



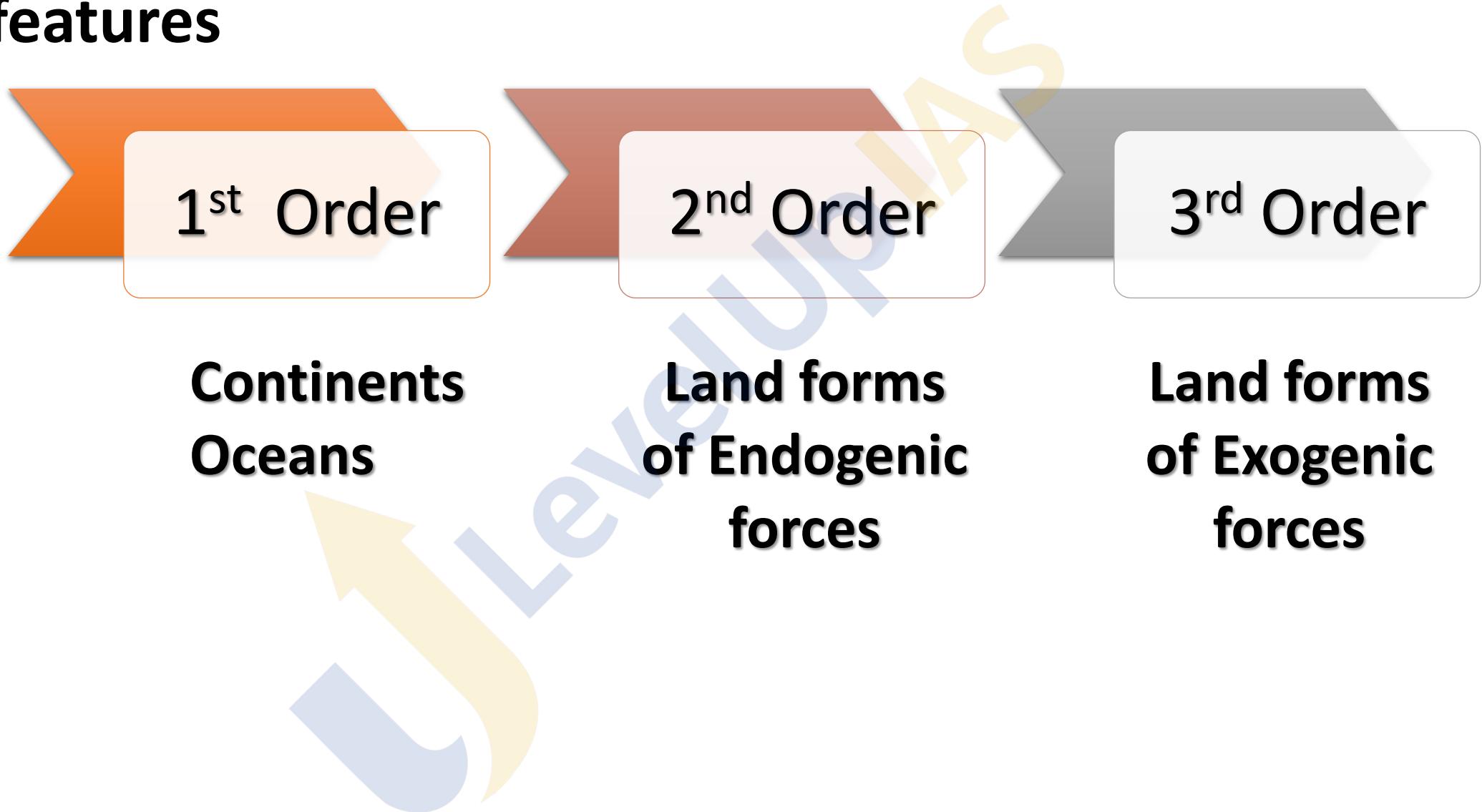
GS FOUNDATION BATCH FOR CSE 2024

Geography - 02 (Landforms)

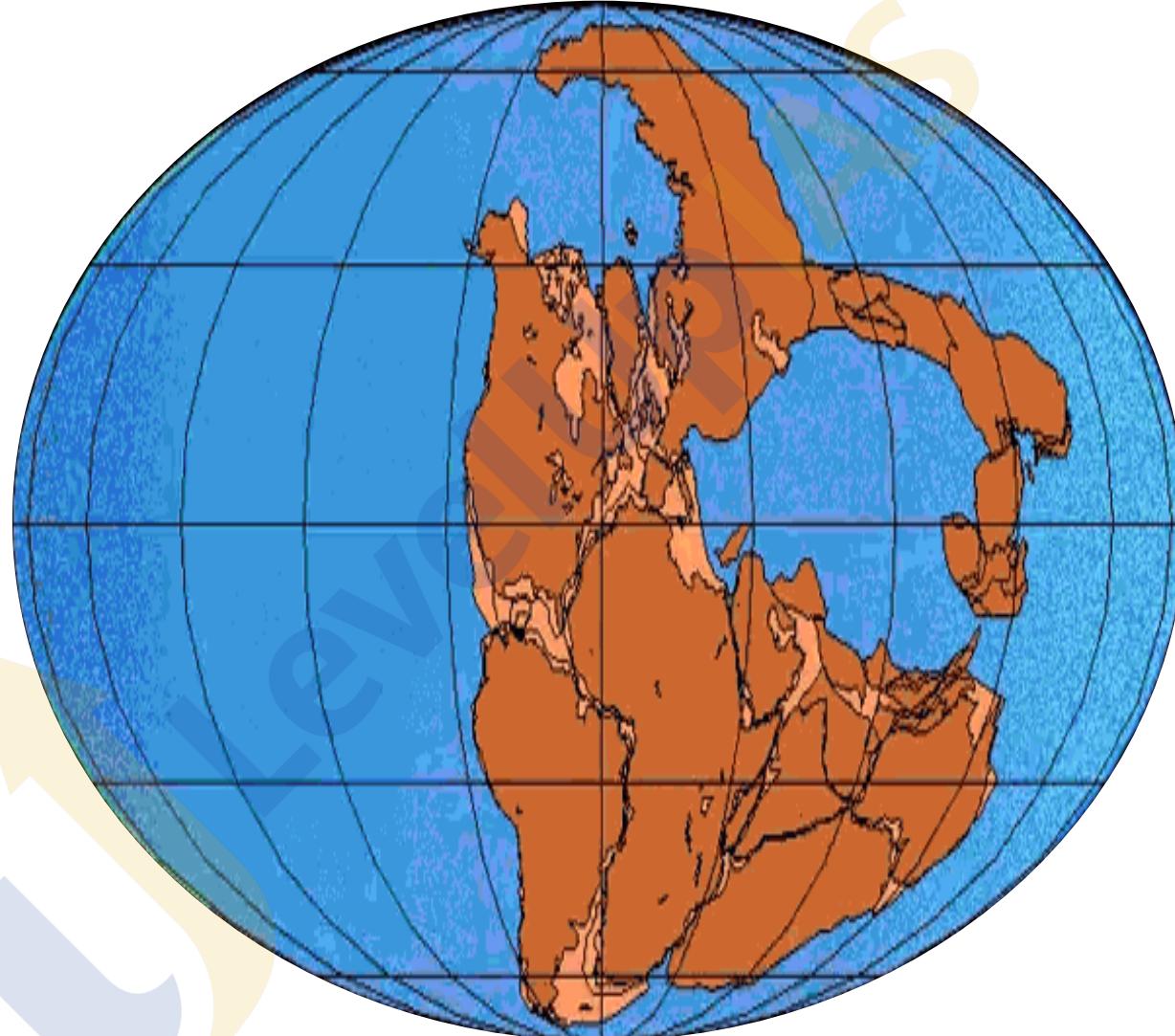


Landforms

Landforms on the basis of relief features



1st Order



2nd Order



3rd Order



Geomorphic Process

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Geomorphic process

Endogenic

Exogenic

Diastrophic

Volcanism

Weathering

Mass
movement

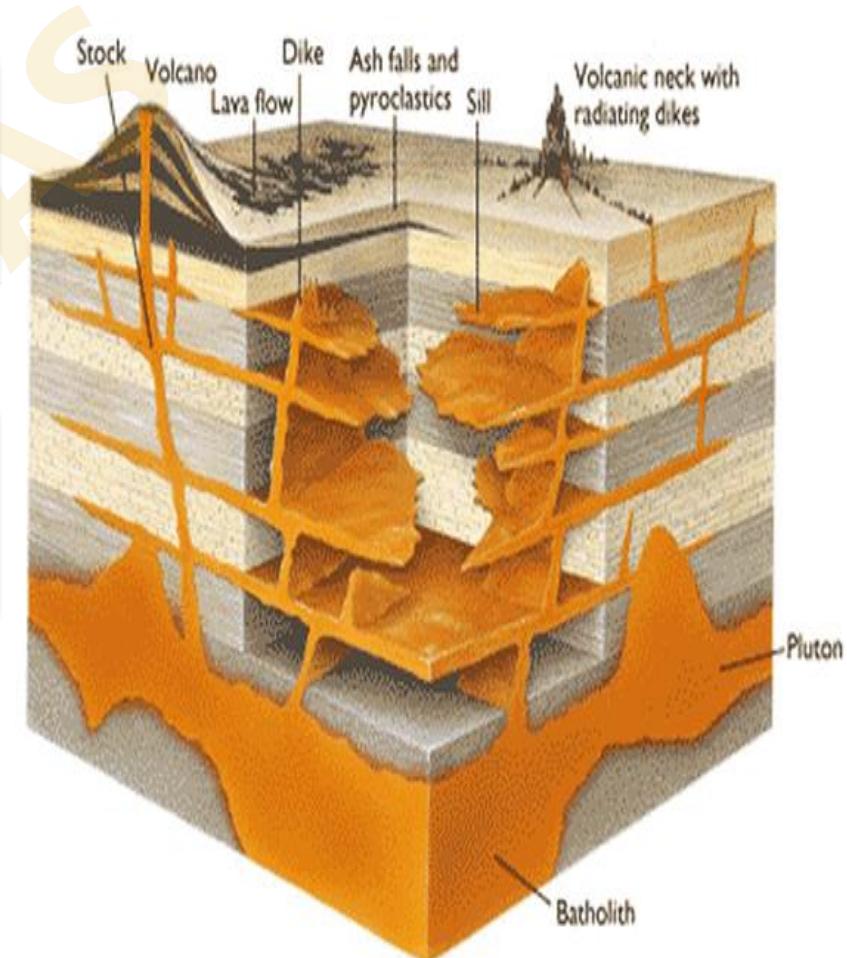
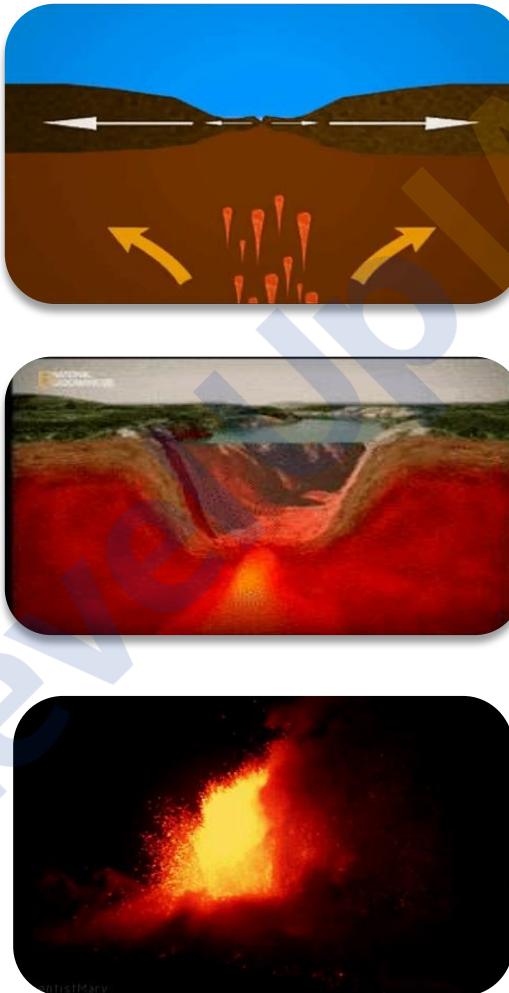
Erosion
/deposition

Endogenic

Diastrophic processes

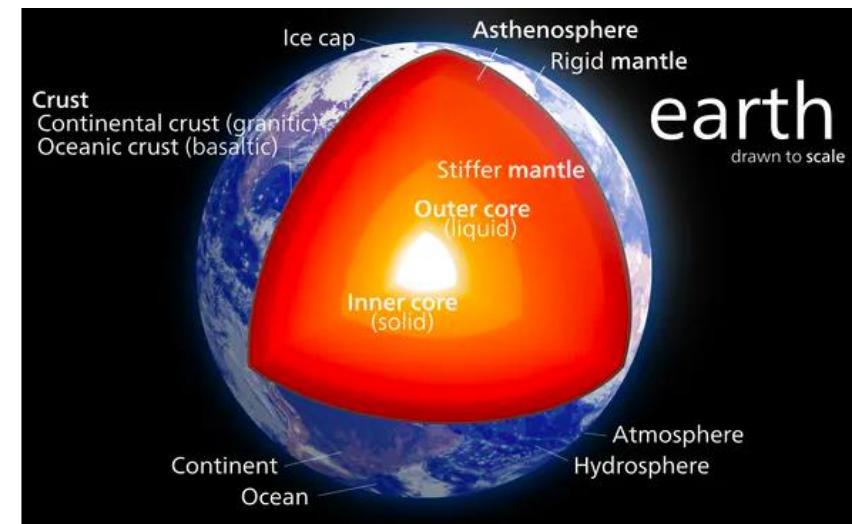
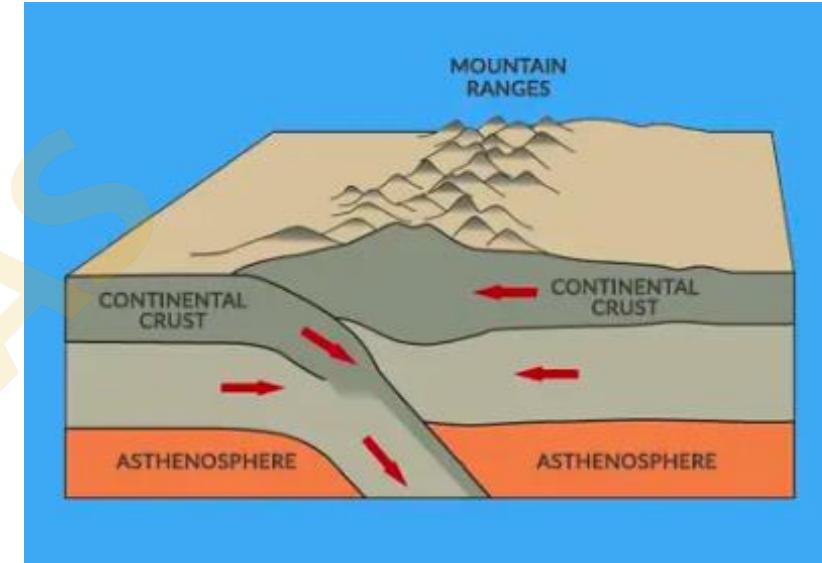


Volcanic processes



Endogenic Forces

- Earth's crust is dynamic and is influenced by Internal forces and External Forces.
- Internal forces that build up the crust are also known as Endogenic forces.
- Endogenic forces continuously elevate or build up parts of the earth surfaces.
- Endogenic forces are called as land building forces.
- For endogenic processes, energy emanates from within the Earth's Interior.
- Energy is mostly generated by radioactivity, primordial heat from the origin of the earth.
- Diastrophism processes elevate or build up the portion of earth crust.
- Diastrophism process include **orogenic forces (mountain building)** and **epeirogenic forces (upliftment of the large portion of earth's crust)**, **Earthquake**, **Plate Tectonics** involving horizontal movement of plates



Exogenic Forces

- External forces induced by sunlight are also known as Exogenic Forces.
- Exogenic forces even out the relief variation on the surface of earth.
- Exogenic forces are called land wearing forces
- Any exogenic element of nature like water, ice, wind, capable of acquiring and transporting of earth material is called geomorphic agent. Elements of nature become active due to gradient, they remove the material from slope and transport them over slope and deposit them at lower level.
- They derive their energy from sun and gradient
- All the exogenic geomorphic process is covered under general term: Denudation. (Denude means to uncover)



Denudation Processes

Weathering: Very Little or no motion of material takes place in weathering. It is an *in situ*/ on site process

Mass movement

**Erosion/
deposition**

Gravitation

**Molecular
stress**

**Chemical
Alteration**

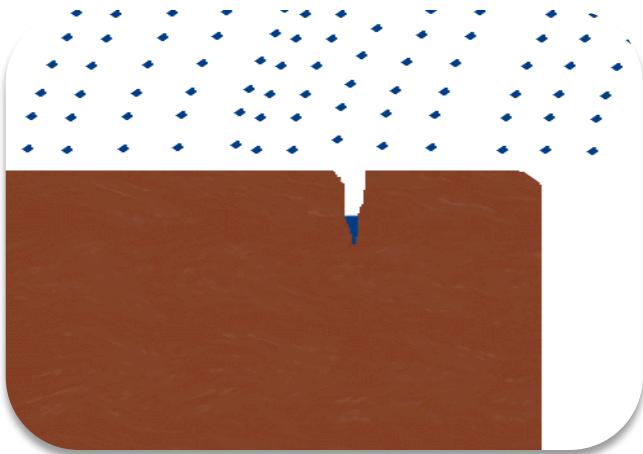
**Gravitational
Force**

**Kinetic
energy**

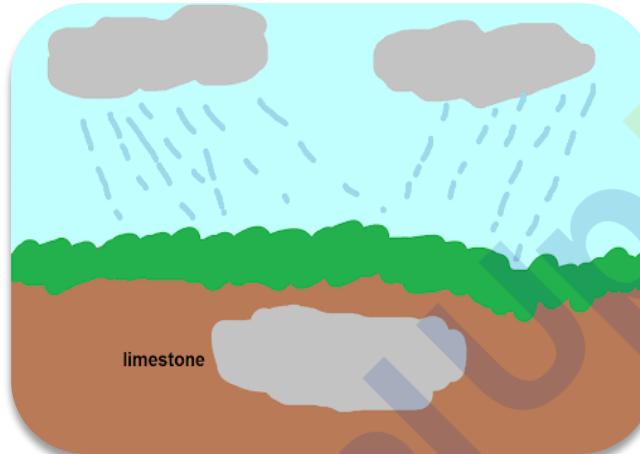
Gravitation force acting on slope pushes the material downslope

Weathering

Weathering is mechanical disintegration and chemical decomposition of rocks due to varied action of weather and climate over earth material



Physical



Chemical

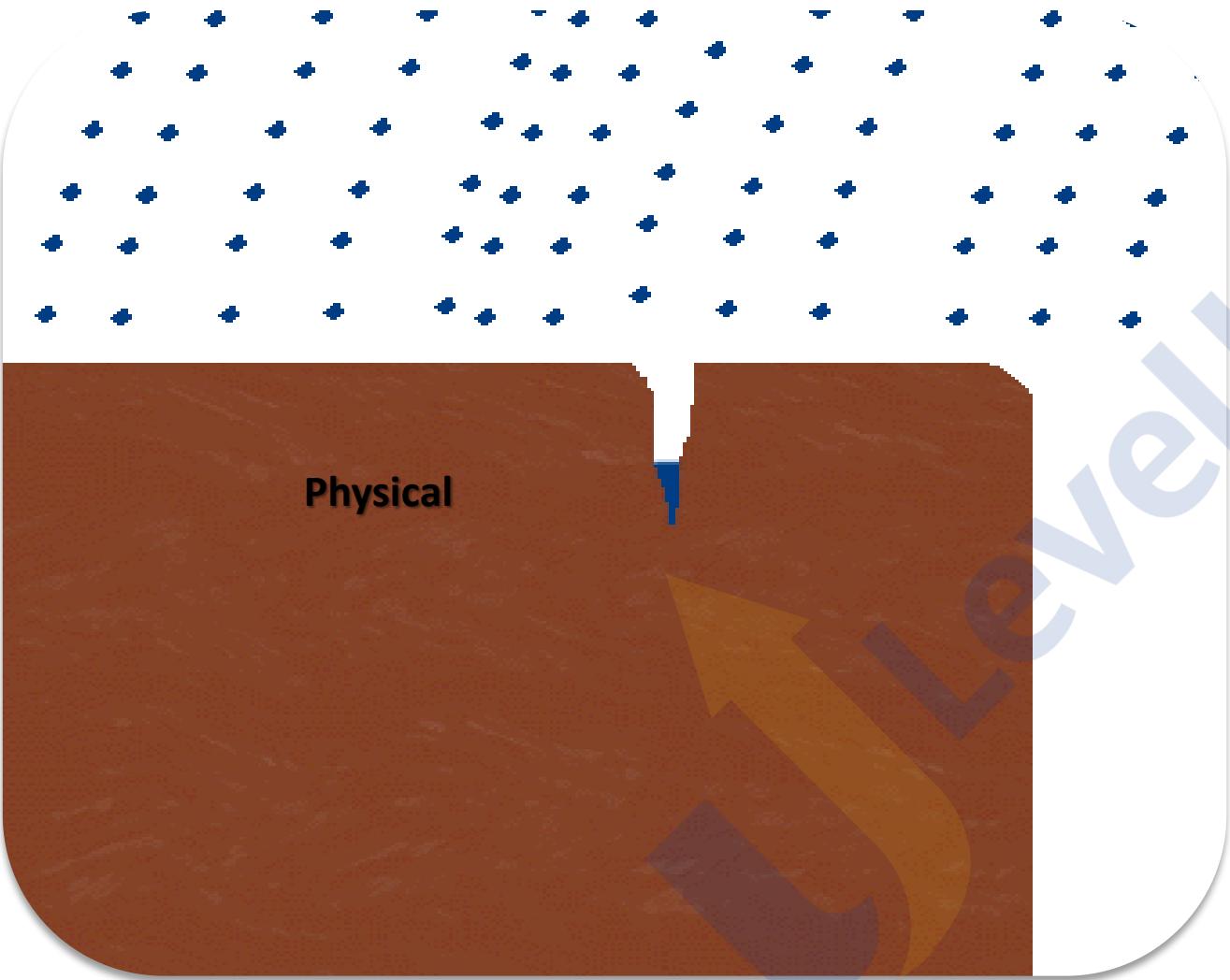


Biological



Onion peeling/ Exfoliation

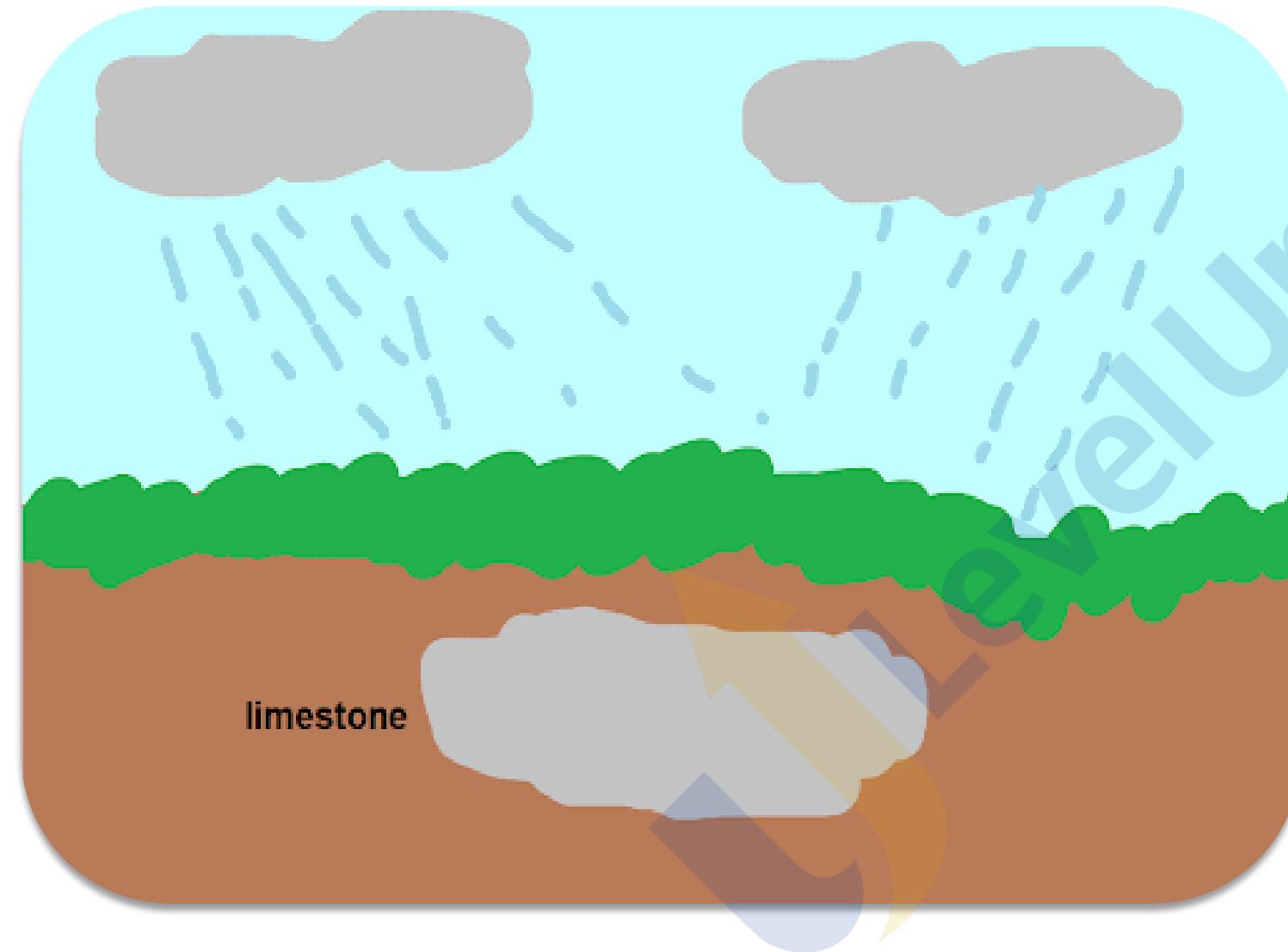
Physical Weathering



Physical weathering process involves

1. Expansion forces due to temperature change
2. Water pressure controlled by alternative wetting and drying cycles
3. Overburden pressure or load

Chemical Weathering



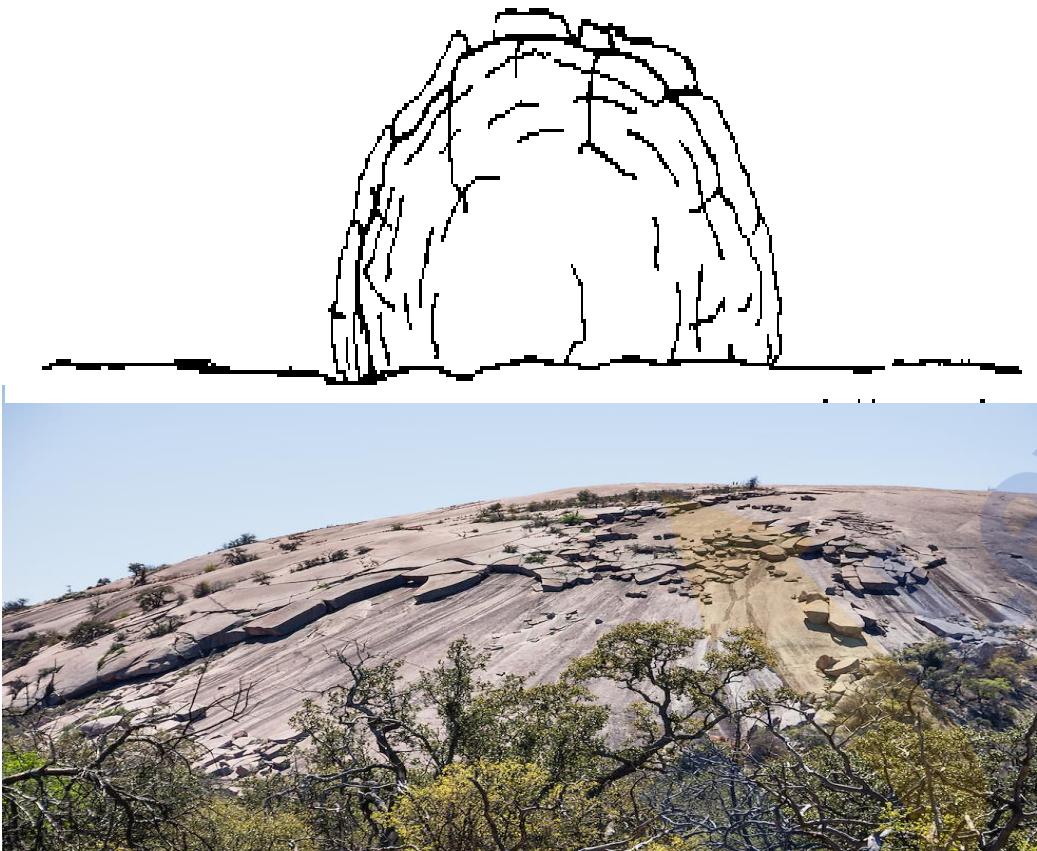
Chemical weathering processes include solution, carbonation, hydration and oxidation and reduction act on rock to decompose the rock

Biological Weathering



1. Removal of material due to growth of organisms
2. Burrowing of material by earthworm, termites, rodents
3. Plants roots break the earth mechanically

Special Landform: Exfoliation and Onion Peeling

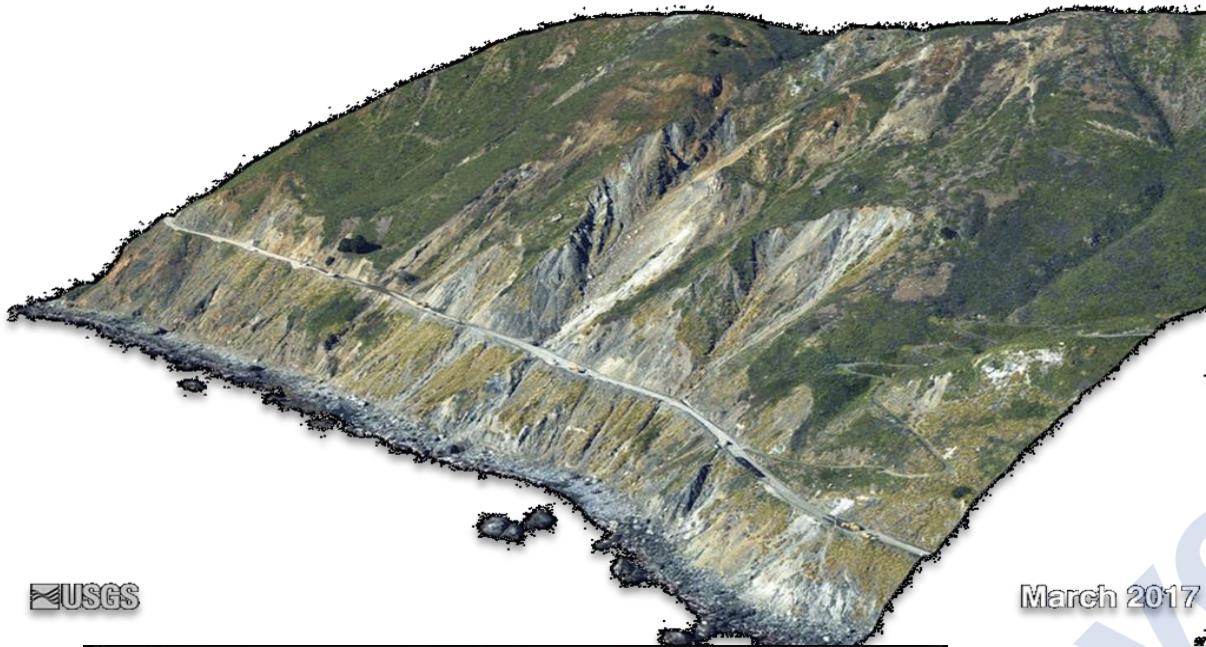


Mass Movement

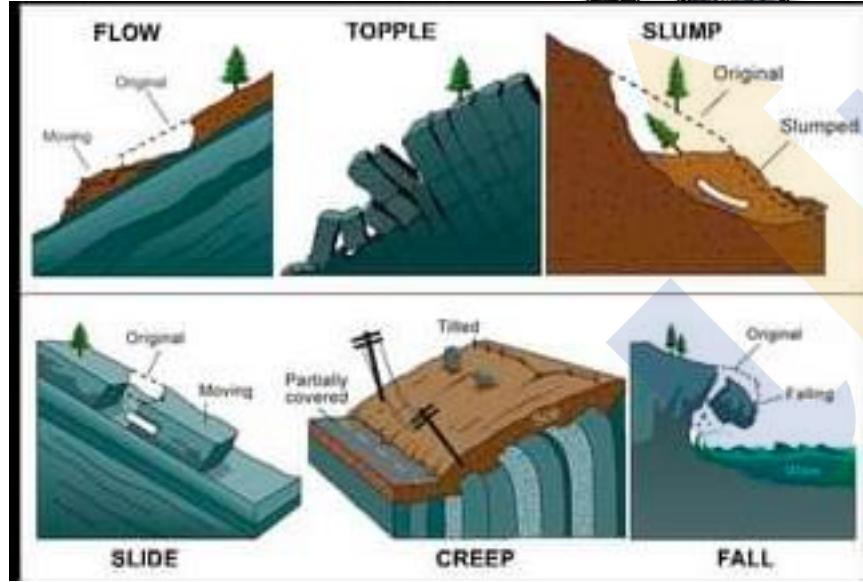


- Mass movement transfers the mass of rock debris down the slope under the direct influence of gravity.
- It ranges from slow to rapid movement affecting shallow to deep columns
- It includes creep, flow, slide.
- Weathering is not a prerequisite for mass movement.
- No geomorphic agent like running water, glaciers, wind, waves participate in the process of mass movement
- Mass movement do not come under erosion

Mass Movement



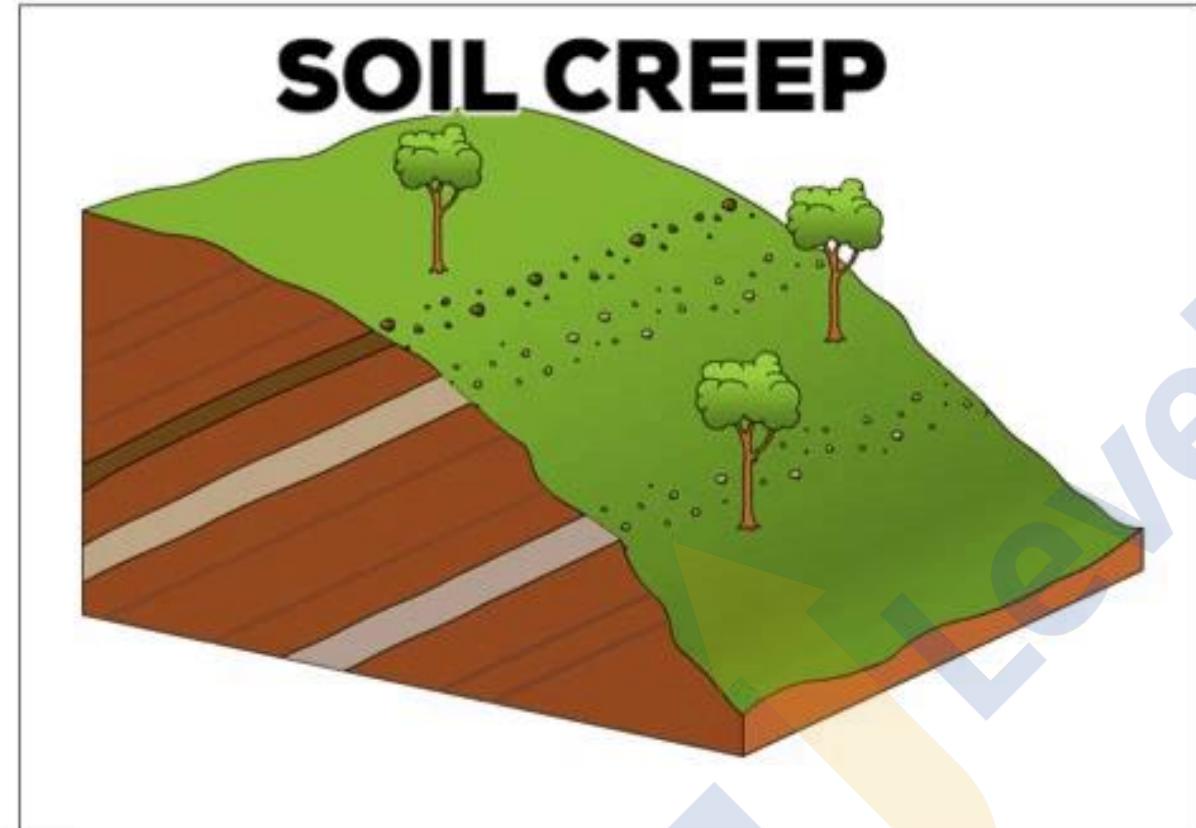
March 2017



- Landslide is relatively rapid and perceptible movement
- Slumping is slipping of one of the several units of rock debris with a backward rotation motion with respect to slope



SOIL CREEP



- It occurs on moderately steep, soil-covered slopes (and does not require water lubrication unlike solifluction).
- Except by prolonged observation, the movement is exceedingly slow and unnoticeable.
- Eg: Electric posts in sloppy regions have drifted from their horizontal linearity. This is called a **creep effect**.

Rapid Movements

- **Earthflow:** Earthflow refers to the movement of water-saturated clayey or silty earth elements down low-angle terraces or hillsides.
- **Mudflow:** A mudflow occurs when thick layers of weathered materials become saturated with water and flow down along definite pathways in the absence of vegetation and cover, and when significant rainfall occurs.
- **Debris avalanche:** It occurs more frequently in humid areas with or without vegetation. It is similar to a snow avalanche and happens in narrow pathways on steep mountains.



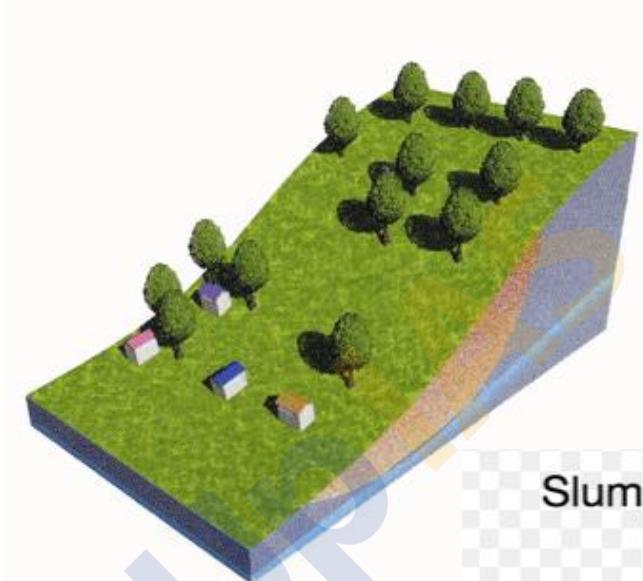
Solifluction

- It's the gradual downslope movement of water-saturated or lubricated soil mass or fine-grained rock debris.
- It's a kind of creep in which the movement is influenced by lubricated water.
- Because groundwater strata are occupied in between permanently frozen soil and rocks in permafrost zones, it primarily occurs there.

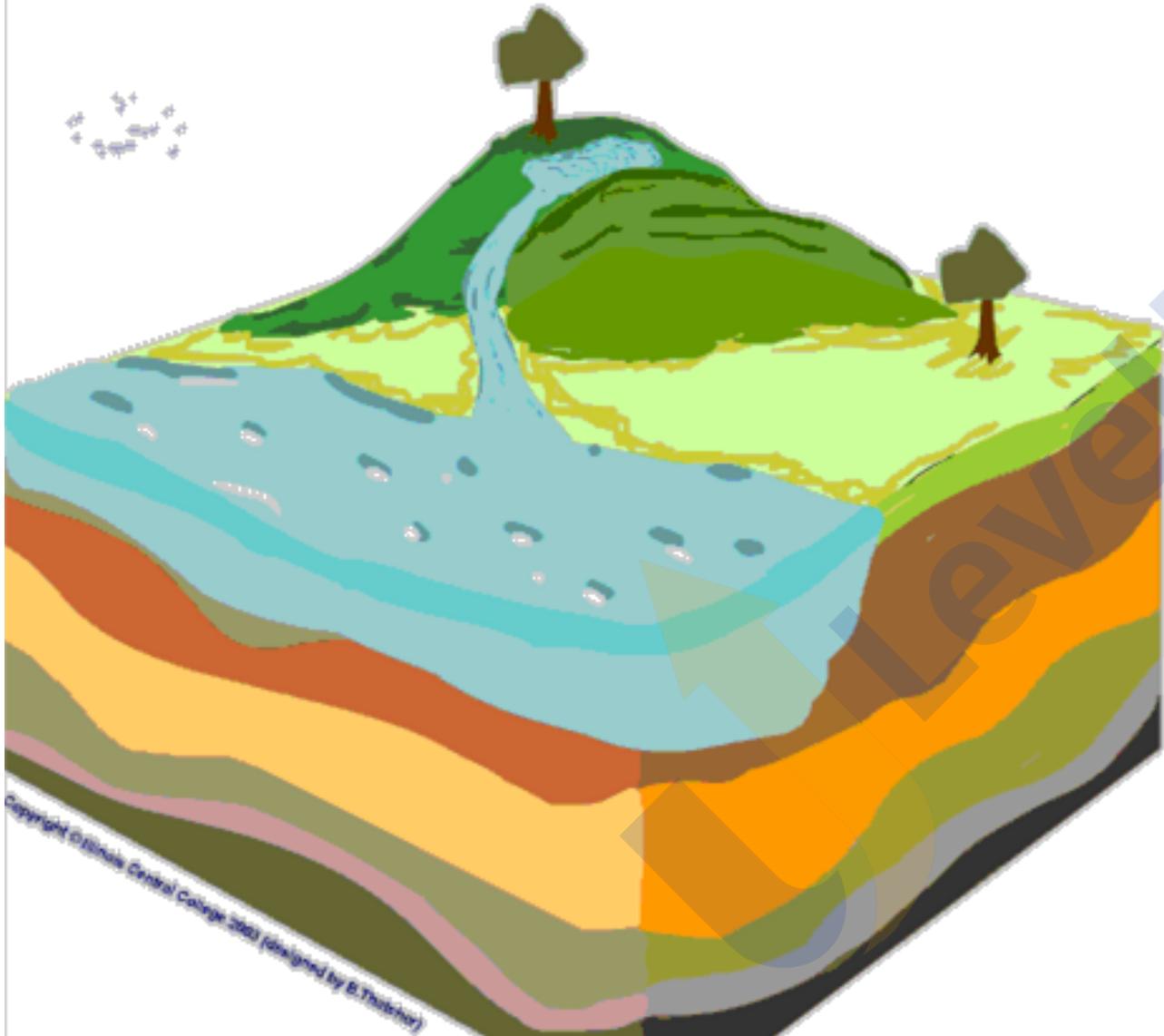


Landslide

- Landslide is relatively rapid and perceptible movement
- In landslide, the materials involved in landslides are rather dry.
- **Slumps, debris slides, rockslides** are the forms of landslides
- **Slump:** A form of landslide in which many units of rock debris slide backward in relation to the slope over which the movement occurs.
- **Debris slide:** There is no backward rotation in this sort of landslide. The drop is nearly vertical.
- **Rockslide:** refers to the movement of individual rock masses.

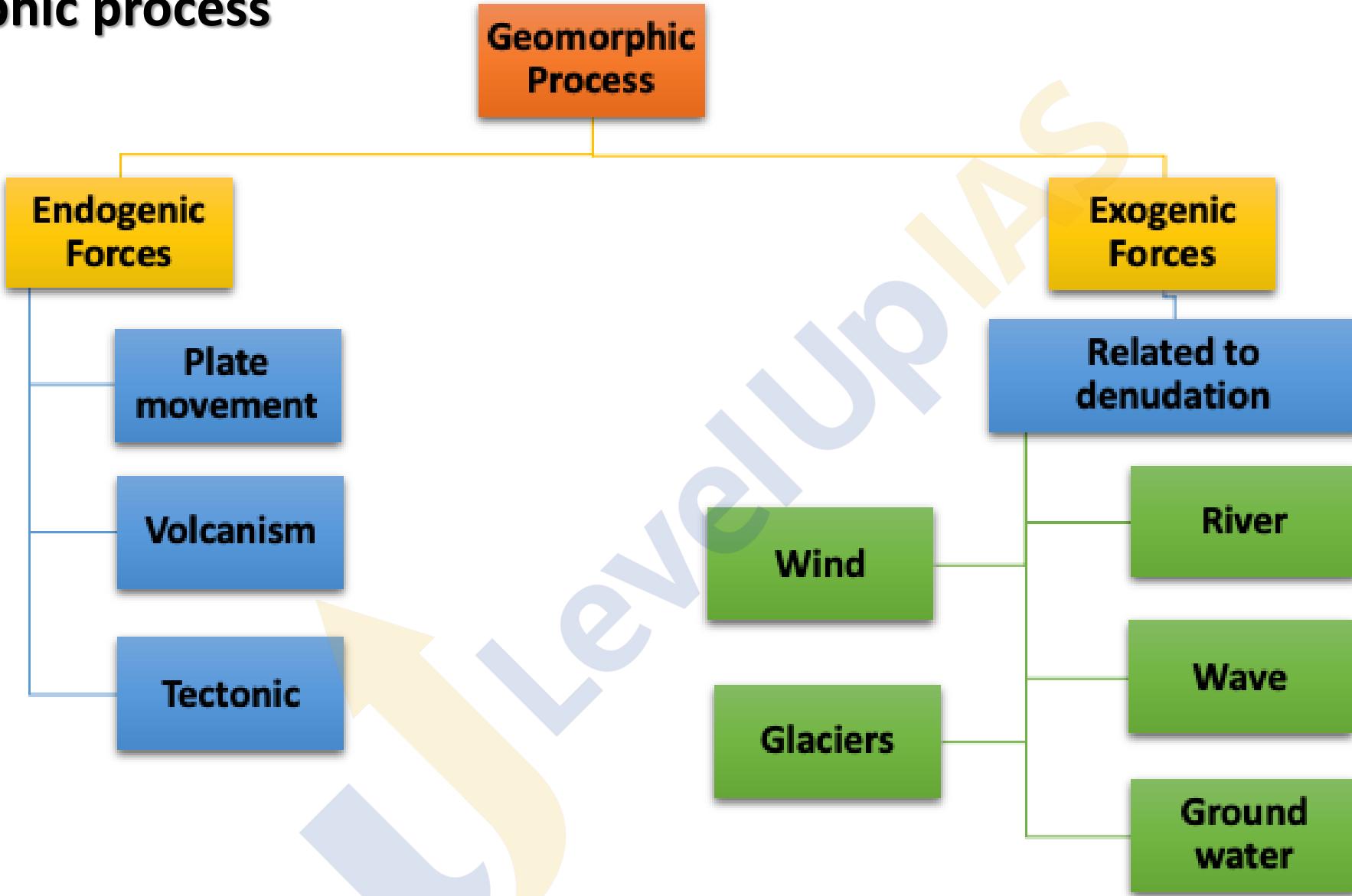


Erosion/ deposition



- Erosion is the process of rock debris being collected and transported by geomorphic processes such as running water, wind, and waves.
- Weathering enhances erosion, although it is not a requirement for erosion to occur. (i.e erosion can occur in both weathered and unweathered environments).
- Deposition occurs as a result of erosion.
- On moderate slopes, erosional agents lose their velocity and energy, and the materials they carry begin to settle.
- No agents are involved in the deposition process. It's simply the effect of erosion.

Geomorphic process



2013

Consider the following:

1. Electromagnetic radiation
2. Geothermal energy
3. Gravitational force
4. Plate movements
5. Rotation of the earth
6. Revolution of the earth

Which of the above are responsible for bringing dynamic changes on the surface of the earth?

- (a) 1, 2, 3 and 4 only
- (b) 1, 3, 5 and 6 only
- (c) 2, 4, 5 and 6 only
- (d) 1, 2, 3, 4, 5 and 6

Factors responsible for dynamicity

1. Electromagnetic radiation
2. Geothermal energy
3. Gravitational force
4. Plate movements
5. Rotation of the earth
6. Revolution of the earth

Landform by the rivers



Erosional Landforms

Depositional landforms

Special features

Course flow

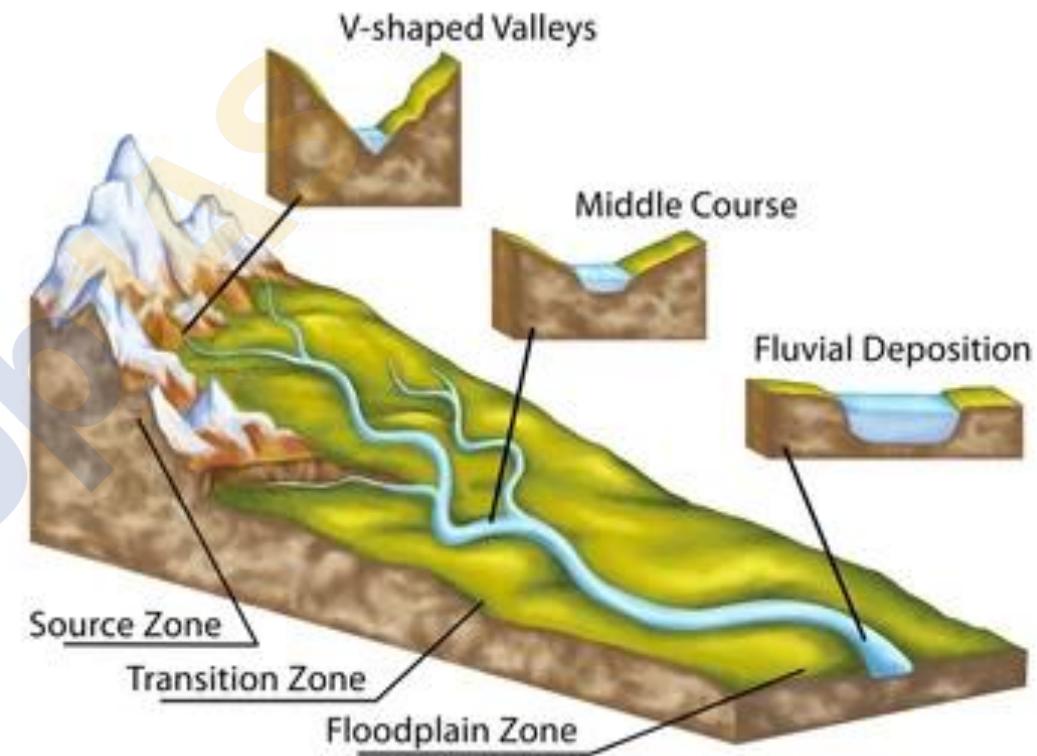
1. Most of the erosional landforms by river are associated with rivers flowing over steep gradient. (Steep Slope: More erosion and less deposition) (Erosion: Vertical Erosion is more than Lateral Erosion)

2. With time, stream channels over steep gradients turn gentler due to continued erosion, vertical erosion becomes less dominant and lateral erosion of banks increases. (Middle Course)

3. With continued erosion, slope turns gentle and as a result rivers lose their velocity and facilitate active deposition. (Gentle Slope: More deposition and less erosion)

4. Gentler the river channels in gradient or slope, the greater is the deposition and as a consequence the hills and valleys are reduced to plains (Peneplain)

River: Process and landform



River: Process and landform

Youth

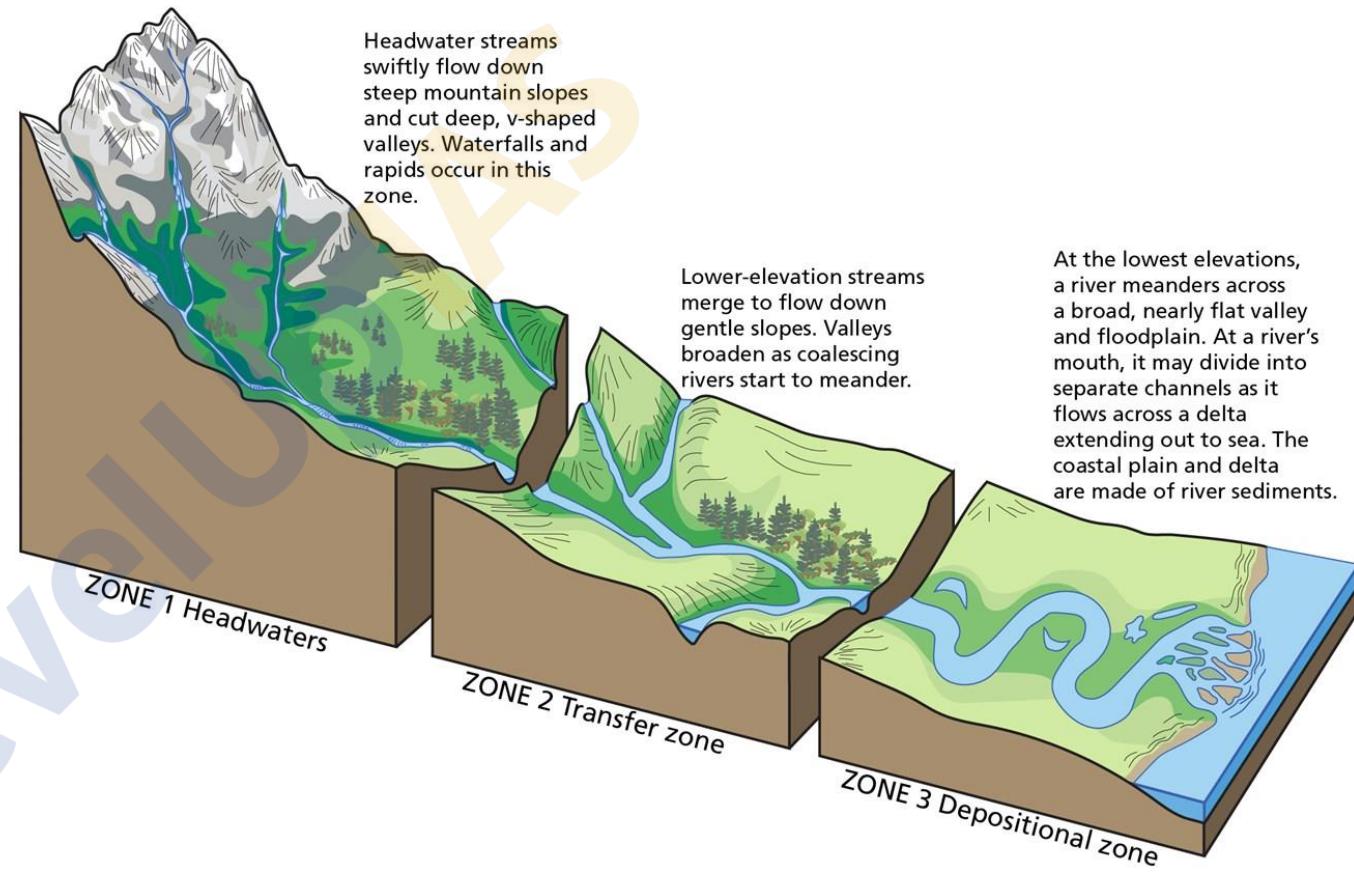
1. Streams are few
2. Shallow V shaped valleys
3. Very narrow floodplain
4. Meanders if present develop over these broad upland surfaces.
5. Waterfalls and rapids may exist .

Mature

1. Streams are plenty
2. The valleys are still V shaped but deep;
3. Wider floodplains so streams flow in meanders
4. Waterfalls and rapids disappear.

Old

1. Gentle gradients.
2. Streams meander freely over vast floodplains showing natural levees, oxbow lakes, etc.
3. Most of the landscape is at or slightly above sea level.



Erosion by the river



Landforms by erosion



Janub Al-batina George,
Oman

Canyon

V shaped valley
Steep step like Slope
Wider at top than at bottom

George

Deep Valley with very steep to straight side
Almost vertical wall and almost equal in width at top as well as at bottom



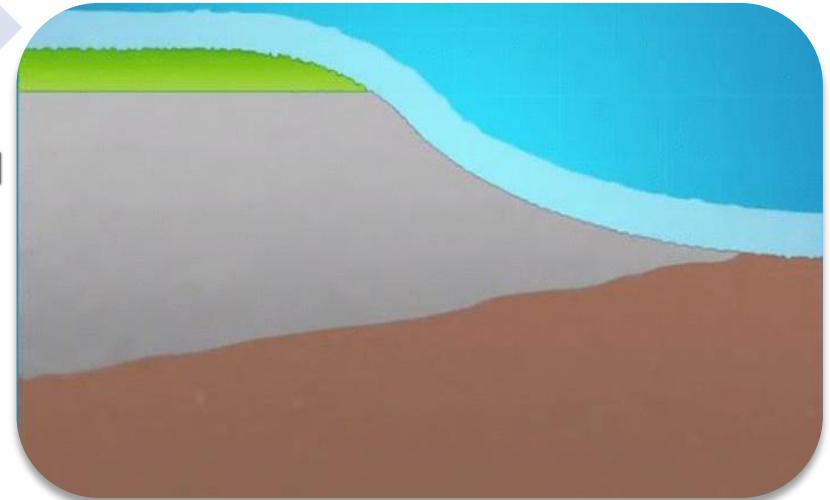
Grand Canyon, USA

Landforms of erosion

1. Over the rocky beds of hill stream circular depressions are formed called potholes
2. Formed because of abrasion of bedrock by rock fragments.
3. Once a small and shallow depression forms, pebbles and boulders get collected in those depressions and get rotated by flowing water and consequently the depressions grow in dimensions.
4. At the foot of waterfalls also, large potholes, quite deep and wide, form because of the sheer impact of water and rotation of boulders. Such large and deep holes at the base of waterfalls are called plunge pools



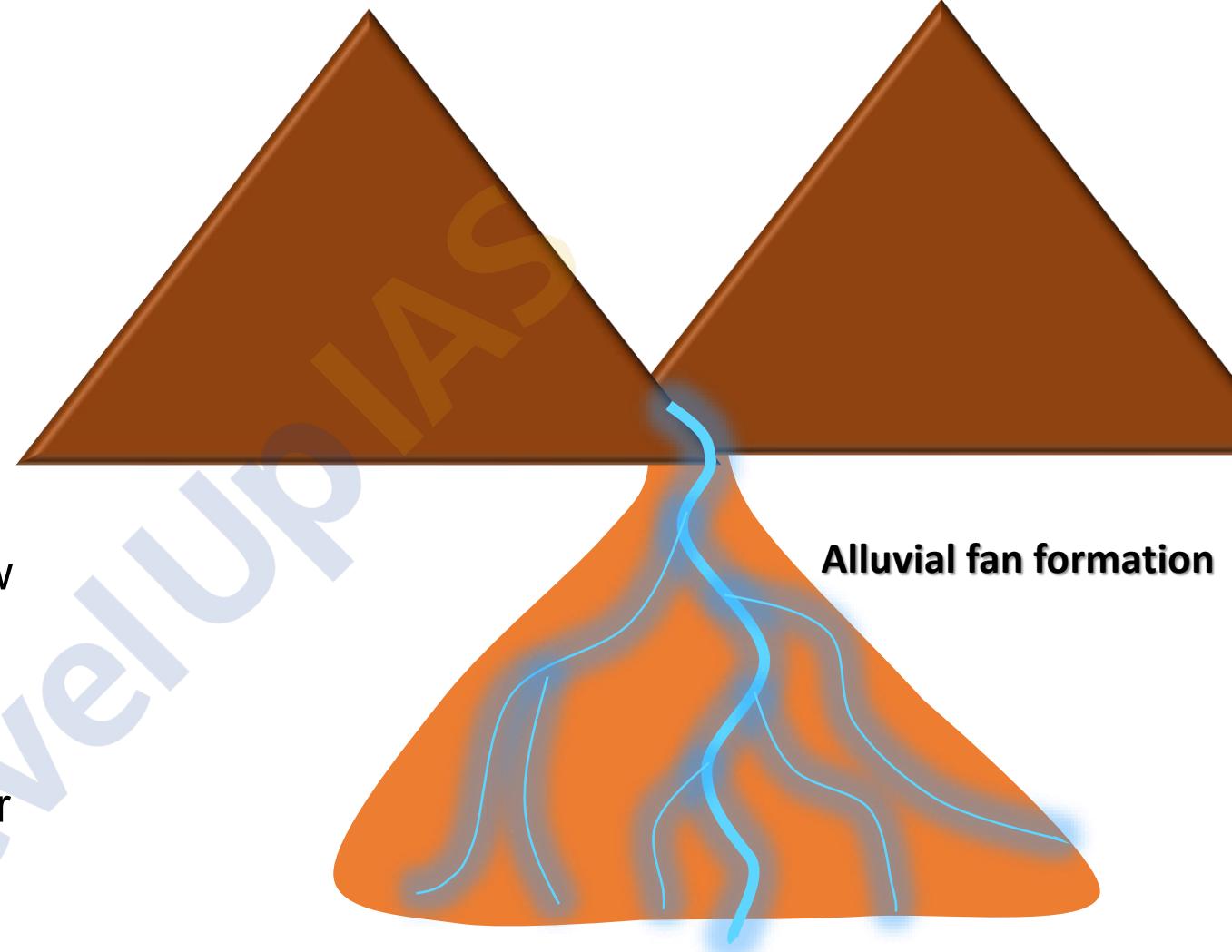
Pot holing



Plunge pool formation

Landforms of deposition: Alluvial Plain

1. Alluvial fans are formed when streams flowing from higher levels break into foot slope plains of low gradient.
2. Normally very coarse load is carried by streams flowing over mountain slopes.
3. This load becomes too heavy for the streams to be carried over gentler gradients and gets dumped and spread as a broad low to high cone shaped deposit called alluvial fan
4. Usually, the streams which flow over fans are not confined to their original channels for long and shift their position across the fan forming many channels called distributaries.
5. Alluvial fans in humid areas show normally low cones with gentle slope from head to toe and they appear as high cones with steep slope in arid and semi-arid climates.



Landforms of deposition: Natural Levee



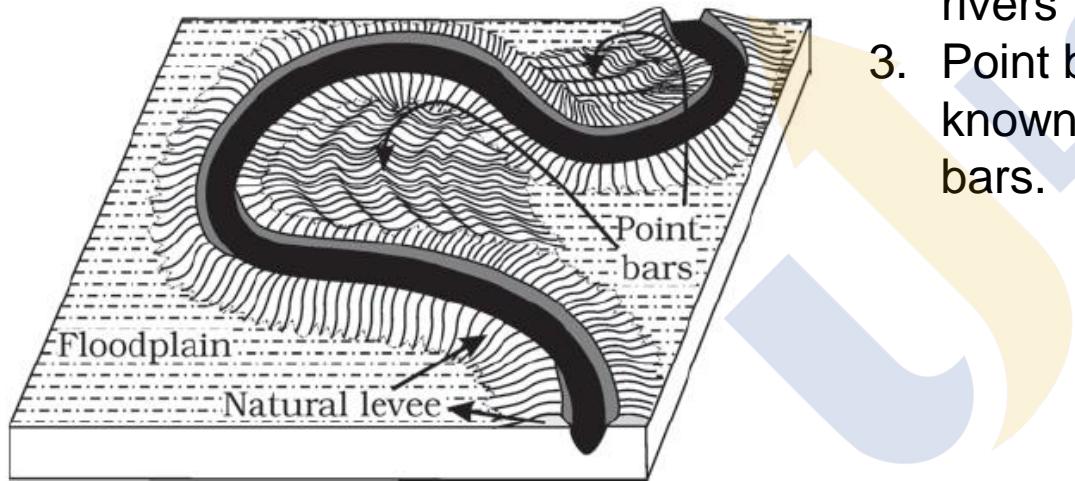
Formation of river terraces

1. **River terraces** are surfaces marking old valley floor or floodplain levels.
2. River terraces are basically **products of erosion** as they result due to vertical erosion by the **stream into its own depositional floodplain**.
3. There can be a **number of such terraces at different heights** indicating former river bed levels.
4. The river terraces may occur at the same elevation on either side of the rivers in which case they are called **paired terraces**.

Landforms of depositions:

Flood Plain

1. Floodplain is a major landform of river deposition.
2. Fine sized materials like sand, silt and clay are carried by relatively slow moving waters in gentler channels and are found in the plains
3. In plains, channels shift laterally and change their courses occasionally



FLOOD PLAIN

Natural levees

1. They are found along the banks of large rivers.
2. They are low, linear and parallel ridges of coarse deposits along the banks of rivers
3. Point bars are also known as meander bars.

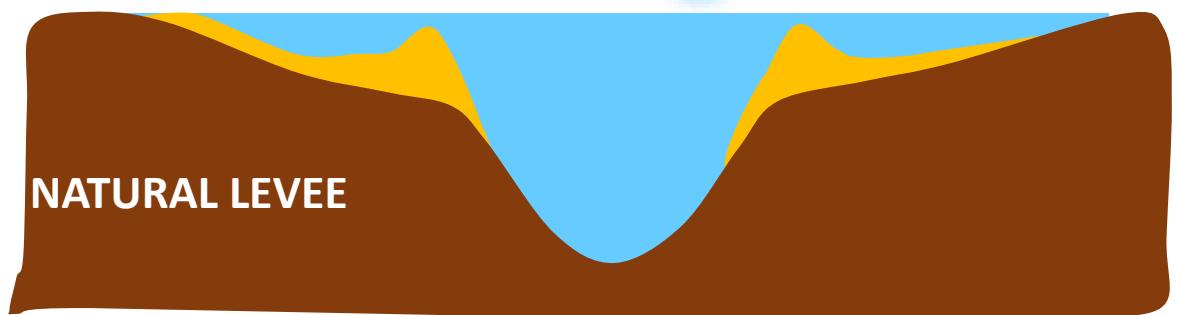
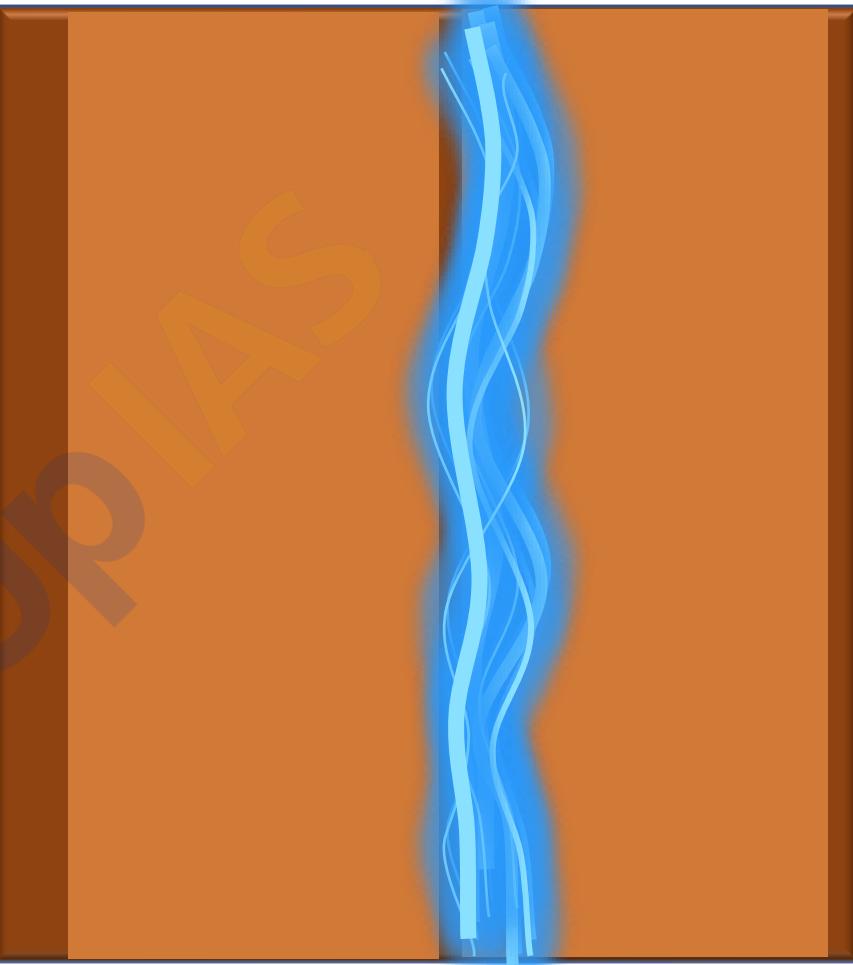


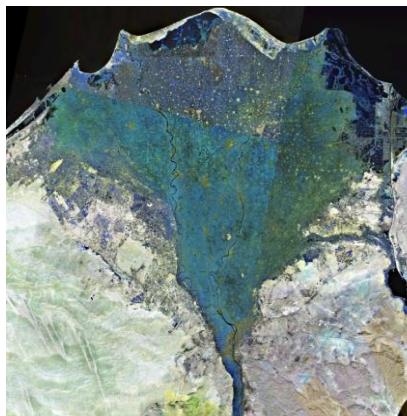
Figure 7.5 : Natural levee and point bars

Landforms of depositions:

Deltas

1. Deltas are like alluvial fans but develop at a different location.
2. The load carried by the rivers is dumped and spread into the sea.
3. If this load is not carried away far into the sea or distributed along the coast, it spreads and accumulates as a low cone.
4. Unlike in alluvial fans, the deposits making up deltas are very well sorted with clear stratification.
5. The coarsest materials settle out first and the finer fractions like silts and clays are carried out into the sea. As the delta grows, the river distributaries continue to increase in length and delta continues to build up into the sea.

Types of Delta: Arcuate Delta, Cuspate Delta, Bird-foot Delta.



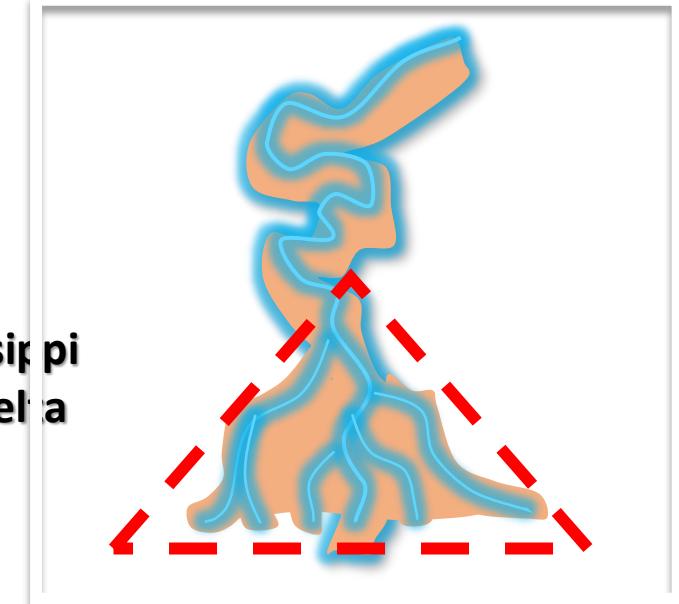
Nile river delta



Ebro river delta



Mississippi river delta

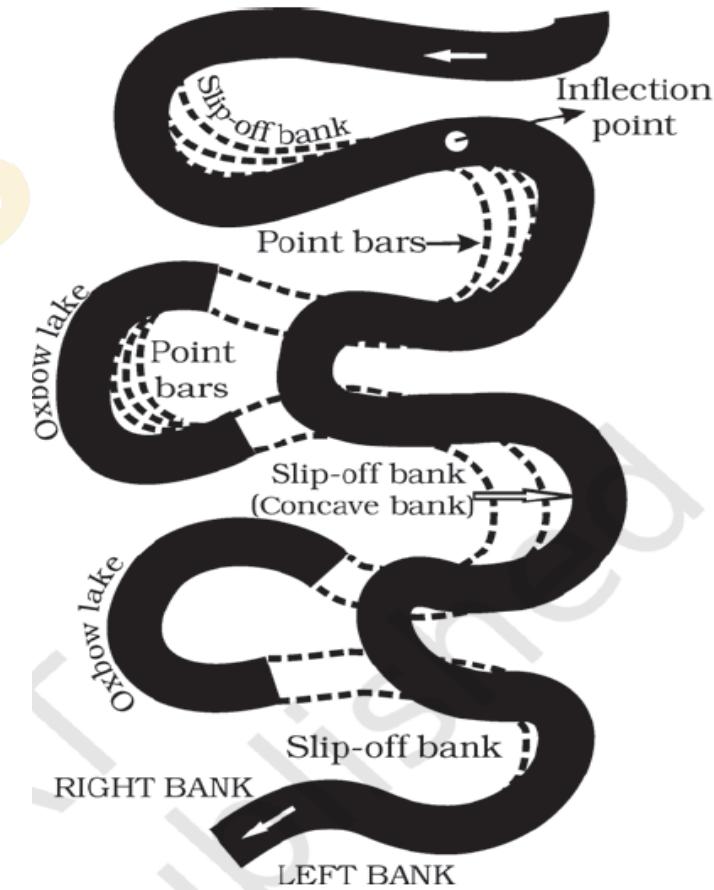




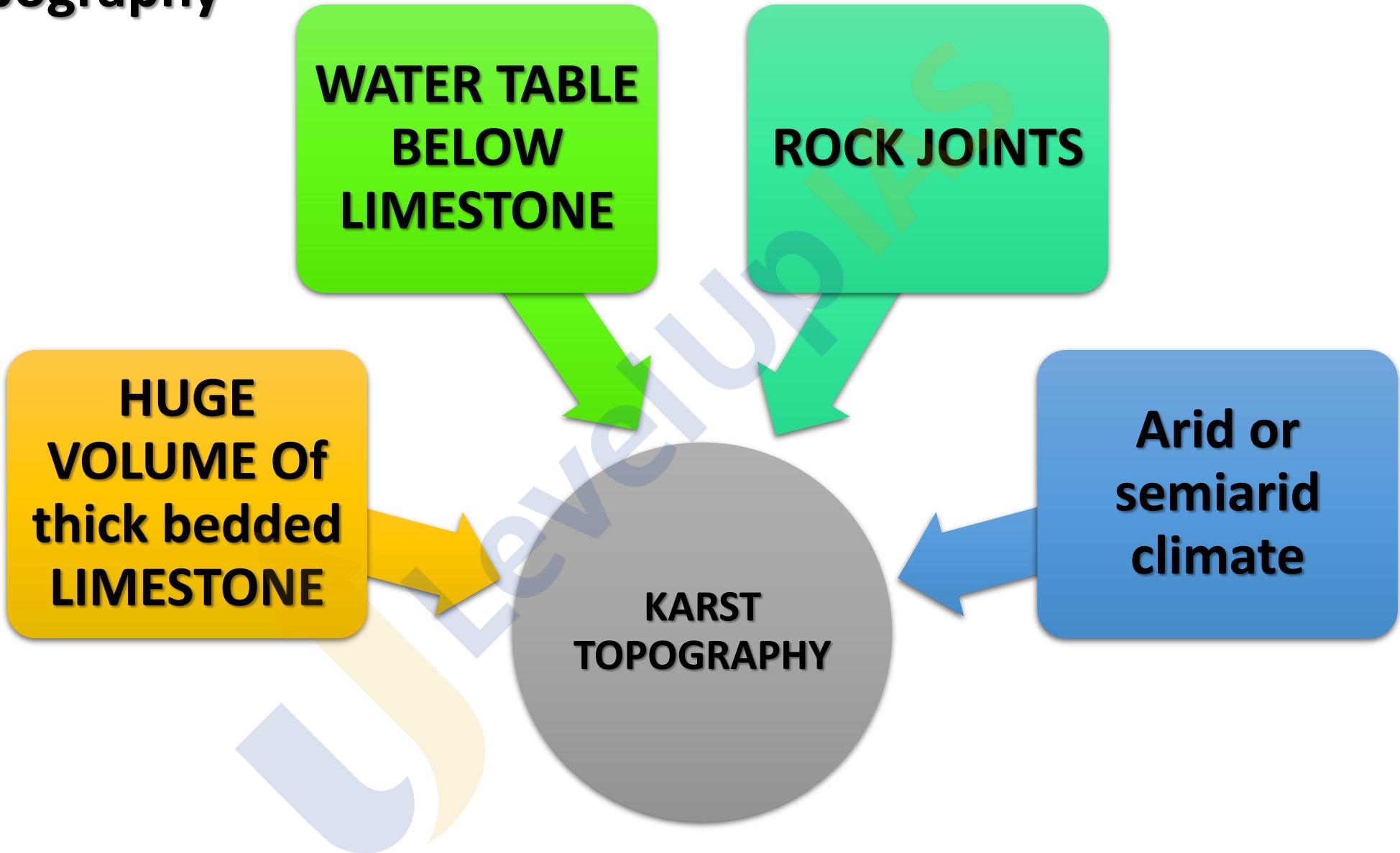
Minute
Earth

Meander

1. In large flood plains, rivers rarely flow in straight courses and tend to meanders
2. **Reasons:** (i) Water work laterally on gentle gradient bank (ii) Soft unconsolidated alluvial deposits along the bank (iii) Coriolis force acting on the fluid water
3. Due to meander, slight irregularities widen into a **curvature**.
4. Curvature deepens due to deposition on the inside of the curve and erosion along the bank on the outside. If there is no deposition and no erosion, the river will not change its course.
5. There is active deposition along concave bank (**Cut off bank**) and undercutting along convex bank. The concave bank is known as **slip off bank**.
6. As meanders grow into deep loops, loops cut off at the inflection points and are left as ox-bow lakes.



Karst Topography

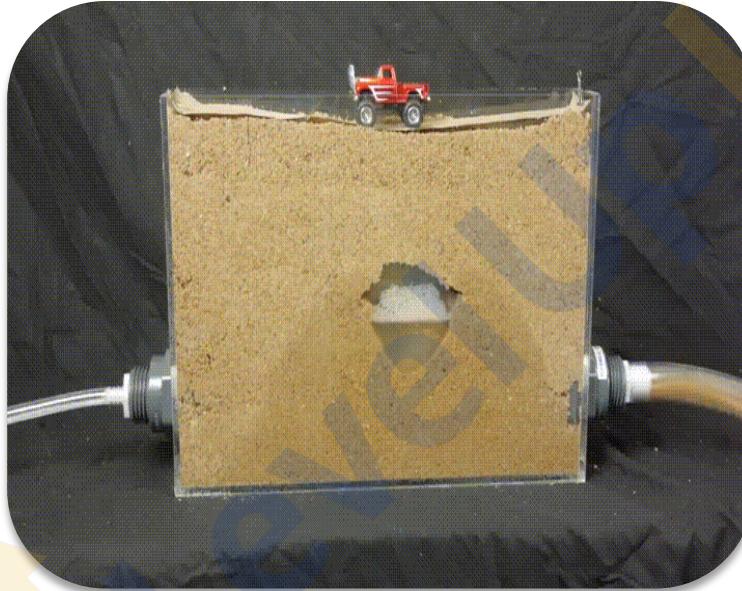
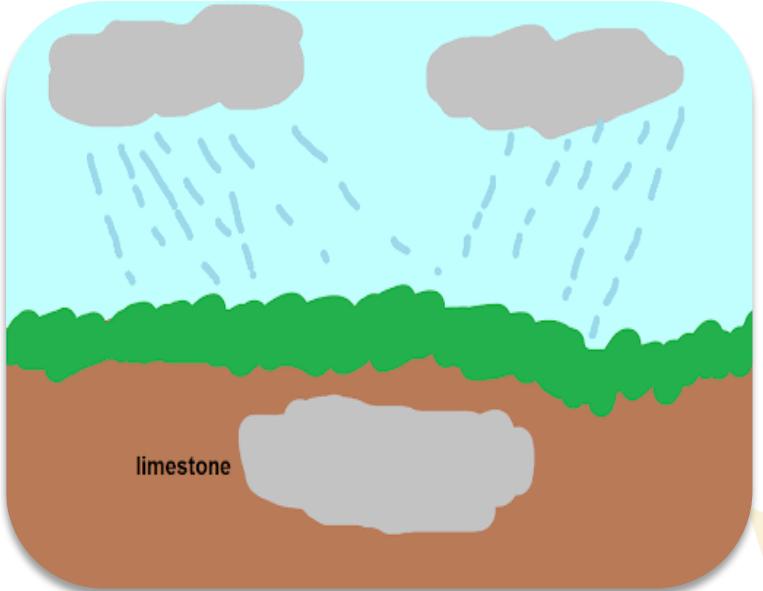


Ground Water

1. Surface water percolates well when the rocks are permeable, thinly bedded and highly jointed and cracked.
2. After vertically going down to some depth, the water under the ground flows horizontally through the bedding planes, joints
3. It is this downward and horizontal movement of water which causes the rocks to erode.
4. Physical or mechanical removal of materials by moving groundwater is insignificant in developing landforms. That is why, the results of the work of groundwater cannot be seen in all types of rocks.
5. But in rocks like limestones or dolomites rich in calcium carbonate, the surface water as well as groundwater through the chemical process of solution and precipitation deposition develop varieties of landforms.
6. These two processes of solution and precipitation are active in limestones or dolomites creating Karst Topography



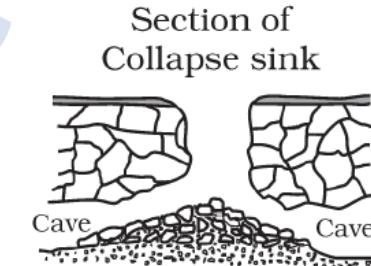
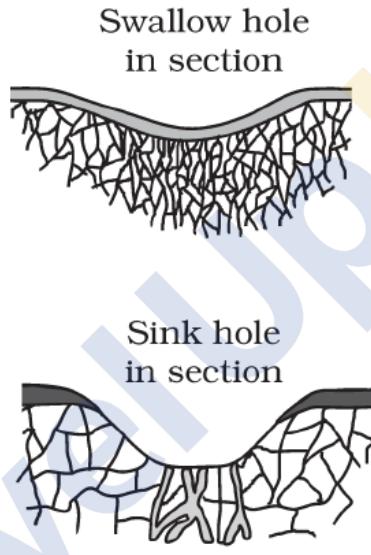
SOLUTION:



Erosional Landform

1. Small to medium sized rounded shallow depressions called swallow holes
2. A sinkhole is an opening more or less circular at the top and funnel-shaped towards the bottom with sizes varying in area
3. Sinkhole forms as solution forms first and if the bottom of a sinkhole forms the roof of a void or cave underground, it might collapse leaving large cave or a void below called as collapse sinks/ Doline
4. When sink holes and dolines join together because of slumping of materials along their margins or due to roof collapse of caves, long, narrow to wide trenches called valley sinks or Uvalas form.
5. Gradually, most of the surface of the limestone is eaten away by these pits and trenches, leaving it extremely irregular surface called as limestone pavements.

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FUNDAMENTALS OF PHYSICAL GEOGRAPHY

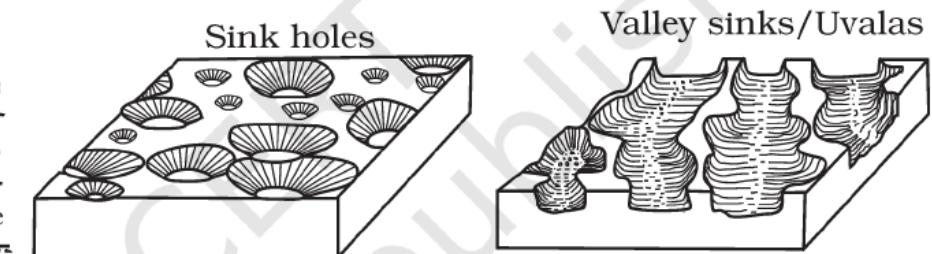
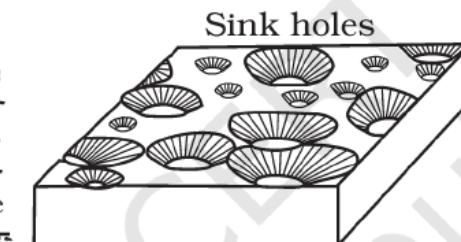
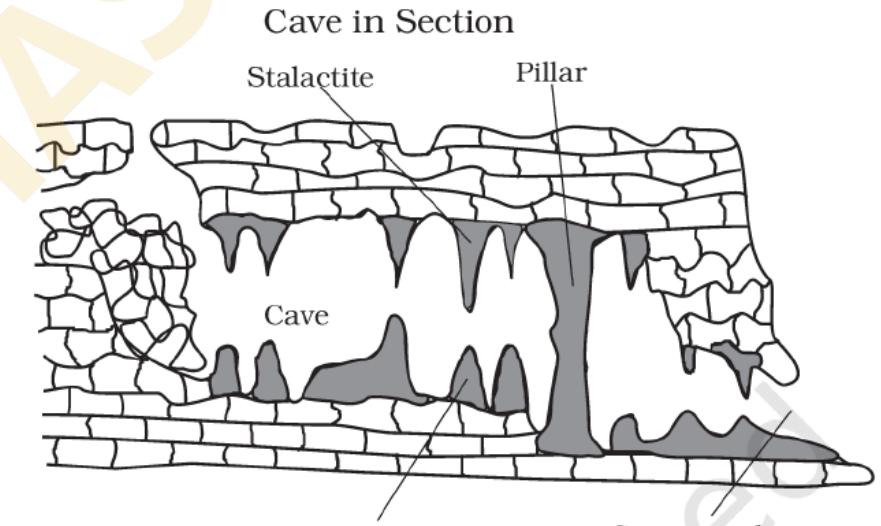
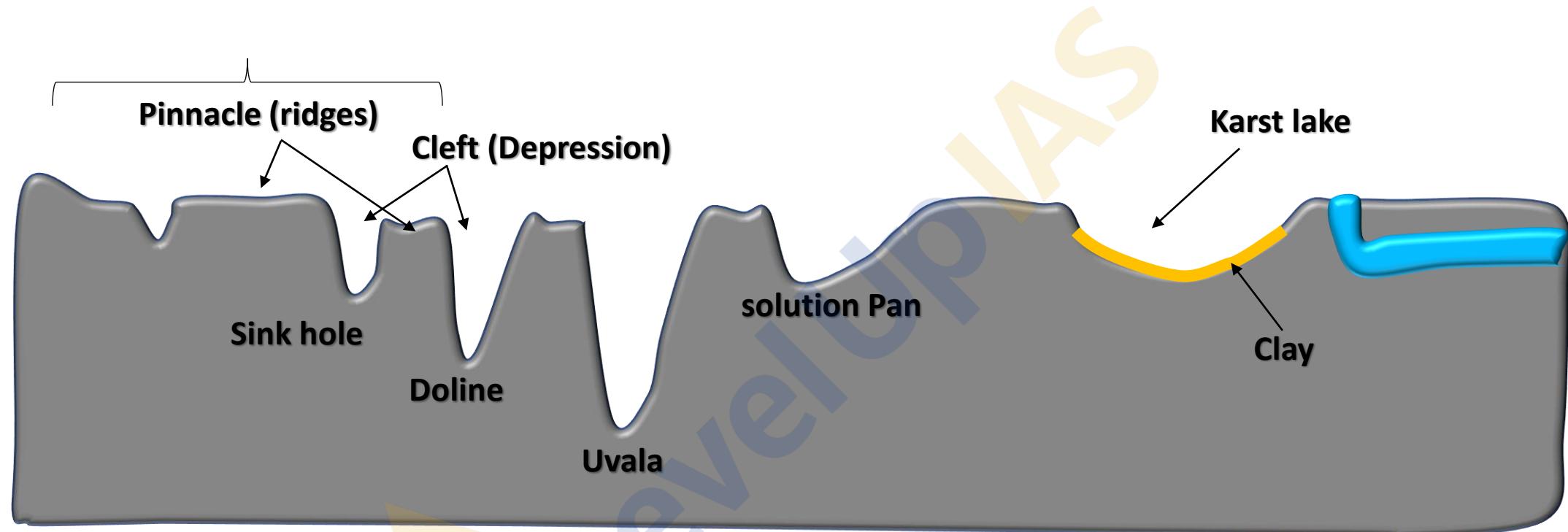


Figure 7.8 : Various karst features



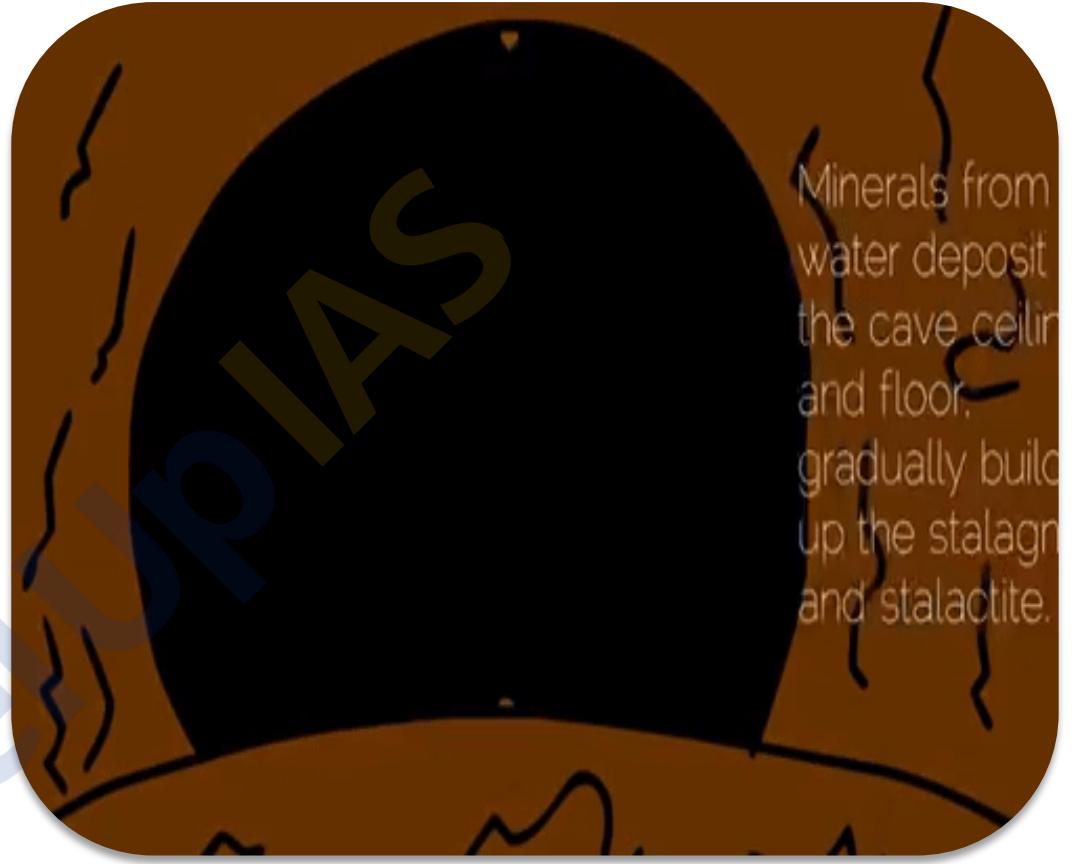
Limestone Pavement



Different Types of Karst Landforms

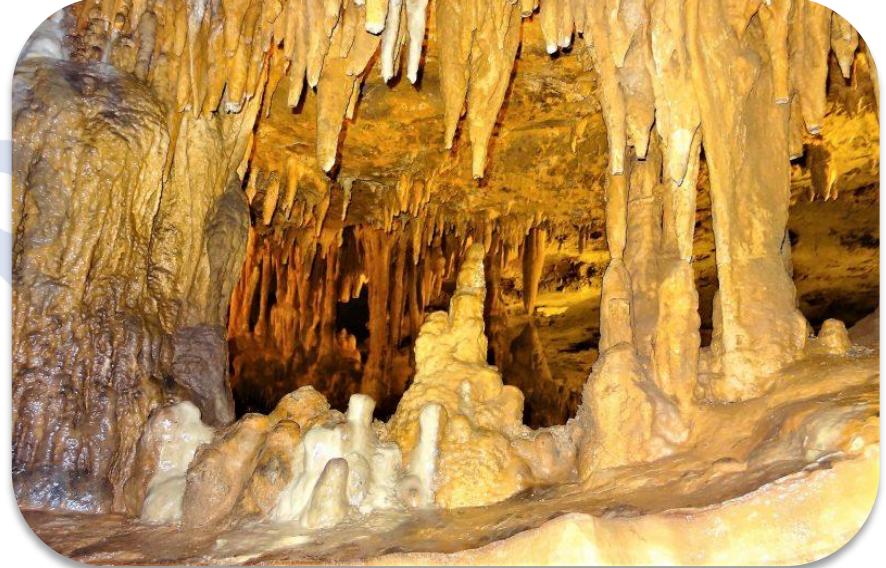
Depositional Landform

1. Stalactites hang as icicles of different diameters. Normally they are broad at their bases and taper towards the free ends showing up in a variety of forms.
2. Stalagmites rise up from the floor of the caves. In fact, stalagmites form due to dripping water from the surface or through the thin pipe, of the stalactite, immediately below it
3. Stalagmites may take the shape of a column, a disc, with either a smooth, rounded bulging end or a miniature crater like depression.
4. The stalagmite and stalactites eventually fuse to give rise to columns and pillars of different diameters.





Cave Curtains



Karst cave