

Syllabus

Denudation: Meaning and agents of denudation; work of river and wind.

Stages of a river course and associated landforms — V-shaped valley, waterfall, meander and delta.

Wind - deflation hollows and Sand dunes.

Denudation is the process of breaking and removing the rocks from the surface of the earth. It is wearing away of landmass by various processes like weathering, erosion mass movement and transportation. It results in lowering the level of land, rounding exposed rock surfaces and levelling the peaks.

Processes Involved in Denudation

Weathering refers to the disintegration of rocks by atmospheric agents at or near the surface of the earth. It happens due to a change in weather conditions like temperature, moisture and precipitation.

Erosion refers to the displacement of rocks by agents like wind, water or ice. Erosion is caused by the movement of these eroding agents and the resulting smaller particles are transported to another place, whereas in weathering such movement occurs.

Mass Movement or Mass Wasting refers to the large-scale movement of loose material (rock-waste) down the slope on account of gravity. The steeper the slope, the more rapid the movement.

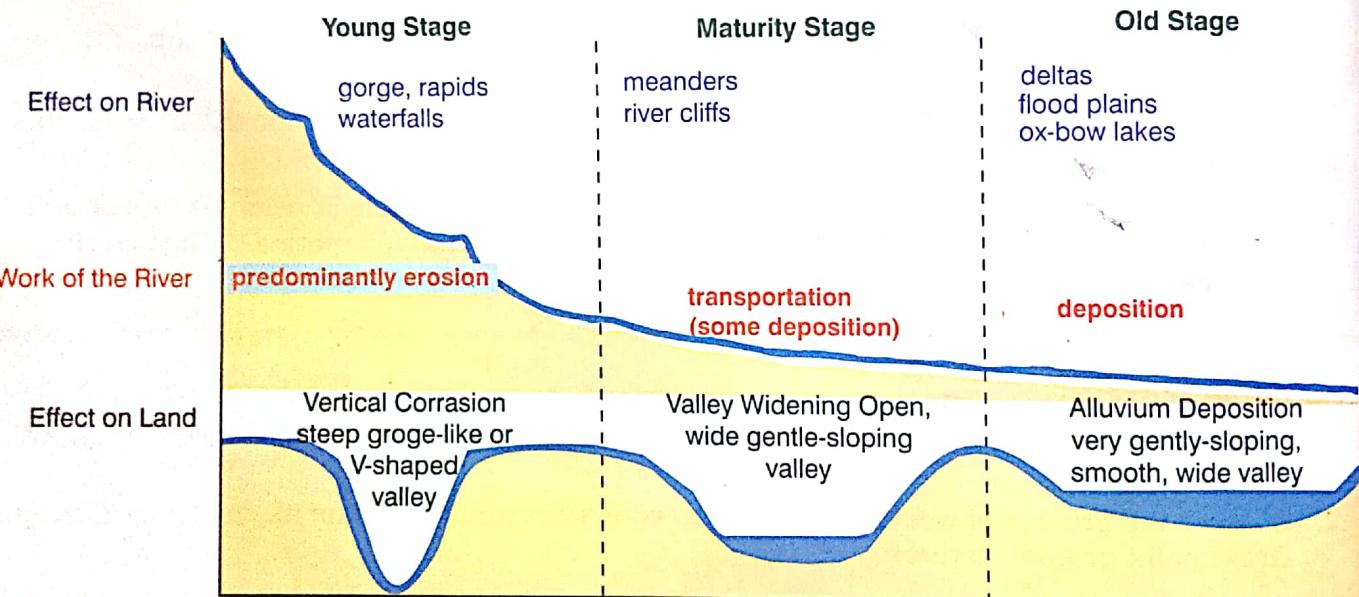


Fig. 10.1 Work of the River.

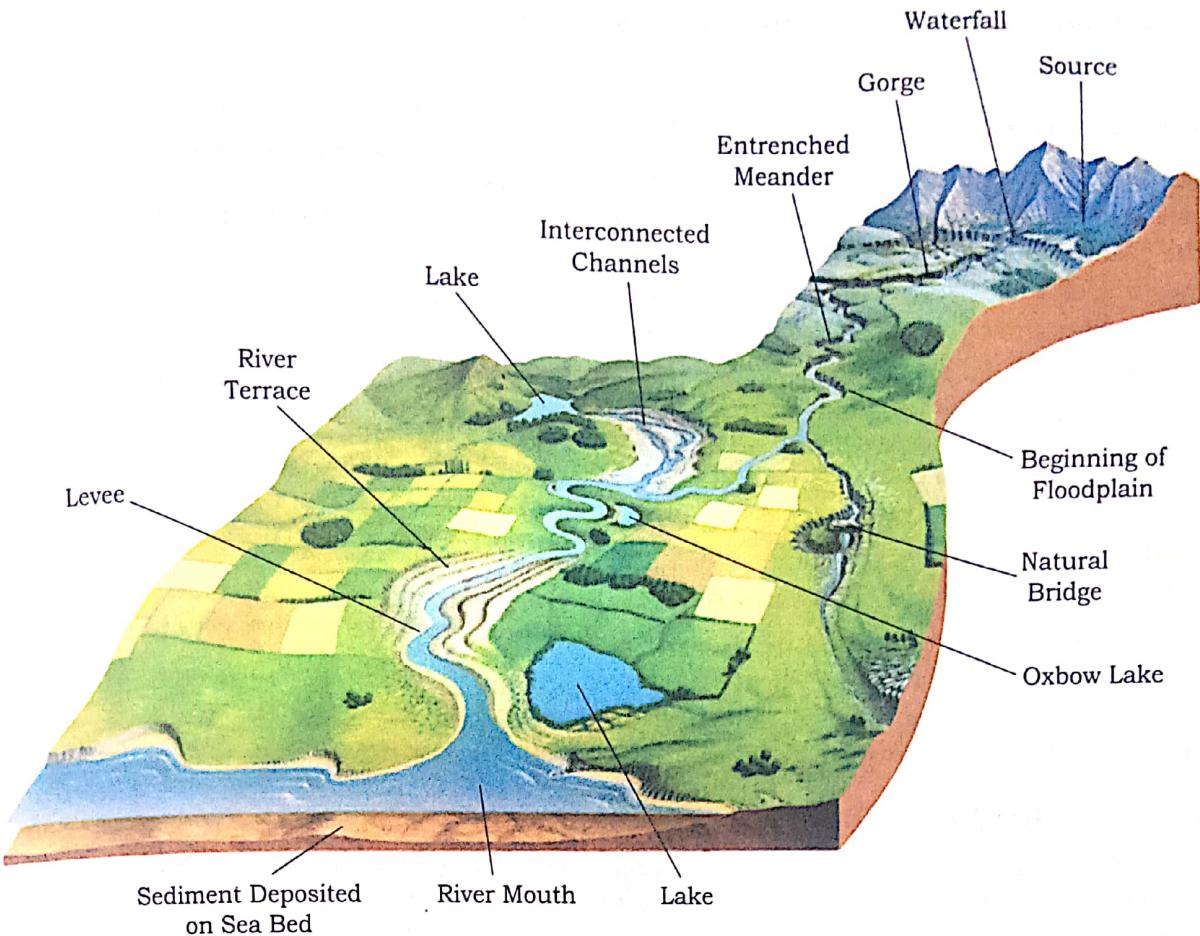


Fig. 10.2 Typical features of a river from Source to Mouth

Transportation refers to the movement of material loosened by erosion and transported to the other place by the action of wind or water.

Deposition refers to the laying down of material that has been weathered, eroded and transported by natural processes such as water, wind and ice.

Agents of denudation erode, transport and deposit sediments at the earth's surface to produce erosional and depositional landforms. The four active agents of denudation are water, wind, waves and glacial ice. In this chapter we shall study the work of rivers and wind as agents of denudation.

WORK OF A RIVER

Rivers are the greatest agents of erosion, transportation and deposition. The force of erosion of a river depends on the degree of inclination or gradient of its course, the volume of water it carries, the load of the sediments, velocity of water, and water discharge.

Factors Affecting Work of a River

Various factors affect erosion, transportation and deposition work of a river. Some important factors include the following:

- (i) **Velocity of water:** Erosion and transportation are both maximum when velocity is high. In other words, erosion and transportation are proportionate to the velocity of water. Deposition, on the other hand takes place when velocity of water is low.
- (ii) **Volume of water:** The larger the volume of water, the greater is the power of erosion and transportation. Deposition, on the other hand, takes place better when there is reduced volume of water as well as when the load is greater.
- (iii) **Load:** Load is the material transported by a river. The load of a river, does all the work of erosion and deposition. Mass wasting, deepening of river valleys and

formation of landforms depend on the load a river carries.

Course of a River

Rivers normally originate in mountains from glaciers or from lakes. Some rivers like those in the Deccan Plateau region are formed due to meeting of various streams during rainfall. The place of origin of a river is called its *source*. Where a river enters the sea or disappears before joining the sea is called its *mouth*. *The streams or small rivers which join the main river are called its tributaries. Where a river divides into channels or smaller rivers, they are called its distributaries.* The path along which the river flows is known as the *course of a river*.

From the source to its mouth, a river is divided into three main sections—*Upper Course, Middle Course and Lower Course*. These three sections are also called the *Profile of a River*.

UPPER COURSE

In the upper course of its flow, the river is *young* (i.e., it is in the initial stage). At this stage, the river flows swiftly, for the gradients are steep. The upper course of a river generally lies in a hilly area and the river flows a considerable distance over a steep slope. Along its course, it erodes its bed and banks; and carries large boulders of rock with it. Under the impact of rush of water and the load the river carries, erosion action is swift and effective.

Therefore, in the upper course the dominant activity of a river is *erosion*. Many landforms are shaped by this activity of the river.

Landforms

The significant landforms resulting from erosion in the upper course of a river are the following:

(i) **V-shaped Valleys:** A V-shaped valley is a narrow valley that has a profile suggesting the form of the English alphabet 'V'. It is formed from a stream eroding downward, through a process, called down cutting. These valleys are formed in the initial stages of rivers and have steep slopes.

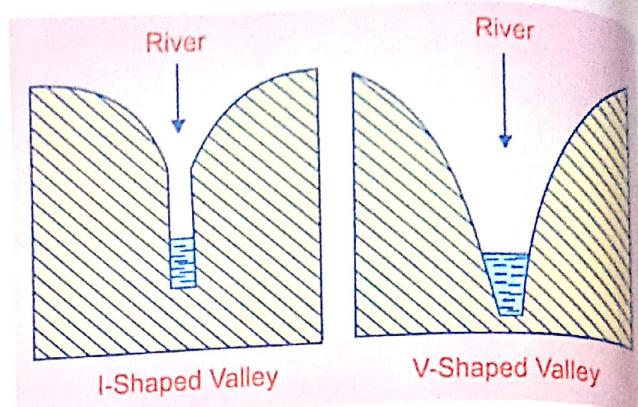


Fig. 10.3 River Valleys.

In regions of hard rocks it develops almost vertically in an *I-shape*. River valleys are normally formed in areas of sufficient rainfall and where rocks are not very hard or resistant.

(ii) **Waterfall:** A *waterfall* is defined as a vertical fall of water of enormous volume from a great height in the long profile of a river. A *waterfall* is generally formed due to large differences in the rate of erosion. The smaller differences lead to formation of step-like features known as *rapids*. The water that falls down the edge of a hard resistant rock may have at the bottom a soft rock. It is this soft rock that gets eroded fast and creates a hollow basin called *plunge pool*. Some of the world's highest and best known falls are *Angel Falls* (986 m) in Venezuela and *Yosemite falls* (778 m), California, USA. *Jog Falls* or *Gersoppa falls*, on a tributary of Kaveri river, have a plunge of 60 metres.

MIDDLE COURSE

The second stage of a river is known as the *maturity stage*. It corresponds to the middle course. At this stage, the gradient is reduced, and the river flows more slowly. The middle course of the river begins when it leaves the mountain area and enters the plains. In the middle course the energy required to transport the materials is just enough to drag large particles.

Two other important characteristics of the middle course are:

(i) the lateral cutting is more active than down cutting; and

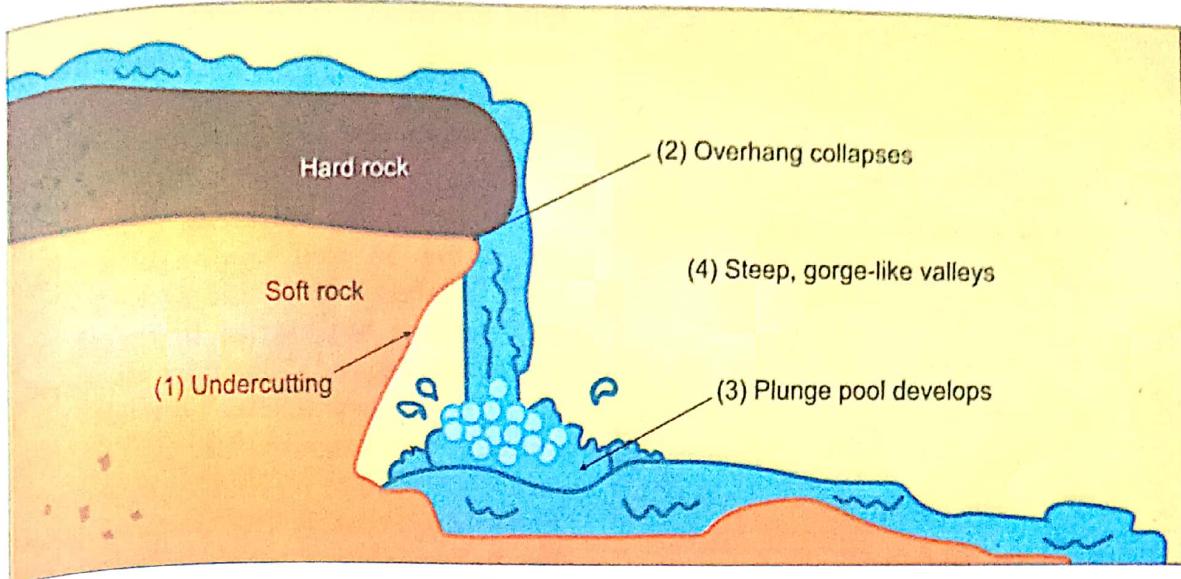


Fig. 10.4 Waterfall.

(ii) the volume of water in the river increases due to many tributaries joining it.

As a result of these characteristics, the river carries its load in different ways. Fine particles remain suspended in water, large particles are just dragged along the bed of the river and smaller ones are rolled down in the centre. The river also gets widened as a *result* of great volume of water and the impact of the load.

Landforms of The Middle Course

In the Middle Course, the river's deposition work is more important than its erosion work. Therefore, the landforms of deposition are more prominent than the landforms of erosion.

Meander: River meanders are bends of longitudinal courses. S-shaped meanders which are common to most rivers result when a channel forms a curved path. These are the result of both erosion and deposition work of rivers. Meanders generally form under conditions of a gentle slope and sufficient water in rivers. The river flow is diverted by an obstruction allowing the river to do lateral erosion work. When the curvature of meander loops are made more and more circular, the curvature then becomes more sharp and the river breaks through the meander to form an *oxbow lake*. The Ganga in India and Mississippi in the USA are famous for their meanders.

LOWER COURSE OF THE RIVER

The third stage of a river is known as the *old stage*. This corresponds to its lower course. The river flows sluggishly and makes many landforms. In the lower course of the river all the ideal conditions for depositional landforms exist. But the load-transporting capacity is drastically reduced due to sluggish flow as well as division of a river into many distributaries.

Landforms of The Lower Course

Delta: The river divides itself into many distributaries. These distributaries are also subdivided into mini-distributaries. This is due to deposition of sediments over a large area near the mouth of rivers. Such sedimentation occurs on the sides of the stream, at the mouth,

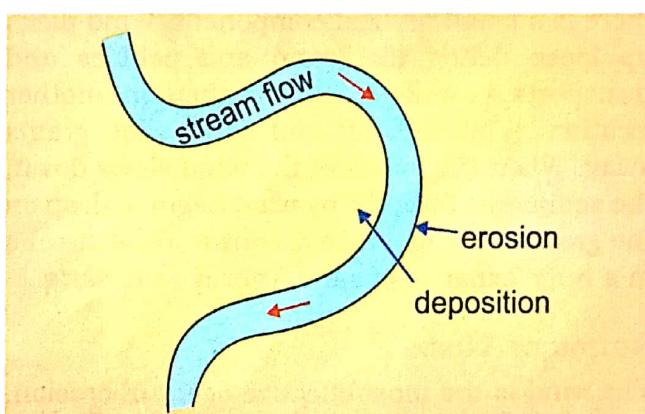


Fig. 10.5 Meander.

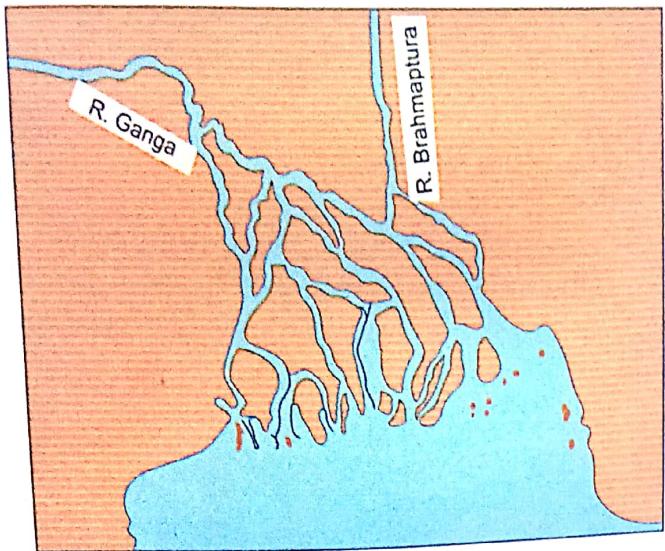


Fig. 10.6 Delta.

in the front part as well as in the bed of the river. The deposition over a large area results in a triangular-shaped formation called delta. It resembles the Greek letter Δ.

Not all the rivers form deltas. There are certain conditions for the formation of deltas. These conditions include nearly calm sheltered sea, large amount of sediment supply and a reasonable size of the river. The small rivers do not form deltas. The deltas have also their own structure and undergo upliftment or subsidence. The deltas also grow at a certain rate. For example, the Ganga-Brahmaputra delta is growing towards the sea. It is also one of the largest in the world.

WORK OF WIND

The movement of air over the earth's surface is known as wind. It is almost horizontal, although there is a small vertical component. Wind picks up loose debris like sand and pebbles and transports as well as deposits them in another location. Wind can lift and carry sand grains away. When the speed of the wind slows down, the sediments brought by wind begin to drop on the ground. If this process continues, it results in a huge expanse of sand known as deserts.

ACTION OF WINDS

The wind is the most effective agent of erosion, transportation and deposition, in arid regions. Since there is little vegetation or moisture to

bind the loose surface materials, the effects of wind erosion are more pronounced in the desert region.

Wind erosion is operative in the following ways:

(i) **Deflation Hollows:** Deflation involves the lifting as well as the blowing away of loose materials from the ground. The sand and pebbles are carried in the air or driven along the ground. The finer dust and sands may be deposited even outside the desert margins. *Deflation results in the lowering of the land surface to create depressions called deflation hollows.* The Qattara Depression of the Sahara Desert which lies almost 450 feet below sea level is a good example of depression.

(ii) **Sand Dunes:** Dunes are called hills of sand. They are formed by the movement of winds. Such hillocks may be active dunes, constantly on the move. They may also be inactive fixed dunes, rooted with vegetation. Dunes are found in deserts where the sand is being continuously moved, reshaped and redeposited.

Shape and Size: Dunes have heights ranging from a few metres to about 150 metres. In desert regions of the Sahara, Thar, and West Australia, there are many sand dunes. They are in different shapes and sizes. In fact, their shape and size depend upon factors such as:

(a) The direction and force of wind.

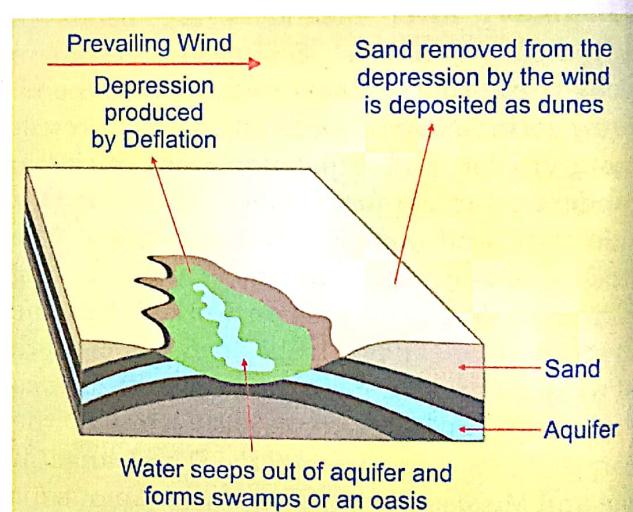


Fig. 10.7 Deflation Hollow

- (b) The speed of wind, carrying the dust and sand particles.
- (c) The nature and amount of sand brought by the wind.
- (d) Water features e.g., lakes, streams etc., in the close-by area.
- (e) The nature of vegetation on the land.
- (f) The nature of the surface, where the formation of a sand dune takes place.

Shifting or Migration: Sand dunes often move in the direction of the wind. The dunes of Trade Wind deserts take definite forms, moving in a definite direction. Migratory sand dunes are uncertain and dangerous. When they migrate with the wind, they damage towns and villages.

The shifting of a sand dune can be checked by the growth of vegetation on the wind-ward slope. Dunes are found in the tropical deserts of Asia and Africa.

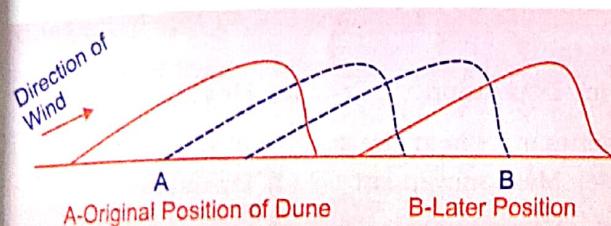


Fig. 10.8 Shifting of Sand dune

The following two types of dunes are seen in the tropical deserts:

(a) Barchan: These are moon-shaped dunes. They are live dunes which advance steadily before winds that blow from a particular direction. They are found in the deserts in the Sahara. Barchans are initially formed by an accumulation of sand at an obstacle, such as a heap of rocks. They occur transversely to the wind, so that their horns thin out and become lower in the direction of the wind.

The windward side is convex and gently-sloping while the leeward side (being sheltered) is concave and steep. The crest of the sand dune moves forward as more sand is accumulated.

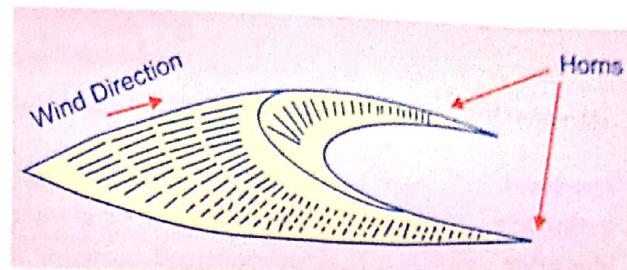


Fig. 10.9 Barchan

The migration of the barchans is a threat to desert life. They sometimes encroach on an oasis, burying palm trees or houses.

Long-rooted trees and sand-holding grasses are planted to halt the advance of the dunes in order to prevent the fertile land from being devastated.

(b) Longitudinal Dunes or Seifs: These are long and narrow sand-ridges which grow parallel to the direction of the prevailing wind. They are found in the interior parts of deserts. In the Libyan desert, they are known as Seifs (means 'sword' in Arabic). In the Thar Desert they are confined to the western margin, where the force of south-west monsoon influences their formation.

An important feature of such a dune is that in its crest line there are rise and fall patterns. Seifs are found in the Sahara, Iran, Thar Desert (India) and West Australia.

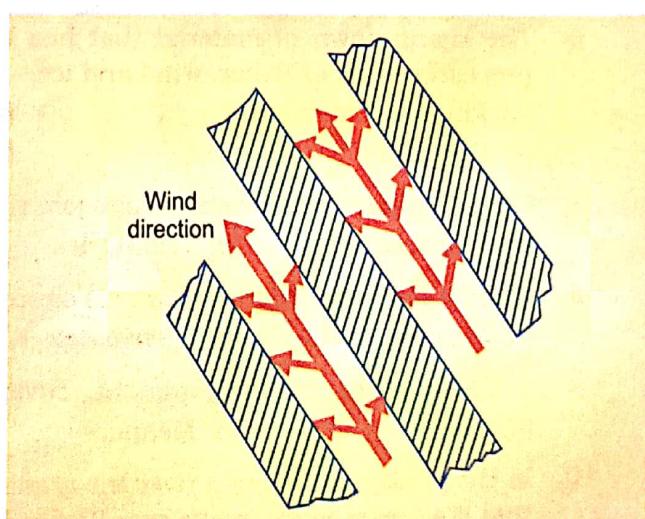


Fig. 10.10 Longitudinal sand dunes

Terms to Remember

Denudation	: Laying bare. It includes weathering, erosion, mass movement and transportation.
Gradient	: The degree of inclination of a sloping surface.
Tributary	: A stream, river or glacier that feeds another larger one.
Meander	: A pronounced curve or loop in the course of a river channel.
Estuary	: The tidal mouth of a river where fresh and saline water are mixed.
Deflation Hollow	: A hollow created by erosion of wind.
Dunes	: Hills of sand formed by the movement of winds.
Barchans	: Moon-shaped, live dunes which advance steadily before winds that blow from a particular direction.
Seifs	: Stationary, long and narrow sand-ridges which grow parallel to the direction of the prevailing wind and remain in a fixed position.

EXERCISES

I. Choose the correct option:

1. The process of breaking and removing the rocks from the surface of the earth:
(a) Erosion (b) Mass movement (c) Denudation (d) Weathering
2. Denudation is the process that wears away landmass and reshapes the surface of the earth. Which of the following process is NOT involved in it?
(a) Weathering (b) Erosion (c) Deposition (d) Mass wasting
3. The disintegration of rocks by atmospheric agents at or near the surface of the earth:
(a) Erosion (b) Weathering (c) Mass movement (d) Denudation
4. The displacement of rocks by agents like wind, water or ice:
(a) Deposition (b) Transportation (c) Erosion (d) Mass wasting
5. The large-scale movement of loose materials (rock-waste) down the slope on account of gravity:
(a) Mass movement (b) Deposition (c) Denudation (d) Weathering
6. The laying down of material that has been weathered, eroded and transported by natural processes such as water, wind and ice.
(a) Physical Weathering (b) Deposition
(c) Denudation (d) Tributary
7. The streams or small rivers which join the main river are called:
(a) Transporterries (b) Tributaries (c) Distributaries (d) Meanders
8. When a river divides into channels or smaller rivers they are called its:
(a) Tributaries (b) Distributaries (c) Meanders (d) Transporterries
9. In the upper course the dominant activity of a river is:
(a) Valley (b) Meander (c) Erosion (d) Mass wasting
10. In the middle course of a river the gradient is gentle so the flow of the river slows down such that it appears like a snake over its floodplains forming which of the following?
(a) Deltas (b) Gorges (c) Meanders (d) Rapids

11. _____ are moon-shaped dunes.
 (a) Dunes (b) Sand Dunes (c) Barchans (d) Seifs
12. Stationary, long and narrow sand-ridges which grow parallel to the direction of the prevailing wind and remain in a fixed position.
 (a) Dunes (b) Sand Dunes (c) Barchans (d) Seifs
13. The lowering of land, rounding of exposed rock surfaces and levelling of the peaks:
 (a) Denudation (b) Erosion (c) Mass wasting (d) Deposition
14. Which amongst the following is not a factor affecting work of a river?
 (a) Velocity of water (b) Quality of water
 (c) Volume of water (d) Load of water
15. How do migratory dunes damage towns and villages?
 (a) They cover all surfaces with thick layers of sand.
 (b) The large mass of sand shifts further.
 (c) They can be checked by building walls.
 (d) All of the above.
16. Name the landform that is formed as a result of the action of wind wherein loose materials are lifted and blown off to be deposited outside the desert margins.
 (a) Sand Dunes (b) Barchans (c) Deflation Hallows (d) Seifs

II. Complete the following table.

	Effect on the river	Work of the river	Effect on land
Young Stage (Upper Course)	Formation of gorge, rapids and waterfalls.	Mainly erosion.	Formation of V-shaped valleys.
Maturity Stage (Middle Course)
Old Stage (Lower Course)

II. Short Answer Questions

- What do you mean by denudation?
- Name the factors which affect work of a river.
- What is the main function of a river in its upper course? Name the landforms formed in the upper course of a river.
- How is a waterfall formed?
- State the two characteristics of a river in its middle course.
- How are meanders formed? Give one example of a meander.
- Name two landforms in the lower course of a river.
- Where is wind erosion most predominant?
- What are known as Deflation Hollows?

10. Name two chief landforms of wind deposition.
11. Name two chief types of sand dunes.
12. State any two characteristics of barchans.

IV. Structured Questions

1. (a) State the difference between weathering and denudation.
(b) Name the various processes involved in denudation. What are the results of denudation?
(c) Give a geographical reason for each of the following:
 - (i) Erosion is the dominant activity of a river in its upper course.
 - (ii) Landforms of deposition are more prominent in the middle course of a river.
 - (iii) All the rivers do not form deltas.
(d) Describe the work of wind erosion and state two important landforms of wind erosion.
2. (a) Briefly describe the factors which affect the work of a river.
(b) Describe the three stages of a river.
(c) Give a geographical reason for each of the following:
 - (i) The effects of wind erosion are more pronounced in desert areas.
 - (ii) Migratory sand dunes are uncertain and dangerous.
 - (iii) Long rooted trees and sand holding grasses are grown bordering fields near deserts.
(d) State the factors on which the shape and size of dunes depend?

V. Thinking Skills

1. What is the relationship between denudation, weathering and erosion? Give examples to support your answer.
2. While travelling from Haridwar to Prayagraj, the course of which river did you follow? List the landforms associated with it along the course you followed.

VI. Project / Map Work

1. On the outline map of the world mark one of the following in each continent (i) Rivers which form deltas; (ii) Desert.
2. Prepare a power point presentation on the effects of rising sea levels due to global warming in the world's most populated delta — the Ganga Brahmaputra delta.
3. In this chapter you have studied the action of winds that results in desertification in arid areas. Make a list of activities that could prevent and reverse desertification.

