3. Agents of Erosion

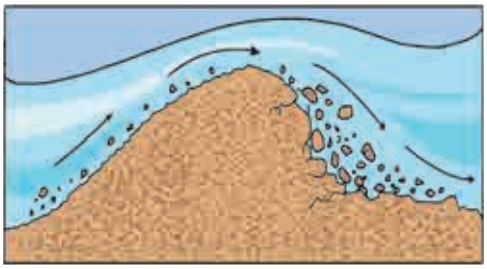
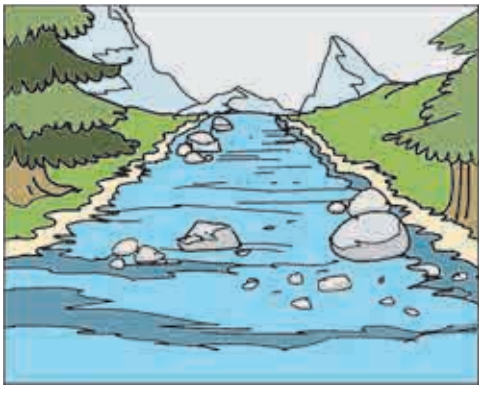
Can you tell?

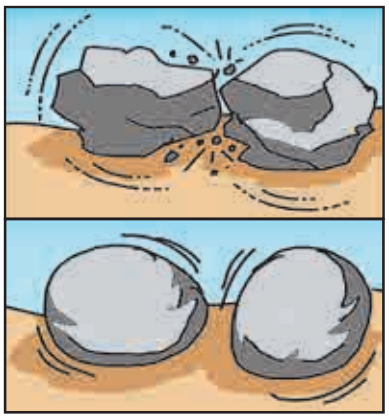
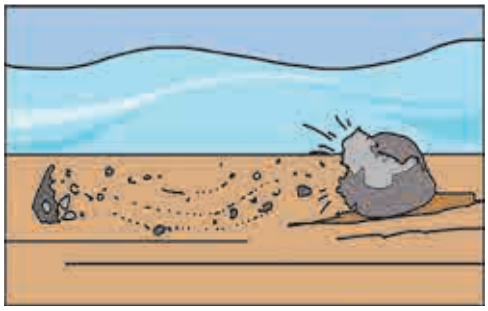
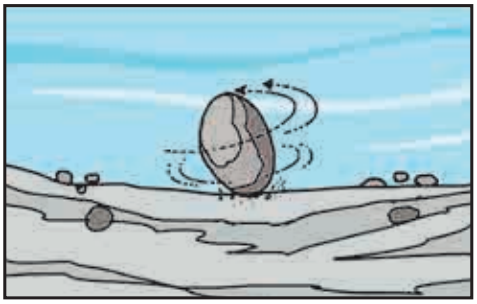
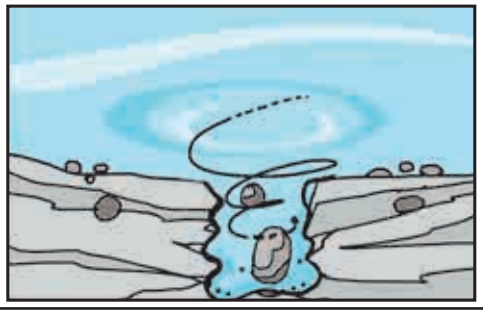
The names of many places may have some relation with the landforms located there. The names of few of them are given below as example. You are expected to find out the particular landforms to which they are associated. Find about them and try to locate them on a map using an atlas. Make a list of similar examples from India. Discuss your findings in the class.

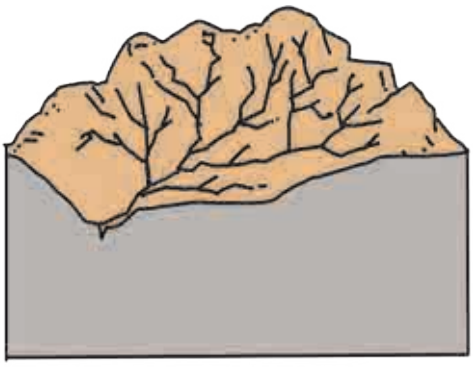
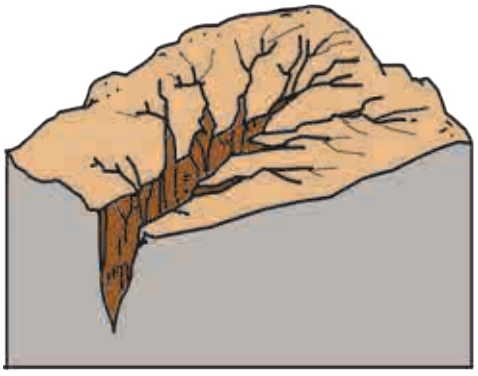
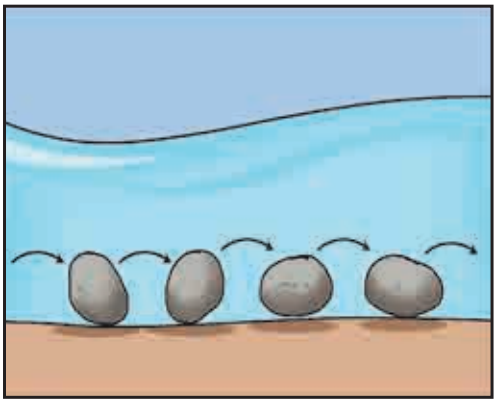
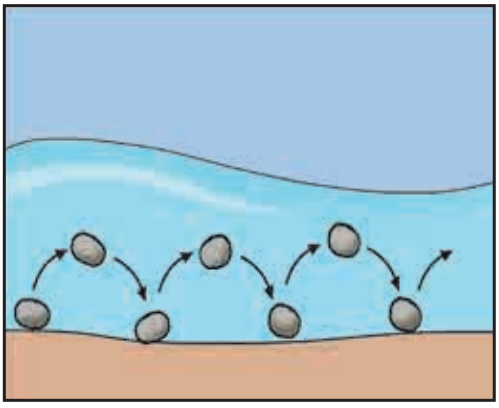
Name of the place	Landform associated with the name	Location
Revdanda	Sand bar	Raigad, Maharashtra
Ganpati Pule	Beach	Ratnagiri, Maharashtra
Pravara Sangam	Confluence of rivers	Ahmadnagar, Maharashtra

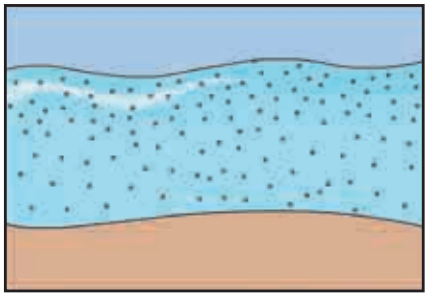
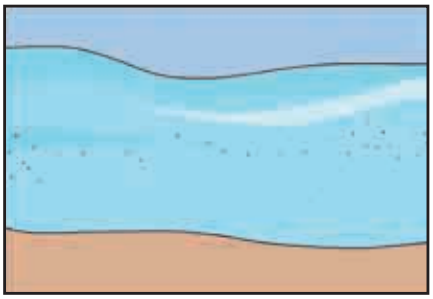
Geographical explanation

You have seen how landforms may be used to name places or villages. Landforms have been formed due to certain processes. Agents work upon them. Landforms develop over a long period. You have already learnt about the agents of erosion: running water (river), sea waves, wind, underground water and glaciers. They are the medium. These agents detach or separate, pick up, move, and eventually lay down broken rock particles. These agents of erosion cause various processes when they pick up, move and deposit these rock particles. These processes lead to erosional and depositional landforms. Some processes are common across all agents but some are specific to a particular agent. Try to understand these processes with the help of the table given below. The adjacent diagrams will help you to visualize how the process operates.

Sr. No.	Processes of Erosion	Agent	Diagram
1.	Plucking is the process by which moving ice exerts pressure on majority portion of rocks on bed or along the bank. This causes uprooting of rock portion which is getting exposed to the flow. This uprooting of particles is called plucking. The eroded bedrock will have a rugged surface.	Glacier	
2.	Abrasion involves the scratching and polishing of the surface or bedrock by the particles which are moving onto it. Just as sandpaper is used for smoothening, the rock particles involved in abrasion rub against and wear away the surface. The eroded bedrock or surface will have a smooth side. Abrasion increases as velocity increases.	Wind, glacier, sea waves	

Sr. No.	Processes of Erosion	Agent	Diagram
3.	Attrition is when rocks and pebbles bump into each other and break up into smaller fragments. During transit, materials reduce in size. Rock particles become more rounded.	Wind , Waves, river	
The difference between abrasion and attrition is that abrasion affects the surface along which the material moves and attrition relates to the material that moves.			
4.	Solution - Solution is when certain types of rocks get eroded as a result of acids in the sea or river water. When minerals in rocks like chalk and limestone are dissolved in water, they are carried in the water. The load is not visible. In particular, limestone, dolomite and sandstone coasts are very susceptible to this type of erosion.	Underground water, river, sea waves	
5.	Deflation – The particles which are loosened on the surface are blown away by the wind. This action is more intense where vegetation is absent. After removal, the portion from where sand is blown off appears as a depression. These are called deflation hollows.	Wind	
6.	Drilling - Bedload moves along the running water. As and when this flow encounters an obstacle due to relief on the bed or joints in the bed, the flow tends to develop a circular pattern. This circular system becomes stable, though the water continues to flow in downstream direction. This leads to development of a whirl. The trapped sediments also follow the similar circular motion. The continuous action of these trapped sediments and the whirl deepens the bed of the river at a given point. Eventually, it develops into a larger depression assuming a shape of a pot.	River	 

Sr. No.	Processes of Erosion	Agent	Diagram /Figure
7.	Down cutting, also called downward erosion is a process of hydraulic action that deepens the channel of a stream or valley by removing material from the stream's bed or the valley's floor.	River, glacier	
8.	Head ward erosion is the backward erosion by river in the source region. Gravel or soil in the source region may collapse due to steep slope. This is carried away by the stream. This causes the river to move backward. Such erosion takes place in the opposite direction of the flow of the river.	River, glacier	
9.	Lateral erosion is the erosion that occurs on the sides of valleys of a river or glacier. The valley side slopes are eroded by the tributary streams. As and when, rate of downcutting decreases, the effect of lateral erosion becomes evident. This process is also called valley widening. In the valley floor region too lateral erosion occurs that mainly leads to widening of flood plains.	River, glacier, sea waves	
Sr. No.	**Processes of Transportation**	**Agent**	**Diagram /Figure**
10.	Traction – The material acquired by the agents is transported by rolling, pushing and dragging along the surface. The material consists of boulders and big rocks.	All except groundwater	
11.	Saltation – Often, rock materials move forward by leaps and bounds through this process. Saltation is when material such as pebbles and gravel and coarse sand that is too heavy to be carried in suspension is bounced along the surface by the force of the water or wind.	River, wind and sea waves	

Sr. No.	Processes of Transportation	Agent	Diagram /Figure
12.	Suspension - Fine light material is carried along with wateror air in the upper layer. They are very small in size. For a long distance, they do not come to rest.	River, wind, sea waves	
13.	Solution – The material is carried in water in a dissolved state. In areas where limestone or similar soluble rock is present, the amount of dissolved load in water is greater.	River, sea waves, groundwater	
14.	The process of deposition takes place due to certain factors in the course followed by the agent. The velocity at which the agent is moving has a great impact on deposition. If the stream or wind slows down, the carrying capacity will decrease and the particle sizes carried and deposited will also decrease. If a stream flows faster, say, during floods or when the river is in the mountains, then the carrying power of the stream will increase and the sizes of particles deposited will increase as well. If there is a change in the slope of the land, or change in direction of flow, deposition may occur there. Winds change their directions. When the slope is almost absent like in plain regions, the rivers are unable to carry sediments further and start depositing. Smaller particles settle more slowly than the larger particles, due to gravity. The smaller particles tend to stay in suspension for longer periods of time. Smaller particles are carried away till the end by river or wind. And their deposition occurs in the later stage. An obstacle like tree or mountain or similar structure may come in between. The agents may slow down because of obstacles. Deposition may take place at such a point.		

Understanding these processes will help you see how the action of different agents of erosion leads to landform formation. These landforms are a sum result of erosional, transportation and depositional processes. These processes act together or may also act singularly at different locations. Based on the effect of each of them, landforms produced by different agents can be classified as erosional and depositional landforms.

Let's recall.

You have already learnt about various landforms formed by the agents of erosion in Class IX. Identify the landforms given in class IX textbook from page no. 30 to 38. Identify the agent which is responsible for their formation. Also, state whether they are erosional or depositional landforms. Complete the table accordingly in your notebook.

Sr. No.	Page No.	Name of the landform	Agent	Erosional / Depositional
1	30			
2	31			
3				
4				

Geographical explanation

You must have realized that not all agents of erosion are present everywhere. In arid regions, wind is the dominant agent while river is the most common of all. Karst topography occurs only where there are dolomite or calcium rocks. There are many factors which control the formation of landforms. They are climate, type of rocks, intensity of erosion, slope of the land and obstacles. These factors affect the processes of erosion and deposition and the processes discussed above. For example, the wind starts depositing when it is not able to carry the heavy load of the sediments. Thus, the process of forming depositional landforms begins. Rivers start depositing when their speed reduces.

Though all agents of erosion are not present everywhere, process of erosion and deposition occurs everywhere. Common processes lead to different landforms through different agents. Flood plains are formed due to deposition by rivers while drumlins are formed by deposition by glaciers.

Agents of erosion and landforms :

Let's understand how each and every agent works to form various landforms.

Work of river :

Think about it.

Have you ever been to a river and seen its bed? Discuss in the class about your observations about the river, its banks, its bed and its velocity.

Geographical explanation

A river, which is flowing water, erodes rock materials, transports them to newer places and deposits them. In this process, it creates many landforms. Picking up pieces of rock and moving them require the river to have kinetic energy. When it has more kinetic energy, it can pick up and move more particles.

As soon as a stream begins from its origin, it starts erosion. In mountainous areas, river flows at a higher speed. Here, the bed gets more eroded than its banks. Gorges are formed with steep banks and a narow bed. For example, the gorges of river Ulhas and river Narmada. Deeper gorges are called canyons.

Find out !

Find out famous examples of gorges and canyons.

Over a period of time, river starts consuming its energy in transporting the material. Consequntly, the bed is less eroded. However the erosion along the banks and the slope of the valley increases. Hence, the valley with almost vertical sides becomes wider resembling the letter 'V'. These valleys are called 'V' shaped valleys.

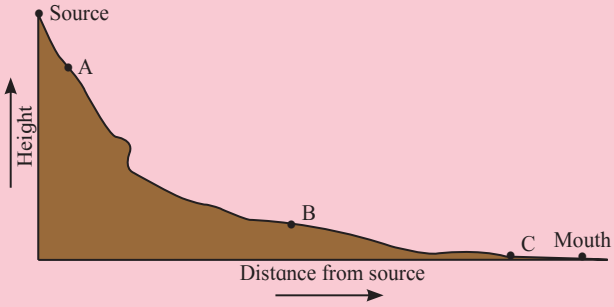
Some times, water flowing over a hilly region comes down a cliff, waterfalls commonly get formed at such locations. When a river runs over alternating layers of hard and soft rock, rapids and waterfalls are formed. Jog falls on the Sharavati river, Chuliya falls on river Chambal and Venna falls in Mahabaleshwar are some well known examples. At the base of the waterfall, plunge pools can form because of constant gush of water on the rock below.

Potholes generally originate in special circumstances, such as below waterfalls or where rocks are structurally weak. Swirling whirlpool motions of the river water causes stones at the bottom to grind the bedrock and enlarge the potholes by drilling while finer sediments are carried away in the current. Potholes may range from a few centimetres to many meters in diameter

and depth. Large potholes can be seen in the beds of river Kukadi at Nighoj in Ahmadnagar district and river Indrayani at Bhegadewadi in Pune district. In river beds, gravels and pebbles are often rounded. This happens because the rock materials carried in the flow tumble and bounce against one another. This process called attrition makes the load fine-grained.

Can you tell ?

Look at the figure below and answer the questions :



1) What features are formed in the upper course of the river? What processes will play an important role?
2) Can you mark the location where a waterfall may formed?
3) Why is there a change in slope from A to B? How will it influence the flow of the river?
4) Which human activities can be conducted in the region around A and B?
5) In which area will the process of deposition overtake erosion?
6) Alluvial fans and deltas are both features formed due to deposition but at different locations. Identify their regions of formation and reason behind their different locations.

When the river enters the plains, there is a change in the slope. The river's velocity is reduced abruptly. As a result, it may deposit some material at the foothills. This leads to formation of alluvial fans. Coarse sediments like boulders and cobbles are deposited towards the apex.

As river enters the plains, the river now uses much of its available energy for transporting the heavy load. The speed of erosion is reduced. Erosion on the outer bank and deposition on the inner bank of the channel leads to formation of serpentine bends called meanders. During floods, streams seek a shorter and straight path and may not meander. This isolates a meander bend from the new flow channel of the river. If the cut-off meander remains filled with water, it forms an oxbow lake.

Flooding in this course increases the erosional work of rivers in the area of the gently sloping plain leading to formation of extensive plains called floodplains. The richness of the soil, formed by material brought by the rivers (alluvium) is beneficial for agriculture to thrive here. During floods, these floodplains become inundated with sediment-filled water that deposits sediments on the sides of the river. This leads to formation of natural levees on the sides of the river banks.

Minimum gradient and close proximity to the sea makes erosion impossible in this region. Heavy load and reduced velocity make the river break into various channels. They are called distributaries of a river because the load gets distributed. Here the river deposits the sediments within its channel as a result flow gets separated. Islands are formed. This takes a some what triangular shape. This distinct landform is called a delta. See fig. 3.1. Deltas can only form at those river mouths where the sediment supply is high. It can be formed where the sea is not very deep. Therefore, some rivers may not form delta because they do not have huge load of sediments. Instead they may form estuaries at the sea.

Fig. 3.1 : Work of river

Work of sea waves :

Can you tell ?

Look at fig. 3.2 A and identify the landforms at A, B, C, D, E, F and G.

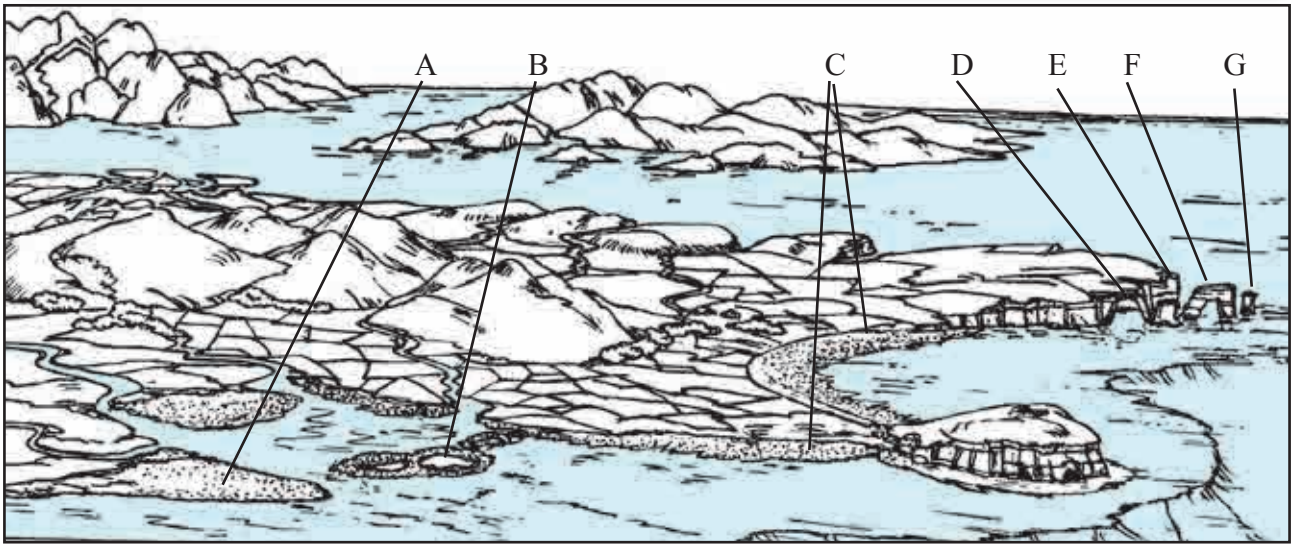


Fig. 3.2 : A) Work of sea waves

Geographical explanation

Like running water sea waves too erode rocks. Abrasion is the most effective form of erosion by waves. Waves also erode rock material chemically through solution. Salt weathering is particularly significant in coastal areas.

If a steep coastal slopes continues deep beneath the water, the impact of waves may break the rocks. Sea cliffs are carved where waves strike directly against rocks. The softer rock along the coastline gets eroded first. Sometimes, waves can erode the softer part and make it hollow enough to be called a cave.

A sea arch forms when waves erode a layer of soft rock underneath a layer of hard rock. If a sea arch collapses, it creates a sea stack, which looks like a large rock in the middle of water. Sea arches also result where two caves meet from each side of a headland.

Surfaces at the base of the cliffs are called wave-cut platforms. Extensive platforms are developed where the rocks are least resistant to wave erosion. This happens due to abrasion. They are visible at lower water levels, such as at low tide. They are also proof of cliff recession.

The most common landform of coastal deposition is the beach. The part of land projecting into the sea is called headland. The coast between two adjacent headlands is concave in shape. The eroded particles are brought by the waves and deposited in this portion. Besides, the rivers and other agents of erosion bring large amounts of sediment from the land. Moreover, as these areas are shallow, the velocity of waves decreases. As a result, all these different types of sediments get deposited in this area along the sea. Predominantly, fine sand gets settled along the coast between the headlands. Such sandy deposits along the coast. are called beaches. Along the coastal areas in Maharashtra, long beaches have developed at Diveagar, Guhagar, Hareshwar, etc. The Marina beach at Chennai is the longest beach in India. See fig. 3.2 B.

Sand also gets deposited along the sides of the headlands. Such deposition extends parallel to the coast from one headland to the another. Over a period of time, these deposits extend over long distances and develop into a bund or bar that protrudes into the water at some distance away from the beach. These are called sand bars. Along the coast in Maharashtra, we can find sand bars at Shrivardhan and Revdanda. The sand bars offer the first protection against storm or tsunami by absorbing most of their destructive force. Between these sand bars and the land, a part of the sea gets enclosed. The water in this enclosed sea is brackish. This brackish water is called a lagoon. Large waves do not get generated in these lagoons as they get separated from the sea. These lagoons are like salt-water lakes. The Chilka Lake in Orissa and the Vembanad lake in Kerala are examples of lagoons. The Chillka Lake in Orissa becomes a fresh water lagoon during monsoons.

Sometimes, such sand bars are not separated from the mainland and extend into the sea. They are known as sand spits. Sand bars and sand spits may get separated from the land.

Uniqueness of coastal areas :

Compare to the other agents of erosion, the work of sea waves goes on ceaselessly. Therefore, its effect becomes apparent within a short period of time. Erosion in some part and deposition in the adjoining part keeps on taking place constantly. The beaches and bars which are normally the products of deposition, are also subject to erosion. Coastal regions are always vulnerable to the risk of getting submerged due to increase in sea level. Coastal regions are also the regions of high population density. Therefore, the coastal zone management warrants serious attention.

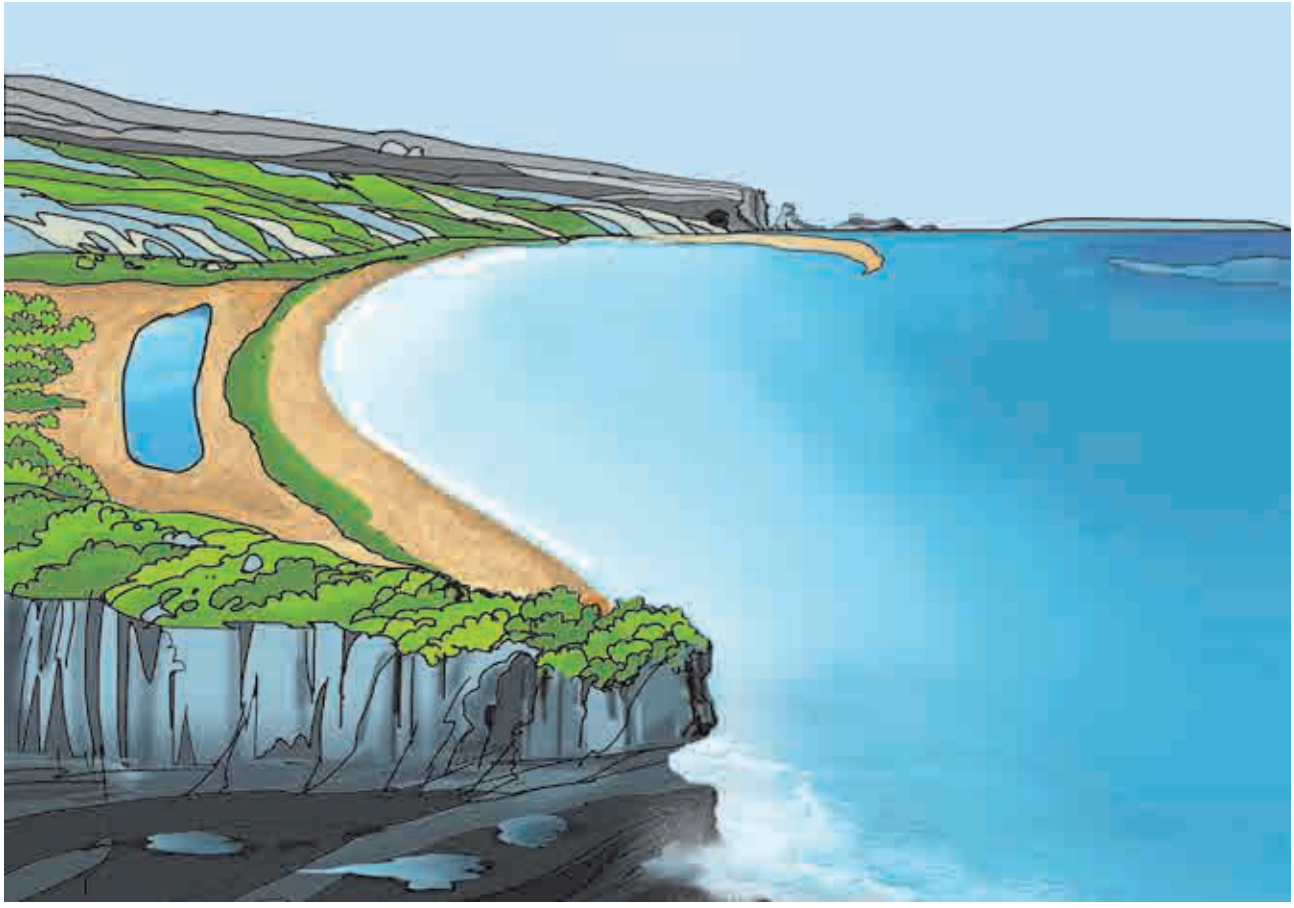


Fig. 3.2 : B) Work of sea waves

Work of winds :

Geographical explanation

On a global level, wind is less effective as an agent of erosion than running water, waves, groundwater or glacier. But, wind is a significant agent in the deserts. Following conditions are necessary for wind to become effective :

a) Aridity : In such areas, rate of evaporation is greater than rate of precipitation.
b) Sparse vegetation cover or absence of trees
c) Presence of dry loose materials at the surface
d) A wind velocity high enough to pick up and move sediments

Strong winds blow frequently in arid regions. These movements of the wind pick up loose surface materials and transport them with wind currents. Deflation occurs when wind blowing fast enough in swirling motion over an area of loose sediment. It is able to pick up and remove small fragments of rock. This erosion can produce shallow depressions, which can vary in diameter from a few centimetres to a few kilometres are called deflation hollows. The Qattar depression in Egypt is formed in this way. It is around 300 km long and 135 km wide. Its depression is 133 m below sea level.

Where the land surface is exposed, wind can polish the rock surface through abrasion. Abrasion carves the windward side of rock into smooth sloping surface. These rocks are called ventifacts. See fig. 3.3 A.

Fig. 3.3 : A) Ventifacts

Abrasion also contributes to formation of mushroom rocks. The high rising rocks in the path of the wind are attacked by the sand that moves with the wind. Winds and the particles they carry attack the base of an individual rock. The larger top part is not eroded as much as the basal part. The particles at medium height are smaller but their velocities are high. Hence, their impact is more. As a result, the portion of rock at medium height is eroded more and the rock as a whole gets the shape of a mushroom. See fig. 3.3 B.

Fig. 3.3 : B) Mushroom Rock

In areas where hard and soft rocks are found, the softer rocks get more eroded faster. The eroded portion of softer rocks appear like elongated ridges and harder rocks appear as elevated portions. A yardang is the remaining part of a ridge where rocks have been eroded. See fig. 3.3 C.

Fig. 3.3 : C) Yardang

Attrition reduces the size of the particles as they dash against each other mutual bouncing.

Transportation is carried out by winds where large-sized particles at lower heights and finer particles at moderate heights through traction and saltation, respectively. All materials transported by the wind are deposited. Coarser, material is often deposited in the shape of hills, called sand dunes. Fine-grained sediment such as silt, can be transported in suspension over long distances from its source area. These deposits are called loess.

Types of Sand dunes : Sand dunes are classified according to their shape and wind direction

a) Barchans are crescent-shaped dunes. They form where supply of sand is minimum. Due to an obstacle in the path of the wind or due to the lowering of its velocity, the sand moving with it gets fropped at some places. The barchan slope that faces the wind is gentle whereas the opposite slope is steep. Such hills can be seen in large numbers in the Great Indian Desert in Rajasthan.

b) Longitudinal dunes are long dunes deposited in the direction of the wind. They appear parallel to the wind direction. They do not migrate like the barchans but extend in the wind direction. They are also called seif dunes. They are sometimes hundreds of kilometres long. Such dunes can bee seen in Rub-al-Khali desert in Saudi Arabia.

Loess deposits form loess plains varying in thickness from few centimeters or less to more than 100 meters. They are formed far away from deserts when winds carry suspended particles for hundreds or thousands of kilometres. In northern China, the loess is 30 to 90m thick. It is formed by the winds coming from the Gobi Desert. They are fertile plains. See fig. 3.3 D.

Fig. 3.3 : D) Work of wind

Work of groundwater :

Study fig. 3.4 A. given above and answer the following questions.

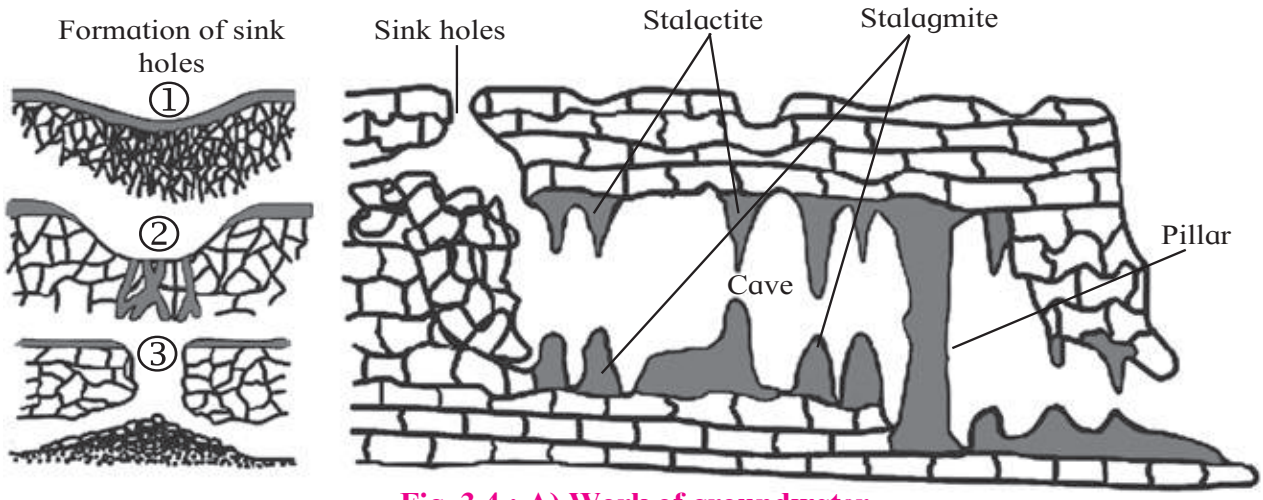


Fig. 3.4 : A) Work of groundwater

1) Which rocks are mainly found here?
2) Identify the spot where stream disappears.
3) Which major erosional process works in this area?
4) Identify the landforms formed by deposition.
5) Why do depositional landforms not form on the surface in areas of Karst terrain?

Geographical explanation

Like water flowing at the surface, water beneath Earth's surface moves, carries other substances, influences the form and appearance of the landscape.

Water from precipitation, or melt-water soaks into the ground. In areas, where the bedrock is soluble in water, like limestone, water below the surface is an important agent in shaping the landform features. Sub-surface water dissolves, removes, transports and deposits materials. Through the chemical removal of rock materials, underground water is an effective agent especially where limestone is present.

The most common soluble rock is limestone, a sedimentary rock composed of calcium carbonate (CaCo3). Landform features created by sub-surface water are found in many parts of the world. The region around Mediterranean sea has large scale limestone features. These have majorly developed on the Karst Plateau along Croatia's Dalmatian Coast. Landforms developed by underground water anywhere in the world are therefore called Karst landforms. Other examples outside Europe are found in Mexico, USA, Caribbean Islands and southern China. In India, they are found in isolated parts in Meghalaya, Bora caves in Andhra Pradesh, Kanhur Plateau in Maharashtra, some parts of Madhya Pradesh and Chhattisgarh.

Karst topography needs three important factors to develop :

i) **Carbon dioxide :** Warmer humid climate have greater amount of vegetation, which supplies CO_2 to sub-surface water. CO_2 is necessary for the acidity of water which makes dissolving easier.

ii) **Active movement of underground water :** Water saturated with dissolved CO_2 should have easy movement. The greater the permeability of the rock, the faster ground water will flows.

iii) **Joints :** Fracture patterns and joints in the rocks in an area encourage passage for water.

Erosional and depositional landforms : Infiltration of water into the sub-surface tends to be concentrated where joints and fractures exist in the rocks. This is the reason why the groundwater forms landforms below the surface. In areas of land with water-soluble rocks, such as gypsum and limestone, the acidic water dissolves the rock. Such cracks enlarge with time. They eventually become larger and then due to continuous solution, develop into roughly circular surface depressions called sinkholes. The surface streams which sink disappear underground through sinkholes. The surface streams which sink disappear underground through sinkholes. Sudden collapse of sinkholes could be a significant natural hazard.

In some areas, groundwater dissolves rock,leaving network of passageways. Sometimes, the water that moves down through sinkholes, strikes a compact and impermeable rock layer. Instead of penetrating further, it starts getting stored and flows parallel to the surface. Minerals like calcium carbonate present in the rock there, get dissolved in this water. Over a period of time this process gives rise to caves. Some are large enough and may extend to few kilometres. For example, one of the caves in Meghalaya in India is 23 km long.

The dripping water leaves behind a deposit of calcium carbonate. Water dries in these caves from the ceiling. Water saturated with calcium carbonate dripping onto the floor of a cave builds up similar but more massive structures. The structures growing from the ceiling are called stalactites. Those growing from the ground of the cave are called stalagmites. Stalactites and stalagmites often continue to grow and may meet to form columns or pillars. When the dripping water contacts the cave air, it releases CO_2 to the air. This is the reverse of carbonation process causing the water to precipitate calcium carbonate. See fig. 3.4 B.

Fig. 3.4 : B) Work of groundwater

Work of glacier :

See fig. 3.5 A, B, C. Answer the following questions.

1) What differences do you find in the three figures?
2) Identify the landforms formed due to erosion by glaciers.
3) Where can U–shape valley be formed?
4) In which region will deposition start?
5) Identify the landforms formed by deposition by glaciers.

Geographical explanation

Glaciers are important agents of erosion in high altitudes beyond the snowline and in polar areas. In areas with high latitude and high altitudes, precipitation is always in the form of snowfall. As a result, layers of snow accumulate and convert into ice. Due to tremendous pressure of ice, layers of ice start moving down slope very slowly. Such a flow of ice is called glacier. As glacier is in solid state, its velocity is very low. Like other agents of erosion, glaciers too parry out erosion, transportation and deposition. Glaciers remove rock particles from the surface on which they flow by plucking and by abrasion. Abrasion and plucking at the base of a glacier lead to formation of Roche moutonnees They are bedrock hills that are smoothly rounded on the upper side by abrasion and plucking on the lower side.

Ice movement, accompanied by weathering and mass wasting, steepens the wall at the head of the glacier. It deepens into armchair-shaped depression called cirque. Often two or more cirques develop side-by side. This leaves the area between any two of them into a narrow wall. This is called arête. Where three or more cirques are formed, the headward erosion of the glacier erodes the summit. This leads to formation of a characteristic peak which is called a horn. The Matterhorn in the Swiss Alps is an example. As the glaciers move ahead, they erode the sides as well as the bottom of the valleys they flow through (lateral and vertical erosion) equally.

This makes the valley broad at the bottom. This is called a U-shaped valley. You can see the difference in the landform before glaciation sets in. The presence of glaciers (moving ice) changes the landscape. See fig. 3.5 A, B, C.

Like rivers, glaciers too have tributaries. These tributaries also form U-shaped valleys. But, the rate of erosion is different because of difference in sizes of glaciers. The main valley gets eroded faster and becomes deeper than the tributary glacial valleys. These appear to be hanging, when seen from the main valley. They are therefore called hanging valleys. At the confluence of hanging valleys and main valley snow falls in blocks. At these locations, waterfalls form after the glacier disappears.

1) **Drumlin :** Coarse material that moves with glacier gets deposited at different places in the form of heaps. They appear to have egg like shape. Such heaps are called drumlins. At times, large number of drumlins get deposited in an area. If you see this from a higher elevation, it appears like a basket of eggs.
2) **Eskers :** When the coarse material, moving with the glaciers is deposited in linear and zigzag manner it is called an esker.
3) **Erratic rock :** In the areas under the influence of glaciers generally at high latitudes, huge rock pieces are found to have been deposited in the area where the local rocks are of different formation. Such rock appear as erratic ones to the area in which they are deposited. These can be considered as guest rocks.

Glaciers generally deposit load of sediments along the side and front of the ice. These deposits are called moraines. The moraines deposited at the sides of the wall are called lateral moraines. At the toe or foot of the glacier, sediment is deposited in a jumbled heap of all grain sizes forming a curved depositional ridge called end moraines. End moraines, that mark the farthest advance of a glacier are called terminal moraines. Where two tributary glaciers join together, their lateral moraines merge underneath to form medial moraines.

Use your brain power !

In which diagram of the three will you find end moraines? See fig. 3.5 A, B, C.

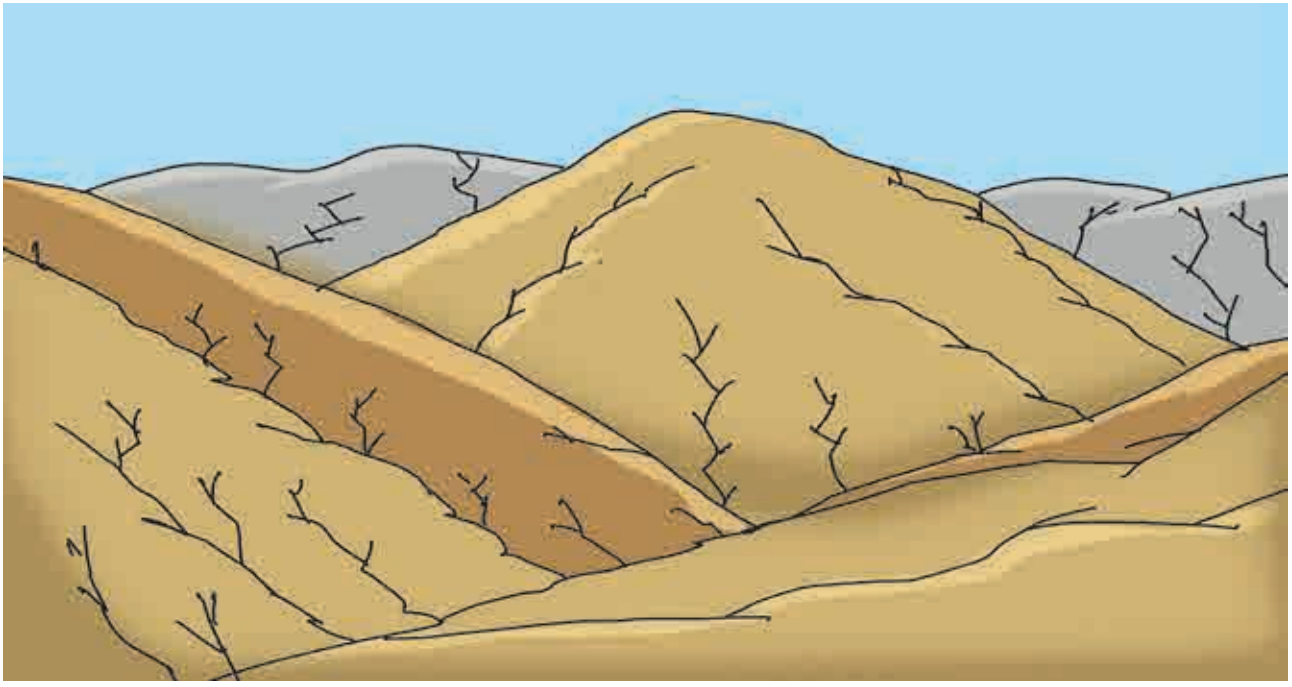


Fig. 3.5 : A) Pre-glaciation

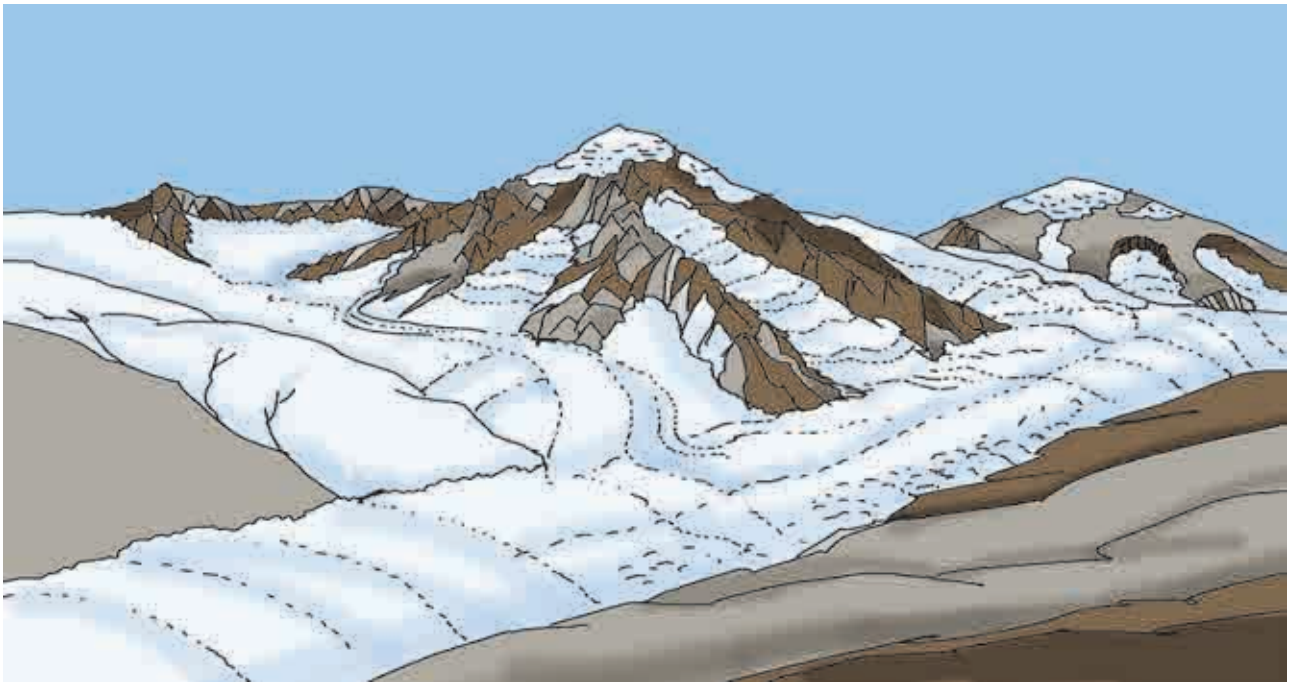


Fig. 3.5 : B) During glaciation

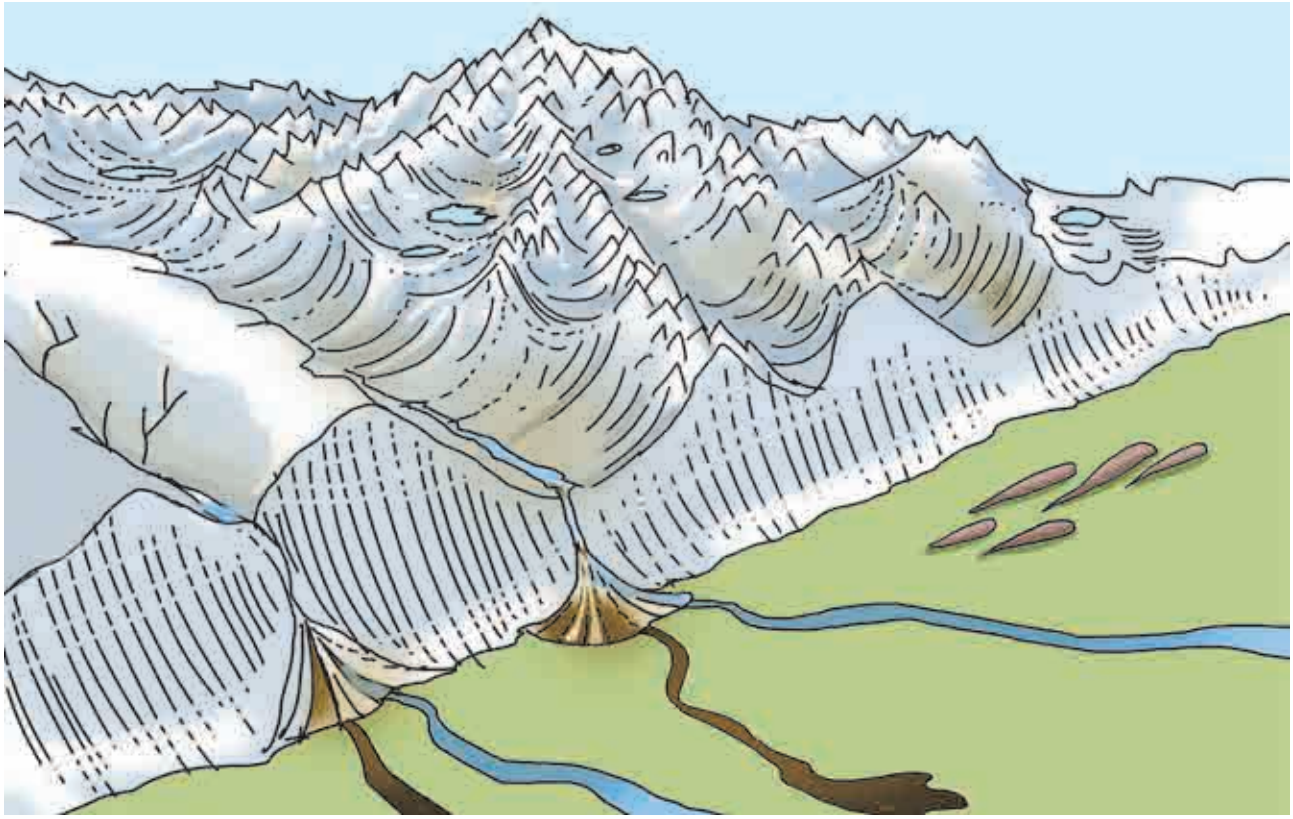


Fig. 3.5 : C) Post glaciation

Exercise

Q. 1) Complete the table :

Agents	Erosional landforms	Depositional landforms
1) River		
2) Wind		
3) Sea waves		
4) Groundwater		
5) Glacier		

Q. 2) Choose the correct option by identifying the correct correlation in the sentences :

1) Water or snow enters the cracks in the rocks and makes it weak. When the glacier passes on these rocks, it pulls the rocks at the bottom along with it. This process is called

a) Plucking b) Abrasion

c) Attrition d) Transportation

2) Sometimes, the river starts erosion upstream. This happens when the head stream gets a lot of water in the early stages of river's flow.

a) Downcutting b) Headward erosion

c) Lateral erosion d) Vertical erosion

3) Soft rock erodes beneath the hard rock due to sea waves. This results into landforms

which further develop as sea arches. The landform is

a) Sea cave b) sea stack

c) sea cliff d) wave cut platform

4) This landform develops due to depositional work of wind. The windward slope of this landform is gentle.

a) Loess plains b) barchans

c) Seif d) Sand hills

5) River, glacier, wind, sea waves and groundwater are the agents of erosion. Following work in the correct order is responsible to form various landforms.

a) Disintegration, picking up, transportation, weathering

b) picking up, disintegration, deposition, weathering

c) deposition, transportation, picking up, disintegration

d) disintegration, picking up, transportation, deposition

Q. 3) Give geographical reasons :

1) The Eastern coast of India have deltas formed by the rivers but the Western coast has estuaries.

2) There is direct relationship between the velocity of the agents and the process of deposition.

3) Compared to all the agents, sea waves work ceaselessly.

4) One finds many sheep rocks, horns, arêtes and hanging valleys in the Himalayas.

5) Karst landforms are seen concealed under the surface of the earth.

6) Snowline decides the limit of glacier work as an agent of erosion.

Q. 4) Write short notes on :

1) Attrition

2) The work of rivers in hilly areas and human activities

3) Conditions necessary for work of wind.

Q. 5) Distinguish between :

1) Attrition and Abrasion

2) U shaped valley and V shaped valley

3) Stalactite and stalagmite

4) Tributaries and distributaries

Q. 6) Answer in detail :

1) Explain the landforms formed by different agents through the process of abrasion.

2) Explain how the depositional work done by river Ganga has been beneficial to human activities.

3) Which agents of erosion can you see on the cover page of the textbook? Which landforms can you see there? Write the process of formation of any one.

Q. 7) Draw neat and labelled diagrams for :

1) Deflation

2) Wave-cut platform

3) Mushroom rocks

***