12

THE WORK OF MOVING ICE, WIND AND SEA WAVES

12.1 INTRODUCTIONS

You have learnt in the previous lesson about the gradational role of running water and underground water. In addition to these two agents, moving ice, wind and sea-waves too are powerful agents of gradation. These three agents too perform the threefold function of erosion, transportation and deposition. In other words they are removing the weathered material, transporting it from the elavated ground and are depositing the same into low lying areas. This process also tends to 'grade' or 'level off' all irregularities on the surface of the earth in the areas of their operation. We will learn during the course of this lesson how each of these three agents of gradation functions as well as note the details of topographical features formed by each of them.

12.2 OBJECTIVES

After studying this lesson, you will be able to :

- define glacier, snow-line, snowfield, continental and valley glaciers;
- explain with help of diagrams the formation of main erosional and depositional features produced by glaciers;
- differentiate among the various types of moraines;
- explain the features formed by the wind with the help of diagrams;
- explain with the help of diagrams the various relief features formed by sea-waves;
- give examples of features formed by these three agents of gradation preferably from India.

THE WORK OF MOVING ICE

12.3 SNOW - FIELDS

In regions where the temperature always remains below freezing point, precipitation occurs in the form of snowfall. Wherever the rate of snow melting or its evapouration is lower than the rate of snowfall in a year, snow accumulates into great mass of ice. Permanently snow covered regions of this type are called snow - fields. Snow - fields occur in polar regions and on high mountainous areas. Snowfields are always found above the snow line. Snow line is an imaginary line above which there is permanent snow. The height of the snow - line is not uniform at all places. It is affected by the following factors :

(a) Latitude : In equatorial regions due to high temperature the snow line is situated at a greater height but decreases towards the poles. The snow-line in the polar regions is generally at the sea level because the temperature in these areas remains below the freezing point throughout the year.

(b) Amount of Snowfall : The height of the snow line is generally lower in those areas where the amount of snowfall is more than its loss.

(c) Direction of Winds : The snowline is higher in areas experiencing dry and hot winds because they melt the snow quickly. On the other hand the snowline is lower in areas lying across the path of cold and humid winds.

(d) Slope of the Land : The slope of the land also affects the snowline. Snow falling on steep slopes does not stay long. It slips down into the valleys. This causes the snowline to be higher in such regions. On the other hand, snowline is lower in areas of gentle slope.

* Region permanently covered by snow and ice is called snow- field.
* Snowline is the lowest limit of permanent snow. Factors affecting snowline are-latitude, amount of snowfall, direction of winds and slope of the land.

12.4 Glacier

In region experiencing snowfall, the snow keep on accumulating in layers one above the other. Its overlying pressure is applied to the underlying snow. It is so great that snow in lower layers becomes granular, hard and compact. The pressure also quickens the melting of some of the snow, which on refreezing starts turning into a granular ice. Again it is the pressure of the overlying layers which makes this solid mass of ice mobile. This great mass of ice moving more under its own weight is called a glacier. Its velocity is very low and it moves from a few centimetres to a few metres in a day.

Types of Glaciers

On the basis of their location or area of origin, glaciers are divided into two types: (i) continental glaciers and (ii) valley glaciers.

(i) Continental Glaciers

A thick ice sheet covering vast area of land is called a continental glacier. The thickness of ice in such regions goes upto thousands of metres. Glaciers of this type build up at the centre and move outward in all directions. Continental glaciers of today are found mainly in Antarctica and Greenland. The precipitation in these regions occurs in the form of snow. It gets accumulated year by year because of relatively slower rate of its melting.

(ii) Valley Glaciers

When a mass of ice from the high mountainous regions starts moving down into the pre-existing valleys, it is called a valley glacier or a mountain glacier. The shape of the valley glaciers depends on the valley it occupies. Where the valley is broad, the glacier spreads outwards and where the valley is narrow, the glacier contracts.

The longest glacier in India is the Siachen Glacier in Karakoram range which is 72 kilometres long. Gangotri Glacier in Uttar Pradesh is 25.5 kilometres long. There are many smaller glaciers in other parts of the Himalaya. Their length varies from 5 to 10 kilometres. The two important rivers of India, the Ganga and Yamuna, originate from Gangotri and Yamunotri glaciers respectively.

* A moving mass of ice and snow is called a glacier. Glaciers are of two types-continental glaciers and valley glaciers.

INTEXT QUESTIONS 12.1

Answer the following questions briefly :

1. What is the name given to a moving mass of ice and snow ?

   _____ .

2. What is the name given to the areas lying above the snow-line ?

   _____ .

3. What is the name given to lowest limit of snow - fields

   _____ .

4. Name two types of glaciers.

   (a) _____ (b) _____

12.5 LANDFORMS PRODUCED BY GLACIER

Like running water and underground water, glacier also does the work of erosion, transportation and deposition. Although the zone of action of glaciers is rather limited, topographical features made by them are frequently found spread over even in areas once affected by glacial action.

(A) Erosional work of glacier

As a glacier moves over the land it drags rock fragments, gravel and sand along with it. These rock fragments become efficient erosive tools. With their help glacier scrapes and scours the surface rocks with which it comes in contact. This action of glacier leaves behind scratches and grooves on rocks.

The landforms created by glacial erosion are :

(i) Cirque (or Corrie)

It is an armchair shaped hollow which is the collecting ground of ice at the head of a valley glacier. It is further deepened by the plucking action of snow and ice lying and filling it up. Sometimes the deepest parts of these hollows are occupied by accumulated water, to form Corrie Lake (or Tarn).

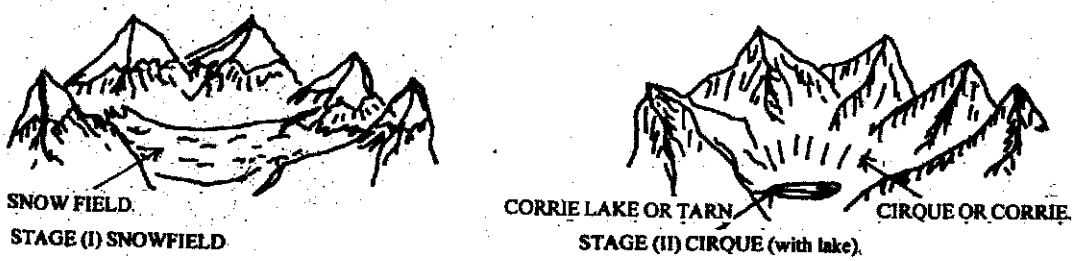


Fig. 12.1 Formation of Cirque

(ii) 'U' - shaped Valley

The glacier does not carve a new valley like a river but deepens and widens a pre-existing valley by smoothening away the irregularities. In this process the glacier broadens the sides of the valley. The shape of the valley formed in this manner resembles the letter 'U'. It is therefore called a 'U' - shaped valley. (See Fig. 12.2). Such a valley is relatively straight, has a flat floor and nearly vertical sides.

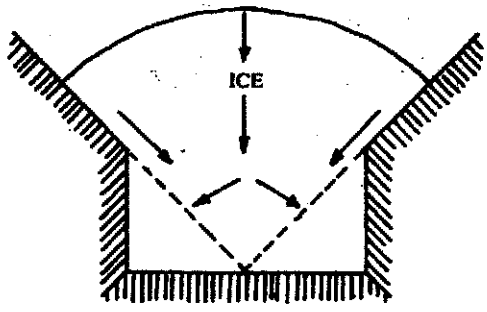


Fig. 12.2 U-shaped Valley

(iii) Hanging Valley

Just like tributary streams of river, there are tributary glaciers also which join the main glacier after moving over their mountainous path. These tributary glaciers like the main glaciers carve U - shaped valleys. However, they have less volume of ice than the main glaciers and thus their rate of erosion is less rapid. As a result their valleys are smaller and not as deep as that of the main glacier. Due to this difference in deepening, the valley of the tributary glacier is left at a higher level than that of the main glacier. The valley of the tributary glacier just looks like hanging downwards at the point of its confluence with the main valley. This type of a topographical feature is called a hanging valley. This feature is visible when ice has melted in both the valleys. (See Fig.12.3 and 12.4). When the ice in the hanging valley melts, a waterfall is formed at the point of confluence of this stream with the main river.

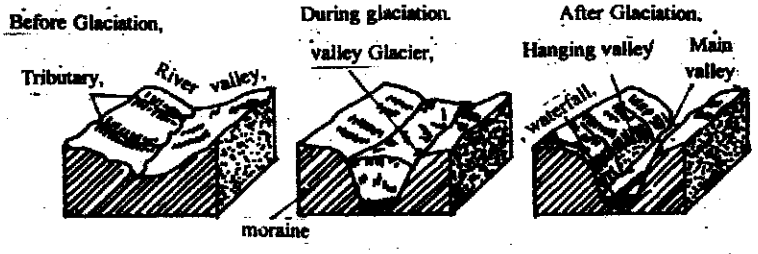
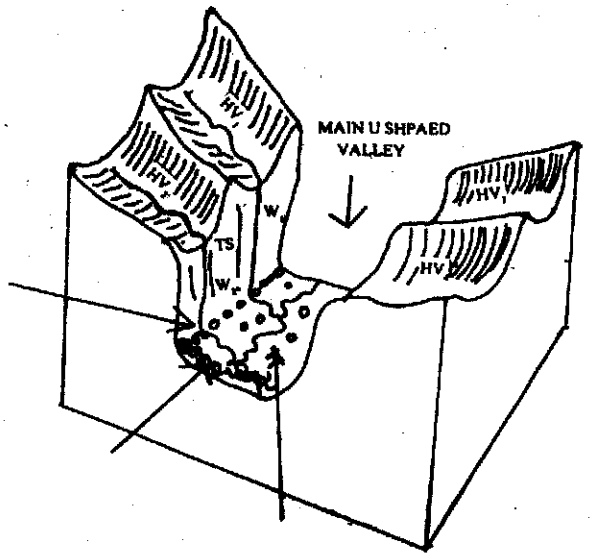


Fig.12.3 Stages in the development of a glaciated valley



HV_1 — HV_2 = Hanging valleys
TS = Truncated Spur.
W_1, W_2 = Water Falls.

Fig. 12.4 Main Features of a Glaciated Valley.

* The main erosional features formed by a valley glacier are (i) Cirque(or Corrie), (ii) U-shaped valley and (iii) hanging valley.

(B) Transportational work of Glacier

Although the glacier moves very slowly it drags with it large boulders and rock fragments. Glacier gets this material from the mountain slopes, valley sides, valley bottom and from air. This material is called the load of glacier.

(C) Depositional work of Glacier

When the glacier melts or retreats, it deposits its load in different parts. The debris thus deposited are called moraines. Depending upon their location in the valley moraines are of four types:- (i) terminal moraine, (ii) lateral moraine, (iii) medial moraine and (iv) ground moraine. (See fig. 12.5)

(i) Terminal Moraine : When the glacier melts, the debris are deposited at the end of the valley glacier in form of a ridge. It is called terminal moraine. Morainic material ranges from fine clay to large angular boulders.

(ii) Lateral moraine : The moraine which is deposited on either side of a glacier is called lateral moraine.

(iii) Medial moraine : When two glaciers join each other, their lateral moraines also join. Moraines thus formed on the confluence of two glaciers are called medial moraines.

(iv) Ground moraine : It consists of deposits left behind in areas once covered by glaciers. It is seen only after the glacial ice has disappeared by melting.

Fig. 12.5 A Glacier with Small Tributaries (showing. moraines)

* The material deposited by glaciers containing rock fragments of various size are called moraines.
* The moraines deposited at the end of the valley glacier is called terminal moraine.
* Moraine deposited on the sides of the glacier is called the lateral moraine.
* Moraine deposited at the confluence of two glaciers is called the medial moraine.
* Moraine deposited at the bottom of the glacier is called ground moraine.

INTEXT QUESTION 12.2

1. Name three topographical features made by glacial erosion.

   (a)_____ (b)_____ (c)_____.

2. Name one topographical feature made by glacial deposition.

   _____

3. Name three activities of glacier.

   (a)_____ (b)_____ (c)_____.

WORK OF THE WIND

12.6 LANDFORMS PRODUCED BY THE WIND

The wind, as an agent of gradation is most active in the arid or desert regions because they provide ideal conditions for wind action.

In these regions of high daytime temperature, the bare rocks get heated up followed by their very rapid cooling at nights. This leads to their expansion and contraction causing their disintegration into finer fragments. The wind picks up these fragment and carries them away. In the process the rock particles strike against each other and get broken down into progressively smaller particles. The sand particles present in the wind act as erosive tool in cutting down surface rocks and producing a variety of landforms. When the velocity of the wind is reduced, generally due to some obstructoin in its path, its carrying capacity is also reduced and a part or the whole of the material is deposited. This deposition produces a variety of landforms. Thus the work of the wind is also three fold, viz. erosion, transportation and deposition.

(A) EROSIONAL WORK OF WIND

The erosional work of wind is performed with the help of sand particles suspended in it. The wind carries them upto a height of a few metres from the surface. The erosional action of wind is not uniform in all areas. Its intensity depends upon the velocity of the wind, amount and size of the sand particles present in the air, nature of the rocks and climate. The erosional work of the wind involves three processes. These are abrasion, attrition and deflation. When the sand particles present in the wind wear down the rocks by polishing and scouring, it is called *abrasion*. When the wind-borne material strikes against each other, they are reduced to progressively smaller and rounded particles, it is called *attrition*. The process of removal of unconsolidated rock particles by wind is called *deflation*.

Landforms Produced by Wind Erosion

Some of the topographical features made by wind erosion are as follows:

(i) Mushroom Rocks (Or Rock Pedestals)

When rocks, consisting of alternate hard and soft layers are subjected to wind abrasion, differential erosion results. The soft layers are easily eroded but the hard layers resist erosion. As a result of undercutting near the base (due to greater amount of sand and rock particles being transported close to the ground), the resulting feature resembles a rock pillar shaped like a mushroom. It is aptly called rock pedestal or mushroom rock. Such formations are common in the Sahara Desert, and are also seen near Jodhpur. (See fig. 12.6)

Fig. 12.6 Mushroom Rock

(ii) Wind Eroded Basins

These are actually hollows or basins formed by deflation (the blowing away of unconsolidated rock particles by strong winds). Continued deflation results in the

formation of these hollows or basins. The Quattara depression in Egypt is perhaps the finest example of such a hollow.

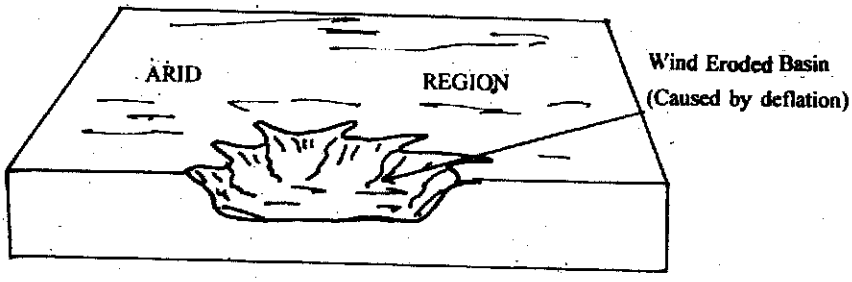


Fig. 12.7 Wind Eroded Basin

* Mushroom rocks are formed in the desert regions by means of wind erosion.
* Wind-eroded basins are formed by wind deflation.

(B) TRANSPORTATION BY WIND

We know that the particles of dust, smoke, pollen grains, seeds of plants, microscopic organisms and volcanic dust are present in the air. Some of these particles can be seen during a dust storm. Wind can carry with it light and unconsolidated material. Among various types of particles present in the air, dust particles are most numerous. Wind picks up these particles from ploughed fields and arid areas. The amount of dust particles present in the air in areas covered with vegetation is much less than in arid region. That is why most of the work of the wind is confined to only arid and desert regions.

Wind is an important agent of transportation in the arid region. The transported material is sometimes deposited in areas very far away from the place from where the dust particles have been picked. Winds blowing from Gobi Desert carry dust to the northern parts of China. In our country also winds blowing from Thar Desert bring dust particles to western Uttar Pradesh and the adjoining parts of Haryana & Punjab. This transported material is deposited in the fertile plains of Uttar Pradesh.

(C) DEPOSITION BY WIND

Under certain conditions, the material transported by wind starts getting deposited at a particular site along its running track. The conditions favouring it are :

(i) When the amount of dust particles present in the air exceeds its carrying capacity, a part of the material being transported is deposited. This is the material which is in excess of the transportation capacity of the wind.

(ii) When the speed of the wind is reduced, its carrying capacity is also reduced.

The material in suspension is thus deposited.

(iii) When an obstruction comes in the path of the wind, air has to rise above this obstruction. When it rises, the velocity of the wind is reduced and it starts dropping its load. This material is deposited in form of a mound at the foot of the obstruction.

Landforms produced by Wind Deposition

Some of the topographical features made by wind deposition are as follows:

(i) Sand Dunes

Sand dunes are a special feature of the desert regions. They are of different types and have a variety of shapes. The major factors affecting their formation are (a) amount of sand available (b) direction and force of wind, (c) an obstruction in the path of the wind e.g. a bush, a stone or a dead animal. As long as the wind is strong enough to carry the sand, the sand dunes are live and they keep on shifting from one place to another. If vegetation or a line of trees starts growing on the dunes they become fixed. They also become staitionary when they are blocked by a hillock. In case there is no such obstruction, sand dunes may bury agricultural land, plains and settlements. To check the expansion of Thar Desert in our country, bushes and trees called tree belts have been planted in many areas.

There are two main types of sand dunes :

(a) Barkhan

Barkhan is a Turkish word meaning a sand hill. They are found in large numbers in Turkestan. In fact they are sand dunes having a crescent or bow-like shape and their slope is in the direction of the wind. They are formed due to an obstruction in the path of the wind. Wind keeps depositing sand at the obstruction and the dunes are formed. Barkhans are formed in areas where the winds blow steadily from one direction. With a change in the direction of the wind, their shapes also change. Horn-like features are formed in areas where the winds blow steadily from one direction. Such dunes with a special appearance are called barkhans. They are found in large numbers in the Sahara Desert.

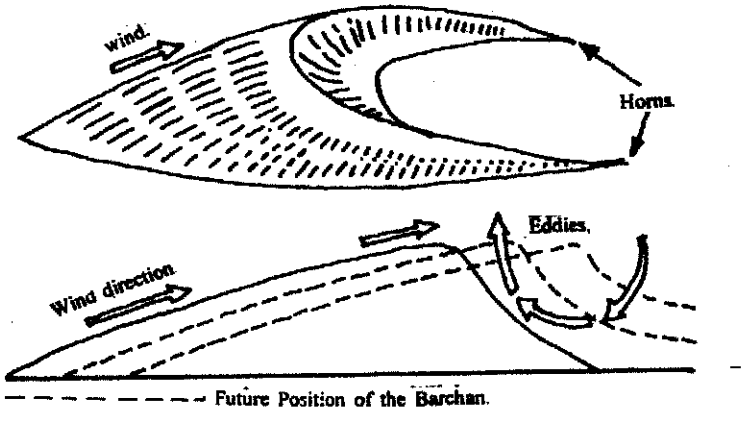


Fig. 12.8 Barkhan and its Migration

(b) Seif Dunes

These are long, narrow ridges of sand that lie parallel to the direction of the prevailing winds. The winds blow straight along the corridors between the lines of dunes, sweeping the corridors clear of the sand, However, eddies set up in the winds blow towards the sides of the corridors, depositing sand there to form these narrow elongated dunes. Seif dunes are common in the western part of the Thar Desert of India.

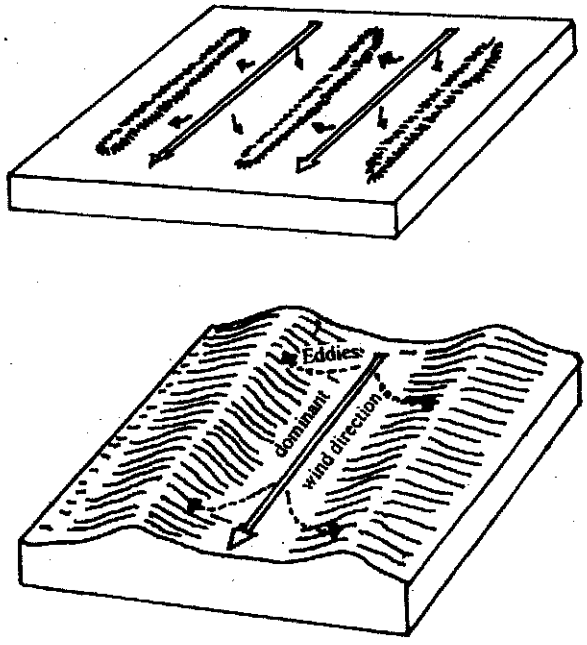


Fig. 12.9 Self Dunes

(c) Loess

Every year wind transports large quantity of fine dust particles from the desert regions. A large deposit of wind-borne dust transported over great distances, some times beyond the desert is called loess. This is generally a yellow or brown coloured soil in which the particles are smaller than those of sand and larger than those of a natural soil.

Sometimes organic matter are also found deposited with loess. This soil is quite fertile. Large deposits of this type is found in northern parts of China. The soil has been deposited over thousands of years by the winds coming from the Gobi Desert. Erosion of loess in China by Hwang Ho, has given it the name of 'Yellow River'

and the sea in which the river falls, is also called Yellow Sea as the yellow loess particles remain suspended in water. Besides China, deposits of loess occur in Mississippi Valley of North America and north of Central European Upland in Germany, Belgium and France. Loess deposits are found in Austalia also.

* Depositional work of wind results in formation of topographical features like sand dunes, barkhans, seif dunes and loess.

INTEXT QUESTIONS 12.3

(a) In which region is the work of wind more effective ?

_____ .

(b) Name three important works of wind.

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

(c) Which major topographical features are made by wind erosion ?

(i) _____ (ii) _____ .

(d) Which important step has been taken to control the expansion of Thar Desert ?

_____ .

(e) Name three important topographical features made by wind deposition.

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

(f) Where are the maximum deposits of loess found ?

_____ .

(g) Why is Hwang-ho river of China called 'Yellow River' ?

_____ .

WORK OF SEA WAVES

We are aware of the fact that the water in the oceans is never at rest. The tides, waves and ocean currents contribute to the restlessness of ocean. Their continuous effect on coast creates a number of relief features. Just like the rivers erode their banks, waves also erode the coasts and deposit the eroded debris at some other place. The work of sea waves as an agent of gradation includes erosion, transportation and deposltion. A number of topographical features are made through these action of waves. Such features are found in the coastal regions. Let us study the work of sea waves in some more details.

12.7 EROSION BY SEA WAVES

Sea waves have a great erosive force. In their role of an erosional agent they perform four functions. When the sea water loaded with rock fragments and sand attack the coastal rocks it is called *abrasion*. The rock particles present in the water hit against each other and break into progressively smaller particles. This process

is called *attrition*. Thirdly the broadening of cracks and crevices in the cliffs along the coast due to the attack of the sea waves is called the *hydraulic action*. The rocks made up of limestone are subjected to *solution action* by the sea waves. All these processes help in formation of new features on the coastal margins.

The action of waves is not uniform in all parts but it varies from one place to another. The major factors affecting the intensity of erosion include the magnitude and force of the waves, direction of attack by the waves, nature and shape of the coastlines, slope and height of the coastal rocks, depth of water, intensity of tides, climatic conditions and the influence of plants and animals. The effect of waves is less if the rocks are hard and it is more if the rocks are soft. Similarly, in the rainy areas, the erosion is more as the wave action is assisted by the erosinal work of the surface run-off. Plants and animal also weaken the rocks in the coastal areas by making holes in them. These weakened rocks can be easily eroded by waves.

- The three major works of sea waves are erosion, transportation and deposition.
- Abrasion, attrition, solution and hydraulic action are the processes which help in erosion by the sea waves.

(A) Landforms Produced by Wave Erosion

Waves, like streams erode the coastal rocks with the help of rock fragments present in the water. Due to the continued erosion by waves the coastline keeps retreating and a number of topographical features are formed in the process. Some of the important features made through wave erosion are mentioned here :

(i) Sea Cliff

The maximum impact of the waves is observed on the lower part of the coastal rocks and consequently the lower part of the rocks is eroded more rapidly than the upper part. This results in the formation of a hollow under the rock and with passage of time this excavation in the lower part of the rock keeps on becoming larger.

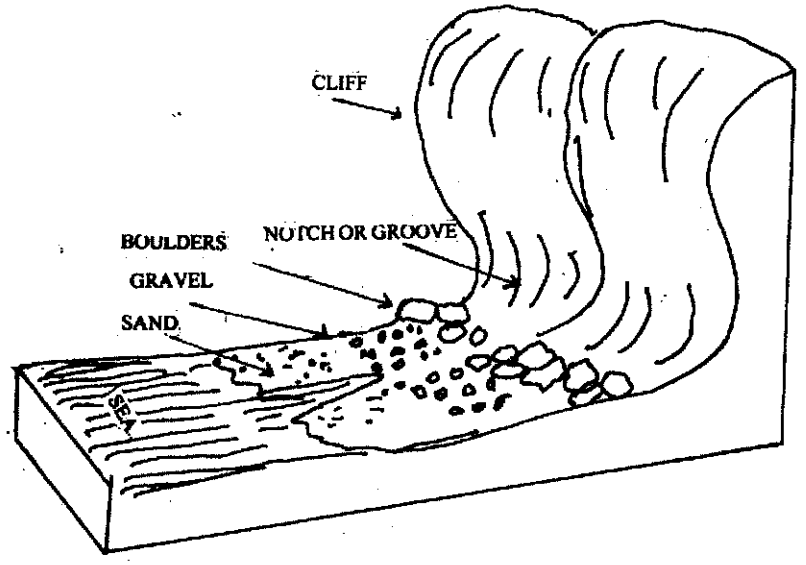


Fig. 12.10 A Sea Cliff

The upper part of the rock is thus left projecting out towards the sea. After sometime, this projecting part fall into the sea under its own weight. As a result a vertical wall is left. This vertical wall is called a cliff. In India a number of sea cliffs are found along the Konkan Coast of India.

(ii) Sea Caves

When the upper part of the coastal rock is hard and the lower part is soft, the erosion is not uniform. The lower part of the rock in such circumstances is eroded much faster than the upper part. Due to differential erosion, a hollow is created in the lower part of the rock. When the waves pound against this hollow, air present in the hollow gets compressed. When the wave comes out of the hollow, the pressure on air is also released and it expands. Due to continuous compression of the air in the hollow, the rocks are subjected to a great pressure and they break. In this process, the hollows in the lower part of the rock keep on enlarging. With passage of time they attain the form of caves and are known as sea caves. Formation of caves depends upon the nature of the coastline and the force of the waves.

(iii) Sea Arches

When a part of coast extends to some distance into the sea, sea waves working from opposite directions cut a passage through the soft rocks. In the initial stages, this passage is a narrow hole but it enlarges into a broad arch. These broad door-like features are called sea arches or natural bridges.

(iv) Sea Stacks

When the roof of an arch is broken by erosion or under its own weight or due to any other reason a part of the original rock remains standing as a solitary mass. It may be the rock forming the side of the arch. This type of a feature is called a sea stack. Stacks are of a number of types depending upon their shape and the nature of the rocks. Sometimes they take the shape of an islands but such islands are not permanent. Small underwater stacks are known as stumps.

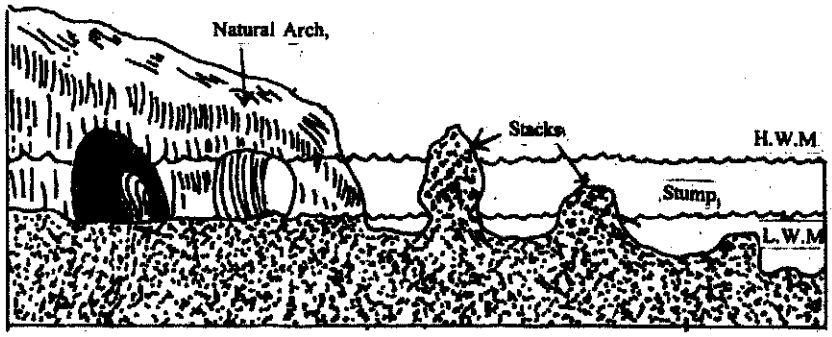


Fig. 12.11 Topographical features made through wave erosion

* Wave erosion is responsible for the formation of sea cliffs, sea caves, sea arches and sea stacks.

(B) Transportation by Sea Waves

Sea waves, currents and tides are the main agents of transportation of eroded material in the coastal regions. However, the role of waves is more important in connection with the formation of coastal relief features. The material deposited on the coasts by the rivers and glaciers etc. is removed and transported by the waves. Transportation by sea waves is carried out in two ways :

(i) Removal and transportation, towards the sea, of the material deposited by river etc. on the coast.

(ii)Carrying of material found in the sea to the coastal areas. During this process, the oceanic materials like pearls, conches and other shells are brought to the coast.

* Transportation by sea waves is responsible for oceanward transportation of the material deposited on the coast and coastward transportation of the material found in the sea.

(C) Deposition by Sea Waves

Sea waves are helpful in the deposition of the material eroded from the coastal areas. Oceanic current are also helpful in deposition of the transported material. Deposition of the material along the coast is selective. The larger particles are deposited first therefore they are found near the coast. On the other hand, the finest particles are deposited last and they are deposited generally away from the coast. This selective deposition is sometimes altered or affected by a change in the intensity or force of the waves. Thus it is sometimes possible to find very fine particles deposited near the coast where generally larger particles are deposited.

A number of topographical featured are formed due to deposition by waves and currents. Some of these topographical features are discussed here :

(i) Beach

Most of the material eroded and picked up by the waves is deposited near the coast. Due to this deposition, the sea becomes shallow and a part of the coastal area is raised above the water level. This raised portion is almost like a flat plain of a platform formed of gravel and sand. This type of depositional features along the coast is called a beach. Beaches are centres of tourist attraction.Marina Beach of Chennai and Kovalam Beach of Thiruvananthapuram are the famous beaches of India.

(ii) Sand Bar

Sometimes the deposits of sand and gravel laid down by waves and currents form embankment, separating shoreline from the sea. They thus form barriers between the sea and the mainland. Such deposits are called sand bars. They sometime pose difficulties in navigating.

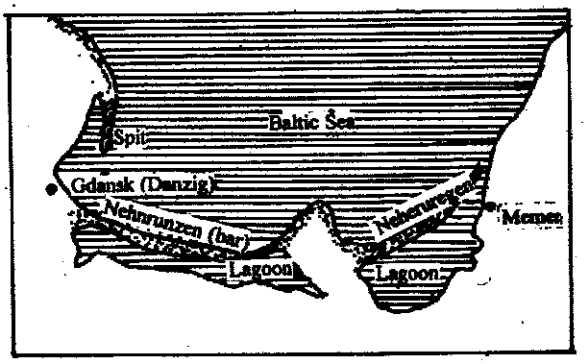


Fig 12.12 Sand Bar and Spit

(iii) Spit

When one end of a bar is attached to the coast and other extends into the sea, it is called a spit. These spits are formed by the accumulation of materials brought by waves like sand and gravel.

(iv) Lagoon

Sometimes due to deposition of waves and currents both the ends of the bar join to enclose a part of the sea water between the coast and the bar. This enclosed part of the sea forms a lake of saline water. This saline water lake is called a lagoon.

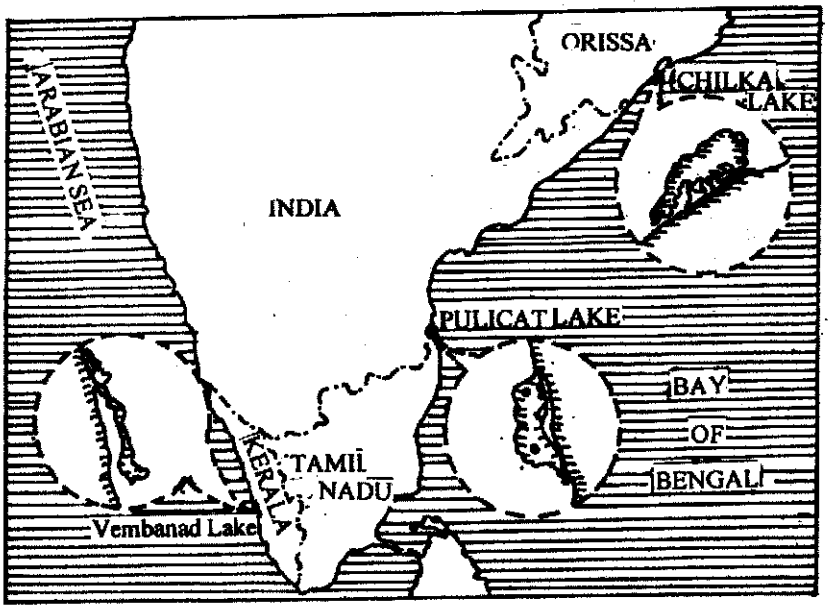


Fig. 12.13 Map showing Famous Lagoons of India

Sometimes the lagoons are formed due to wave erosion also. A lagoon is generally connected with the sea through a narrow passage. The Chilka and Pulicate lakes on the north-eastern coast and lake Vembanad on Kerala coast are examples of lagoon lakes in India.

* Topographical features like beaches, bars, spits and lagoons are formed by the action of waves.

INTEXT QUESTIONS 12.4

1. Fill in the blanks

   (a) Cutting of coastal rocks by waves is known as their _____ work.

   (b) The four processes contributing to erosional action of waves are :

   (a)_____ (b)_____ (c)_____ (d)_____.

   (c) Sea cliff is a result of _____ action of sea waves.

2. Name any three relief features made through erosional action of sea waves.
   (i)_____ (ii) _____(iii) _____.

3. Name two important factors on which the formation of the sea caves depends.

   (i)_____ (ii) _____.

4. Which action of waves is responsible for the formation of spit

   _____.

5. Classify following relief features made by erosional and depositional action of waves :

   Sea stack, Bars, Sea caves, Sea cliffs, Beaches and Arches.

Categories :

(i) Made through erosion (1)_____ (2)_____ (3)_____.

(ii) Made through deposition (1)_____ (2)_____ (3)_____.

WHAT YOU HAVE LEARNT

In areas where the temperature always remains below freezing point, precipitation occurs in the form of snow. Therefore, these areas are covered with snow. Such regions are called snow-fields. Snow-fields are found always above the snowline. Snowline is that line above which the snow never melts completely. Moving ice is called a glacier. They are of two types- continental glaciers and valley glaciers. Glaciers do the work of erosion, transportation and deposition through which a number of topographical features are formed. The major

topographical features of glacial erosion are the 'U' -shaped valleys and hanging valleys. The major depositional features of glacial action are the moraines. There are three types of moraines-terminal moraine, lateral moraine and medial moraine. Topographical features made by glaciers are found in areas of high altitude and high latitude.

Wind like running water, moving ice and underground water, is an important agent of gradation. Action of wind is more effective in arid and semi-arid regions. Wind erodes the rocks, transports the broken material and deposits it in different areas. These three actions of wind are known as erosion, transportation and deposition. Erosinal work of wind include abrasion, attrition and deflation. One of the major topographical features made by wind erosion is mushroom rock which resembles an umbrella in shape. The transportation work of wind is also extensive, the broken particles of rocks are transported to thousands of kilometres. Deposition of the transported material results in formation of a number of topographical features. The important ones among these are the sandunes and loess.

Sea waves are an effective means of gradation in the coastal regions. These important works of waves are the breaking up of the rocks, removal of broken material and laying down of this material in different part of the coastal areas. These three actions of waves are called erosion, transportation and deposition. Erosion by waves is achieved through the processes of abrasion, attrition, hydraulic action and solution. Erosion by sea waves results in formation of topographical features like sea cliff, sea caves, arches and stacks. Transportation work of waves makes possible seaward movements of the material accumulated on the coast and coastward movement of the material found in the sea. Depositional work of sea waves is responsible for formation of topographical features like bars, spit, beaches and lagoons.

TERMINAL QUESTIONS

1. Answer the following questions in brief :

   (i) Why is snowline higher in equatorial regions ?

   (ii) What is a hanging valley ? How is it formed ?

2. Distingwish between the following :

   (a) Continental glacier and valley glacier.

   (b) V-shaped valley and U-shaped valley.

3. Name the major relief features formed by glacial erosion and deposition and explain the process of formation of each with the help of diagrams.

4. In which region is the work of wind more effective? Why it is so?

5. Explain the three processes which help in the wind erosion.

6. How is a mushroom rock formed? Explain with the help of a diagram.

7. Where and why are the greatest deposits of loess found?

8. Why is River Hwang-Ho of China called 'Yellow River' and neighbouring sea the 'Yellow Sea'

9. Which topographical features are formed through erosional action of sea waves? Explain the mode of formation of each.

10. How is a beach formed? Name two important beaches of India.

11. Differentiate between :

    (i) Erosional and depositional work of wind.

    (ii) Solution action and hydraulic action of sea-waves.

    (iii) Lagoon and beach.

CHECK YOUR ANSWERS

INTEXT QUESTIONS

12.1

1. Glacier. 2. Snowfield. 3. Snow-line 4. (a) Continental glaciers, (b) Valley glaciers.

12.2

1. (a) U-shaped valley (b) Hanging valley (c) Cirque
2. Moraine
3. (a) Erosion, (b) Transportation, (c) Deposition

12.3

(a) Desert and semi-desert regions.

(b) (i) Erosion (ii) Transportation (iii) Deposition

(c) (i) Mushroom rock, (ii) Wind eroded basin

(d) (i) Afforestation.

(e) (i) Sand dunes (ii) Barkhans or Seif dunes, (iii) Loess.

(f) In North China

(g) Because of presence of yellow dust particles brought by wind from Gobi Desert.

12.4

1. (a) Erosional (b) Abrasion, Attrition, Hydraulic action, Solution. (c) Erosional
2. (i) Sea cliffs (ii) Sea caves (iii) Sea arches (iv) Sea stack (any three)
3. (i) Nature of the coastline (ii) Force of waves
4. Depositional work.
5. (i) Made through erosion : Sea stacks, cliffs, caves, arches.

   (ii) Made through deposition : Bars, beaches.

TERMINAL QUESTIONS

1. (i) Snowline is higher in the equatorial regions because these regions experience high temperature throughout the year.

   (ii) Refer to section 12.5 (a) (iii) for answer draw the diagram (Fig. 12.4) given on that page.

2. (a) (i) Continental glacier : A large area covered with ice and snow

(ii) Valley glacier : is formed when ice and snow start moving form high mountains into some pre-existing valleys. This moving mass of ice and snow is called a valley glacier.

(b) V-shaped Valley : Due to a steep slope in the higher mountainous regions, the flow of the rivers is very rapid. They erode the bottom of their valleys at a higher rate and this results in the formation of a V-shaped valley. (See figure in the foregoing lesson).

U-shaped valley : Glaciers do not form their valley as the river does. They flow through some old valleys. Such narrow valleys are broadened and deepen by the glaciers to form U-shaped valleys. U-shaped valleys are deep and steep-sided and they are formed through erosion on the valley floor and the valley sides. (See Fig. 12.2).

3. Major relief features formed by glacial erosion are (i) U-shaped valley, (ii) Hanging valley. Major relief features formed by glacial deposition are : (i) Lateral moraines, (ii) Terminal moraines, (iii) Ground moraines, (iv) Medial moraines.

4. In arid or desert regions

Due to partial or total absence of vegetation cover, the wind find the conditions ideal for blowing over vast areas uninterrupted. Besides mechanical weathering breaks the rocks into small particles which are easily blown away.

5. The three processes are abrasion, attrition and deflation. (For details Refer to Section 12.6 (A).

6. Mushroom rock is formed by wind erosion. (For details and diagram, see Section 12.6 (i).

7. Greatest expanse of loess deposits is found in North China. They are formed by deposition of wind-borne material transported from Gobi desert which is deposited here.

8. Due to presence of yellow sand and dust in the water of this river, Hwang-Ho is called 'Yellow river.' This river flows through loess deposits.

The sea into which the river carries this sediments is called 'Yellow Sea' because of the yellow colour of the sediment.

9. The major topographical features made through wave erosion are sea cliffs, sea caves, sea arches and sea stacks. (For details of their mode of formation refer to section 12.7 (A).

10. Beaches are formed through depositional work of sea waves. Two famous beaches of India are Marina Beach of Chennai and Kovalam Beach of Thiruvananthapuram. (For details of mode of formation see Section 12.7 (C) (i).

11. (i) Breaking up and frictional reduction of rocks by wind is called erosion and the process of laying down of wind-borne material is called deposition. (For details refer to section 12.6 (A) and (C).

(ii) The term hydraulic action refer to the process of broadening of the rock joints and cracks by the pressure exerted by air entrapped in the coastal rocks. The term solution refers to the action of water on the soluble rocks like limestone. Such rocks are dissolved by water and thus eroded. (For detail refer to Section 12.7).

(iii) Lagoon and beach are both formed though depositional action of waves. A beach is a raised portion on the sea coast made through deposition of sand and gravel. A lagoon is the enclosed part of the sea separated from the open sea by an enlarged bar. (For details refer to 12.7 (C) (i) and (iv).