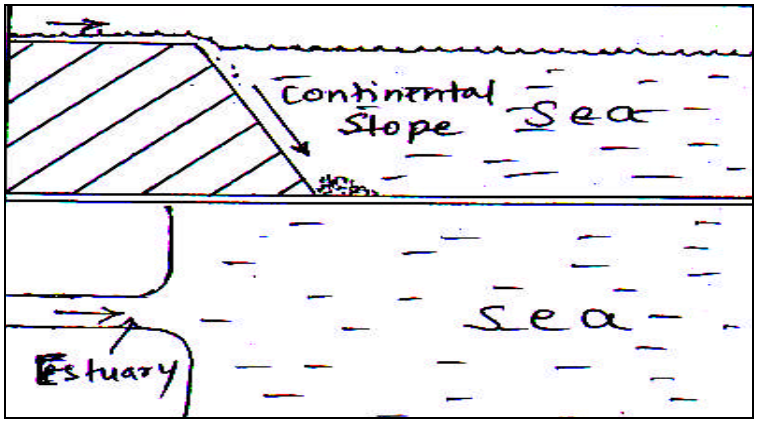



**Figure 3.15. Estuarine Delta**

- **Necessary conditions for the formation of Delta:**

For the formation of delta the river must have large quantities of eroded material. In order to have large quantities of eroded material, the river must have active erogen in its upper course of its valley.

The material brought by river must be deposited at the faster rate than it can be removed by the action of ocean currents and tides.

- **Rejuvenation**

The renewal of river's power of downword erosion is known as rejuvenation of a river. It may be caused by a fall in sea level or rise in land level, its old flood plain perched upon the valley side to form a river terrace. Meanders become deeper and their sides more steep, forming incised meanders, waterfalls and rapids become more common.

**Check Your Progress:**

1. Explain with diagram the erosional landform features developed by a river in its Youth Stage.
2. Explain with diagram the landform features developed by a river in its Maturity Stage.
3. Which are the depositional landform features developed by a river. Draw neat diagrams to explain them.

## 3.6. CONCLUSIONS :

It is thus important to note that rivers also play an important role in determining and shaping the landscape features as well as in the provision of fresh water resources in different parts along its course. Each type of landscape provides with some or the other useful resource for the ecosystem and so to the mankind on this earth.

## 3.7 QUESTIONS :

1. Describe the characteristic features which commonly occur in the river valley during its youth stage.
2. Describe the characteristic features which commonly occur in the river valley during its old stage.
3. With the help of neat diagrams explain the following:
   i) Flood plains and natural levee
   ii) Delta may occur.
4. Write short notes on the following:
   i) Interlocking spurs and waterfall.
   ii) Flood plain and Natural Levee.
   iii) Meander and Oxbow lake
   iv) Delta.

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# Unit - 4

## WORK OF GLACIER AND WORK OF UNDERGROUND WATER

**Unit Structure:**



## 4.0. INTRODUCTION

A Glacier is a moving mass of ice. It can be considered a river of ice, but the velocity of movement in glacier is lesser than that of a river. In fact the movement is very slow. When a lot gets accumulated in slopy areas, the elower4 layers of accumulation attain a momentum in the downward direction under the influence of gravitational force. Movement in ice is possible in relatively flat areas also. Glaciers originate in areas where the most of the precipitation occurs in the form of snowfall. Polar ice caps and high mountain areas are the major sources areas of formation of glacier. Glaciers today, except in high latitudes and at high altitudes are of minor importance in shaping of landforms. But those that existed some 200 to 250 million years ago left their imprints upon millions of square kilometers of the earth's surface in Northern part of North America, Europe, Asia and Antarctica. Thousands of glaciers existed in mountains, but today there are either no glaciers or are only small ones.

Masses of ice which covers large areas of continents are called Ice sheets and those which occupy mountains and valleys are called Valley Glaciers. Today, ice sheets occur in Himalayas, Andes, Alps and Rockies.

Glaciers play a crucial role in the lives of many people. Glaciers store water which is slowly released through melting process thus making it available during the dry season when there

is almost no rain. Melting glaciers provide freshwater resources to local communities settled at the base of these ice masses in the temperate, polar and high altitude regions. For example, rivers flowing in northern part of India from Himalayas are therefore perennial and provide water to the northern plains of Indus, Ganga and Brahmaputra river basins. The Gangotri Glacier, one of the largest glaciers in the Himalayan Mountains, is the source of the Ganga River. The Ganga is the most important source of freshwater and electricity in India and Bangladesh. (Electricity is created by dams and hydroelectric power plants along the Ganga.) Hence these regions are rich in agriculture with very high population densities. Glaciers also play an essential role in regulating weather systems. **Glaciers** are **important** indicators of global warming and climate change in several ways. Melting ice sheets contribute to rising sea levels. As ice sheets in Antarctica and Greenland melt, they raise the level of the ocean. Tons of fresh water is added to the ocean every day.

With increasing temperature due to global warming most of the ice of the earth surface has melted. However, there are still extensive areas around the poles and smaller areas in the high mountain areas mentioned above, where glaciers are in existence.

## 4.1. OBJECTIVES :

- To understand the importance of glaciers
- To study the work of glaciers in the formation of different landform features.
- To study the spatial distribution and location of landforms developed by glaciers.
- To understand the importance of underground water
- To study the work of underground water in the formation of different landform features.
- To study the spatial distribution and location of landforms developed by underground water.

## 4.2. WORK OF GLACIER :

Glaciers erode and transport a lot of material from the highlands to the lowlands. Erosional work by glacier is carried through **abrasion** (friction) and **plucking** (wearing and tearing of frozen blocks of rocks at the base and of the path of glacier).

## 4.3. EROSIONAL AND DEPOSITIONAL LANDFORMS DEVELOPED BY GLACIAL ACTION :

- **Erosional landforms:**

i) **U-shaped valley**: 'U' Shaped valley is developed because of simultaneous plucking and abrasion of solid glacier flows. Glacial valley is steep with wide base as top giving the shape of **'U' (Figure 4.1.)**. In U-shaped valley, sometimes waterfalls from hanging valley build up alluvial fans of coarse material.

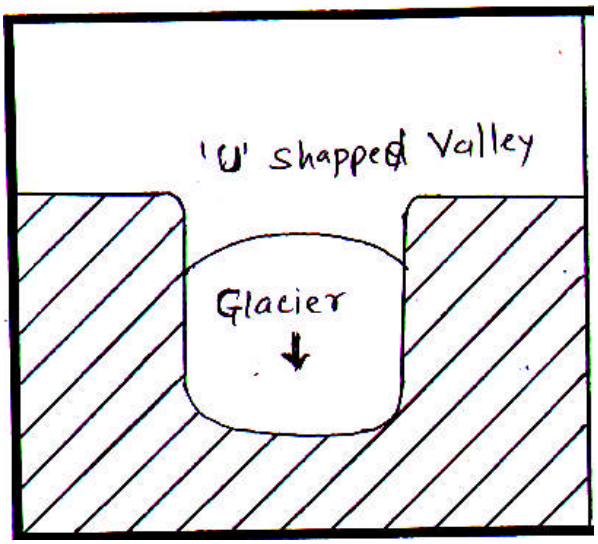


**Figure 4.1 : U Shaped Valley**

ii) **Hanging valley**: Hanging valley develops when vertical erosion of the main valley is much faster and greater than that of tributary valley, which contain many small or no glaciers. After glaciers has retreated the floor of the main valley lies far below the floor of the tributary valley appearing as **hanging valleys (Figure 4.2.)**. The streams of hanging valleys join the main glacier via waterfalls, which may be several hundred meters high.

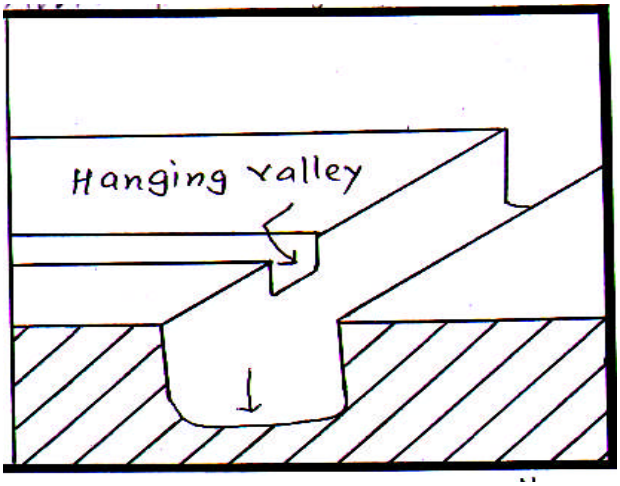


**Figure 4.2 : Hanging valley**

iii) **Cirque:** A cirque is a semi-circular steep sided depression formed through glacial erosion. A cirque is formed at the head of a valley glacier where snow accumulates and gets compacted in the depressions to form a **cirque** glacier that flows down the slope to feed the valley glacier **(Figure 4.3.)**.

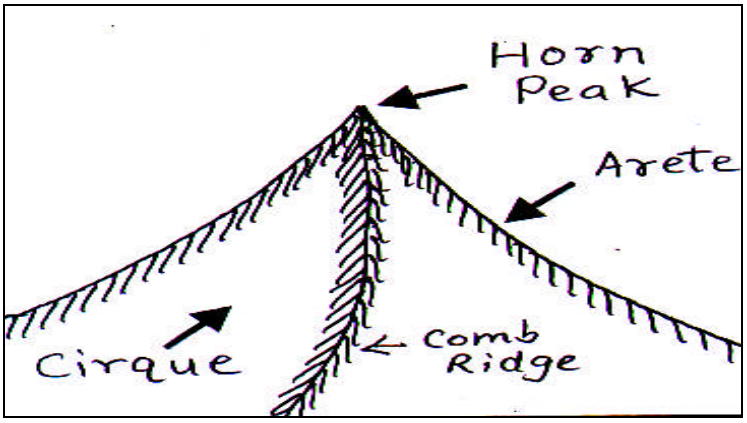


**Figure 4.3 Cirque, Arete and Horn Peak**

iv) **Giant Stairways**: A series of small cirques formed one above the other on an undulating slope is called as **Giant stairways**. They are giant in size and appear like a series of steps on the mountain slope.

v) **Aretes and comb ridges**: When cirques are formed on two sides of a mountain range the mountain divide becomes narrow due to cutting backwards by the glaciers on the opposite sides. Such steep –edged ridges are called **arêtes (Figure 4.3.).**

The edge of an arête appears like the blade of a knife from distance. Some of the glaciers eating backward, cut through the ridge passages that look like a series of narrow passes at high altitude. The ridge thus attains the shape of a comb. Such a discontinuous ridge is called a **comb ridge (Figure 4.3.)..**

vi) **Horn**: When many glaciers develop cirques on the opposite slope of a ridge, they cut across parts of the ridge top forming wide gaps. The consecutive gaps are separated by tall remnants of ridge. These higher remnants of the ridge are called **horns. (Figure 4.3.)**

vii) **Col, pass, and saddle:** When two glaciers develops cirques on the opposite sides or slopes of a ridge, and they meet by cutting across the ridge, a passage of sag is formed, leaving two horns on the two sides or leaving arêtes on their sides. Such a sag or gap in the ridge is called a '**Col**'. When 'Col' is lowered sufficiently through erosion so that they are used regular

crossing across the ridge, they are called as **'passes'**. A very wide pass is known as a '**saddle'.**

viii) **Nunatak:** A **Nunatak** is a solitary peak surrounded by ice and cirques on all sides which looks like an island in the snow. These features are common in tundra region where mechanical and chemical weathering transform these Nunataks to a lower ordinary rock.

ix) **Crag and Tail:** Differential erosion rate of hard and soft rock in glacial region creates crag and trail topography by glaciers. The area which experiences glacier flow causes erosion to from a steep slope forming Crag. Whereas the other sides are protected from erosion and forms a long gentle tail **(Figure 4.4.).**

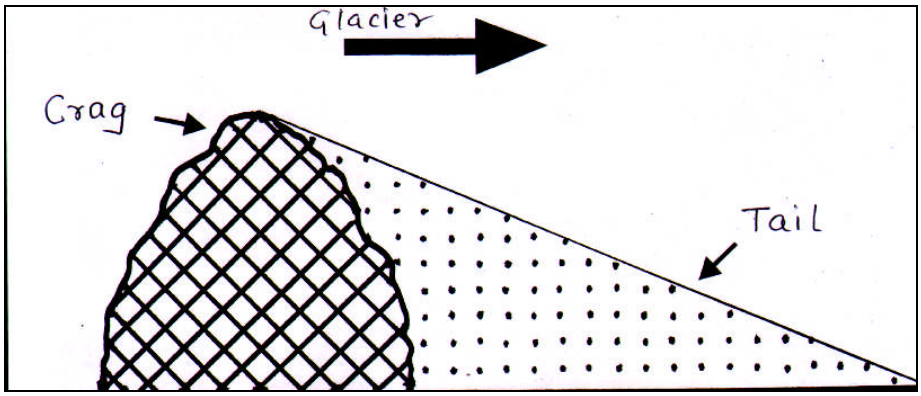


**Figure 4.4 Crag and Tail**

x) **Truncated spurs/ Kames and Roches Moutonnees**: In general, glacial troughs are straighter than normal valleys. Glacial troughs do conform to original valley course, but stream of ice may straighten their troughs by abrasion of spur ends and there by produce truncated spurs. A **truncated spur** is a steep bluff on the side of glacial trough, protruding between tributary, possibly hanging valley. **Roches moutonnees** are streamlined asymmetric hillocks, mounds or hills having one side smoothly moulded wit gentle slope and the other side with craggy steep slope **(Figure 4.5.).** They are found in the glacier valleys of Kashmir Himalaya.

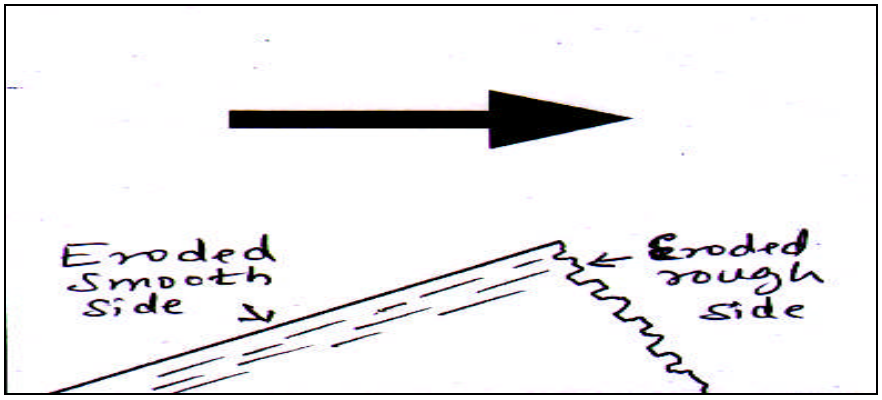


**Figure 4.5 Roches moutonnees**

xi) **Rock basins:** Basins formed by abrasion glacial erosion in snow covered areas are called as **rock basins**. These rock basins are large in size and shallow in depth which are developed in valleys and are filled with water. For example Five Great Lakes of North America.

xii) **Fiord**: Glacial troughs occupied by the sea are called as **'Fiords'.** Fiords are deep near the coastal area and become shallow at a distance towards the sea. For example they are found in Norway, Finland, Sweden, Labrador, Alaska, and British Columbia.

- **Depositional landforms:** They are developed due to settling of glacier sediments of varying size. They include moraines or morainic ridges and drumlins.

**i)** **Moraines:** A **moraine** is any glacially formed accumulation of unconsolidated glacial debris (soil and rock) that occurs in glaciated regions. There are four types of moraines classified on the basis of their formation and location in the glacier region **(Figure 4.6.).** These are:

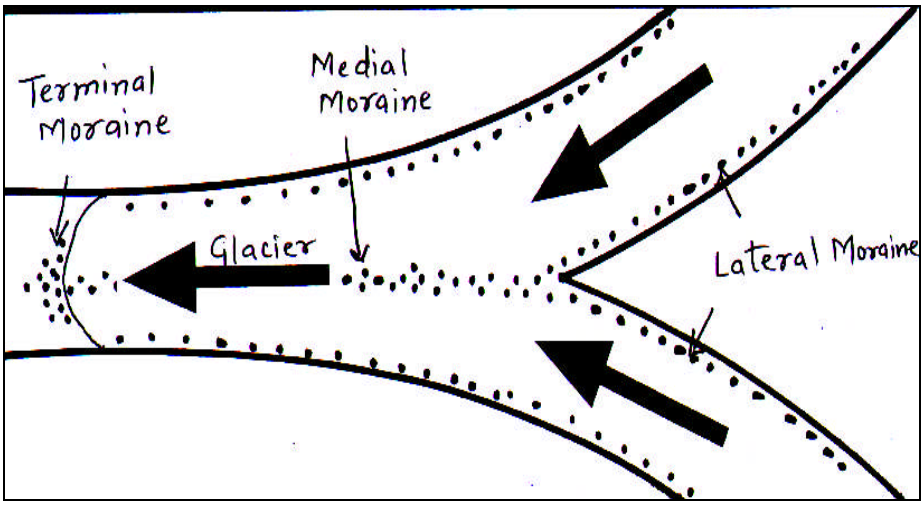


**Figure 4.6 Types of Moraines**

a) **Terminal moraines:** They are also known as end moraines formed due to deposition of glacial till across the moving ice sheets at the snouts of glaciers after ablation of ice.
b) **Lateral moraines:** These are parallel high ridges of debris that are deposited along the sides on the top of the glacier that get preserved**.**
c) **Medial moraines**: is a ridge of moraine running down the center of a valley floor. Medial moraines are formed at the confluence of two glaciers where the debris on the edges of the adjacent valleys sides join and are carried on top of the enlarged glacier. After the melting of the glacier or its retreat the debris is deposited and a ridge down the middle of the valley floor is created. These are medial moraines. The Kaskawulsh glacier in the Kluane National Park, Yukon , Canada.

d) **Ground moraines**: Ground moraines are till-covered areas with irregular topography often forming gently rolling hills or plains **(Figure 4.7.).** Ground moraines are formed when the till melts out of the glacier in irregular heaps, forming rolling hills. They are accumulated at the base of the ice as lodgment till, but may also be deposited as the glacier retreats. In alpine glaciers, ground moraines are often found between the two lateral moraines. Ground moraines may be modified into drumlins by the overriding ice.

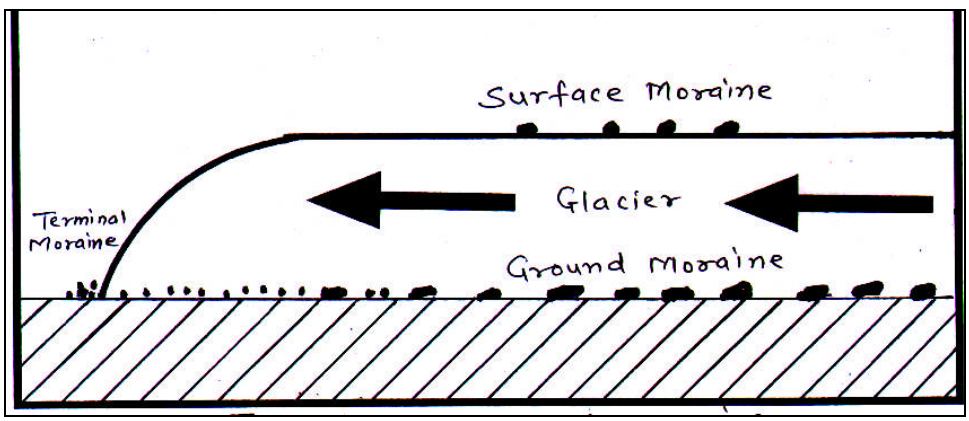


**Figure 4.7 Types of Moraine**

ii) **Till plains:** A **till plain** is an extensive flat plain of glacial till that forms when a sheet of ice becomes detached from the main body of a glacier and melts in place, depositing the sediments it carried. For example, Wisconsin glaciations covering much of northern Ohio in Canada.

**iii) Drumlins:** are swarms of rounded hummocks resulting from the deposition of glacial till are called as **'drumlins'.** They vary in height from 10 to 70 metres or more and in length from a few kilometers to several hundred kilometers. A typical drumlin is

half ellipsoid in shape much like inverted spoon, but many variations in shape are found. Generally, drumlins display a striking parallelism. There are four major belts of drumlin in North America: an area in New England, Southern New Hampshire, Eastern Massachusetts, a belt in New York and Ontario in southern and northern part

**iv) Outwash Plain:** The area beyond the margins of a glacier where melt water deposit sand, gravel and mud washer out from the glacier. The outwash plain becomes progressively finer down valley and grades into silts and clays in the lower valley courses.

v) **Eskers:** are common features in the areas of continental glaciations when stagnation of ice takes place. These are sinuous ridges that are stratified sand and gravel filling the super glacial channels **(Figure 4.9.).**


**Figure 4.9 Esker**

vi) **Erractics:** Deposition of rocks from upper and middle course to the lower course from different regions by glaciations is called as erractics **(Figure 4.10).**

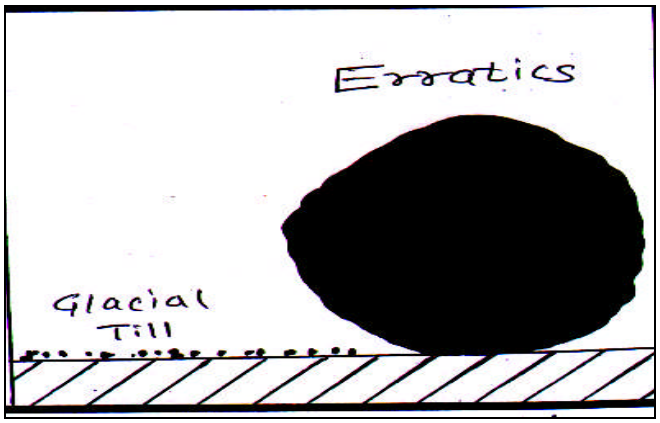


**Figure 4.10 Erratics**

**Check your progress:**

1. Define Glacier.
2. Where do glaciers form?
3. What is the importance of glaciers?
4. What is the work of glacier?

## 4.4. WORK OF UNDERGROUND WATER (KARST TOGORAPHY)

### 4.4.1. Introduction:

Rainwater that percolates underground reaches the surface through springs or is extracted through artesian wells **(Figure 4.11.)**. This is possible if the surface rocks are porous and the underlying deep below is impervious. The subsurface water (underground water) flows down the slope and oozes out as spring along the hill/mountain slope as springs **(Figure 4.12)**. Areas lacking in surface water bodies extract subsurface water by digging wells. However depending upon the amount of rainfall and amount of water availability underground the water-table level keeps fluctuating. Some wells have gone dry, some are seasonal while others may be perennial **(Figure 4.12).**

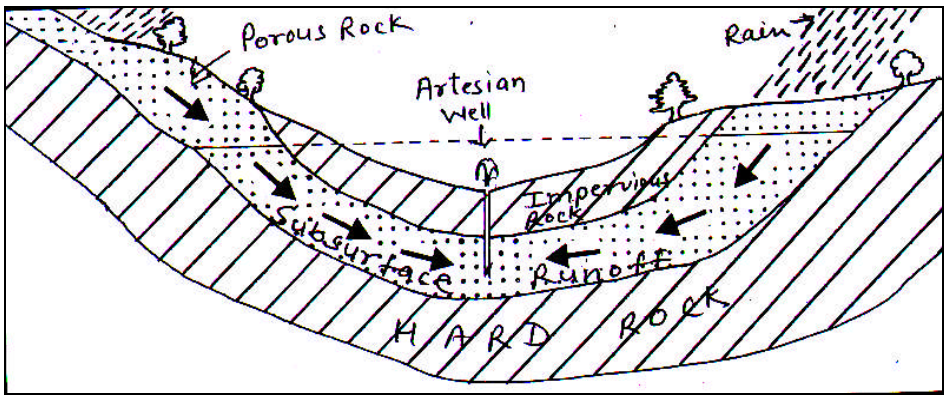


**Figure 4.11 Artesian Well**

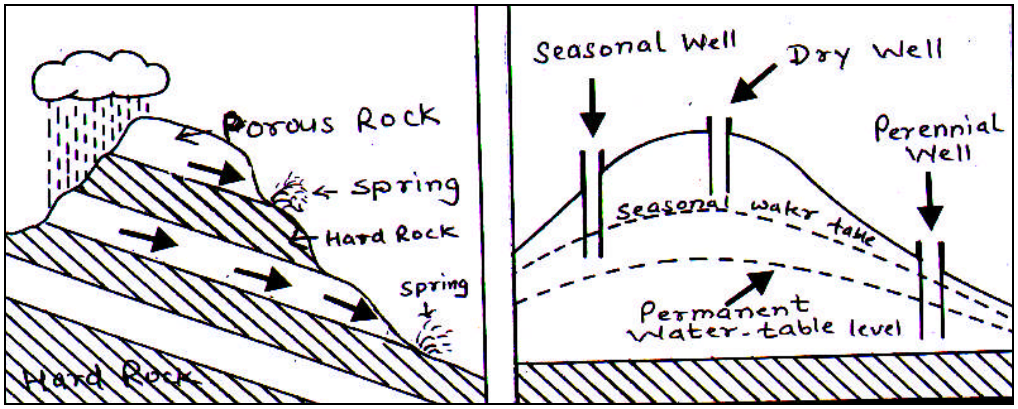


**Figure 4.12 Springs and Wells**

Karst topography is a landscape which is formed due to the dissolution of soluble rocks including limestone, dolomite and gypsum. It is characterized by sinkholes, caves, and underground drainage systems. Nearly all surface karst features are formed by internal drainage, subsidence, and collapse triggered by the development of underlying caves. Rainwater becomes acidic as it comes in contact with carbon dioxide in the atmosphere and the soil. As it drains into fractures in the rock, the water begins to dissolve away the rock creating a network of passages. Over time, water flowing through the network continues to erode and enlarge the passages; this allows the plumbing system to transport increasingly larger amounts of water. This process of dissolution leads to the development of the caves, sinkholes, springs, and sinking streams typical of a karst landscape.

### 4.4.2. Conditions Essential for the development of Karst :

Development of Karst topography needs following four conditions:

**i) Soluble Surface Rocks :**

The rocks at the surface need to be soluble that are preferably limestone.

**ii) Nature of soluble Rock :**

Secondly, the soluble rock should be dense, highly jointed and preferably thinly bedded.

**iii) Existence of Entrenched Valley :**

Third condition which favours excellent development of Karts is the existence of entrenched valleys below uplands underlain by soluble and well jointed rocks. This favours ready downward movement of groundwater through rock

**iv) <u>Moderate Rainfall Region</u> :**

Finally, the region must be of moderate rainfall. It is important to note that all notable Karts regions are in areas of moderate rainfall. In general, arid and semiarid regions do not exhibit marked development of Karts.

**4.4.3. <u>Characteristic of Limestone Region</u> :**

The most important characteristic of limestone region is the almost complete absence of surface drainage. The permeability of limestone permits rain to soak into it very easily.

- **Erosional landforms:**

i) **Terra Rossa:** In the gentle slope of limestone region the descending solution of groundwater leaves behind a residue of red, clayey soil on the surface which extends down upto the opened joints. Under oxidizing conditions, when the soils are above the water table, iron oxide (rust) forms in the clay. This gives it a characteristic red to orange colour. This residual soil is called as **Terra Rossa.** Terra Rossa is typically found in regions with a Mediterranean climate.

ii) **Lapies/ Karren / Bogaz:** Limestone surface exposed at high relief with running water across the surface of blocks forms straight, grooved, pitted, etched, fluted, rugged surface called as **Lappies.**

iii) **Dolines and Uvala**: When Swallow holes join together, producers very large opening called a **doline**. Likewise dolines may join up to give even larger openings are called **Uvala.**

iv) **Swallow-holes or sink holes:** Rivers rising in a non-limestone region sometimes flow into a limestone region. If this happens such rivers disappear into swallow holes or sink holes in the surface and continue to flow inside the limestone as Underground River. Small vertical holes are known as Sinkhole and larger holes are known as swallow holes.

v) **Karst lake:** Karst lake are formed due to clogging of doline within washed clay that starts holding water above the regional water table level.

vi) **Karst window:** They are formed due to the collapse of upper surface of sink-holes or dolines.

vii) **Polje:** Most extensive and larger depressions formed in karst topography are called **Polje.** For.eg. karst region of Jamaica and Yugoslavia.

vii) **Blind valley:** The valley of a surface stream in limestone formation region disappears through a swallow hole or sink hole is termed as **blind valley.**

**viii) Underground Caves and caverns:** Caves are most significant landforms produced by erosional works (mainly corrosion, solution and abrasion) of groundwater in limestone lithology. Some underground caves are of great size e.g. in U.S.A and New Mexico State there is very large underground cave known as Carlsbad and Mammoth caves. They are 1219 meters length, 190 meters wide and 300 meters depth consisting of several chambers.

**ix) Hums:** Hums are residual hills that remain after the karst landscape has been fully eroded.

- **Depositional landforms:**

**i) Dripstone:** Some amount of water entering in the cave through a fracture from ceiling gets evaporated and a small amount of calcium carbonate is left behind. Such succeeding evaporation adds more calcium carbonate to form a cylindrical or cone shaped protrusion built downward from the ceiling is called as dripstone.

**ii) <u>Stalactites, Stalagmites and Pillars</u>:** There are a variety of depositional features in the caves, which add to their beauty. The most striking features are usually accumulations of calcium carbonate on the ceilings of the caves and floors of the caves. Downward extending of the deposition of calcium carbonate is known as Stalactites and the upward growing of the deposition of calcium carbonate is known as Stalagmites. When stalactites and stalagmites join each other, there is formation of pillars **(Figure 4.13.).** Sometimes the roof of an underground cave collapses and gorge with almost vertical sides develops. Little soil cover may occur in shallow patches, which support only a few scrubs and grasses in the limestone region.

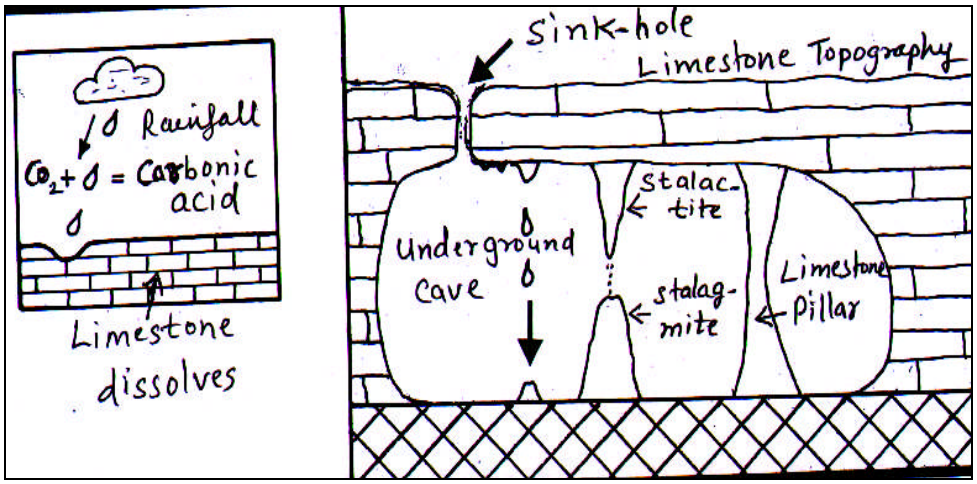


**Figure 4.13 Karst Land form features**

iii) **Drapes or curtains:** They are formed in caves when rivulet of underground water flows along an inclined roof. The curtain attached to the ceiling hangs downwards. The continuous dripping of water may be facilitated by roof joint, producing a fluted curtain or drapes across the cave. Other depositional features include Helictites, Globulites, etc.

**Check your progress?**

1. What is Karst topogaphy.
2. Where are karst topography formed?
3. What is the importance of Karst topography?

## 4.6 CONCLUSION:

Glaciers thus play a crucial role in the hostile regions and are a source of fresh water during summers that supports life in the polar, temperate and high altitude regions. Their importance further increases as many rivers in temperate and particularly in tropical areas are perennial because of the melting glaciers during summers providing freshwater sources to the people living in their surroundings. Different landform features developed by erosional and depositional process of glaciers provide a scenic beauty to the landscape that has promoted tourism activity in these areas and thus a source of income to the local community.

## 4.7 QUESTIONS :

1) Describe with illustrations the erosional landforms produced by glaciers.
2) Briefly explain the depositional landforms produced by glaciers.
3) What is the essential condition for the development of karst region?
4) Explain in brief erosional features of karst region. Give suitable diagrams
5) Explain with suitable diagrams the depositional landforms produced in karst region.

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# Unit - 5

## WORK OF WIND AND WORK OF SEA-WAVES

**Unit Structure:**



## 5.0. OBJECTIVES:

- To study the importance of wind and their types.
- To study the work of wind as an agent erosion and associated landforms.
- To study the work of wind as an agent deposition and associated landforms.
- To study the importance of sea waves and their types.
- To study the work of sea waves as an agent erosion and associated landforms.
- To study the work of sea waves as an agent deposition and associated landforms.

## 5.1. INTRODUCTION:

Winds play an important role in the changing the weather of an area that influences various human activities in the world. Winds are also responsible in shaping the landforms through different types of aeolian processes. Winds also act as agents for dispersal of plant seeds to produce various species in different areas. They act as natural cleansing agent by removing and dispersing the air pollution produced in an area. At times they are furious and may

lead of spread of wild fires in the forest; destroy the standing crop, bring down the trees and weak structures etc. The work of wind and the features associated with it are explained below:

## 5.2. WORK OF WIND (AEOLIAN LANDFORMS):

Wind is an important agent of erosion in deserts. Its work involves erosion of dry, loose, and unprotected geomaterials and their transportation and deposition. It is the most active agent of erosion in arid and semi-arid regions of tropical and temperate regions.

## 5.3. EROSIONAL AND DEPOSITIONAL LANDFORMS OF WIND:

- There are three processes responsible for erosional and depositional work carried by wind ( figure 5.1.). These are:

  **i)** **<u>Deflection</u> :** The process of removing, lifting and blowing away dry and loose particles of sand and dust by winds.

  **ii)** **<u>Abrasion</u> :** It breaks up rocks by sandblasting by wind when they hit sand particles against standing rocks.

  **iii)** **Attrition :** In this process the sand particles, while they are moving collide against each other and are converted into finer particles.

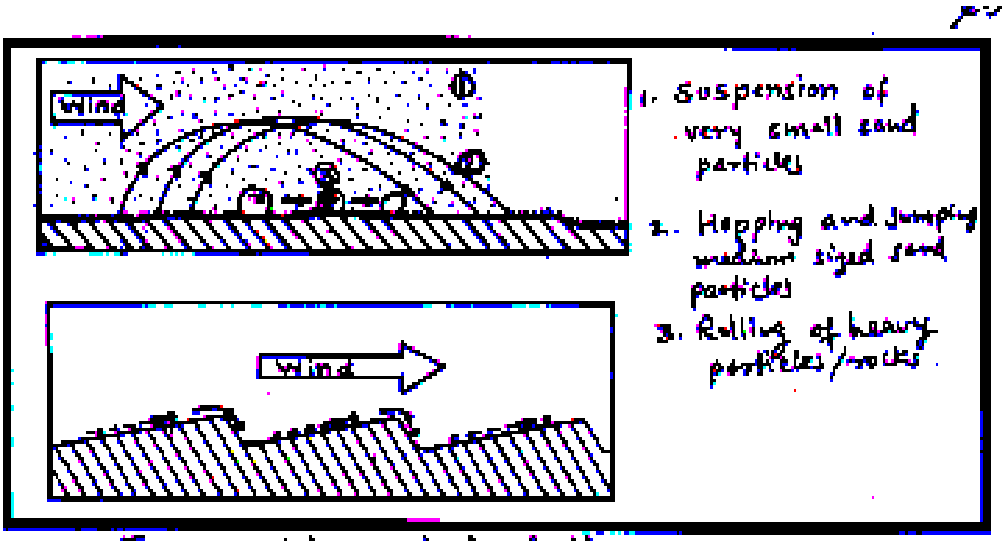


**Figure: 5.1. Wind Action**

- **<u>Features produced by Wind Erosion</u> :**

  Some of the features produced by wind erosion are as follows:

**i)** **Deflation Basin:** emoval of sand particles in large amount by strong winds blowing in a particular region gives rise to the formation of a basin. This feature produced by wind erosion is termed as **deflation basin Figure 5.2.**

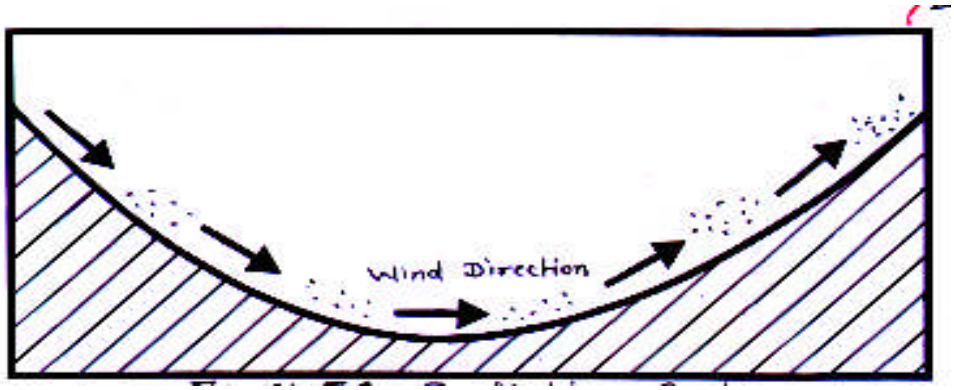


**Figure 5.2: Deflation Basin**

**ii)** **<u>Zeugen/ Mushroom Rock</u>:** It is also known as mushroom rocks in Death Valley California **Figure 5.3.**. This is an upstanding rock in desert, caped with a harder stratum and undercut by wind at base. It is indicative of differential erosion. The base is being softer, more easily eroded rock. They are more common in arid area such as eastern province of Saudi Arabia.

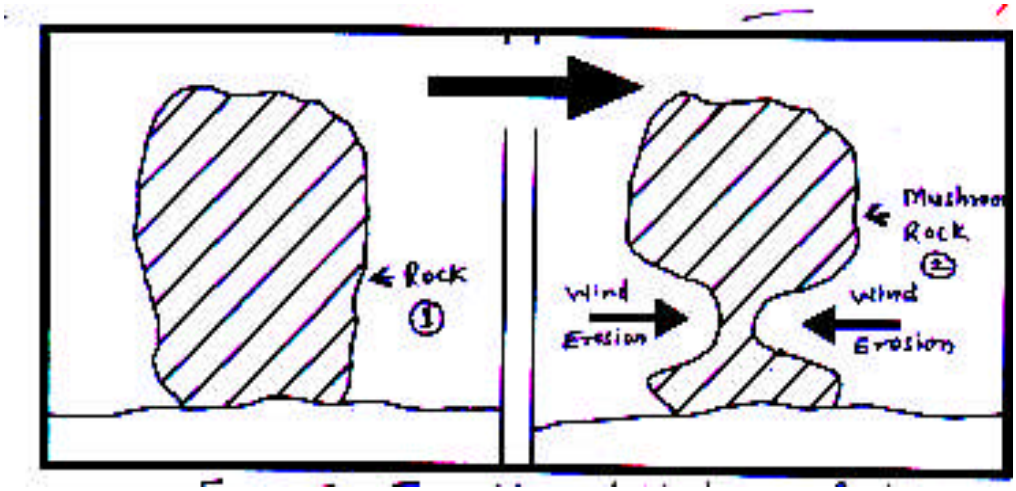


**Figure 5.3. Mushroom rock**

**Zeugen** may be as high as 30 meters. Ultimately they are undercut and gradually worn away. **Figure 5.4.**

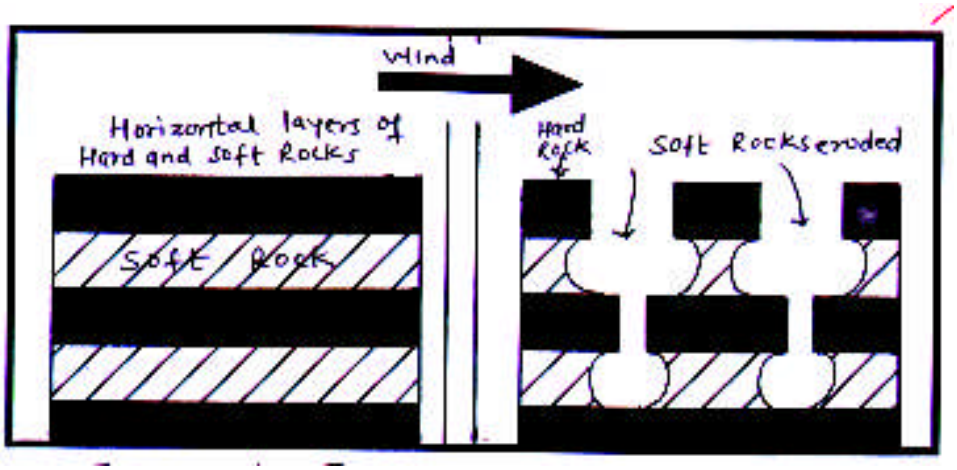


**Figure 5.4. Zeugen**

iii) **<u>Yardangs</u> :** Yardangs are formed by wind erosion when bands of hard and soft rocks lie parallel to the prevailing winds in a desert region. **Figure 5.5**. Such rocks are turned into ridge and furrow landscape by wind and abrasion. The belt of hard rock standup as rocky ribs up to 15 meters in height yardangs are very in the central Asian deserts and in the Atacama desert.

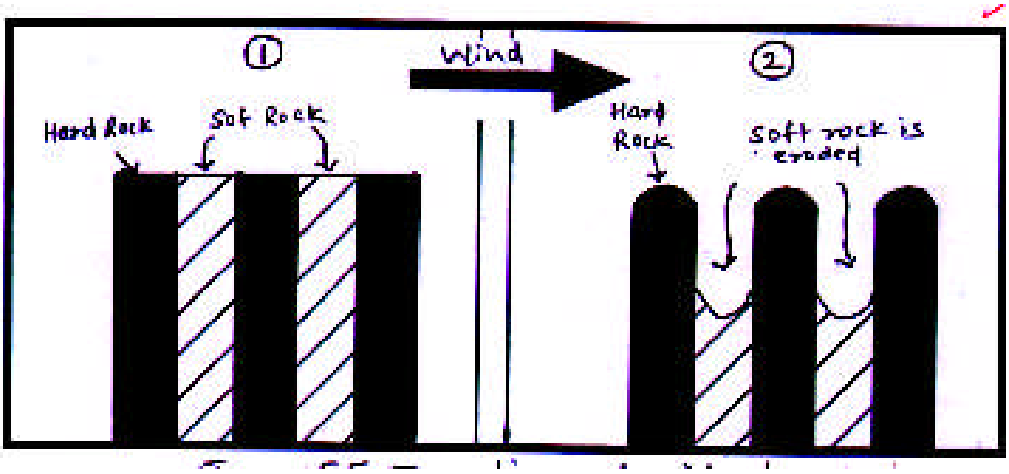


**Figure: 5.5. Yardangs**

iv) **<u>Inselberg</u> :** In some desert areas erosion by wind has removed all the original surface except for isolated pieces which stand up as round topped masses of rocks called Inselbergs . **Figure 5.6**. Inselbergs are common in Australian Desert, Kalahari Desert in Africa, Northwest Nigeria and parts of Algeria.

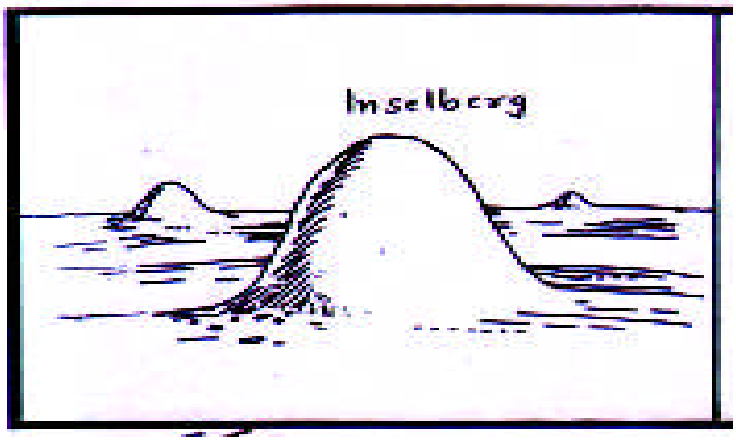


**Figure : 5.6. Inselberg**

v) **Rock Windows:** are formed by erosive action of a wind that are more prominent in a particular direction and area/point figure 5.7.

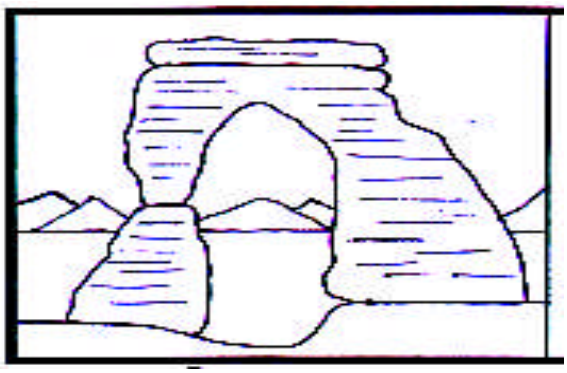

**Figure: 5.7. Rock Windows**

vi) **Mesa:** This landform feature is developed in semi or semi-arid region where the erosion of upland is uniform on the top giving rise to flat topped are called as **Mesa figure 5.8**

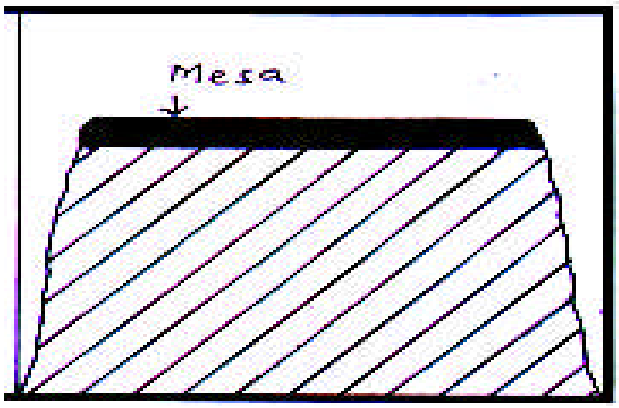


**Figure: 5.8. Mesa**

**vii)** **Vetifacts or Dreikanters:** Angular fragments of the rocks developed by wind erosion in the stony desert area is termed as **Ventifact or Dreikanters figure 5.9.**

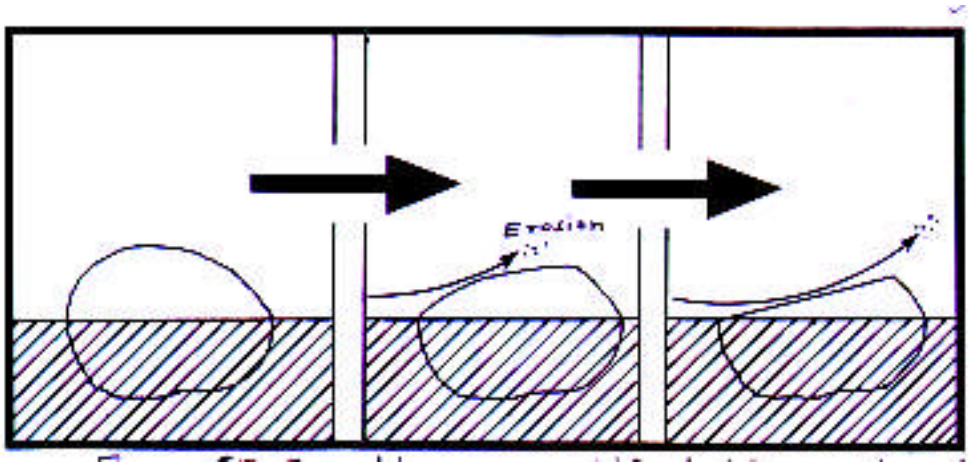


**Figure: 5.9. Vetifacts or Dreikanters**

**<u>Features produced by wind deposition</u> :** When very powerful wind blows across the desert, carry large amounts of desert dust and sand particles from one desert to another desert or in surrounding areas. When wind velocity decrease such material is immediately deposited, resulting in formation of some depositional features by wind called as sand dunes (figure 5.10).

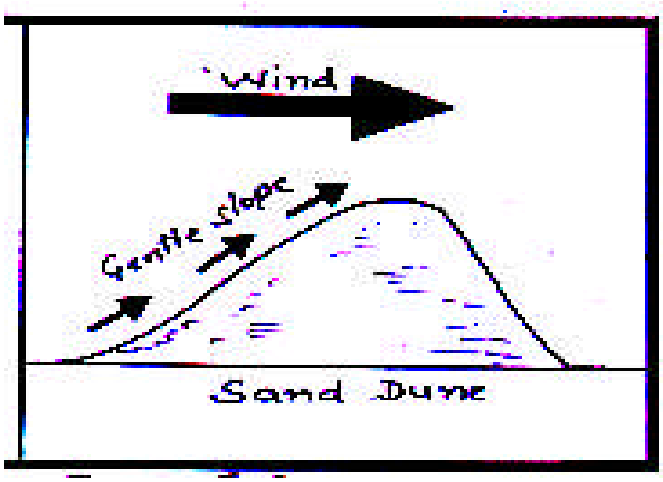


**Figure 5.10.Sand Dune**

There are two types of sand dunes i) Barkhan or crescent shaped dunes and ii) Self dunes.

**i)** **<u>Barkhan or crescent shaped sand dunes</u> :**
Barkhan is a crescent shaped dune, lies at right angles to the prevailing wind **Figure 5.11.** A barkhan usually develops from

the accumulation of sand caused by a small obstruction like a rock or some vegetation. As the mound of sand grows bigger and bigger its two edges are slowly carried forward down-wind and a typical crescent shape slowly develops. The windward face of barkhan is gently sloping but the lee-ward is steep and slightly concave. A barkhan moves slowly forward as sand particles are carried up the windward face and slip down the lee-ward side. The height of barkhan ranges from a few meters to 30 meters.

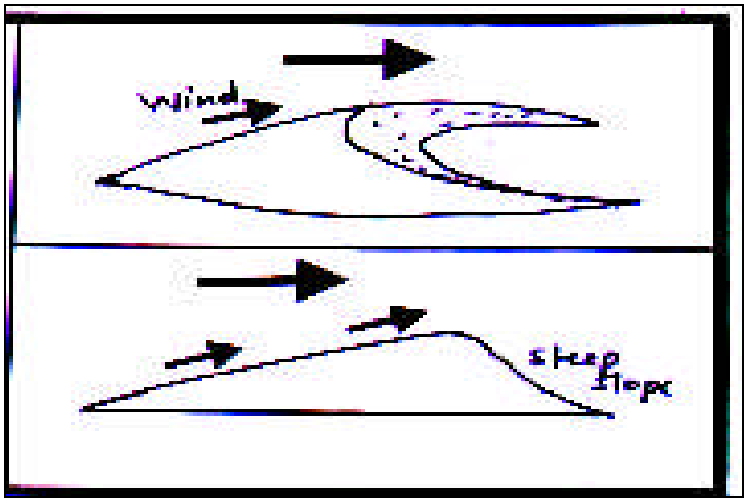


**Figure: 5.11. Barkhan / Crescent shaped Sand Dunes**

**ii) Seif Dunes:** Seif dune is generally long and straight dune, which is parallel to the prevailing wind **Figure. 5.12.** The corridors between the dunes are swept clear of sand by this wind. The dunes are lengthened by the prevailing wind. Seif dunes are generally several hundred meters high and many kilometers long. Many seif dunes occur in that desert of Rajasthan and desert in Western Australia.

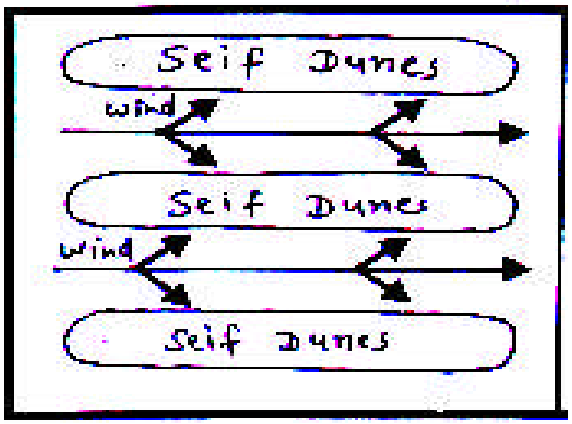


**Figure: 5.12. Seif Dunes**

**iii) <u>Loess</u>:** Every year wind blows fine particles out of the deserts. Some particles are blown into sea and some are deposited on land. Fine particles deposited on the land outside desert are called Loess. There are extensive deposits of loess in North China. Loess in China are formed by dust blown out by wind from Gobi Desert Loess deposits in China has been intensively eroded by rivers and produced 'badland' landscape.

**Check your Progress:**

Q. 1. Explain the importance of winds.

Q.2. Which processes are responsible for the work carried by wind?

Q.3. Explain the erosional landforms developed by wind action.

Q.4. Explain the depositional landforms developed by wind action.

## 5.4. INTRODUCTION TO SEA WAVES:

Sea waves are defined as undulation of seawater characterized by well developed crests and troughs. The generation of sea waves is probably because of the mechanism of release of some of sort of energy caused by atmospheric circulation of winds that is responsible for movement of fluids of two contrasting densities (air and sea water) along the interfaces of two masses of fluids of varying densities. Sea waves the most powerful agent responsible for the formation of various landforms. Sea waves play an important role in the coastal ecosystems function. Today they are playing an important role in contemporary tourism of surfing sports to earn large revenue in few naturally bestowed countries. Ocean water currents help to move eroded debris and deposit it as slit, sand and gravels along the coast. However, the coastline is undergoing changes over a period of time due to the action of sea waves, tides and ocean currents.

## 5.5. WORK OF SEA WAVES:

Various processes are involved in the work of sea waves that produce different types of erosional and depositional landforms in the coastal areas. Sea waves operate in the following ways to transform the coastal landscape:

i) **Corrosion:** Sea waves armed with rock debris of different sizes and shapes charge against the base of the cliff and wear them back by corrosion. Ocean currents and tides complete the work by sweep in the eroded materials into the sea.

ii) **Attrition:** The constantly moving sea waves that transport beach materials such as boulders, pebbles, sand etc. These waves also hurl these fragments against each other, until they are broken by attrition into very small pieces.

iii) **Hydrolic Action:** Dashing sea waves against a cliff face causes air in cracks and crevices to become suddenly compressed. When the wave retreats, the air expands with violent explosion. Again and again such action enlarges the cracks and crevices and fragments are broken down.

## 5.6. EROSIONAL AND DEPOSITIONAL LANDFORMS OF SEA WAVES:

- **Coastal Landforms of by Sea Wave Erosion :**

i) **Headlands (Capes) and Bays :** On exposed coasts, the continued action of waves on rocks of various resistance causes the coast lines to be eroded irregularly **Figure 5.13**. This is particularly pronounced where hard rocks e.g. granite basalt occurs in alternative bands with softer rocks e.g. sand and clay. The soft rocks are worn back into inlets, bays and harder rocks persists headlands capes etc.

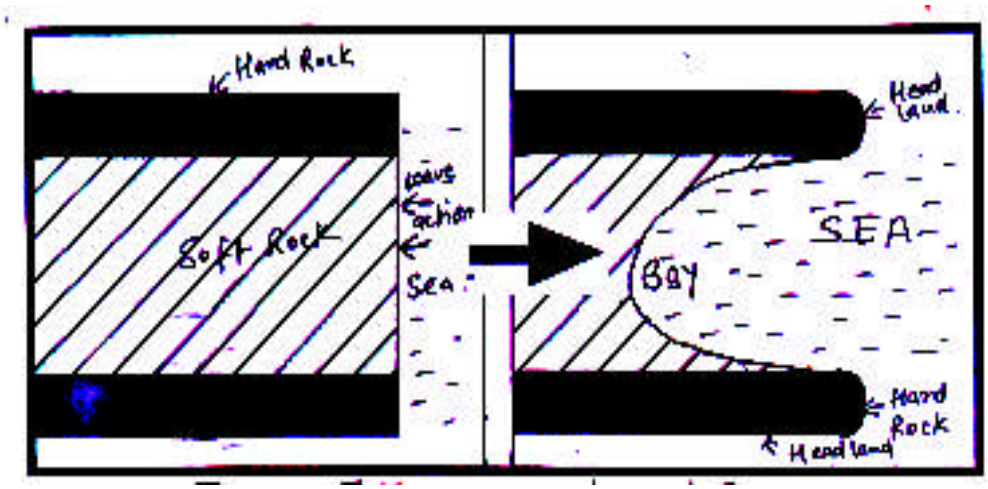


**Figure: 5.13. Headlands and Bays**

ii) **Sea-cliff:** A steep rocky coast rising almost vertically above sea-level is called as sea-cliff. **Figure: 5.14.**

iii) **Wave-cut Platform:** Generally any very steep rock facing adjoining the coast forms cliff. The rate of recession however, will depend on its geological structure, i.e. the stratification and jointing of the rocks and their resistance to wave attack. If the bed deep seaward, large block of rock will be dislodged and fall into sea. The cliff will rise in series of stapes. On the other hand, if the beds dip landwards, the cliff will be more resistant to wave erosion. At the base of the cliff the sea cuts a **notch** which gradually undermines the cliff as the cliff recedes landwards and eroded base is left behind called **wave-cut platform Figure: 5.15**.

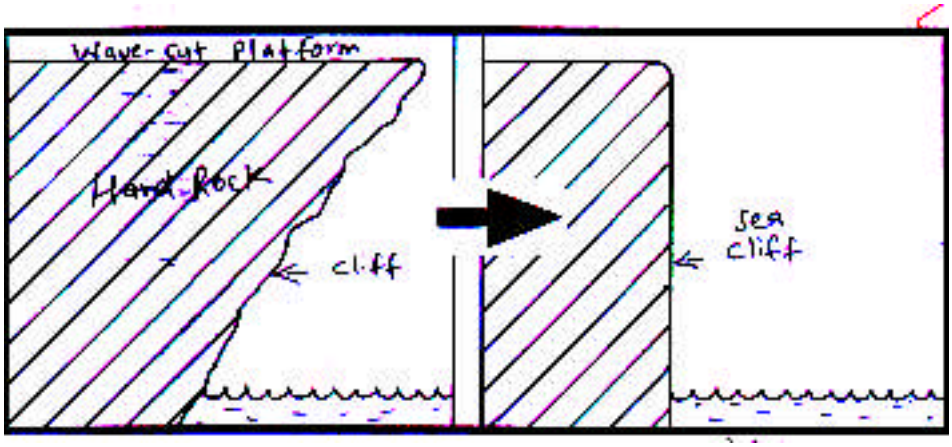


**Figure: 5.14. Sea-Cliff** **Figure: 5.15. Wave-cut Platform**

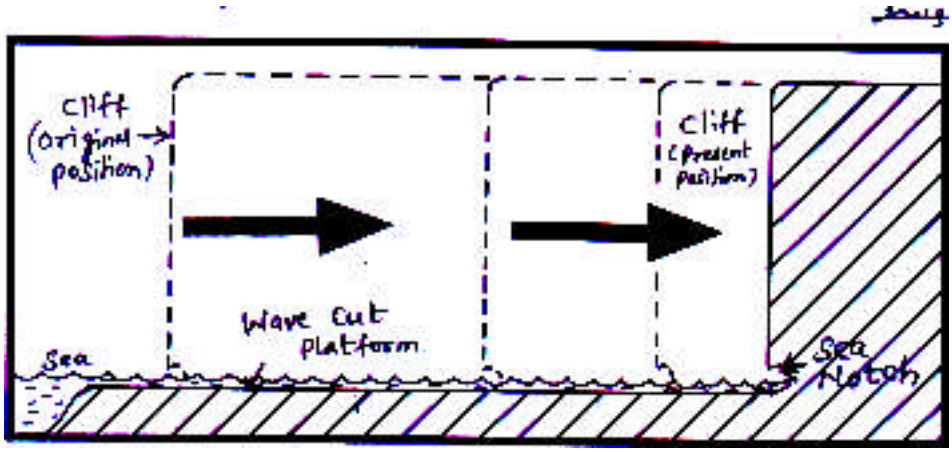


**Figure 5.16: Wave cut platform, cliff and Sea Notch**

**v) Caves, Sea Arches and Sea Stacks and Sea Stump:** These minor erosional features are produced by wave action during the process of cliff formation. Prolonged wave attack on the base of the cliff excavates holes. When two caves approach one another

from either side of the headland and unite, until, they form an arch. Further erosion by waves will ultimately lead to the total collapse of the arch. The seaward portion of the headland will remain as a pillar of rock known as a **stack.** In course of time these stubborn stack will gradually be removed. The vertical rock pillars are eroded leaving behind only the **stump**, which are only just visible above the sea level, particularly at low tides **Figure 5.17**.

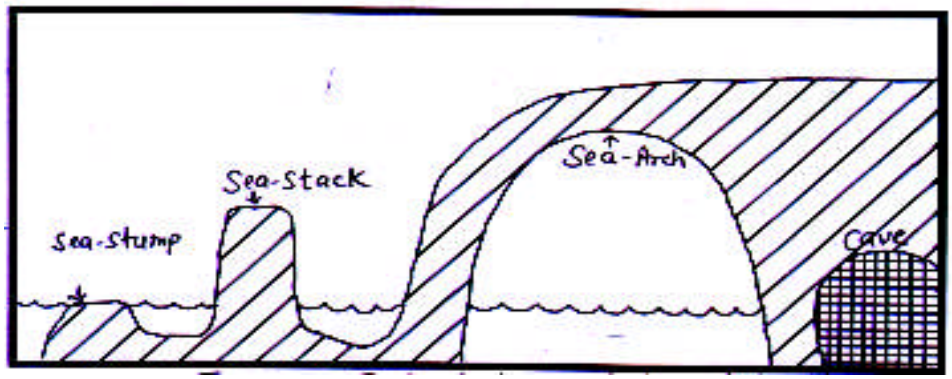


**Figure:5.17. Caves, Sea Arches and Sea Stacks and Sea Stump**

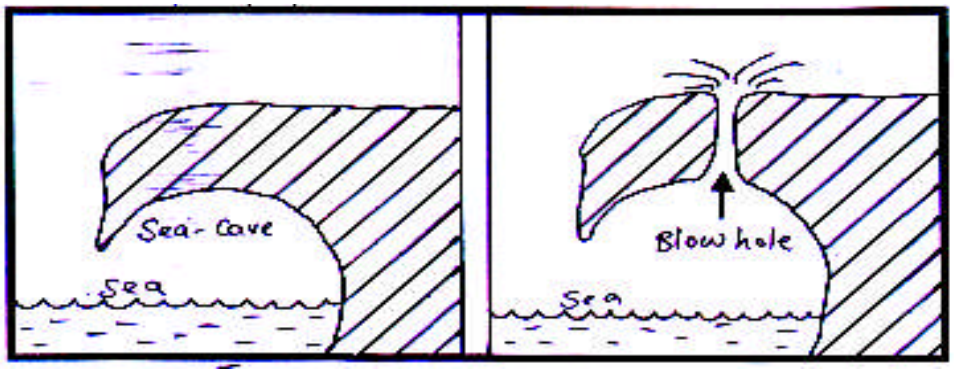


**Figure: 5.18. Sea cave and Blow hole**

- **Coastal Landforms of Sea Wave Deposition :**

  **i) Beach:** The most important depositional feature of the work of deposition by sea waves is beach **(Figure 5.19)**. The main action of constructive waves is to deposit mud, sand and pebbles. When these materials deposited along a coast, form a gently sloping platform called a beach. Beaches usually lie between high and low water levels, but storm waves along some coast throw pebbles and stones well beyond the normal level reached by waves at high tide. The material deposited in this way produces a ridge called a storm beach.

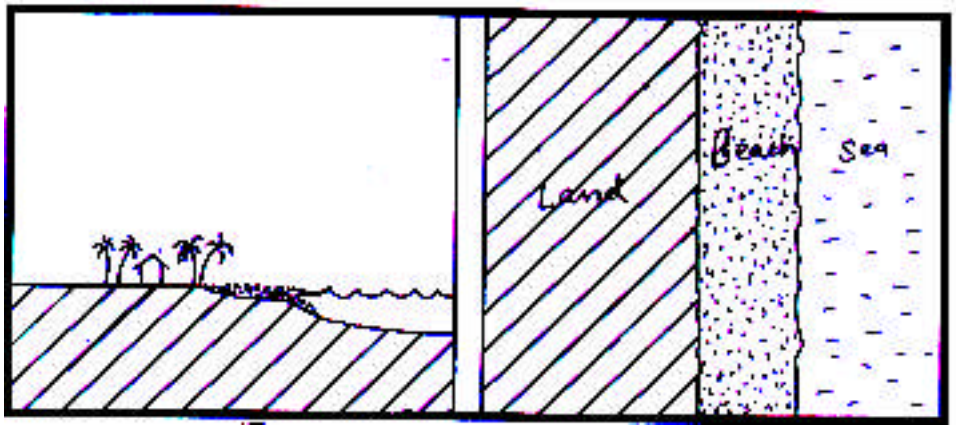


**Figure: 5.19. Beach**

ii) **Spit:** Spit is a narrow, low ridge of sand or pebbles joined to the land at one end and its other end is terminating in the se **Figure: 5.20.** Sometimes, a spit develops at a headland and projects across a bay. Its waves swing into the bay obliquely, the end of the spit becomes curved or like a hook.

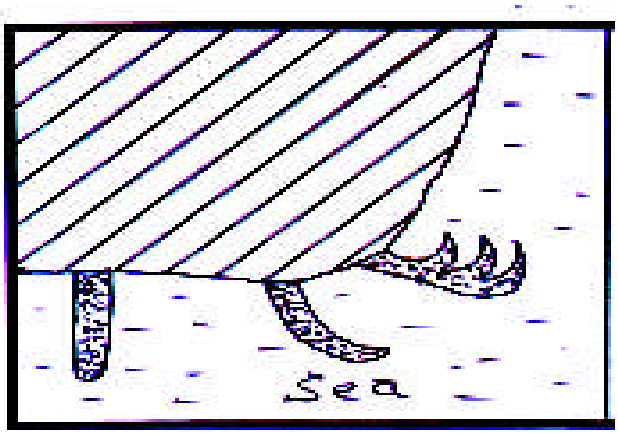


**Figure: 5.20. Spit**

iii) **Bar:** Bar is very similar to spit. The bar which extends right across ais very common type of bar. It starts as a spit growing out from a headland, stretches across the bay to next headland. Such bar is called a bay-bar **Figure: 5.21.**

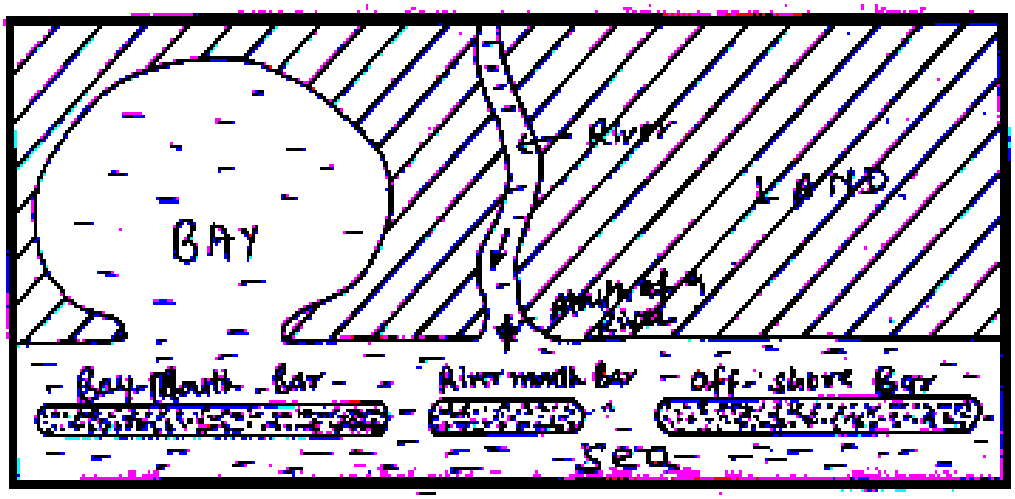


**Figure: 5.21.Types of Bars**

**iv) Lagoon:** A shallow body of seawater separated from Open Ocean by a spit or by Barrier Island or reef.

**v) Tombolo:** This feature is developed close to the coast where the deposition of sand takes place connecting the mainland with the coastal island is **Tombolo.**

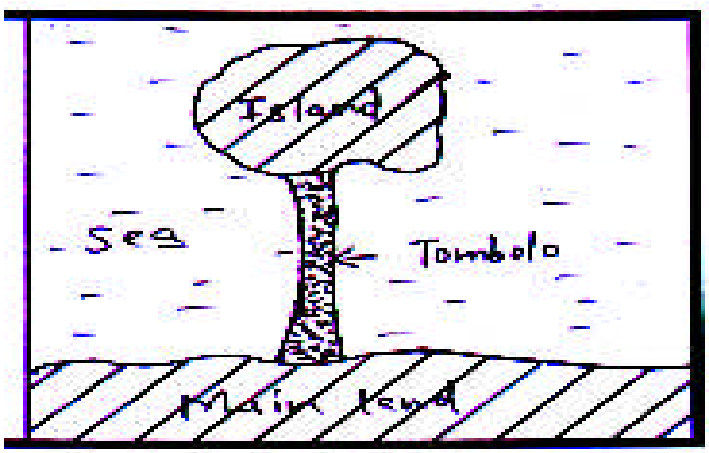


**Figure: 5.22.. Tombolo**

- **Check Your Progress:**

Q. 1. Explain the importance of sea-waves.

Q.2. How is sea wave generated?

Q.3. Which processes are responsible for the work carried by sea waves?

Q.4. Explain the erosional landforms developed by sea waves.

Q.5. Explain the depositional landforms developed by sea waves.

## 5.7. CONCLUSION:

It is thus important to note that winds and sea waves as geomorphic agents play a significant role in shaping and producing different landforms in the arid and semi-arid regions in case of winds and sea –waves along the coastal areas in the world. Different landform features developed by erosional and depositional process by wind and sea waves in respective areas provide a scenic beauty to the landscape to promote tourism activity and thus a source of income to the local community and the country. Besides their role in the promoting the functioning of ecosystems in different ecological area provides with necessary food nutrients at diffident tropic levels in the food pyramid.

## 5.8. QUESTIONS:

1. With the help of suitable diagrams explain the erosional landforms developed by wind action.
2. Explain the depositional landforms developed by wind action. Draw suitable diagrams.
3. Drawing suitable diagrams explain the erosional landforms developed by sea waves.
4. With the help of suitable diagrams explain the depositional landforms developed by sea waves

**References:**

1. Arthur L Bloom, 2009 3rd edition: 'Geomorphology-A Systematic Analysis of Late Cenozoic landforms', PHI Learning Private Ltd. New Delhi.

2. Pednekar,Shinde,Thakur…..(2015): Physical Geography, F.Y.B.A. Semester I and II, Sheth Publishers Private Limited, Mumbai

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# Unit - 6

# PRACTICAL PART A: LANDFORMS

**Unit Structure:**



## 6.0 OBJECTIVES

- The study of landforms is facilitated with the help of contours.
- Value of contour, it spacing and shape helps to identify the nature of slope and the relief feature of the area.
- The drawing of profiles facilitates the nature of surface landform.
- Drawing of different types of relief and river profile assist in comparative analysis of nature of relief between the regions.

## 6.1 INTRODUCTION

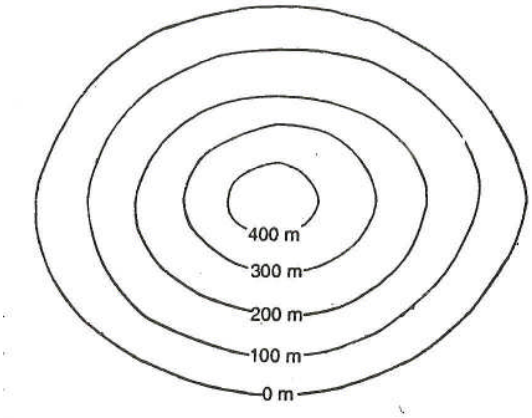
In physical geography it is very important to understand the nature of landform features for planning purposes and to study the type of associated landuse. There are different techniques used for understanding the relief features. Topographic maps represent natural and man-made features of the earth's surface. Relief features in Topographical maps are represented with the help of contour lines. Data of relief is represented on maps with the help of isopleths technique called contours. Contours are the most commonly used quantitative technique for representing relief. Contour lines are imaginary lines joining points of equal elevation above mean sea level. Since contour lines represent a particular elevation therefore two different contour lines will never intersect each other. However two or more contour lines can meet each

other at a point to represent a cliff / caves. Thus expertise in contour reading helps to identify the three dimensional relief at that point on a map and its corresponding relief features on the ground. Representation of landforms and terrain features by contour lines is covered in this chapter to explain the basics of contour drawing and understanding of relief.

## 6.2 CONTOUR AND INTERPOLATION OF CONTOUR LINES:

**A) Contours** are imaginary lines joining places having the same elevation above mean sea level. A map representing landforms of an area by contour is called a contour map. Method of depicting relief features with the help of contours is very useful and multi-resourceful. The contour map helps to understand the nature of topography of an area.

Earlier, ground surveys and leveling methods were used to draw contours on topographical maps. However the invention of topography and subsequent use of aerial photography have reduced the importance of conventional surveying, leveling and mapping methods. In the contemporary period these aerial photographs are used for topographical mapping.
Contours are drawn at different vertical intervals (V.I.) viz: '0' meter, '100' meters, and '200' meters etc. above the mean seal level **Figure 6.1**




**Contours: Figure 6.1**

This is known as contour interval which is '100' meters between two consecutive contours which remains constant on the contour map.

This contour interval is usually constant on a given topographical map. The horizontal distance (H.E.: Horizontal Equivalent) varies from place to place depending upon the nature of slope. The horizontal distance between two points is large when

the slope is gentler (i.e. the consecutive contours are spaced apart) and distance is less when the slope/gradient is steeper (i.e. consecutive contours are closely spaced) on the topographical map.

Following are some of the basic characteristics of contour lines:

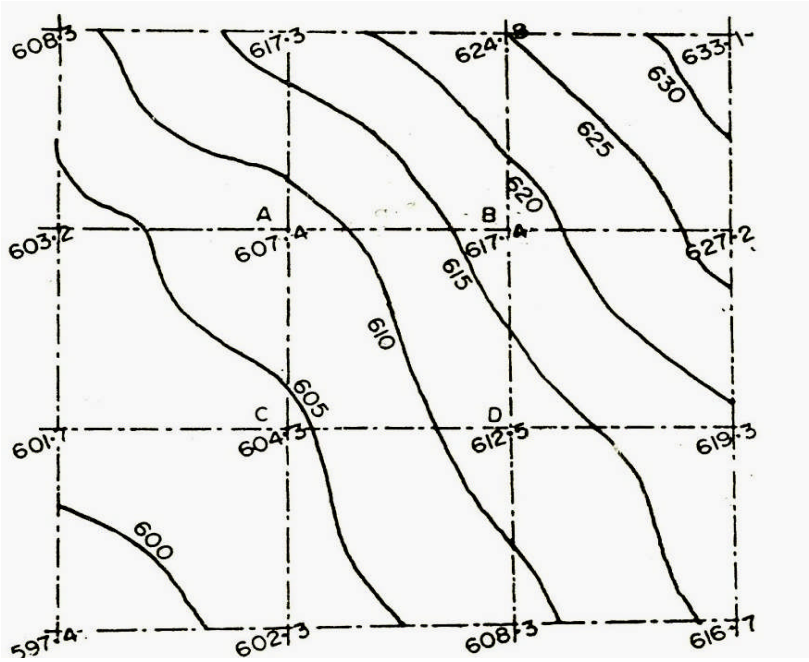
- A contour line is drawn to represent the places having equal height.
- Contour lines and their shapes represent the height and slope or gradient of a landform.
- Closely spaced contours reveal steep slope and widely spaced contours represent gentle slope.
- It is important to note that when two or more contour lines meet at a point they represent features of vertical slope such as waterfalls or cliffs.
- It is important to note that two contours of different height will never intersect each other.

**B) Interpolation of contour lines by Arithmetic method:**

It is a process of spacing the contours proportionately between the plotted ground points by arithmetic method. It is assumed that the slope of ground between two points (height/depth) is uniform.

In this method the positions of contour points between the guide points are located by arithmetic calculations. For example, let A.B.D, and C can be the guide points plotted on the map having elevations of 607.4, 617.3, 612.5 and 604.3 feet respectively **(figure 6.2).** Let A B = B D = C D = C A = 1” on the plan and let it be required to locate the positions of 605, 610, 615 feet contours on this lines. The vertical difference in elevation between A and B is (617.3 – 607.4) = 9.9 feet. Hence the distances of the contours points from A will be:

- Distance of 610 ft contour point = 1/9.9 * 2.6 = 0.26” (approx).
- Distance of 615 ft contour point = 1/9.9 * 7.6 = 0.76” (approx).




**Interpolation of contour lines: figure 6.2**

These two contour points may be located on AB. Similarly, the position of the contour points on the lines AC, CD, BD and also AD and BC may be located.

Contour lines may then be drawn through appropriate contour points as shown in figure **(figure 6.2).**

**Check your progress:**

1. Define Contour and explain its importance.
2. Which method is used for drawing contours?

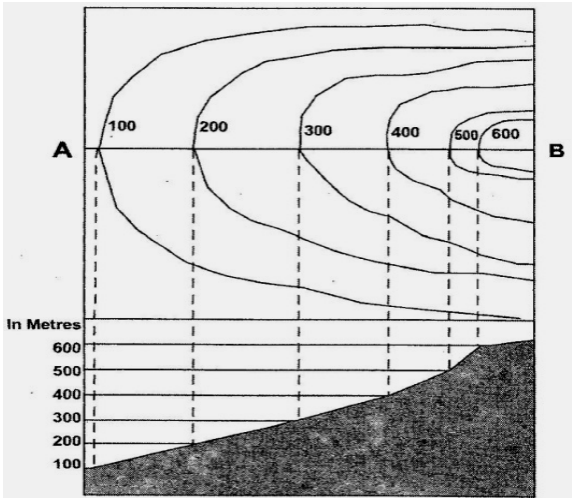
## 6.3 IDENTIFICATION OF CONTOUR LANDFORMS THROUGH CROSS SECTIONS:

Landforms of any area are associated with different types of slopes and relief features. These landform features and slopes are identified and studied with the help of contours by drawing cross sections using topographical map of that area.

**Following are few cross sections of slopes and landforms drawn with the help of contours:**

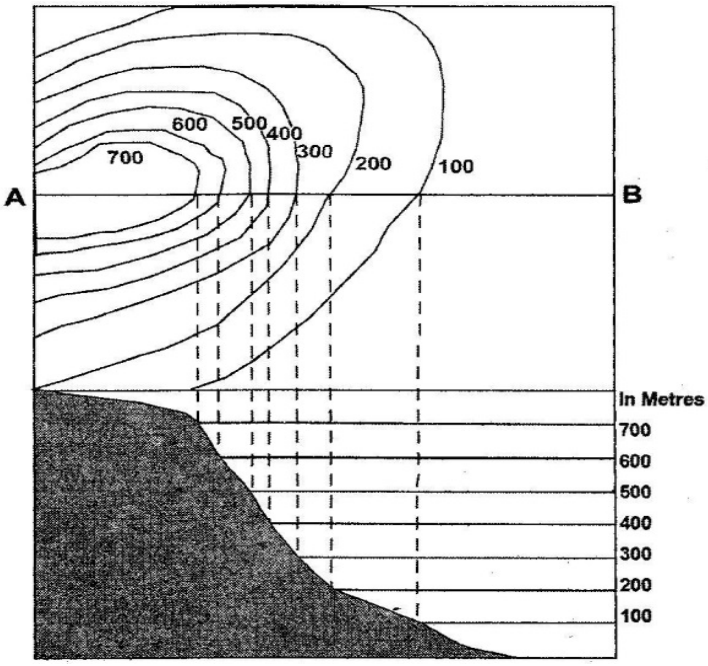
a) **Types of Slope:** Slope can broadly be classified into gentle, steep, concave, convex, uniform, undulating/irregular, and terraced. The landform with varying slopes would reveal contours of distinct spacing pattern on the topographical map.

i) **Gentle slope:** The angle or degree will be low when a slope is gentle. In gentle slope the contours are widely spaced **Figure 6.3.**



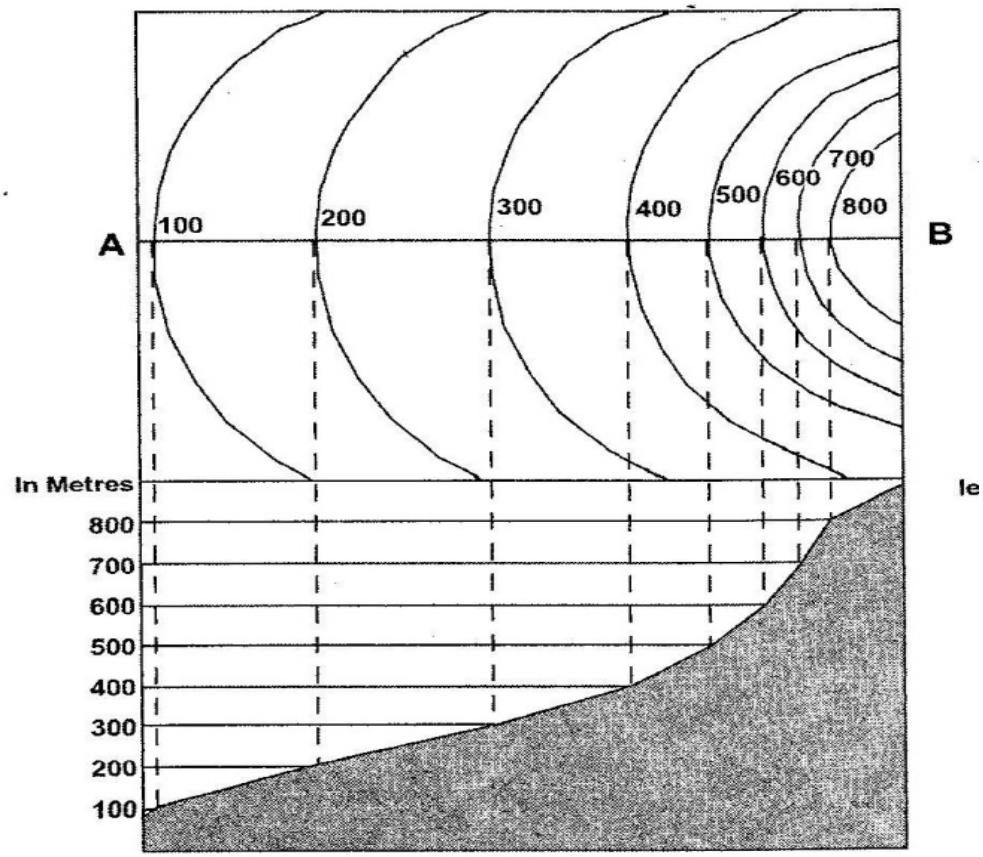

**Gentle slope: Fig. 6.3**

ii) **Steep slope:** The angle or degree will be high when a slope is steep. In steep slope the contours are closely spaced **Figure 6.4.**



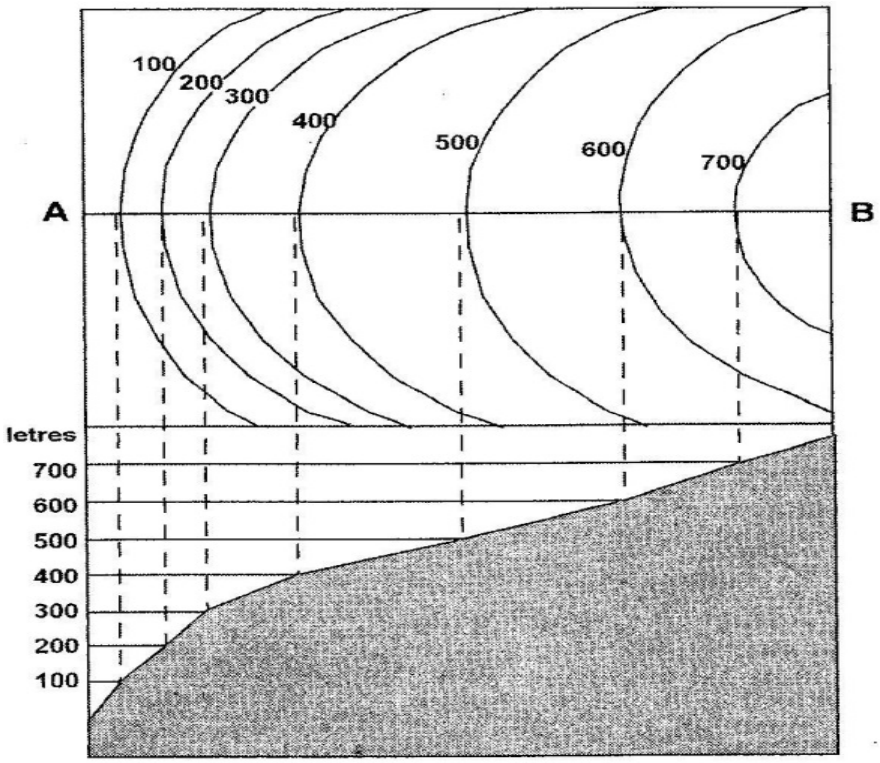

**Steep Slope: Fig. 6.4**

iii) **Concave slope:** The landform has gentle slope in its lower elevation and steeper slope in its higher elevation. Thus the contours in lower elevation are spaced apart and in higher elevation are closely spaces revealing a concave slope of the land at that place **Figure 6.6.**




**Concave Slope; Fig. 6.6**

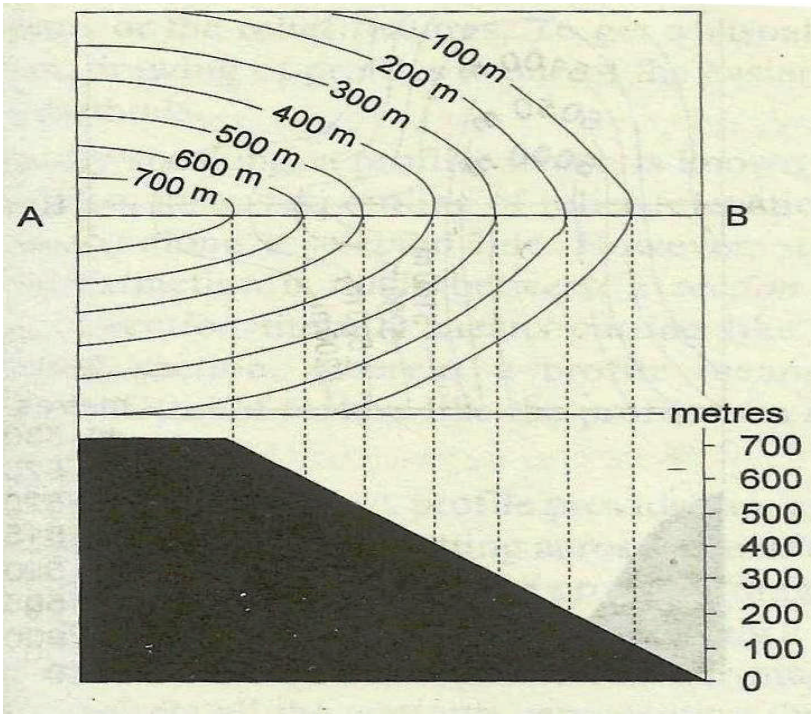
iv) **Convex slope:** The landform has steeper slope in its lower elevation and gentler slope in its higher elevation. **Figure 6.7.**Thus the contours are spaced closely in lower elevation are widely in higher elevation revealing a convex slope of the land at that place.




**Convex Slope; Fig.6.7**

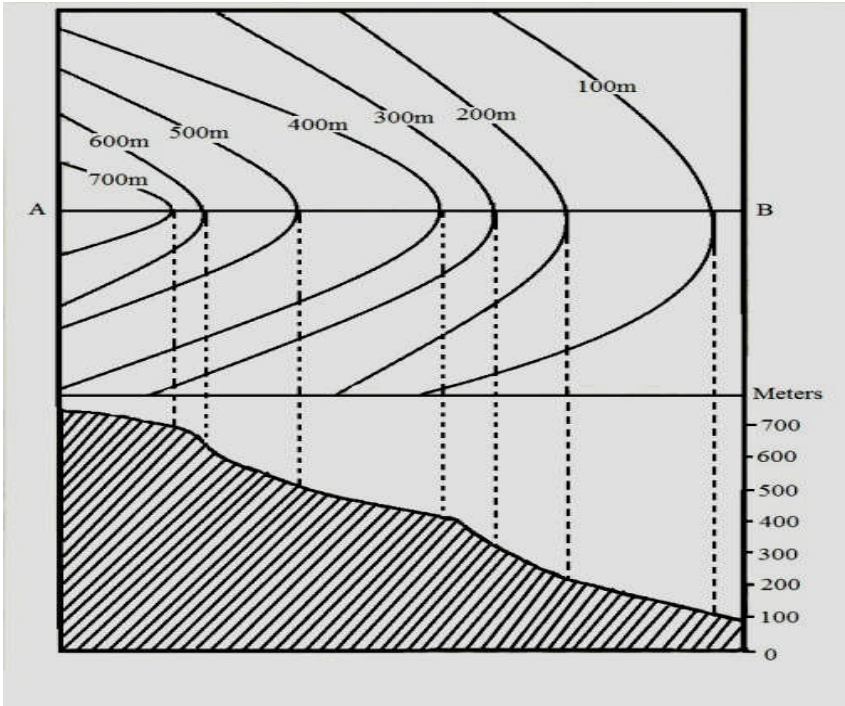
v) **Uniform Slope:** When the slope of an area increases or decreases per unit horizontal distance uniformly is called as uniform slope. **Figure 6.8**

vi)



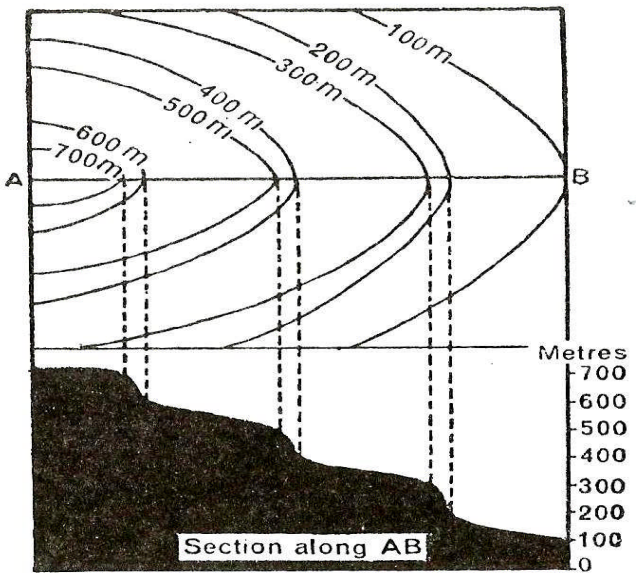

**Uniform Slope: Fig.6.8**

vii) **Undulating/irregular Slope:** It is a slope where the gradient changes with short horizontal distances that can be gentler or steeper thus producing concave and convex slopes. **Figure 6.9**




**Undulating/irregular Slope: Figure 6.9**

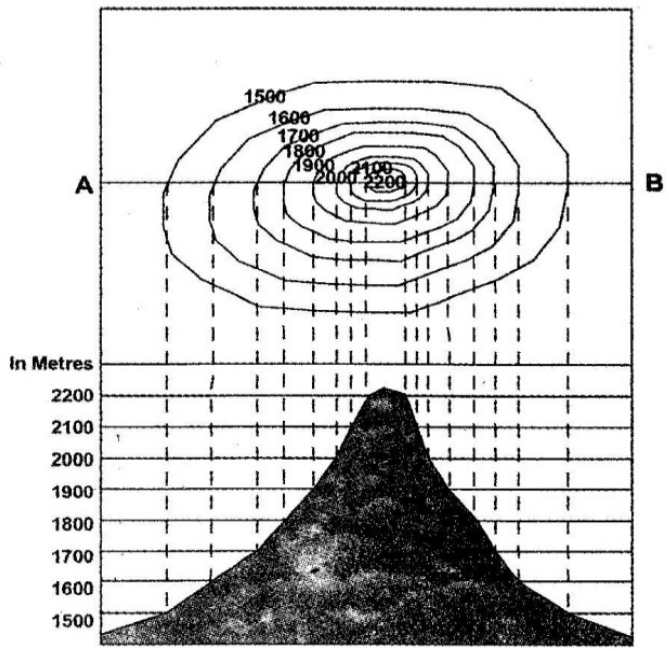
viii) **Terraced/ Stepped Slope**: The contours of terraced slope alternately rise gently and then steeply with increasing altitude of the landform. **Figure 6.10**




**Terraced/ Stepped Slope: Figure 6.10**

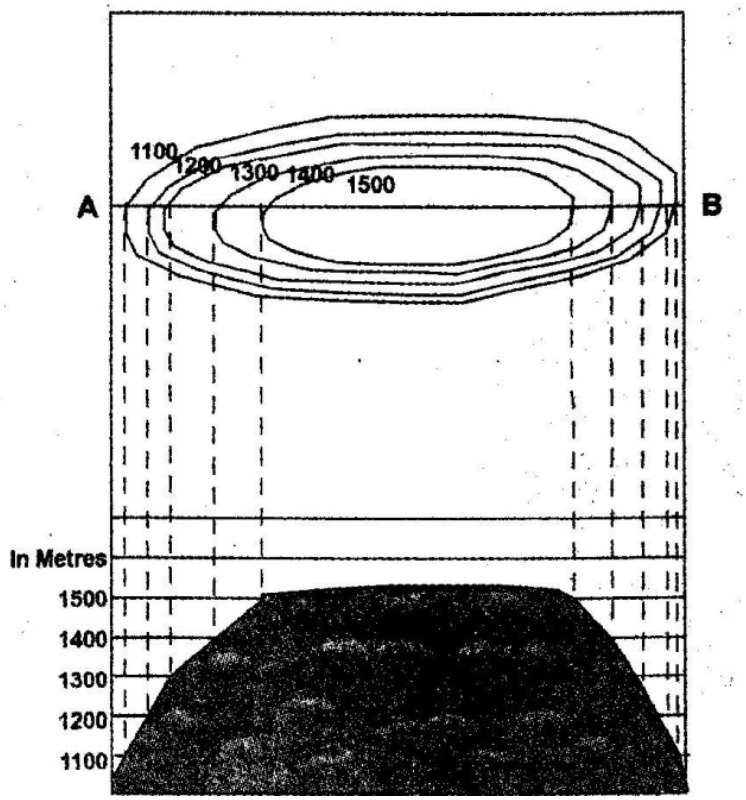
b) **Types of landforms:** Following are some of the important types of landforms that can be studied by drawing cross section across the contours:

**i) Conical Hill / A mount:** Conical hill rises almost uniformly from the surrounding land. A Conical hill with uniform slope and narrow top is represented by concentric contours spaced almost evenly at regular intervals. **Figure 6.11**




**Conical Hill / A mount: Fig.6.11**

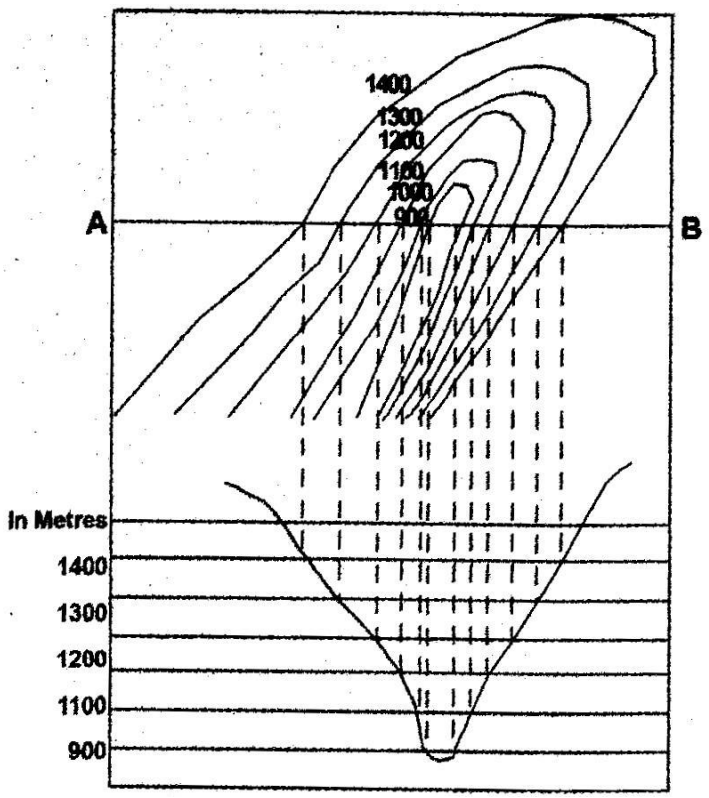
**ii) Plateau:** A widely stretched flat topped highland, with relatively steeper a side rising above the adjoining plain or sea is called a plateau. The contour lines representing plateau are rectangular in shape which are normally close spaced at the margins with inner most contour showing wide gap between its two sides **Figure 6.12**




**Plateau: Fig.6.12**

**iii) Valley ('V' and 'U' Shaped valley):** Valley is a land with deeper steep sides lying between two highlands formed due to lateral erosion by a river or a glarier.

**'V' shaped valley:** it resembles the letter 'V'. A V shaped valley occurs in mountainous areas.

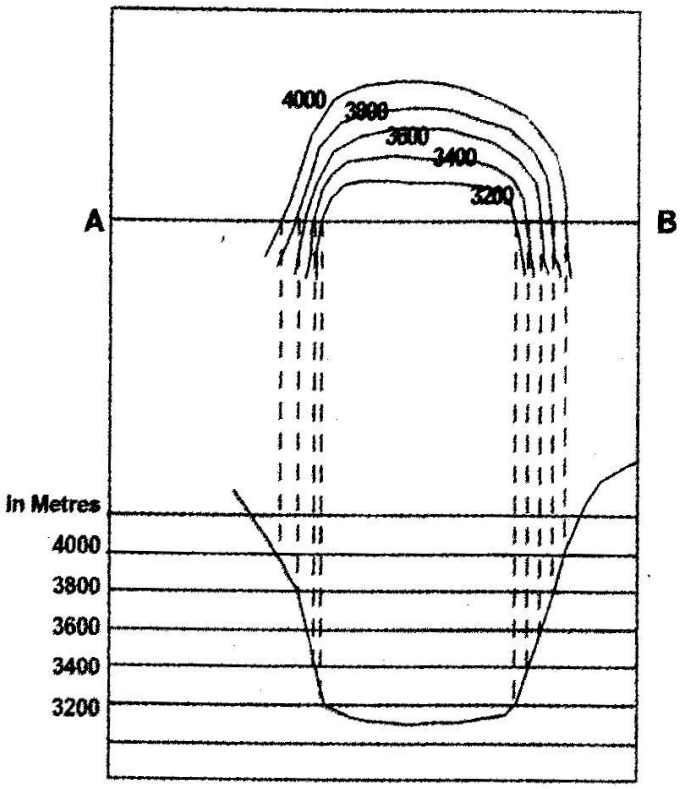



**'V' shaped valley: Fig.6.13**

The lower most part of the V shaped valley is shown by the inner most contour line with very small space between two consecutive contours and the lowest value ( lowest elevation) of the contours is assigned to it.

The contour value increases outwards with uniform intervals for all other contour lines. **Figure 6.13**

**'U' shaped valley:** A U shaped valley is formed by strong lateral erosion of glaciers at high altitudes. The flat wide bottom and steep sides makes it resemble the letter 'U'. The lowermost part of the U shaped valley is shown by the inner most contour line with a wide gap between its two sides. The contour value increases outwards with uniform intervals for all other contour lines.**6.14**



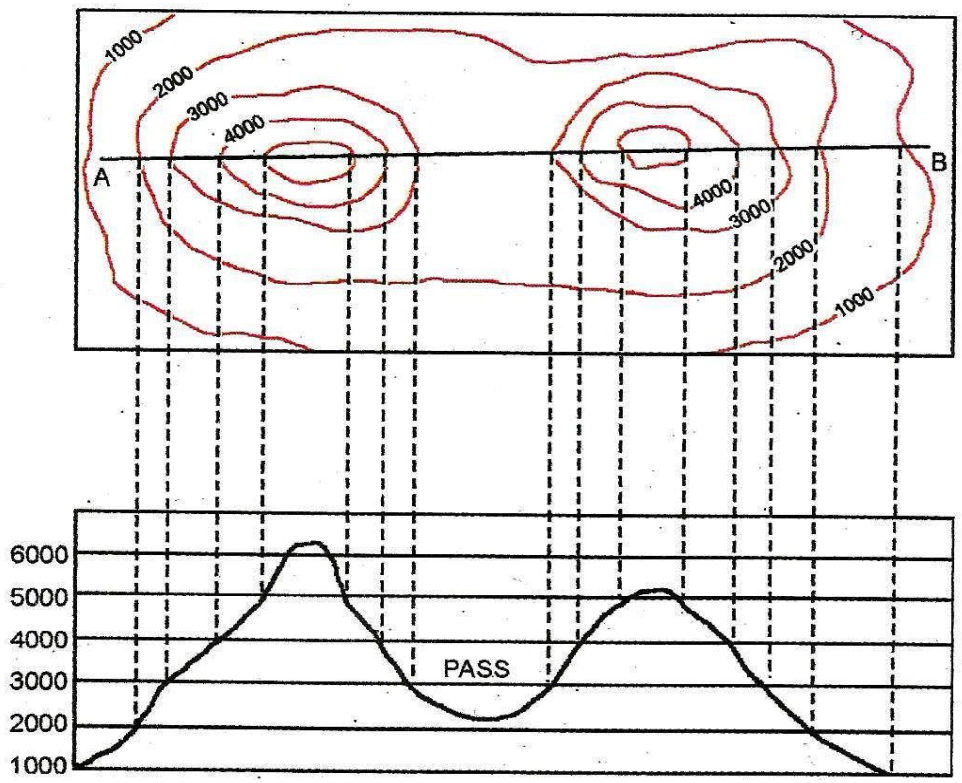

**'U' shaped valley: Fig. 6.14**

**v) Pass, Saddle, Col and Gap: These landform features are noticed in hilly regions.**

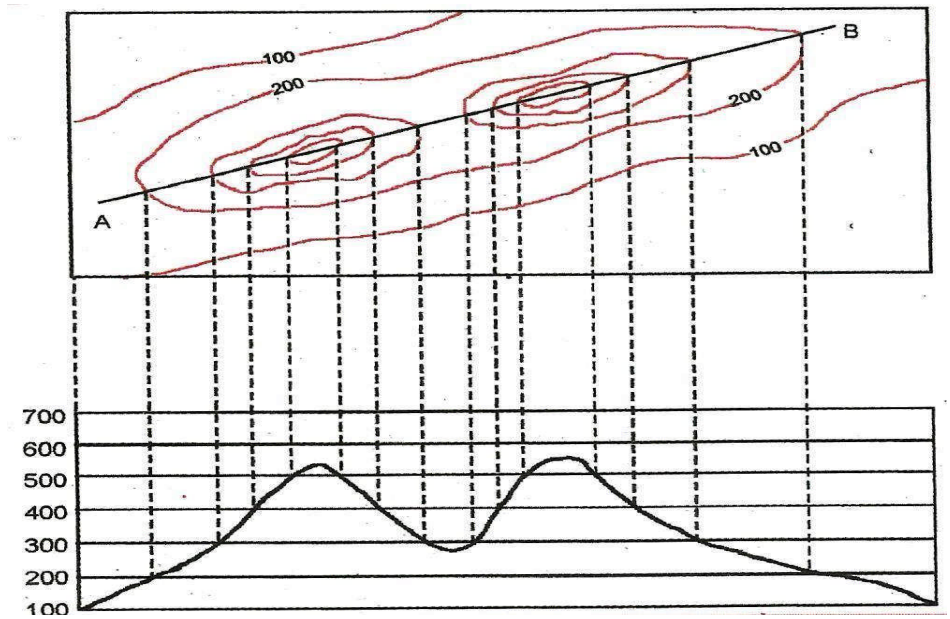
**(a)Pass:** A Pass is found between two hills or mountains and serve as a land route across the hill/ mountain range(**Figure 6. 15 a).**

**(b)Saddle:** It is a shallow depression between two peaks **(Figure 6. 15 b).**

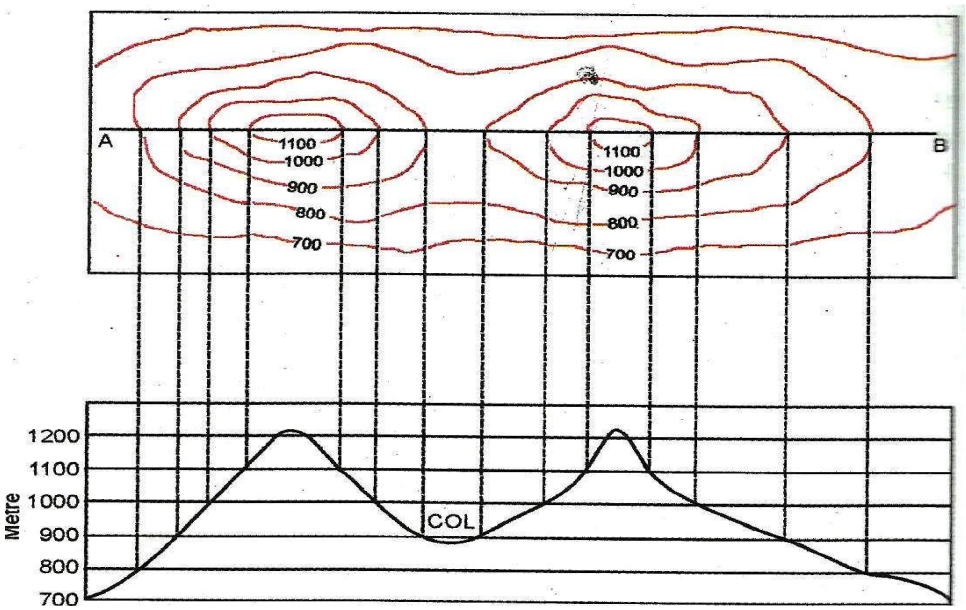
**(c)Col:** A Col is formed between the ridges of a water-shed (**Figure 6. 15 c).**




**Pass: Figure 6. 15 (a)**

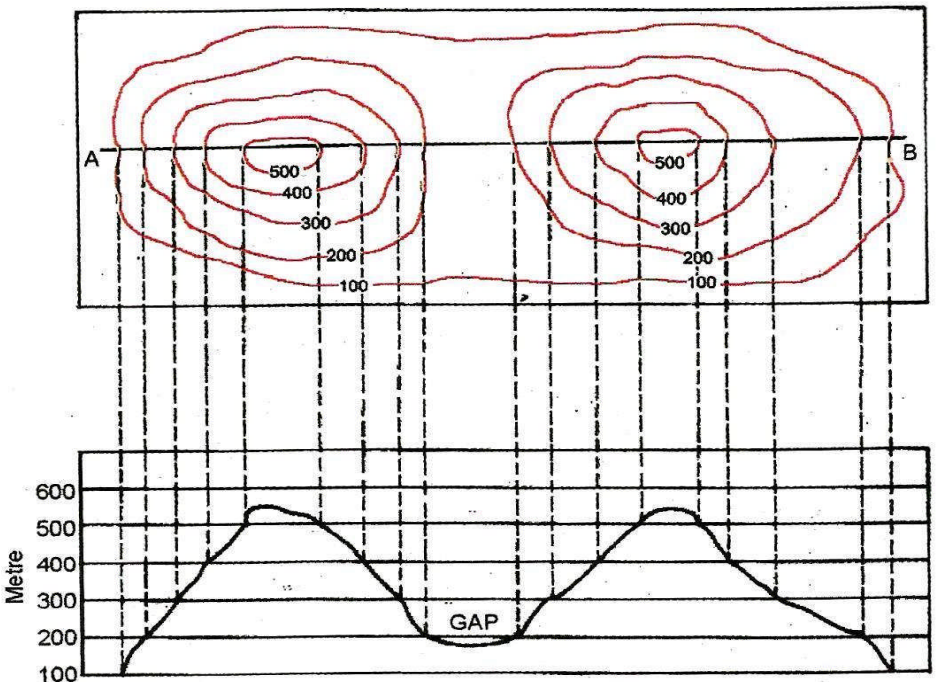



**Saddle: Figure 6. 15 (b)**



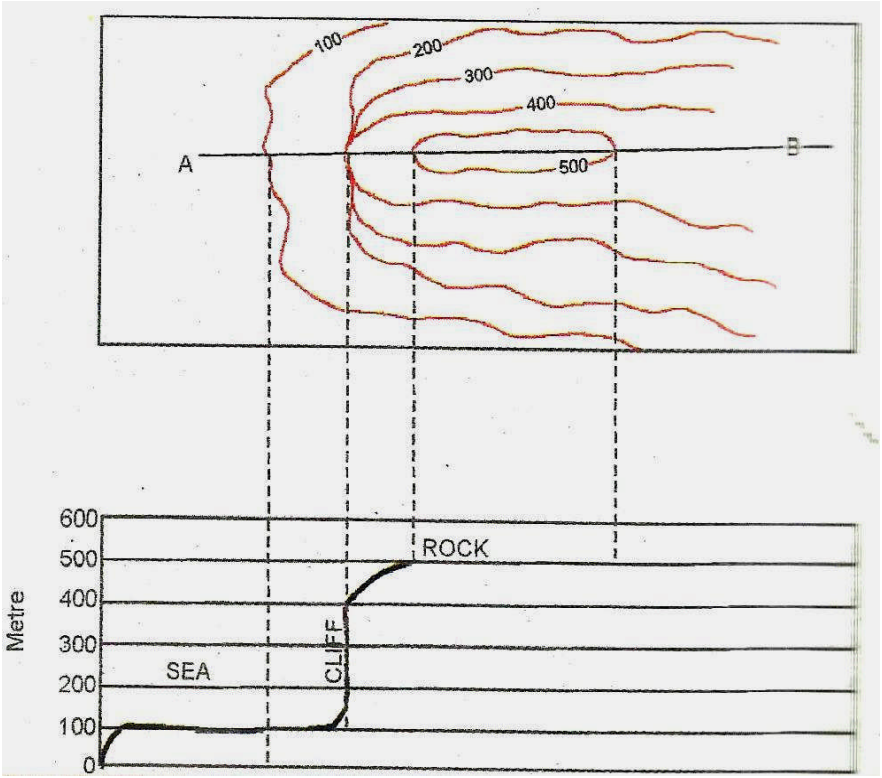

**Col: Figure 6. 15 (c)**

**(d) Gap:** A gap is a low depression close to the ground found between a ranges of hills (**Figure 6. 15 d).**



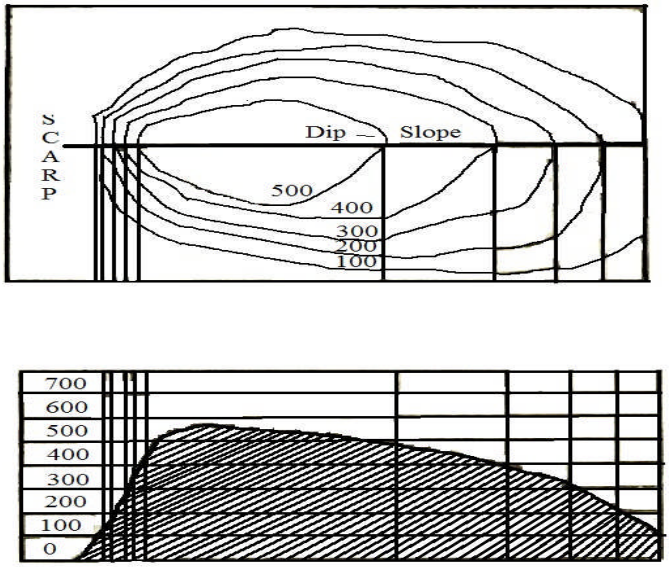

**Gap: Figure 6. 15 (d)**

**vi) Cliff:** A cliff is a steep and straight rock wall in the Rocky Mountains or rocky coast, or rocky hills. Cliff is characterized by sudden steep slope where three to four or more contour lines meet at one point. **Figure 6.16**



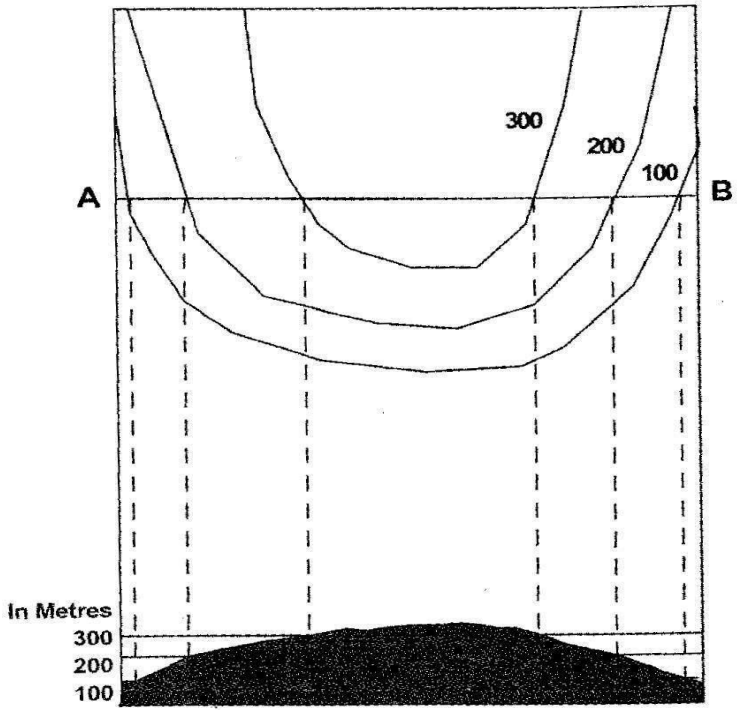

**Cliff: Fig.6.16**

i) **Escarpment/ Scarp:** an escarpment is a long abrupt and steep slope of a hill/ a ridge/ or a plateau. It is formed as a result of faulting or the erosion of an inclined hard rock. **Figure 6.17**



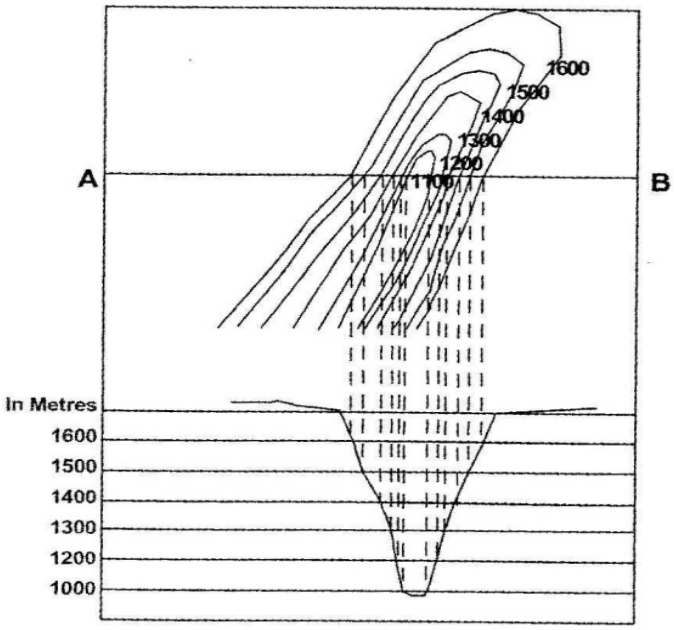

**Escarpment/ Scarp: Figure 6.17**

ii) **Spur:** A spur is an outward projection of high ground into a lower one. It is represented as an outward bulged in the contour lines **Figure 6.18.** In a spur higher contour bends towards the lower contour.



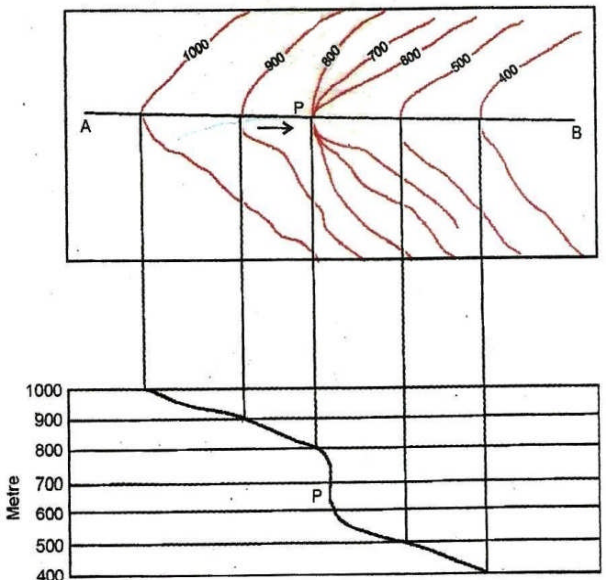

**Spur: Figure 6.18**

iii) **Gorge:** A Gorge is a deep narrow valley with very steep slopes. A Gorge usually develops in a region of hard rock's where the river carves out a steep sided valley for itself due to its enormous capacity of vertical cutting. **Figure 6.19**



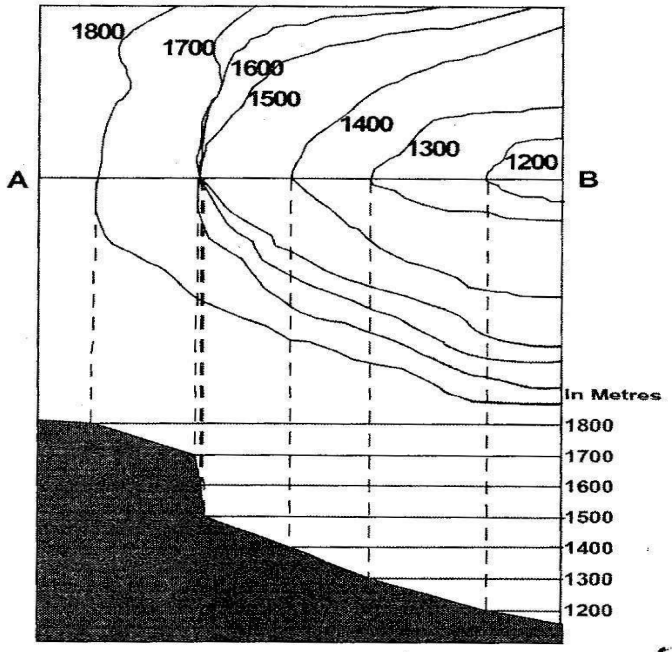

**Gorge: Figure 6.19**

**x) Rapid and Waterfall:** A waterfall is created in the channel of a river that has a steep vertical slope with flowing water. A waterfall is observed where two or more contour lines meet at a point in the bed of a river.



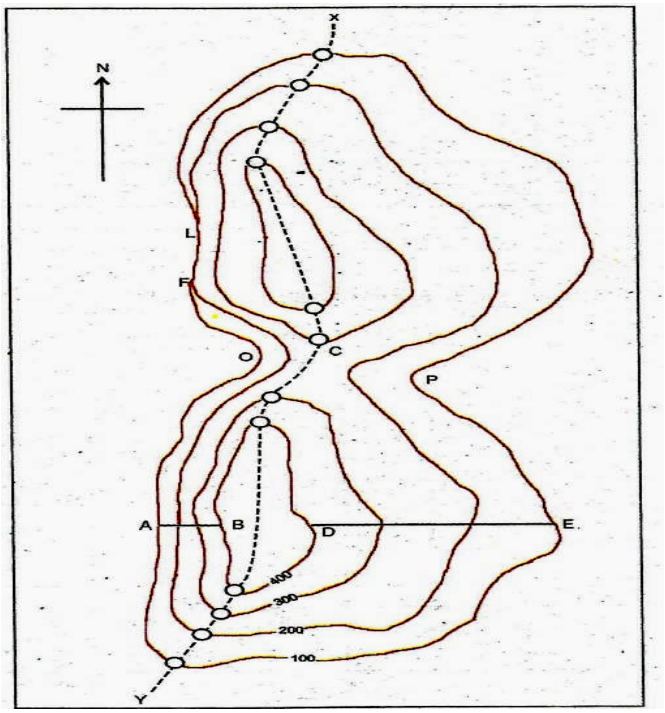

**Rapid: Fig. 6.20 (a)**

A rapid is a miniature waterfall. Generally they are found upstream from the main water fall. Sometimes they occur independently. A rapid also has a considerable slope hence the contours liens are closely spaced while crossing the valley. Rapids are a step like structure formed due to erosion of soft rock and resistant hard rock overlaying each other. **Figure 6.20(a), (b).**




**Water-Fall: Figure 6.20 (b).**

**xi) Water-shed / Water divide:** A watershed is the land area from where water flows on the either sides of the slope and develops small rills/streams. These are well identified in the hilly/mountainous regions. **Figure 6.21.**




**Water-shed / Water divide: Fig. 6.21**

**Check your progress :**

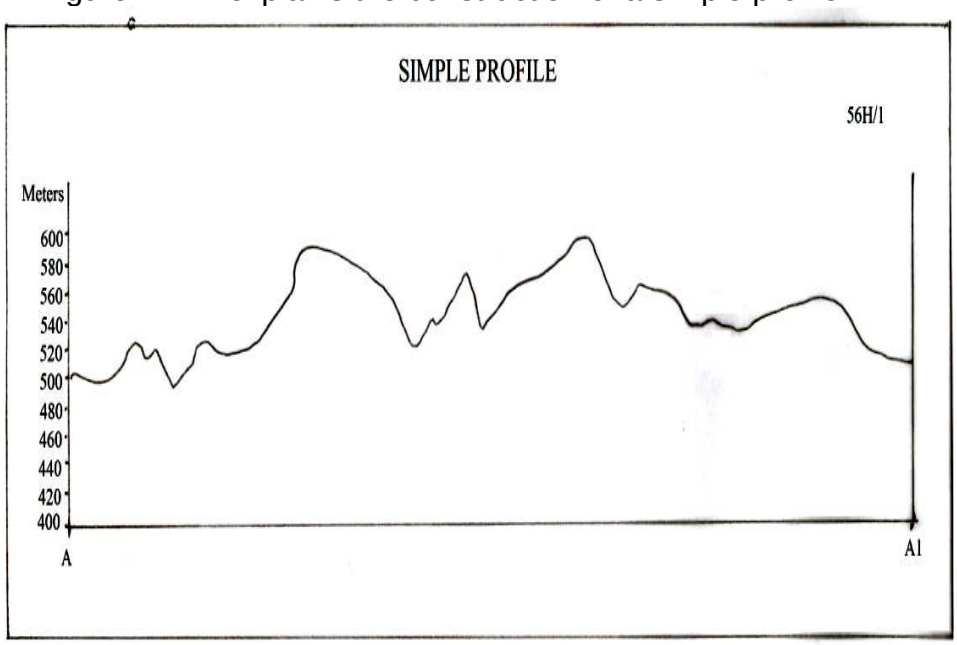
1. Explain different types of slopes with the help of diagrammatic representation.
2. Explain different types of relief features with the help of diagrammatic representation.

## 6.4. RELIEF PROFILES – IMPORTANCE AND TYPES:

A relief profile is a line which shows the rise and fall of the surface of the ground along a chosen line on a map. One of the advanced techniques of representation of relief is to draw a relief profiles. A profile of a relief feature acts as a visual aid in its description and interpretation. Hence it is of particular interest to geographers and especially geomorphologists who are interested in the analysis of landforms and in the process of their upgradation and degradation. Identifying landform features with the help of contours is complex whereas profiles are relatively easy and useful in understanding the relief features.

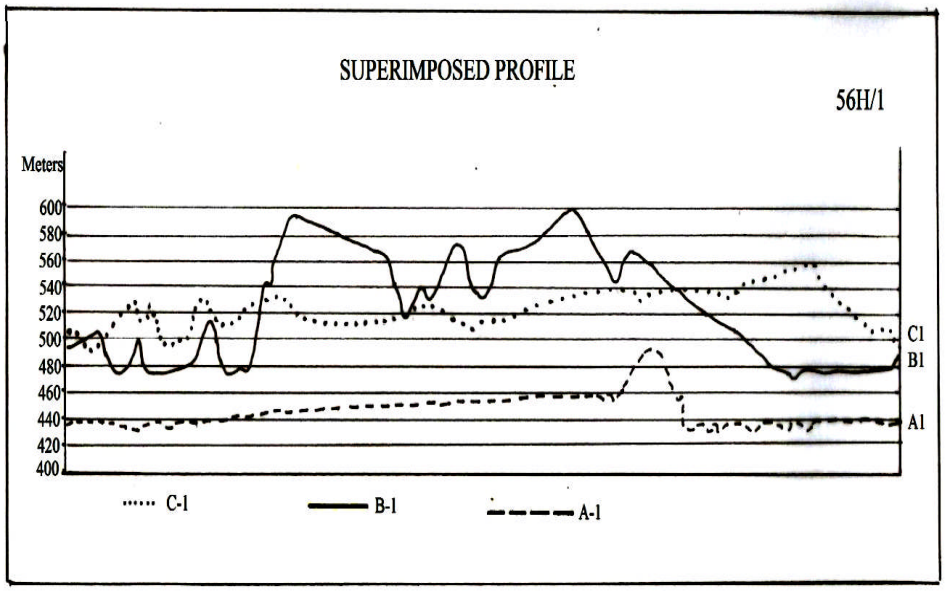
Broadly speaking, a profile which is also known as a section means an outline of a relief (elevation or depression) along a selected line. However, sometimes a distinction is made between a section and profile. A Section is usually a cutting taken for a geological section, whereas a profile is a outline of the surface relief feature like profile of a river valley.

i) **Serial / Simple profile:** These are made by drawing a series of profile or parallel profiles for showing features like a coastline; edges of plateau; a series of spurs; a transverse profile of a river; a junction of two contrasting topographical features etc. Figure 11.22 explains the construction of a simple profile.



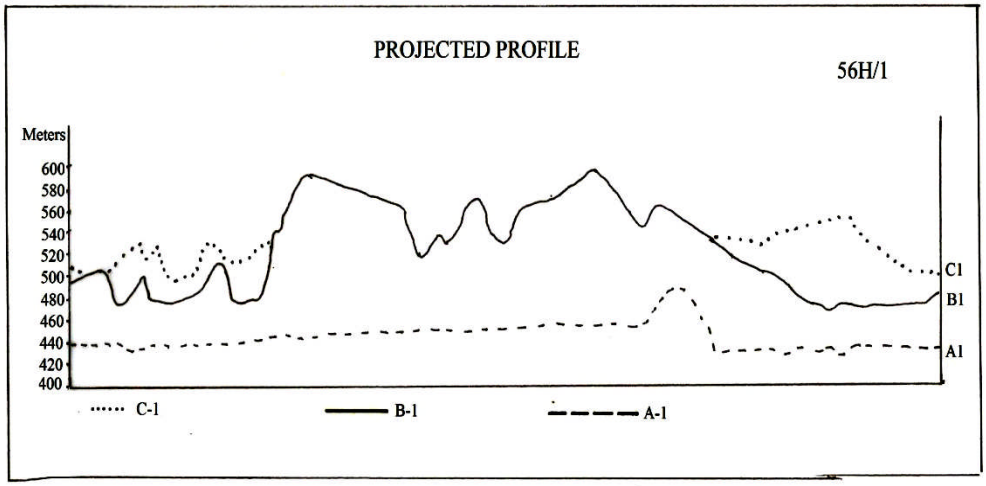

**Serial / Simple profile: Figure 6.22**

ii) **Superimposed Profile:** When a series of profile are superimposed on a single plane it is called as superimposed profile. These successive profiles are numbered for getting clarity. Such profiles are generally used for representing landforms with certain morphological uniformity as shown in **Figure 6.23**. In other cases the serial profile are more useful.




**Superimposed Profile: Figure 6.23**

**iii) Projected Profile:** In the superimposed profiles, the successive parallel profiles are placed on a common base line. However, the lower parts of the profiles are hidden behind the higher intervening altitudes.

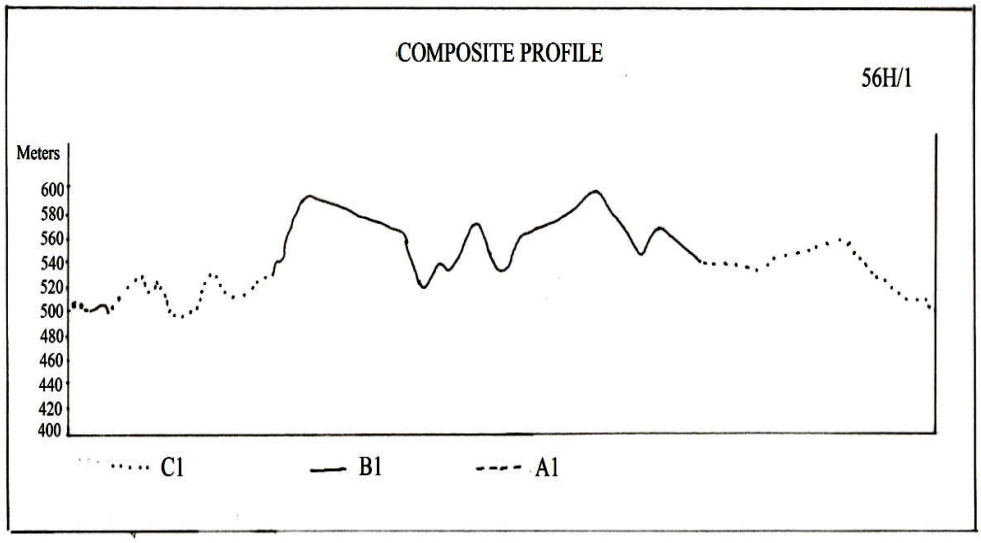



**Projected Profile: Figure 6.24**

If only the visible parts of successive profiles are represented on a common framework one gets a panoramic view of foreground, middle ground and the sky line. Such profiles are known as projected profile or compressed profile as shown in **Figure 6.24.**

**iv) Composite Profile:** If the superimposed profile of a landform is viewed carefully one can discern at the farthest end of such a profile, a summit line, the skyline which provides a general outline of the concerned landform features as viewed from a distance. This

skyline can be represented by a profile or a line drawn by joining the highest parts of a series of parallel profiles. Such a profile is known as composite profile. Such profiles can be used for a comparative analysis of the terrain types in a region or between regions **Figure 6.25.**




**Composite Profile: Figure 6.25**

**Check your progress:**

1. What do you understand by the term relief profile?
2. Give different types of profile
3. Explain the use of profile in the study of landforms.

## 6.5 CONCLUSION:

This module therefore explains the importance of quantitative techniques in identifying different types of slopes and landform features. Comparative analysis and spatial differentiation is therefore possible with the help of such geographical techniques used in practical geography.

## 6.6 QUESTIONS:

1) Explain giving examples the importance of contours in the identification of landform features.
2) What is a relief profile? Giving different types of profiles explain their importance.
3) Draw the cross sections and profile given in figure 11.4 to 11.25

**References:**


1. F.J.Monkhouse and H.R.Wilkinson (1956): 'Maps and Diagrams', Methuen and Co.Ltd. New York.
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3. L.R.Singh (2005): 'Fundamentals of Practical Geography', Sharda Pustak Bhawan, Allahabad.
4. Gopal Singh (2001):'Map Work and Practical Geography', 4th revised and enlarged edition, Vikas Publishing House Pvt. Ltd.

   Dr. B. C. Punmia ( 1994 ): 'Surveying' Volume I, Laxmi Publications Pvt.Ltd. New Delhi.


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# Question Paper Pattern for Semester End Assessment implemented From 2020-2021
# For Geography courses at F.Y.B.A

Duration of examination - 3 hours
Total Marks - 100 (per semester)

**N. B. :** (1) All Questions (Question No. 1 to 5) is compulsory.
(2) Draw neat sketches and diagrams wherever necessary.
(3) Attach map supplement to the main answer book.
(4) Figures to the right indicate full marks.

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Q1. Attempt any **One** question (*module 5*) **20 marks**

A)
B)

Q2. Attempt any **Two** questions (*module 1*) **20 marks**

A)
B)
C)

Q3. Attempt any **Two** questions (*module 2*) **20 marks**

A)
B)
C)

Q4. Attempt any **Two** questions (*module 3*) **20 marks**

A)
B)
C)

Q5. Attempt any **Two** questions (*module 4*) **20 marks**

A)
B)
C)

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