

UNIT

2

Lithosphere – II Exogenetic Processes

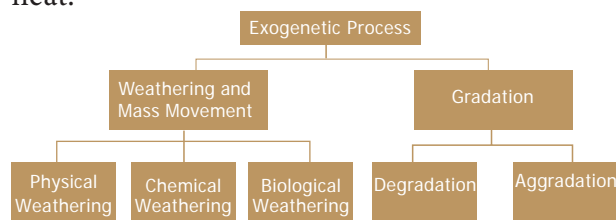
Learning Objectives

- To comprehend the various external processes of the Earth
- To study the different types of weathering and the resultant features
- To learn how the weathered materials are transported by different agents.
- To study about the features formed by erosion transportation and deposition of natural agents



Introduction

The Earth is a dynamic system that undergoes various changes due to internal and external processes. The continuous interaction of these two processes controls the structure of the earth's surface. The external processes are the consequence of solar energy and gravitational forces, whereas the internal processes are an outcome of the earth's internal heat.



2.1 Weathering

Weathering is the breaking, disintegration and decomposition of materials of the earth's crust by their exposure to atmosphere.

There are three types of weathering

- Physical weathering,
- Chemical weathering and
- Biological weathering

Physical weathering

It is the breakdown of rocks without changing their chemical composition, through the action of physical forces. The constant freezing and thawing of rocks during the night and day leads to the expansion and contraction of rocks. Cracks are formed and disintegration occurs eventually. **Exfoliation, block disintegration, granular disintegration,** are the Major types of physical weathering.

Exfoliation

The alternate heating and cooling on rounded rock surfaces leads to the peeling of rocks, layer by layer like an onion. This is called **exfoliation, sheeting** and **shattering** are the other forms of exfoliation.





Granular Disintegration:

Granular disintegration takes place in crystalline rocks where the grains of the rocks become loose and fall out. This is due to the action of **temperature**.



Block Disintegration:

Repeated expansion and contraction of rocks during day and night respectively causes stress on the joints of the rocks which results in block disintegration



Hots

Is weathering a pre-requisite in the formation of soil?

Facts

The disintegrated rock materials, in due course of time, are weathered further, to form soil. Soil is a mixture of disintegrated rock material and decayed organic matter called humus.

Chemical Weathering

Disintegration and decomposition of rocks due to chemical reactions is called

Chemical Weathering. This is predominantly high in the hot and humid regions such as the equatorial, tropical and sub tropical zones. Chemical weathering takes place through the processes of **oxidation**, **carbonation**, **solution**, and **hydration**. The agents of Chemical weathering are Oxygen, Carbon-dioxide, Hydrogen and water.



Oxidation

Oxygen in the atmosphere reacts with the iron found in rocks, thus leads to the formation of iron oxide. This process similar to the rusting of iron, pressure of air and water is known as oxidation, which results in the weakening of rocks.

Carbonation

Carbonation is the mixing of water with the atmospheric carbon-dioxide, forming carbonic acid. Carbonation is important in the formation of caves, in limestone region. When the carbonic acid reacts with the carbonate rocks, the rocks get disintegrated.

Solution

The dissolution of rock substances in water result in the loosening of the rock particles. This inturn breaks down the rocks.

Hydration

Absorption of water into the mineral structure, certain chemicals in the rock enlarge in size in humid conditions. These minerals found in the rock swell and this results in the development of cracks and the

rock wears down. This type of weathering is called hydration.

Biological Weathering

Biological weathering occurs due to the penetration and expansion of plant roots, earthworms, burrowing animals (rabbits, rats) and some human activities.



2.2 Gradation

Gradation is the process of levelling of the land by means of natural agents like rivers, ground water, winds, glaciers, and sea waves. These agents produce various gradational relief features in due course of time. Gradation takes place in two ways: **degradation** and **aggradation**

Gradation is the levelling land surface by various natural agents.

Aggradation is building up of landforms due to natural agents.

Degradation is eroding of land surface

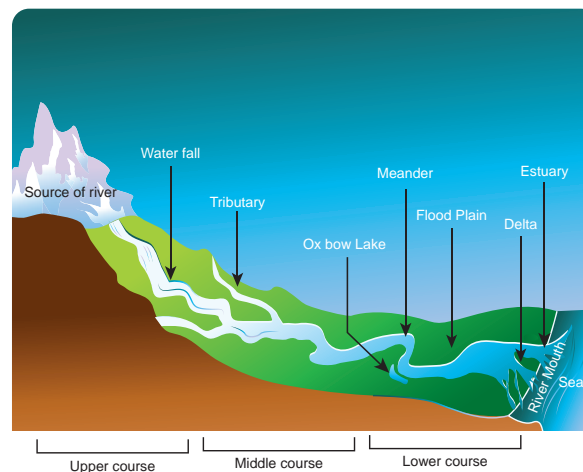
Agents of Gradation

Running water (River) **-(Fluvial Land forms)**

The work of running water (rivers) is the most extensive among all the other agents of gradation. Rivers originate on higher landforms like, mountains, hills and plateaus that receive water from various sources like the rain, glaciers, springs, lakes, etc. The place where the river originates is



called catchment area and where it joins the sea is known as mouth.



Courses of River:

Rivers generally originate from mountains and end in a sea or lake. The whole path that a river flows through is called its course. The course of a river is divided into:

- i. The upper course
- ii. The middle course and
- iii. The lower course

i. The Upper Course

Erosion is the most dominant action of river in the upper course. In this course, a river usually tumbles down the steep mountain slopes. The steep gradient increases the velocity and the river channel performs erosion with great force to widen and deepen its valley. The land features carved by a river in its upper course are **V-shaped valleys, gorges, canyons, rapids, pot holes, spurs, and waterfalls.**

ii. The Middle Course-

The river enters the plain in its middle course. The volume of water increases with the confluence of many tributaries and thus increases the load of the river. Thus, the predominant action of a river is **transportation**. Deposition also occurs due to the sudden decrease in velocity. The river in the middle course develops some typical landforms like **flood plains, meanders, ox-bow lakes** etc.,

iii. The Lower course

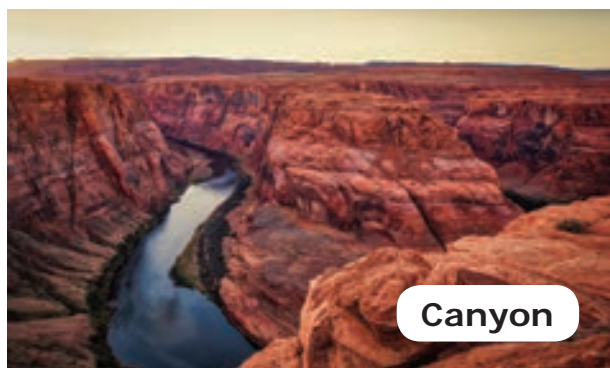
The river, moving downstream across a broad, level plain is loaded with debris, brought down from its upper and middle courses. Large deposits of sediments are found at the level bed and the river, splits into a number of channels called distributaries. The main work of the river here is **deposition** and it develops typical landforms like **delta and estuary**.

- **Tributary** – Small streams that join the main river. Eg. River Bhavani
- **Distributary** – River channels that get separated from the main river. E.g., River Kollidam.

Erosional Landforms of River Gorges and Canyons:

When the river flows through a mountainous region made up of hard rocks, it forms a valley with almost vertical sides called gorge. In India, deep gorges have been formed by Brahmaputra and Indus in the Himalayas.

A deep gorge with steep sides that runs for hundreds of kilometres is referred to as canyon e.g. Grand Canyon of the river Colorado in the U.S.A.



Waterfall

When a river flows in a region where hard rocks lie over soft rocks horizontally, the soft rocks get eroded quickly and the hard rocks project outwards. Thus, the river falls vertically from a steep slope to form a **waterfall**. When the water falls with great

force, it erodes the rock material beneath and creates a depression called a **plunge pool**. Shallow fast flowing water in a stream is called a **rapid** or **river jumps**

The highest waterfalls in the world is Angel falls (979 m) in Venezuela.



V-shaped valley

A 'V'- shaped valley is formed by the vertical erosion of the river where the valley is deepened and widened.



Pot hole

Due to the river action, cylindrical holes are drilled vertically in the river bed, with varying depth and diameter. These are called **pot holes**.



Meander

As the river loaded with debris flows slowly, it forms sweeping loops and bends. It is referred to as meanders.



Ox bow lake

Meanders in due course of time become almost a complete circle with narrow necks. This in turn gets abandoned and forms a lake. This is called an Ox-bow lake.

The world's largest oxbow lake is Lake Chicot in Arkansas of USA. Lake Kanwar in Bihar (India) is Asia's largest fresh water ox bow lake.

Depositional Landforms of River

Alluvial Fan

A fan shaped deposition made by the river at the foothills is called an alluvial plain

Flood Plain

Fine sediments are deposited on river banks when a river floods. These sediments make the region rich and fertile. This is called

a flood plain. As the height of the river banks gets increases due to continuous deposition of a flooded river, levees are formed.

Estuary: Estuary is formed where the river meets the sea. Deposition of silt by the river is not possible here in the estuaries like delta as if the waves keep on eroding the deposits. Ex. River Narmada and Tapi.

Delta

A triangular shaped low lying area formed by the river at its mouth is called delta.

Deltas have fine deposits of sediments enriched with minerals. Eg. Cauvery Delta, Tamil Nadu.



Facts

The Greek letter (Δ) pronounced delta closely resembles the triangular delta of the river Nile. Sunderban Delta formed by the river Ganga-Brahmaputra is the largest delta in the world.

The world's best known geyser is the Old Faithful geyser in the Yellowstone National Park in Wyoming, U.S.A

Karst Topography

As an agent of gradation, underground water creates distinct landforms in limestone regions called Karst Topography.

Ground water is an active agent in limestone regions. Karst topography is formed due to the dissolution of soluble rocks such as limestone, dolomite and gypsum.





Limestone topography of Western Slovenia extends for a distance of 480 km in length and 80 km in width which is termed as Karst in the Slavic language. The world's largest karst area is the Nullarbar located on the Great Australian Coast.

Karst regions are also found in Southern France, Spain, Mexico, Jamaica, Western Cuba, Central New Guinea, Sri Lanka and Myanmar.

Karst Areas in India

Western Bihar	-	Guptadham caves
Uttarakhand	-	Robert cave and Tapkeshwar temple
Madhya Pradesh	-	Pandav caves Pachmari hills
Bastar district in Chattisgarh	-	Kutumsar
Andhra Pradesh (Visakhapatnam)	-	Borra caves

Erosional Landforms of Underground Water

Most of erosion takes place due to the process of solution. When rain water mixes with carbon-di- oxide and enters into a limestone region, it dissolves and destroys much of the limestone. As a result, landforms such as **Terra rossa, Lappies, sinkholes, swallow holes, dolines, uvalas, poljes, caves and caverns** are formed.

Terra Rossa (Italian term for Red soil)

Deposition of red clay soil on the surface of the Earth is due to the dissolution of limestone content in rocks. The redness of the soil is due to the presence of iron oxide.



Lappies

When the joints of limestone rocks are corrugated by groundwater, long furrows are formed and these are called LAPPIES.



Sinkhole

A funnel shaped depressions formed due to dissolution of limestone rock is called sinkholes. Their average depth ranges between three and nine meters



DO YOU KNOW? The World's deepest sinkhole is China's xianozhai Tienkang at 2172 feet. There are as many as 15000 Sinkholes in Illinois

Activity

Take a trough filled with sand. empty a portion of sand in the middle and fill it with sugar. Now level the sand over the sugar. Pour water into the trough and observe what happens. The sugar dissolves and forms a depression. This is similar to the formation of sinkhole.



Caves and Caverns

Caves and caverns are subterranean features of karst topography. Caves are hollows that are formed by the dissolution of limestone rocks when carbon di oxide in air turns into carbonic acid after its reaction with water. They vary in size and shape. Caverns are the caves with irregular floors. Eg. Guptadham caves in Western Bihar.

All types of deposits in the caves and caverns are collectively called **speleothems** which **includes travertines, tufa, dripstones**.

Swallow Holes, Uvalas, Dolines, Poljis are other erosional Features of karst regions predominant in other parts of the world.



Facts

Cave insects lose their senses of sight and develop extraordinary long antenna to compensate the loss of sight

Depositional Landforms of Underground Water

It is interesting to know that a variety of depositional features are formed on the floor, ceiling and walls of the caves and caverns of the Karst Topography.

Stalactite, Stalagmite and Column

When the water containing dissolved calcite gradually drips from the ceiling of the caves, water evaporates and the remaining calcite hangs from the ceiling. Thus **Stalactites** are formed. When the calcite deposits rises upward like a pillar **Stalagmites** are formed.

Sometimes, Stalactites and Stalagmites meet together to form **Columns or Pillars**.



Glaciers:

A Glacier is a large mass of ice that moves slowly over the land, from its place of accumulation. It is also known as 'River of ice'. The place of accumulation is called snowfield. **The height above which there is a permanent snow cover in the higher altitude or latitude is called snowline.** Higher the latitude, lower the snowline from sea level.



Hots

Snowline of Alps is 2700 metre where as the snowline of Greenland is just 600 metre. Find out the reason.

Activity

Fake Snow

Materials needed:- Cup of Baking Soda, Shaving Cream

Method:- Pour one cup of baking soda, Spray the shaving cream

The snow will start forming almost immediately..

The gradual transformation of snow into granular ice is called 'firn' or 'neve' and finally it becomes solid glacial ice.

Erosional Landforms of Glacier

Glaciers are powerful erosive agents. Some of the important erosional landforms are

Cirque, Aretes, Matterhorn, U-shaped valley, Hanging valley, Fiords etc., Most of these glacial features are predominantly seen in countries like Switzerland, Norway etc.,

Cirque

The glacier erodes the steep side walls of the mountain and forms a **bowl-shaped armchair like depression**, it is termed as Cirque

Arete

Aretes are narrow ridges formed when two cirque walls joined together back to back, and forms narrow knife like ridges.

Pyramidal Peak

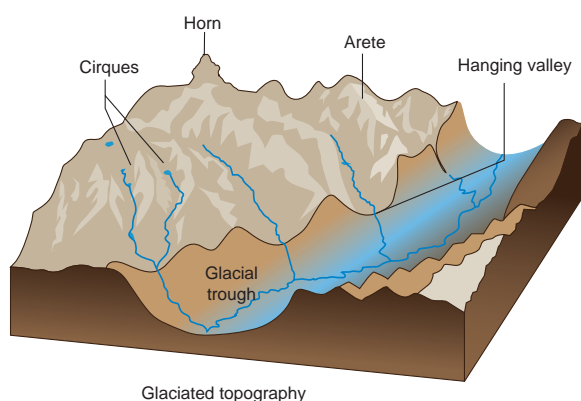
The pyramidal peaks formed when three or more cirques meet together (eg) **Matterhorns**.

U-Shaped Valley

When the glacier moves down along a river valley, the valley further gets eroded deep and wide to form a 'U' shaped valley.

Hanging Valley

These are valleys eroded by tributary glacier and that hangs over the main valley.



Fjord



Fjords are glacial valleys that are partly submerged in the sea.

Depositional Landforms of glacier

After getting eroded, fragments of rocks and boulders along with dirt form **glacial debris**. Glacial debris gets deposited in the low lying areas and form depositional features like **moraines, drumlins, eskers, kames and outwash plains**.

Moraine

1. Materials deposited by Glaciers is called Moraines.
2. Based on the location, they are classified into Ground moraine, Terminal moraine and Lateral moraine.



Drumlin(Basket of Egg Topography)

Drumlins are deposits of glacial moraines that resemble giant inverted teaspoons or half cut eggs.

Esker

Long narrow ridges composed of boulders gravel and sand deposited by streams of melting water which run parallel to a glacier are called eskers.

Outwash Plain

An outwash plain consists of glacial sediments deposited by the melting ice at the terminus of a glacier. It appears as an extensive accumulation of sand, gravel and silt.





Activity

Discuss in a small groups about the effects of global warming.

Wind

When air blows horizontally at or near the earth's surface is called wind. The erosional, transportational and depositional action of wind is predominant in arid regions. This is called as Aeolian Process.

Erosional Landforms of wind

Some of the erosional landforms of wind are mushroom rocks, Inselbergs and yardangs.

Mushroom Rock

Rocks are made up of hard and soft layers. When a rock's bottom is soft, the sand-laden winds blow against it and wear it down. By the constant wearing down action of the wind, the bottom gets eroded away to form a mushroom like structure. This is called a **mushroom or pedestal rock**. Such rocks are found near Jodhpur in Rajasthan.



Inselberg

Inselberg is a German term which means an **island mountain**. Certain hard rocks like igneous rocks are more resistant to wind action. Such **isolated residual hills** rising abruptly from their surroundings are termed as inselbergs. Eg. Uluru or Ayers Rock, Australia.



Yardang

In arid regions, certain rocks have hard and soft layers arranged vertically. When winds blow over these rocks, the soft layers

get eroded leaving irregular crests. These are called yardangs.



Depositional Landforms of wind

Some of the depositional landforms are sand dunes, barchans and loess.

Sand Dune

In deserts, during sandstorms, wind carries loads of sand. When the speed of wind decreases, huge amount of sand gets deposited. These **mounds or hills of sand** are called sand dunes. There are different types of sand dunes.

Barchan

Barch are isolated, **crescent shaped sand dunes**. They have gentle slopes on the windward side and steep slopes on the leeward side.



Transverse Dunes

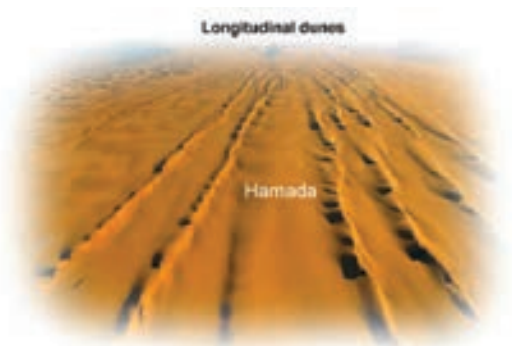
Transverse dunes are asymmetrical in shape. They are formed by alternate slow and fast winds that blow from the same direction.



Longitudinal Dunes (Seif dunes)

Longitudinal dunes are long narrow ridges of sand, which extend in a direction

parallel to the prevailing winds. These dunes are called Seifs in Sahara



Loess

The term loess refers to the deposits of fine silt and porous sand over a vast region. Extensive loess deposits are found in Northern and Western China, the Pampas of Argentina, in Ukraine and in the Mississippi Valley of the United States.



The thickest known deposit of loess is, 335 metre found in the loess plateau in China.

Wave

A steady up (crest) and down (trough) movement of surface water are called waves. Sea waves are the most powerful agents of gradation and their erosional, transportational and depositional processes are confined to a very narrow belt along coastal areas.

Erosional Land Forms of Waves

Some of the erosional landforms of sea waves are **sea cliff**, **sea cave**, **arch**, **stack**, **beach**, **bar** and **spit** and **wave cut platform**.

1. Sea Cliffs

Sea cliffs are steep rock faces formed when sea waves dash against them. The rocks get eroded to form steep vertical walls.

2. Sea Cave

Prolonged wave attack on the base of a cliff erodes rock materials, which result in the formation of **caves**.

3. Sea Arch

When two caves approach one another from either side of a headland and unite, they form an **arch**. (Eg.) Neil Island, Andaman and Nicobar.



4. Sea Stack

Further erosion by waves ultimately leads to the total collapse of the arch. The seaward portion of the headland will remain as a pillar of rock known as **stack**. Eg the Old man of Hoy in Scotland.

5. Wave Cut Platforms

Flat surface found at the foot of sea cliffs are called as wave cut platforms. Wave cut platform is also referred as wave cut benches terrace.

Depositional Landforms of Waves

Beach

Sand and gravel are moved and deposited by waves along the shore to form **beaches**. This is the most dominant and constructive work of the sea. (Eg.) Juhu beach along Mumbai coast, Puri beach in Odisha and Marina beach in Chennai.

Bar

A bar is an elongated deposit of sand, shingle or mud found in the sea, almost parallel to the shoreline.



Spit

A spit is a ridge or embankment of sediment, attached to the land on one end and terminating in open water on the other end. Spits are common at the mouth of estuaries. Eg. Kakinada spit



Recap

- Levelling of uneven landform is called gradation.
- Weathering is the breaking down of the rocks.
- Physical, chemical and biological are the three types of weathering.
- Running water, glacier, underground water, wind and waves are agents of weathering.
- Soil is the weathered materials covering the earth's surface insitu.



EXERCISE



I. Choose the best answer:

1. The disintegration or decomposition of rocks is generally called as
a. weathering b. erosion
c. transportation d. deposition
2. The process of the levelling up of land by means of natural agents.
a. aggradation b. degradation
c. gradation d. none
3. _____ is seen in the lower course of the river.
a. Rapids b. Alluvial fan
c. Delta d. Gorges

4. Karst topography is formed due to the action of
a. Glacier b. Wind
c. Sea waves d. Ground water.
5. Which one of the following is not a depositional feature of a glacier?
a. cirque b. Moraines
c. Drumlins d. Eskers
6. Deposits of fine silt blown by wind is called as
a. Loess b. Barchans
c. Hamada d. Ripples
7. Stacks are formed by _____
a. Wave erosion
b. River erosion
c. Glacial erosion
d. Wind deposition
8. _____ erosion is responsible for the formation of cirque
a. wind b. glacial
c. river d. underground water.

II. Match the following:

1. Distributaries – glacial action
2. Mushroom rock – action of sea wave
3. Eskers – Lower course of river
4. Stalactites – Aeolian process
5. Cliff – karst topography

III. Consider the given statements and choose the right option given below

1. (i). 'I' Shaped valley is an erosional feature of the river
(ii) 'U' Shaped valley is an erosional feature of the glacier



(iii) 'V' Shaped valley is an erosional feature of the glacier

- a. i, ii & iii are right
- b. i & ii are right
- c. i & iii are right
- d. only I is right

2. Statement I: Running water is an important agent of gradation

Statement II: The work of the river depends on the slop of land on which it flows

- a. Statement I is false II is true
- b. Statement I and II are false
- c. Statement I is true II is false
- d. Statement I and II are true

3. Statement: Limestone regions have less underground water.

Reason: Water does not percolate through limestone

- a. The statement is right reason is wrong.
- b. The statement is wrong Reason is right.
- c. The statement and reason are wrong.
- d. The statement and reason are right.

IV. Answer in brief:

1. Define weathering.
2. What do you mean by biological weathering?
3. Mention the three courses of a river with any two land forms associated to each course.
4. What are ox-bow lakes?
5. How does a sea cave differ from a sea arch?
6. List out any four karst topographical areas found in India.
7. What do you mean by a hanging valley?

8. Define: a) Moraine b) Drumlin c) Esker.

9. Mention the various features formed by wind erosion.

10. What is a wave cut platform?

V. Give Reasons:

1. Chemical weathering is predominant in hot and humid zones.
2. Silt deposits are less at estuaries than deltas.
3. Wind can possibly erode the rocks from all sides.

VI. Distinguish between:

1. Physical and chemical weathering.
2. Delta and Estuary
3. Stalactite and stalagmite.
4. Longitudinal and Transverse sand dunes.
5. Inselbergs and yardangs
6. Spit and bar.

VII. Answer in Paragraph:

1. Write a note on weathering classify and explain.
2. Explain the erosional landforms formed by underground water.
3. What is a glacier? Explain its types.
4. Describe the depositional work of winds.

VIII. Map Skill:

On the given outline map of the world, mark the following.

1. Any two deltas
2. A Karst region
3. Any two hot and cold deserts

IX HOTS

1. Is wind the only gradational agent in the desert?
2. Underground water is more common in limestone areas than surface run off. Why?
3. The river channels in the lower course are wider than the upper course.

X. Give geographical terms for the following:

- Chemical alternation of carbonate rocks on lime stone region.
- Flat surfaces near cliffs.
- Erosion + Transportation = Deposition
- The bottom line of a snow field.



INTERNET RESOURCES

1. www.usgs.gov.in
2. www.nasa.gov.in
3. <https://www.isro.gov.in>
4. <https://www.india.gov.in>



ICT CORNER

Karst Topography

Through this activity you will explore **Karst formation**.



Steps

- Use the URL to reach '**Karst Topography**' page. Allow flash player to play, if it asks.
- Click '**Next**' button in the bottom of the page to proceed to the next page and explore the animation.
- Select '**Dissolution**' option from the left and explore.
- Use the arrow keys to move forward and backward to the animation.

Website URL:

<http://folk.uio.no/hanakrem/svalex/E-learning/Karst/>

