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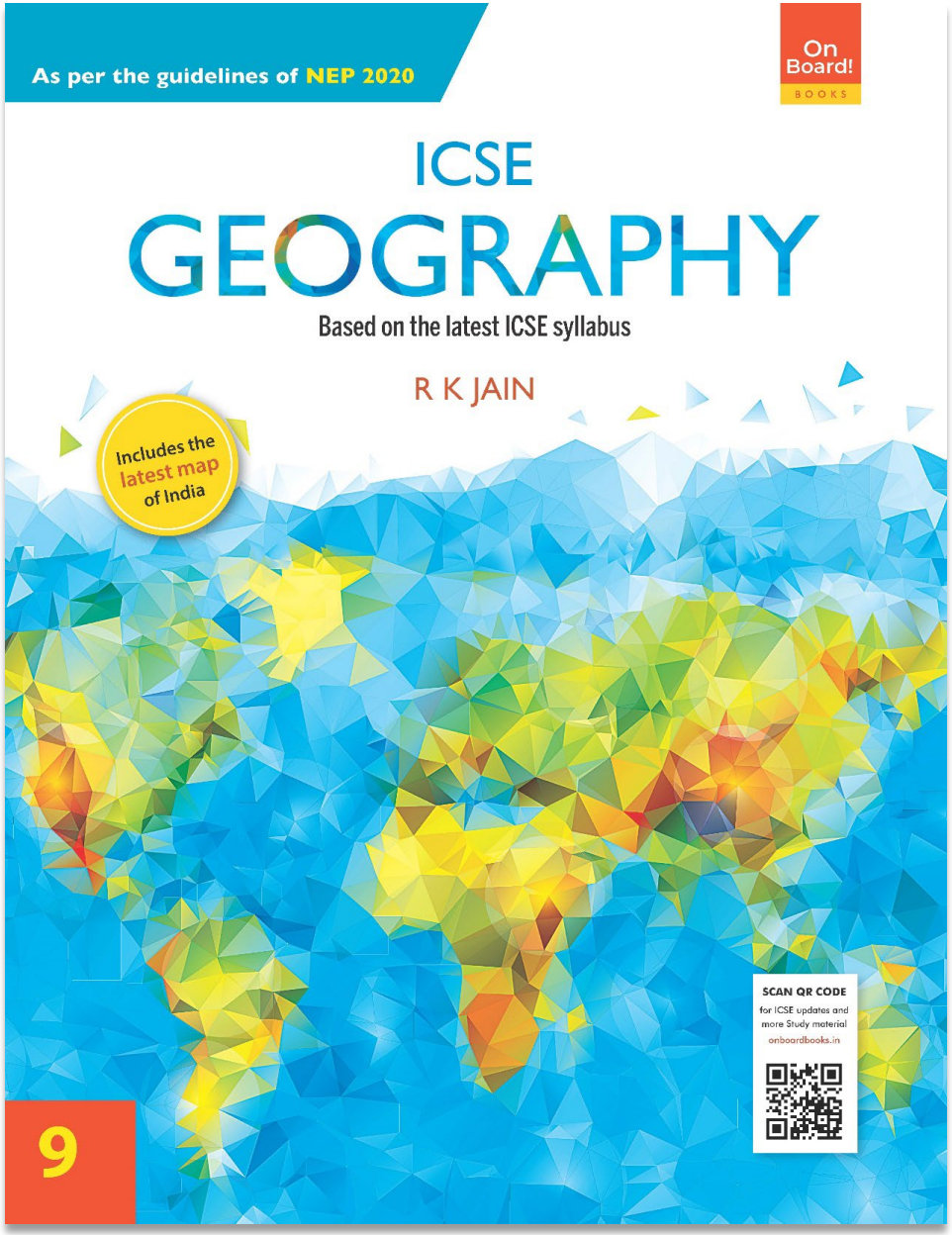
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Class 9

Chapter 10: Denudation

Degradation, also known as **denudation**, stands for the levelling down of Earth's elevated features. The processes of denudation include weathering and erosion. Weathering is generally followed by **erosion**. Erosion is a process in which the transporting agents remove the broken rock materials from the place of its origin to its next resting place. The main agents of erosion are running water, moving ice, wind and sea waves.

Aggradation, also known as **deposition**, stands for filling up the depressions. The agents of aggradation are the same as that of the erosion.

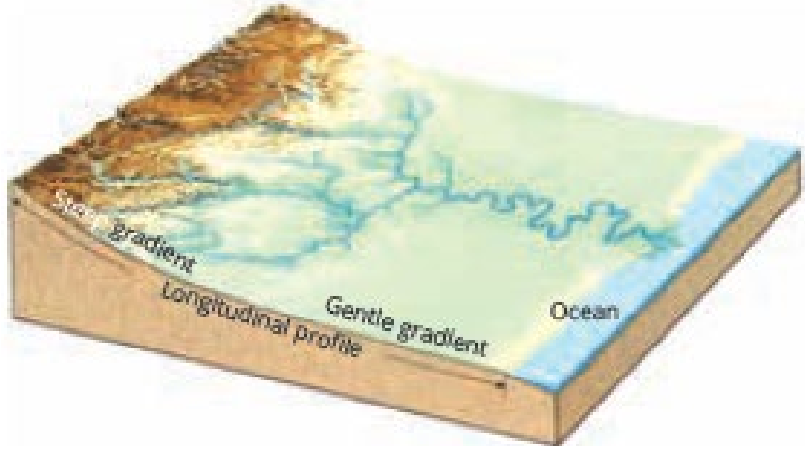
WORK OF RIVER (RUNNING WATER)

The work of the river or running water depends upon the following factors:

a. The amount of water in the river
b. The speed of the river
c. The slope of the river bed
d. The load carried by the river
e. The nature of rocks in its valley

River carries out its work as an agent of gradation in the following three ways:

a. The water in the river dissolves and erodes the rocks on the land surface over which it flows. It results in the widening and deepening of the river valley.



A longitudinal profile of a river

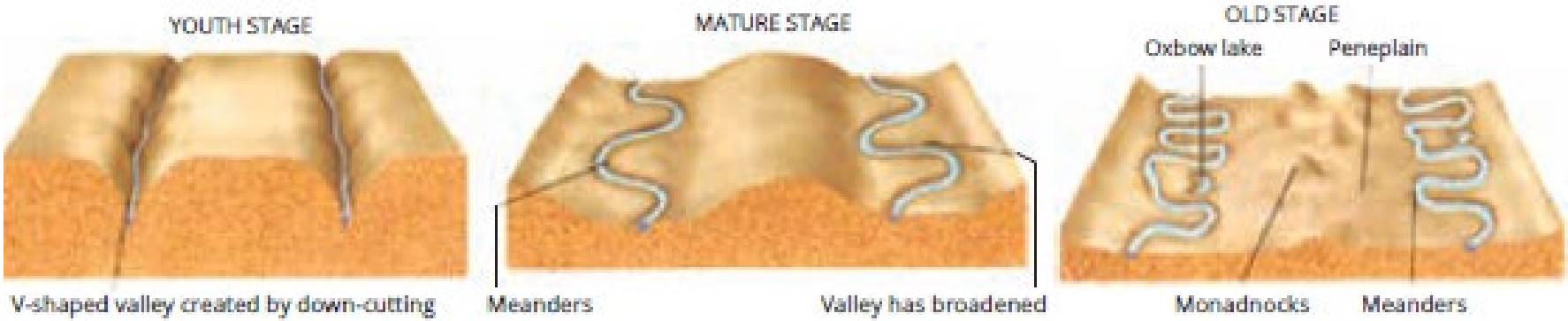
b. The water in the river transports the material which it has dissolved or eroded away. The amount of load, which a river has to transport is not the same throughout the course of the river. The load of the river can be carried as solid material and in solution or both.

c. The water in the river deposits the material which it has transported. As the river flows down towards the sea, it goes on depositing sediments in its channel, along the banks and also in the surrounding areas. This creates several new relief features. The order in which the sediments are deposited are **boulders, pebbles, gravels, sand, silt** and **clay**.

DEVELOPMENT OF A RIVER VALLEY

The development of a river valley is the combined result of erosional, transportational and depositional work of the river. The **valley formation** begins with the carving out of the channel. From the source to its mouth, a river can be divided into three sections:

a. The Upper course or the Young stage
b. The Middle course or the Mature stage
c. The Lower course or the Old stage



The work of running water or river

The Upper Course or the Young Stage

- The main work of the river in this stage is the downward erosion or **down cutting**, which causes the deepening of the river valley.
- Normally a narrow and deep valley with steep walls is developed, called the **I-shaped Valley**.
- The exposed surface on both sides of the deep valley is affected by the agents of weathering.
- The broken rock materials from both sides is taken into the river, partly due to the force of gravity and partly by the rainwater flowing into the river.
- The upper part of the valley is widened due to the work of weathering, giving it a typical **V-shape**. It is known as the **V-shaped valley**.
- Waterfalls are caused either due to a sudden descent or abrupt break in the course of the river. It is a vertical drop of water from a great height.
- The waterfalls are also formed when the tributary streams join the main stream from a higher point, thus forming **hanging valleys**. Such waterfalls are common in the glaciated regions.

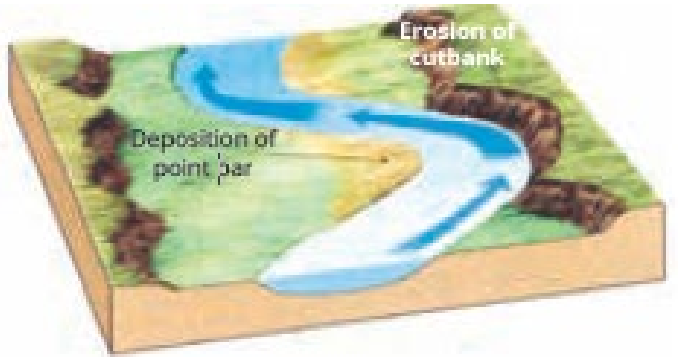
V-shaped valley

Hanging valley

- The normal waterfalls in the course of a river are generally formed due to an abrupt change in the slope of the valley floor.
- The waterfalls vary greatly in their size, shape, height and volume of water.
- The most important waterfall in India is the **Jog** or **Gersoppa Falls** on the Sharawati river in Karnataka. It is about 260 metres high.
- In South America, a tributary of the Orinoco river jumps over the edge of Guiana Plateau to form the highest waterfall in the world – the **Angel Falls**, which is 975 metres high. The **Niagara Falls** in North America and the **Victoria Falls** in Africa are also famous waterfalls in the world.
- The steep sloping segments of the rivers are called **rapids**. They are smaller than the waterfalls.
- The streams in the upper course sometime offer possibilities for the development of hydroelectricity.

The Middle Course or the Mature Stage

- The middle course of the river begins, where the river leaves the mountains and enters the plains.
- Due to the abrupt change in slope of the river bed, the speed of the river slackens.
- Now a number of tributaries join the main river and thus the river's volume increases. It also carries a greater load of sediments.



Lateral movement of meanders

- At this stage the down cutting is less important than the widening of the valley floor.
- The lateral cutting of the valley results in the development of a flat valley floor.
- The materials transported by the river are deposited as alluvium on its flood plain.

The sluggish water of the river is turned at the slightest obstruction. This can form a system of **meanders**. It is a characteristic feature of a river in its flood plain.

The word **meander** is derived from the name of a small winding river **Meanders** in Turkey. This river has numerous loops or meanders in its course.
The shape of the loop or meander is usually semi-circular but sometimes it is also circular. Each bend of a meander has two types of slopes on valley sides:
a. One side of the meander loop has concave slope, where the river strikes the valley-sides directly. This side is subjected to severe erosion resulting in the formation of cliffs.
b. The other side of the meander loop has a convex slope. Here sand, gravel, and even alluvium are deposited.

The meandering of river is a natural process and is controlled by a number of factors, such as:
a. The variety of rocks
b. The general topography of the area
c. The amount and distribution of annual precipitation
d. The vegetation cover
e. The discharge of water in the stream
f. The stage of the river development
g. The cycle of erosion, i.e. the time factor

A meandering river

The **Gomti** river in Uttar Pradesh is a highly meandering stream. The course of the **Ganga** river between Allahabad and Varanasi has developed a highly meandering course.

EFFECTS OF WEATHERING

- Rocks are disintegrated and decomposed due to the work of different processes of weathering. They produce a large amount of rock waste. Normally the wastes lie over the unweathered fresh rock and are called **regoliths**.
- The weathered rock material is very useful in the process of soil formation, and can also expose mineral deposits
- Weathering can cause damage to human settlements in the foothill zones when the mass movement of rock waste come down the hill slopes.
- The rapid rate of weathering, due to deforestation in hilly areas, can cause overloading of rivers and retard their flow. This can also cause rapid rate of siltation of river beds.
- Continuous removal and transfer of disintegrated and decomposed rocks through landslides, rockfall, rock slides, etc. can cause lowering of the height of the affected areas and also help in the evolution and formation of various landforms.

WEATHERING IN DIFFERENT CLIMATIC REGIONS

The effects of weathering on rocks vary according to the prevailing climatic conditions in that area. The climatic conditions play an important role in different weathering processes.

1. The Equatorial Regions experience hot and humid climate almost throughout the year. In such conditions, the chemical weathering is more rapid and continuous.

2. The Tropical Regions have a distinct dry season and wet season. The evaporation is high and oxidation of iron and aluminium takes place. In this region weathering helps in the formation of laterite soils.

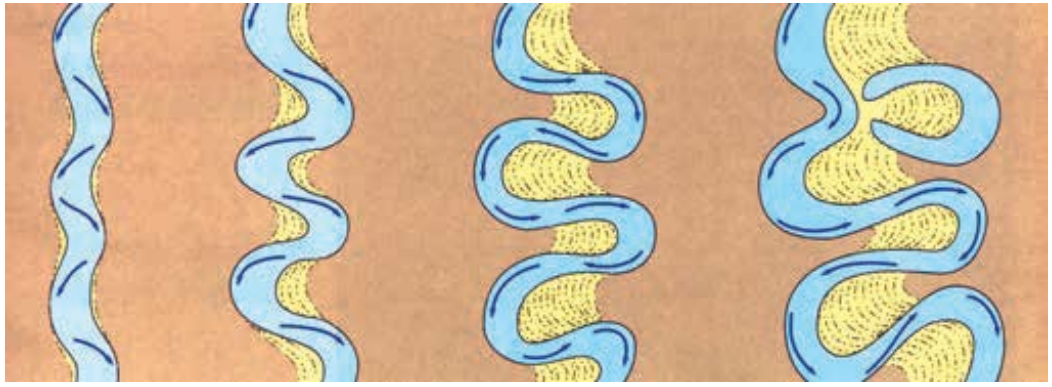
- In the meanders, the beds are highly curved and arms are very close to each other. Most of the rivers in the Northern Plains of India have developed ox-bow type of meanders.
- In course of time, due to lateral erosion, the meandering loops become almost circular and come very close to each other.

Meandering loop in the Grand Canyon, USA

- The strip of land between these two loops continues to become narrow till the river cuts through this strip and takes a straight course.
- Thus the circular meander or loop is left behind completely cut off from the main channel forming an **ox-bow lake**. Actually the formation of an ox-bow lake is both due to erosion and deposition.

The Lower Course or the Old Stage

- In the lower course, generally, the slope of a river's bed is very gentle and the flow of the river is very slow. This causes a fall in the transporting capacity of the river.



The development of meanders in a stream

- Thus the work of the river in the lower course is mainly depositional.
- Down cutting and widening of the valley floor is not very prominent.

The rivers in the lower course, due to a fall in their transporting power, deposit their excess load of sediments on the floor of the river channel. This is normally in the form of channel bars and islands. These bars and islands divide the river channel into a network of smaller channels and develops a **braided stream**.

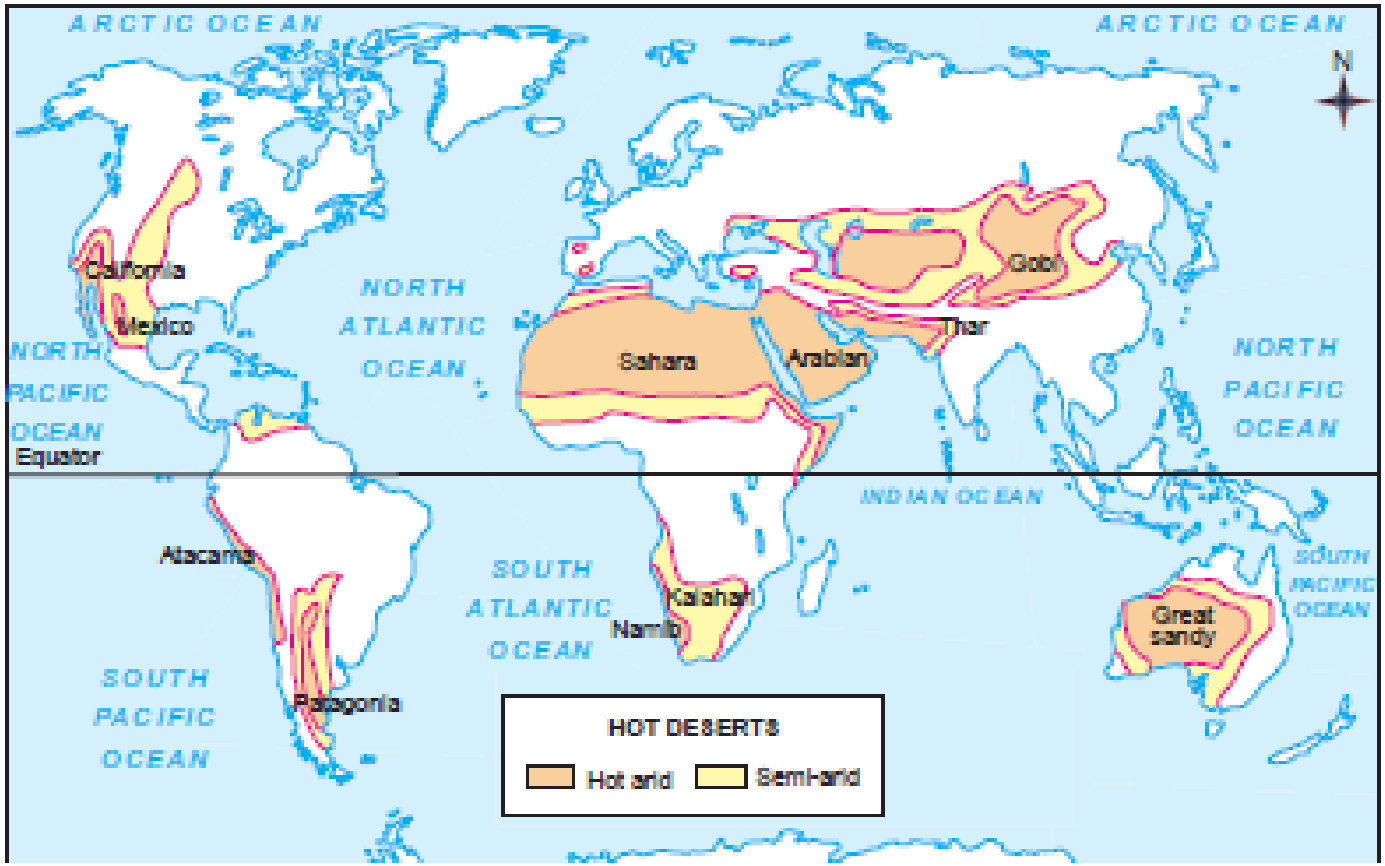
When a river enters a lake or a sea, it tends to deposit its load at its mouth. This leads to the formation of **delta**. The word **delta**, derived from the Greek letter Δ, was first used by the Greek historian **Herodotus** (485 – 425 BC) for the triangular feature of the Nile river in Africa. Whether small or large, almost every river can form a delta.

A braided stream

Various types of deltas

WORK OF WIND

The work of wind as an agent of denudation is not as effective as that of rivers, glaciers or sea waves in the evolution and development of major landforms. It is generally associated with the arid and semi-arid environments. It is not active in cold deserts, as the surface may be hard or covered with ice sheets. The velocity of wind is of primary importance in its erosional work.



World – Arid and semi-arid deserts

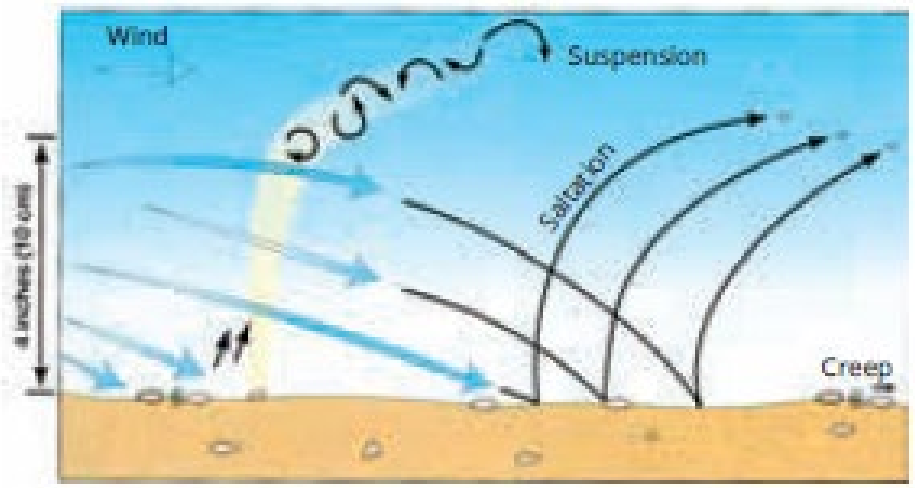
Deflation

- The process of removing, lifting and blowing away dry and loose particles of sand and dust by the wind is called **deflation**. It is derived from the Latin word **deflatus** meaning blowing away.
- The continuous deflation can remove most of the loose materials and thus, depressions or hollows are formed.
- Since deflation can remove mostly fine particles, larger particles such as gravel are left over the surface.

Desert pavement (After deflation)

Transportational Work of Wind

- The wind can transport the material on and above the ground surface.
- The finer materials are transported to greater distance in one step, while the coarse materials are transported in stages by rolling and jumping.
- The wind can transport materials through suspension, saltation and traction.



Transportational work of the wind

- Fine particles of dust are kept in **suspension** by the upward moving air, and can be carried to great distances.
- Slightly bigger particles are transported through bouncing, leaping or jumping. This mechanism of wind transport is called **saltation**.
- When the material touches the ground and moves forward without saltation, it is called **traction**.

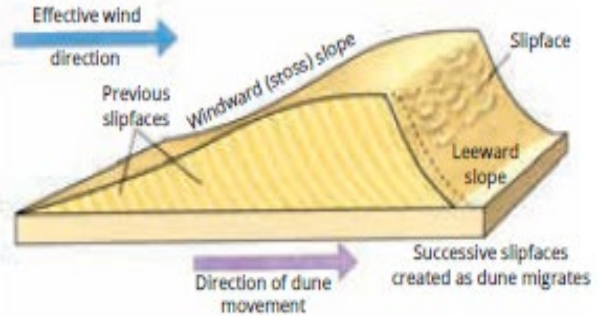
Depositional Work of Wind

The depositional work of the wind starts when its force or velocity declines or some obstruction like trees, bushes, forests, marshes, swamps, etc. comes in the way of the wind.

The fine dust particles are deposited in big masses or sheets known as **loess**, while the coarser particles are deposited in the form of hillocks known as the **sand dunes**.


Sand dunes

- Heaps of sand are generally called **sand dunes**, which are composed of coarser materials and are located within the desert margins.
- The formation of sand dunes takes place when the sand accumulates in the form of low mounds due to the obstruction in the wind speed by some fixed obstacles.
- The sand mounds gradually grow in height and length and finally become typical sand dunes.



Formation of sand dunes

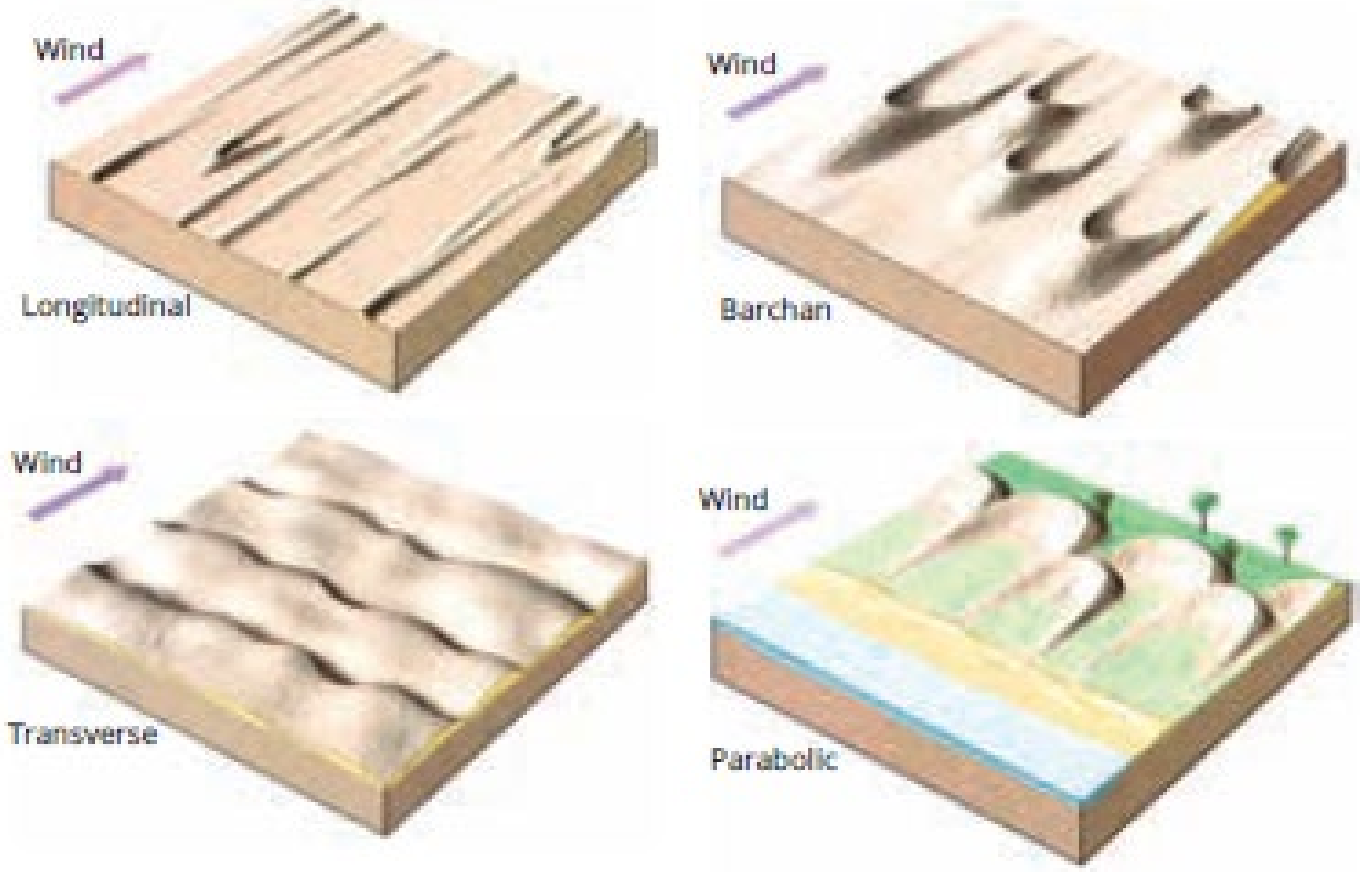
The sand dunes are of three types according to their shape:

1. Longitudinal sand dunes
2. Transverse sand dunes
3. Parabolic sand dunes or Barchans

1. **The Longitudinal Sand dunes** are formed parallel to the direction of the wind. They extend for hundreds of kilometres in length with an average width of about one kilometre. The longitudinal sand dunes are separated by the sand-free bare surface, called **hammada**. They are found mostly in the Australian, the Libyan, the Sahara, the Kalahari and the Thar deserts.

2. **The Transverse Sand dunes** are formed perpendicular to the direction of winds. They appear wave-like and are generally formed along the coasts or on the margins of the deserts. The height of the transverse sand dunes in the Thar Desert of India varies from 5 metres to 25 metres.

3. **The Parabolic Sand dunes or Barchans** are a special type of transverse sand dune. A barchan also migrates like an ordinary sand dune. The sand-free corridors between two ranges of barchans are used as caravan routes.



Types of sand dunes

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