

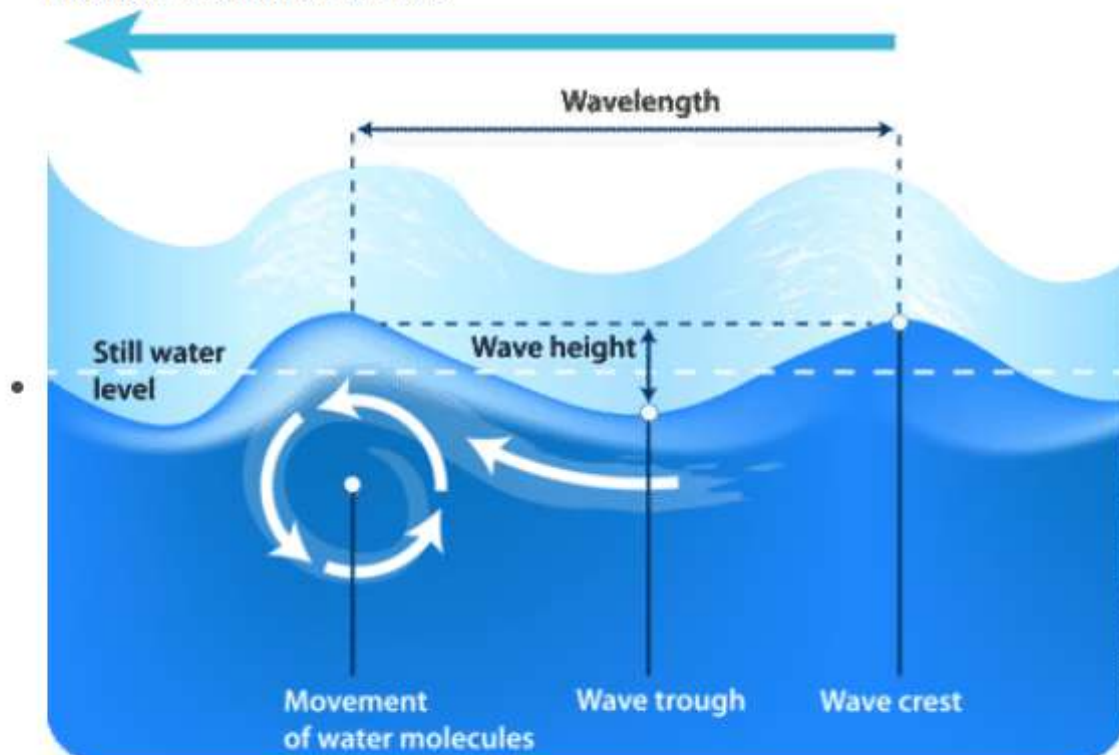
## Geography Class 18

### REVISION OF THE PREVIOUS CLASS (9:10 AM):

- **Mass movement** involves the movement of weathered material along downhill slopes under the influence of gravity, with or without the assistance of water.
- **Slow Mass Movements**- Creep/Soil creep, Solifluction, etc.
- **Rapid Mass Movements**- Landslide, Earthflow, Mudflow, Rockslide/Rockfall, etc.
- Western Ghats are relatively tectonically stable because their formation process stopped long back.
- The region sees considerable mass movements like landslides, but less than the Himalayas.
- **Landforms** are the results of exogenetic events that happen on the earth's surface, which happen due to either erosion or deposition.
- A river passes through three stages- Youth, Mature & Old.
- The river is at its highest erosive capacity in its youthful stage.
- Waterfalls often form in the upper stages of a river where it flows over different bands of hard and soft rocks.
- Cascades are a series of small, continuous waterfalls.
- **River capture** is a process of headward erosion, especially in the youthful stage.
- Due to this, a faster-eroding river can completely take over a parallel-flowing river.
- Depositional features of rivers are meanders, oxbow lakes, alluvial fans, deltas, estuaries, floodplains, and natural Levees. etc.
- **Karst landform** is seen as a result of groundwater action in regions rich in limestone and dolomite.
- Erosional karst landforms- sink-hole, doline, Uvala, polje, blind valley, etc.
- Depositional karst landforms- Stalactites, Stalagmites, calcite pillars, etc.

### Marine Topography:

- They are formed due to the action of **sea waves**.
- Sea waves are created by energy passing through water, which causes the circular motion of water.

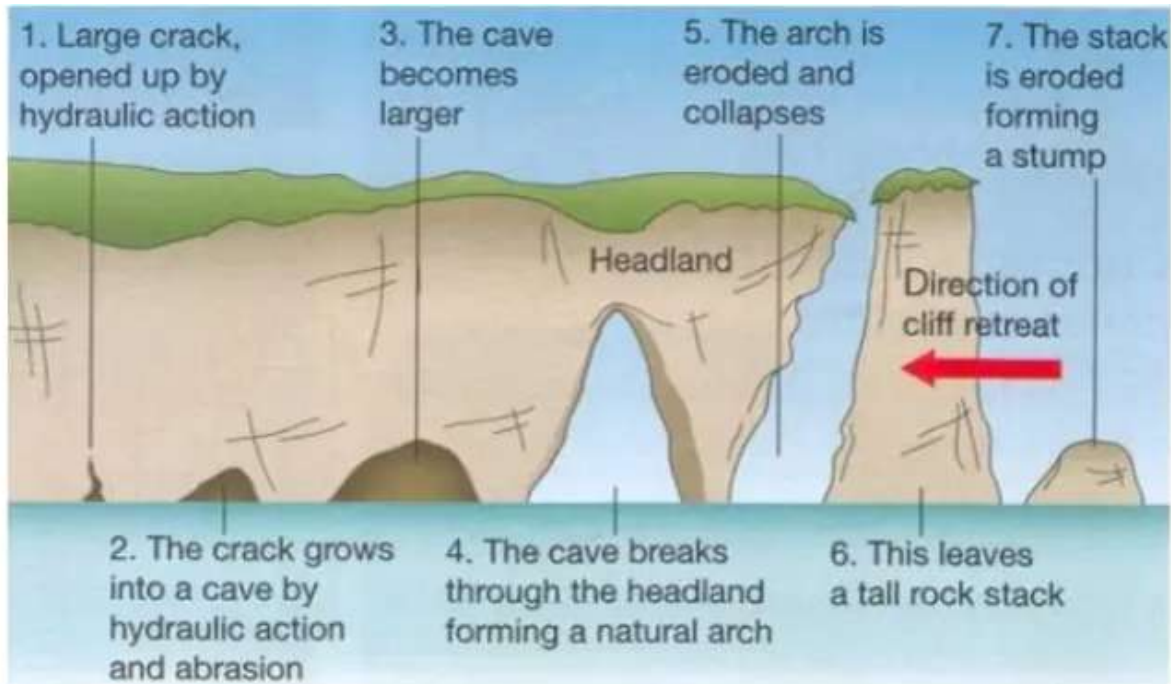


- However, water does not actually travel in waves and only energy is transmitted.
- Marine landforms can be both erosional and depositional in nature.

## LANDFORMS DUE TO MARINE ACTION (9:30 AM):

Topography	Agent	Processes/Conditions	Erosional Features	Depositional Features
Marine topography	Sea water	<ul style="list-style-type: none"> <li>◦ Corrasion</li> <li>◦ Attrition,</li> <li>◦ Corrosion,</li> <li>◦ Cavitation,</li> <li>◦ Hydraulic action.</li> <li>◦ <b>We do not see:</b></li> <li>◦ Deflation</li> <li>◦ Plucking.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Cliff</li> <li>◦ Wave Cut platform</li> <li>◦ Bay</li> <li>◦ Gulf</li> <li>◦ Hanging valley</li> <li>◦ Sea caves</li> <li>◦ Sea arch.</li> <li>◦ Sea Stack</li> <li>◦ Sea Stump.</li> <li>◦ Blowholes</li> </ul>	<ul style="list-style-type: none"> <li>◦ Wave built platform</li> <li>◦ Beaches</li> <li>◦ Offshore sand bar(not connected with the land).</li> <li>◦ Sand Spit(connected with the land from one side)</li> <li>◦ Tombolo( sand spit connected with land from both sides.</li> <li>◦ Lagoons/Backwaters</li> </ul>

- The hydraulic action develops a crack that eventually widens through both hydraulic action and abrasion to form caves.
- On the expansion of these caves, it breaks the wall behind and transforms itself into a **sea arch**.
- Over time, the sea bridge collapses and leaves behind a single-standing rock structure called sea stacks.
- This collapses due to the ability of erosion that disturbs the stability of holding the sea bridge.
- The stack when denuded due to erosional activity and weathering, becomes a **sea stump**.



- The wave action compresses the air along the vertical weaker joints inside the sea caves.
- The movement of air through these cracks shall result in a whistling sound in the coastal region.
- This movement creates more chances of enlarging the cracks.
- The strong action of waves can at times lead to water sprouting at the top and we will get **blowholes**







### Bay or Gulf:

- The narrow deep intrusions mainly result in headward erosion by the waves in the zone (soft rock materials). Further continuation into the larger openings is called a bay or gulf.

### Differences between the Bay and Gulf:

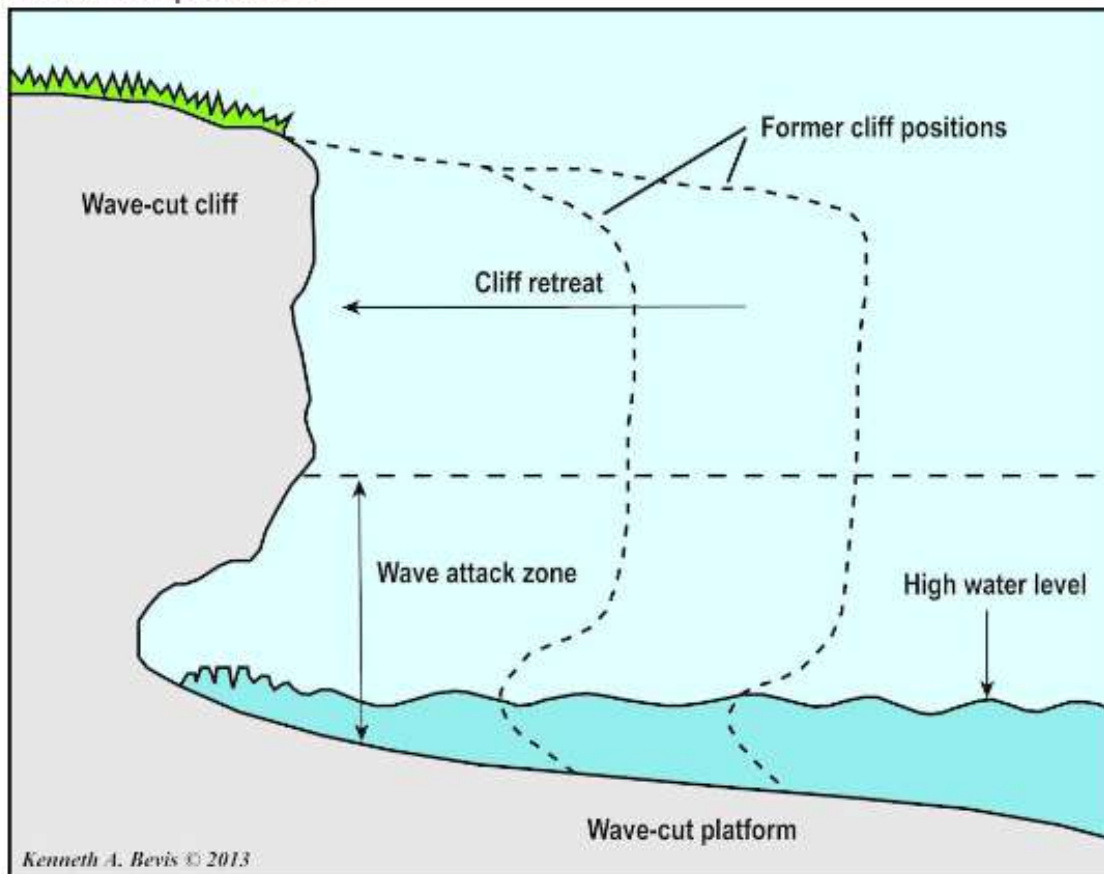
Bays	Gulfs
They are open bodies.	They are enclosed bodies.
They have a wider mouth.	They have narrower mouths.
They are generally larger.	They are generally smaller.
<b>For example- the Bay of Bengal</b>	<b>For example- the Gulf of Khambhat</b>
 A map of the Bay of Bengal, showing its location between India, Bangladesh, Myanmar, Thailand, and Indonesia. The Bay is labeled 'Bay of Bengal' and is connected to the Indian Ocean. Major cities like Calcutta, Dhaka, Rangoon, Bangkok, Madras, Colombo, Medan, Kuala Lumpur, and Singapore are marked. A scale bar indicates 0, 250, 500, and 1,000 Kilometres. A north arrow is also present.	 A map of the Gulf of Mexico, showing its location between the United States, Mexico, and Central America. The Gulf is labeled 'Gulf of Mexico' and is connected to the Atlantic Ocean and the Caribbean Sea. Major cities like Houston, Galveston, New Orleans, Miami, and Cancun are marked. A scale bar indicates 200 miles and 200 kilometers. A north arrow is also present.

### Sea Cliffs:

- They are formed after waves attack the shore, and headlands are eroded.

### Wave cut platforms:

- These are the platforms formed due to the action of sea waves.
- Hydraulic action and corrosion result in eroding the bottom of the cliff consistently.
- It starts from a notch and results in the eventual breaking of the sea cliff to form a wave-cut platform.



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## Depositional landform :

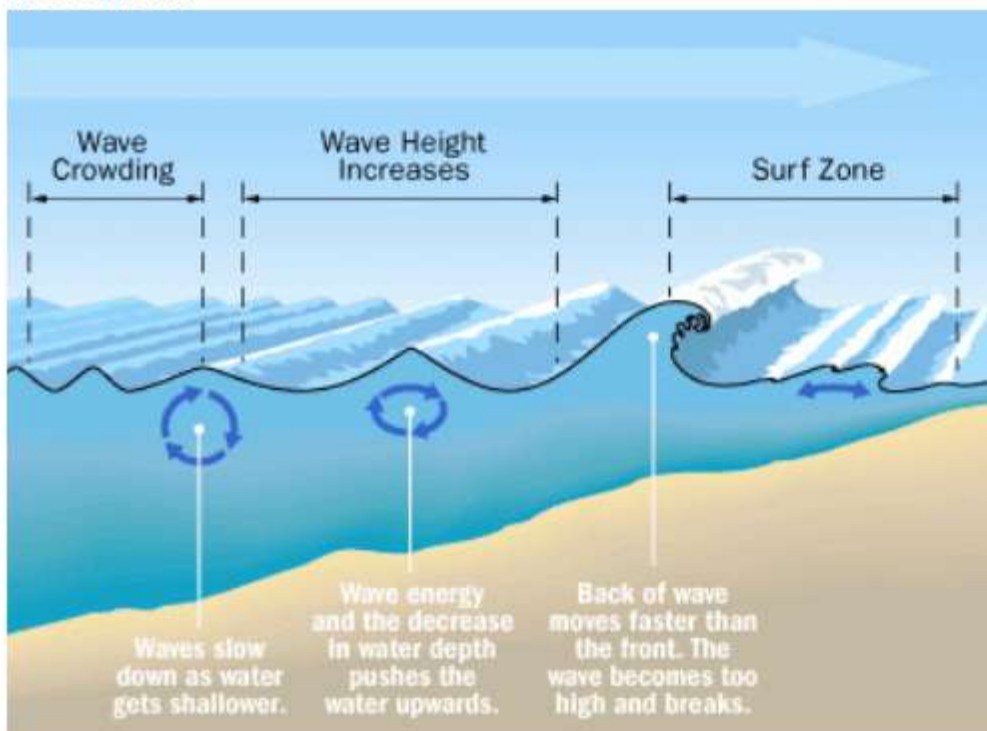
### Beach:

- The beach is a landform formed adjacent to the land by the depositional action of the seawater.
- If the debris is fine loose sediments it results in forming **sandy beaches**.
- **Marina Beach** of Chennai is the longest beach in Asia.



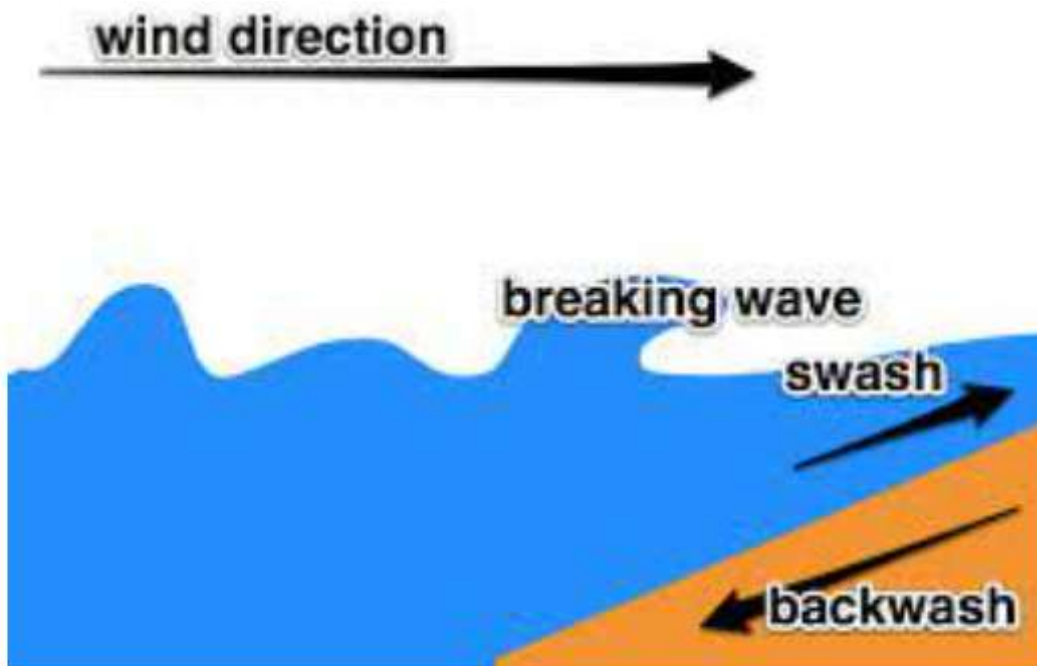
### Wave formation and propagation:

- While in the mid-sea, the wave's motion happens circularly without any disturbance.
- When the wave approaches the beach, the downward portion of the wave motion gets restricted due to land.
- The waves hence break from below, and the upper limb sees a net forward movement.



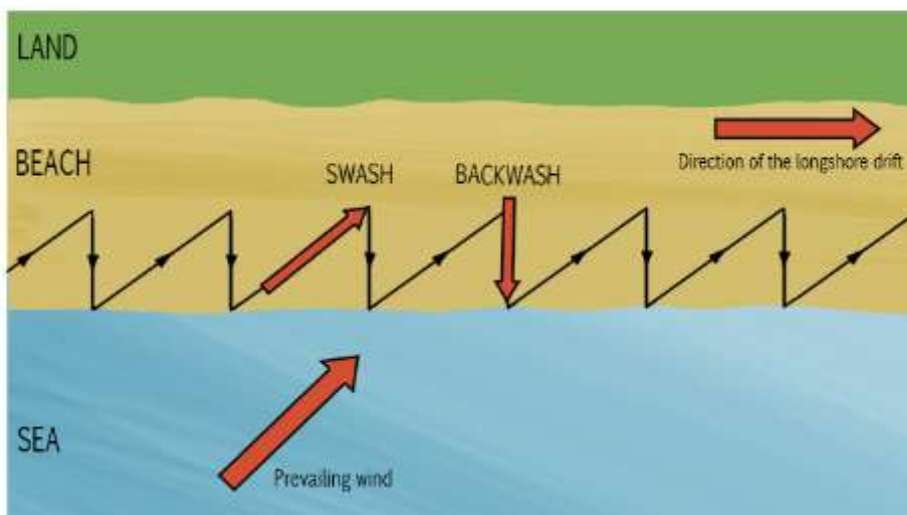
- The region of breaking waves is called the **surf zone or breaker zone**.
- After breaking into the surf zone, the waves (now reduced in height) continue to move in.
- They run up onto the sloping front of the beach, forming an uprush of water called **swash**.
- The water then runs back again as **backwash**.





### Longshore drift:

- Whenever the wind blows parallel to the coast, we see the long-shore drift.
- It hits the coast farther from where it was supposed to hit.



- Only in the regions of longshore drift, we can see spits(perpendicular to the coast), bars(parallel to the coast), and tombolo

### Bar:

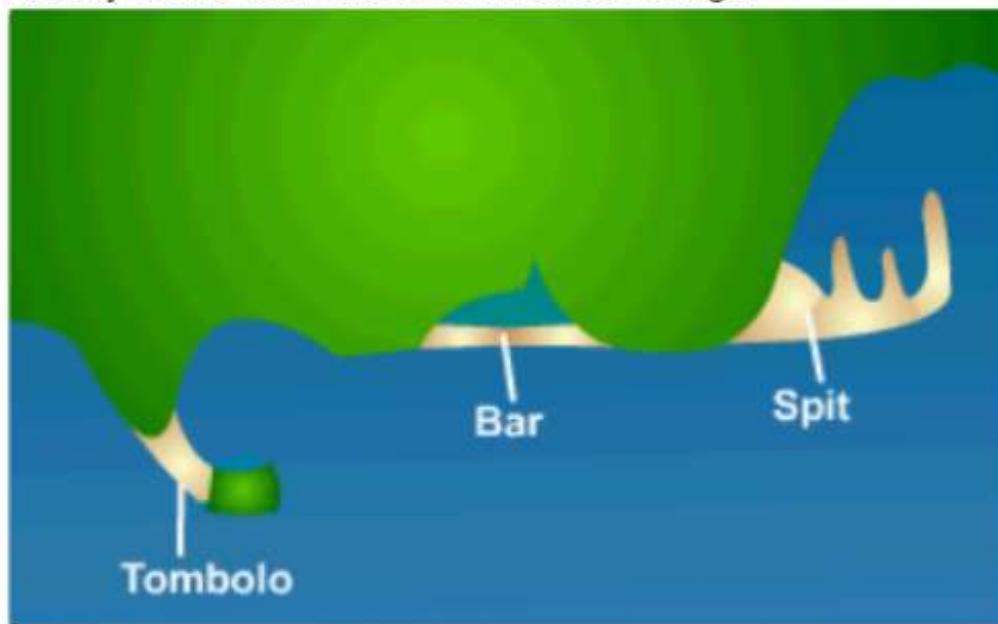
- The deposition of sand and rock debris along the coast.
- When this bar develops away from the shore, parallel to the coast it is called a **barrier bar**.
- The **Shriharikota** satellite launch station is situated on a sand bar near **Pulicat Lake**.
- When one side of the bar is connected to the coastal land, it is called **spit**.
- While if the other end develops a hook-shaped curvature towards the land, it is called a **hook**.
- When the sand deposition or the sand bar develops like a sand isthmus connecting the mainland and the island, it is called a **tombolo**.

### Examples in India:

- Lake Vembanad( lagoon) and Lake Astaimudi( lagoon) near Kollam.
- The bars that happen to enclose small water bodies on the mainland sides result in the formation of **backwaters or lagoons**.
- In Kerala, it is called "**Kayals**".

### Tombolo:

- Sediments are deposited by a longshore drift between the mainland and the nearby island in the form of a natural bridge.



### ARID/DESERT TOPOGRAPHY(9:55 AM):

- Arid landforms are formed where evaporation is more than precipitation.
- But even grasslands have more evaporation than precipitation.
- But grasslands have good water retention due to vegetation cover, which is very sparse in nature.
- Annual precipitation must be less than 25 cm.
- Deserts can be both hot and cold.

#### Arid landforms

Topography	Agent	Processes/Conditions	Erosional Features	Depositional Features
Arid topography/ Aeolian landforms	Wind	<ul style="list-style-type: none"><li>◦ Abrasion</li><li>◦ Attrition,</li><li>◦ Deflation.</li><li>◦ Frost shattering.</li><li>◦ Salt weathering.</li><li>◦ Exfoliation.</li><li>◦ <b>We will not see:</b></li><li>◦ Corrosion.</li><li>◦ Hydraulic action.</li><li>◦ Cavitation</li></ul>	<ul style="list-style-type: none"><li>◦ Deflation hollows</li><li>◦ Ventifacts</li><li>◦ Mushroom rocks.</li><li>◦ Zeugen</li><li>◦ Yardang</li><li>◦ Inselberg</li></ul>	<ul style="list-style-type: none"><li>◦ Sand dunes(Barchan, Seiff)</li><li>◦ Sand bars (transverse &amp; longitudinal)</li><li>◦ Bolson/Playa Lake</li></ul>

### **Mechanisms of erosion:**

#### **Deflation:**

- In this case, the sand particles are lifted and transported from one place to another.
- This results in the formation of depressions called **deflation hollows**.

#### **Abrasion (Sandblasting):**

- When the sand particles carried by the winds hit any rock surface and erode them, this process is known as sandblasting or abrasion.

#### **Attrition:**

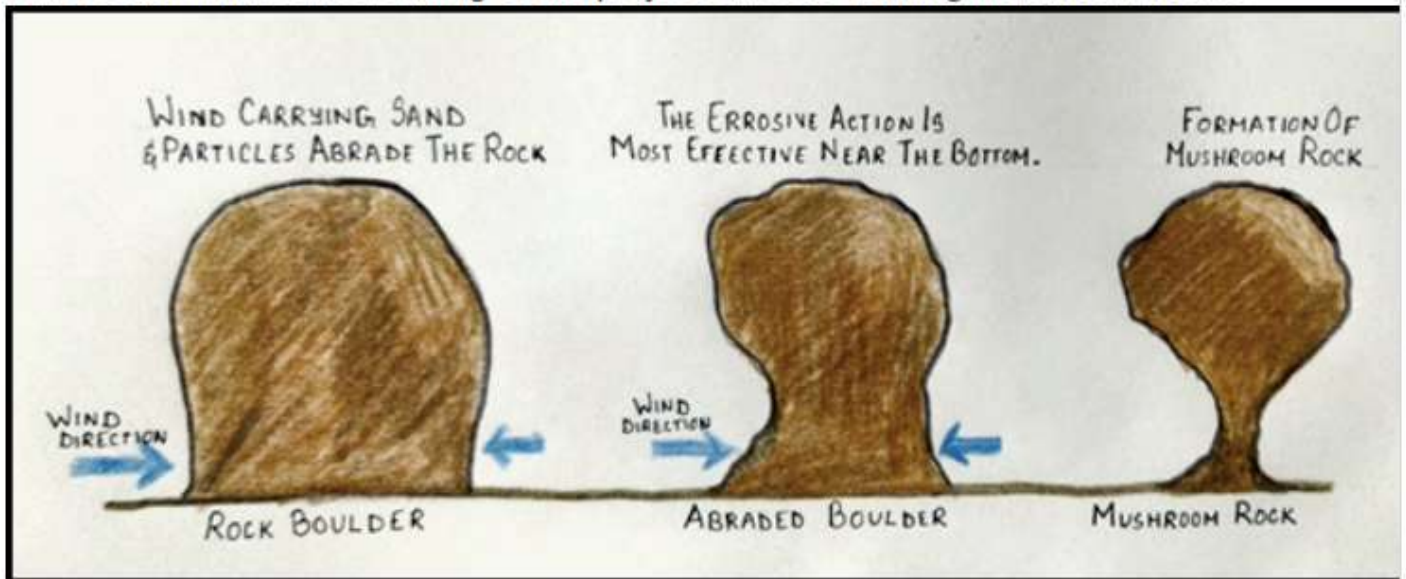
- When the rock particles hit each other, they break into smaller fragments.
- **Oasis** is the fertile region around a Bolson/Playa lake, and not the lake itself.
- Walls can be built around the oasis so as to prevent the filling up of the oasis by the next cycles of scooping.



## EROSIONAL AEOLIAN LANDFORMS (10:30 AM):

### Mushroom rocks:

- The process of sandblasting on the projected rocks shall result in the formation of mushroom rocks.
- Since the composition of the rocks is both hard and soft rocks, soft rocks get weathered due to the action of sandblasting.
- Sandblasting is more prominent at the base as winds cannot pick up the sands to heights.
- This results in the undercutting of the projected rocks forming mushroom rocks.



## Mesa and Butte:

- A tableland with alternating hard and soft rocks when subjected to both the agents of erosion- wind and water, it forms mesa and butte topography.
- The relief that is bigger in size is called a **mesa**.
- While on continued denudation, it can result in a reduction in the height and width of the mesa to form a flat-topped hill called a **butte**.
- Mesa on continued denudation by water can result in the formation of ravines.



**Driekanter/ Ventifacts:**

- They are the polished pebbles of the rock fragments formed due to the sandblasting activities.
- Their smoothened sides indicate the direction of winds.





**Desert pavement:**

- When Driekanter and Ventifacts are arranged naturally in a mosaic fashion, they result in the formation of desert pavement.



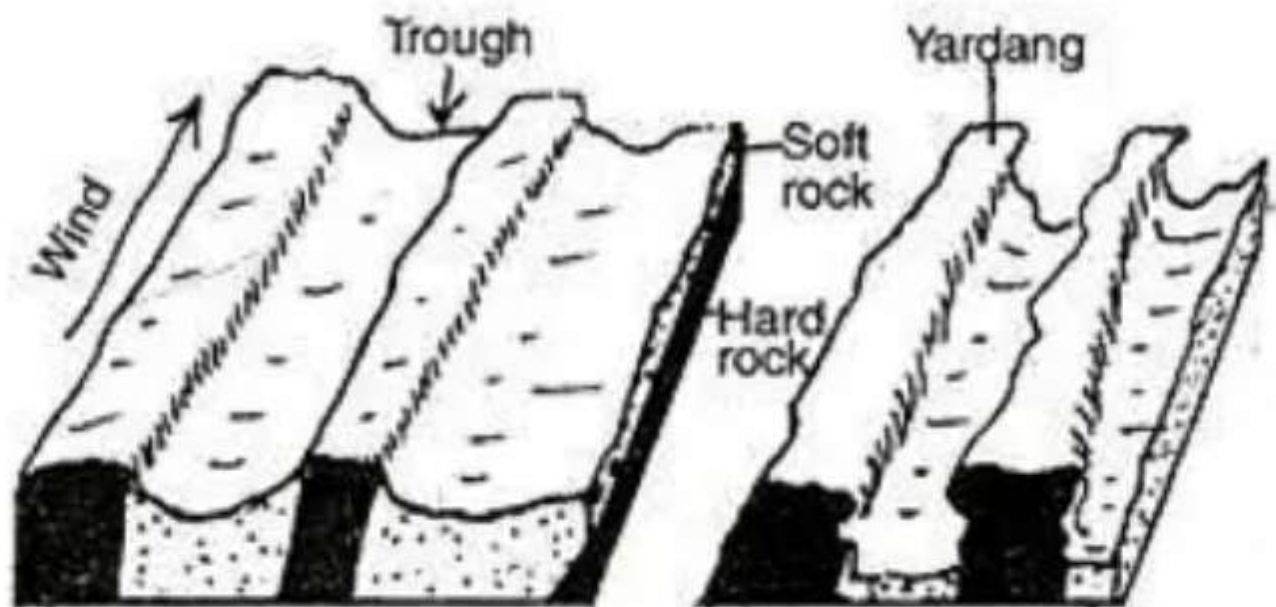


### **Yardangs:**

- Yardangs are vertical bands of hard and soft rocks where due to the action of the wind, the soft rocks are eroded (abrasion) leaving behind long and narrow corridors and ridges.
- These ridges are called Yardangs.

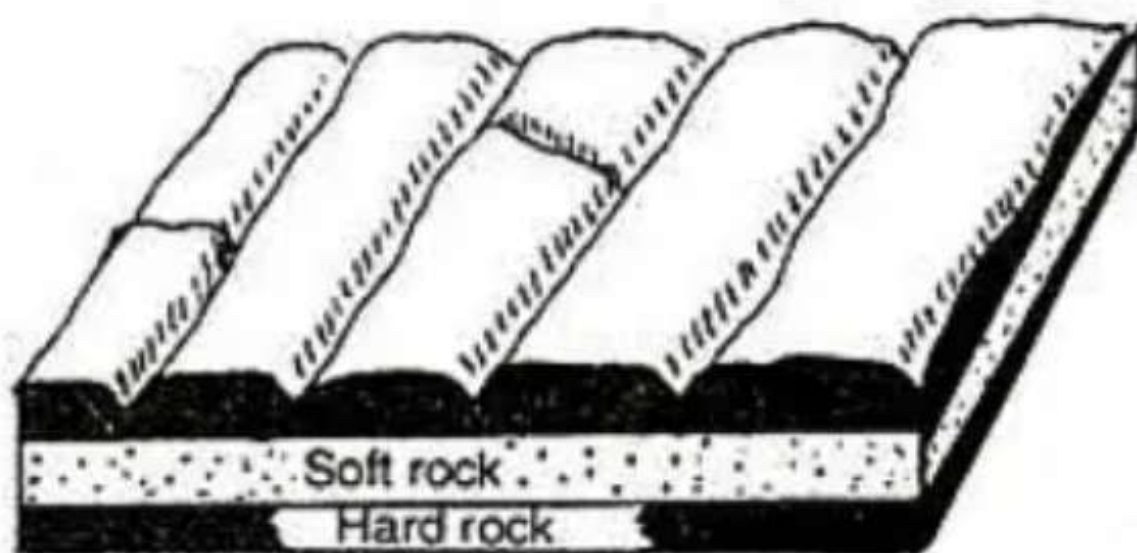
### **Zeugens:**

- They are seen when the bands of hard and soft rocks are arranged into a tabular mass.
- In this case, the differential erosion of hard and soft rocks by the winds shall eventually reduce the size by making significant furrows along the joints and forming Zeugen.



Belts of softer rocks are abraded into troughs.

Hard rocks are undercut and narrow ridges rise as yardangs.



**Fig. 1.79** Weathering, dew and temperature open up joints.

## **Depositional aeolian landforms:**

### **Sand dunes:**

- They are mounds of sand accumulated and deposited in different sizes and shapes.

### **Types of sand dunes:**

#### **Barchans:**

- The crescent moon-shaped formations with the windward side having a convex shape and the leeward side with a concave shape.
- Such deposition with extended arms on the concave side or leeward side are called barchans.

#### **Seifs:**

- When the speed of the wind and the number of sediments carried vary, it results in the uneven length of the arms on the leeward side forming Seifs.

#### **Parabolic dunes:**

- These are similar to barchans, but the scattered obstructions such as natural vegetation can result in developing a concave shape on the windward side and a convex shape on the leeward side.

#### **Longitudinal dunes:**

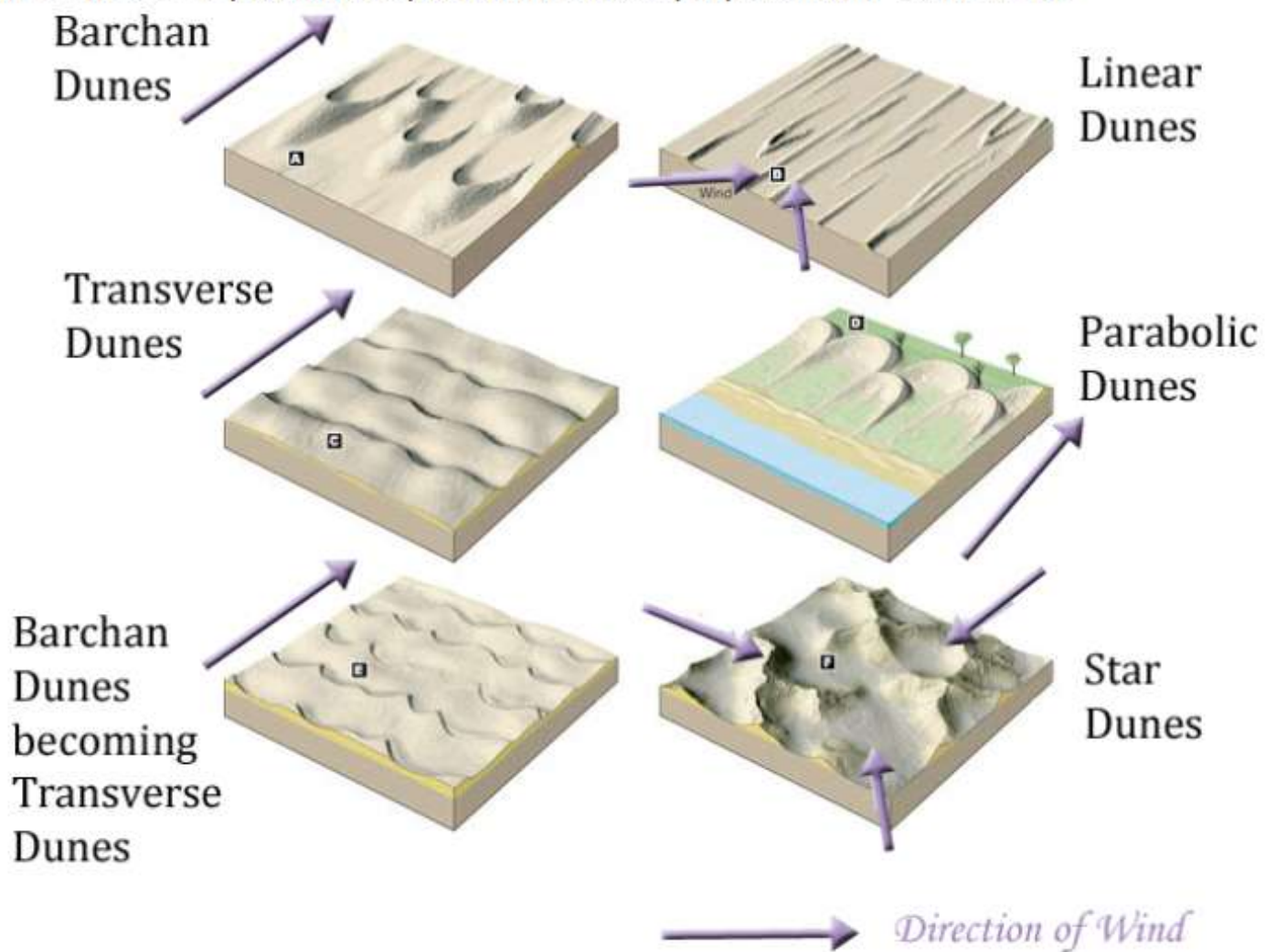
- These are the dunes formed parallel to the directions of winds due to the extremity in the speed of the winds.
- The collected sand is deposited laterally forming longitudinal dunes.

**Star dunes:**

- The presence of central projection or high peaks causes star dunes.

**Transverse dunes:**

- When the sand particles deposit themselves perpendicular to the wind.



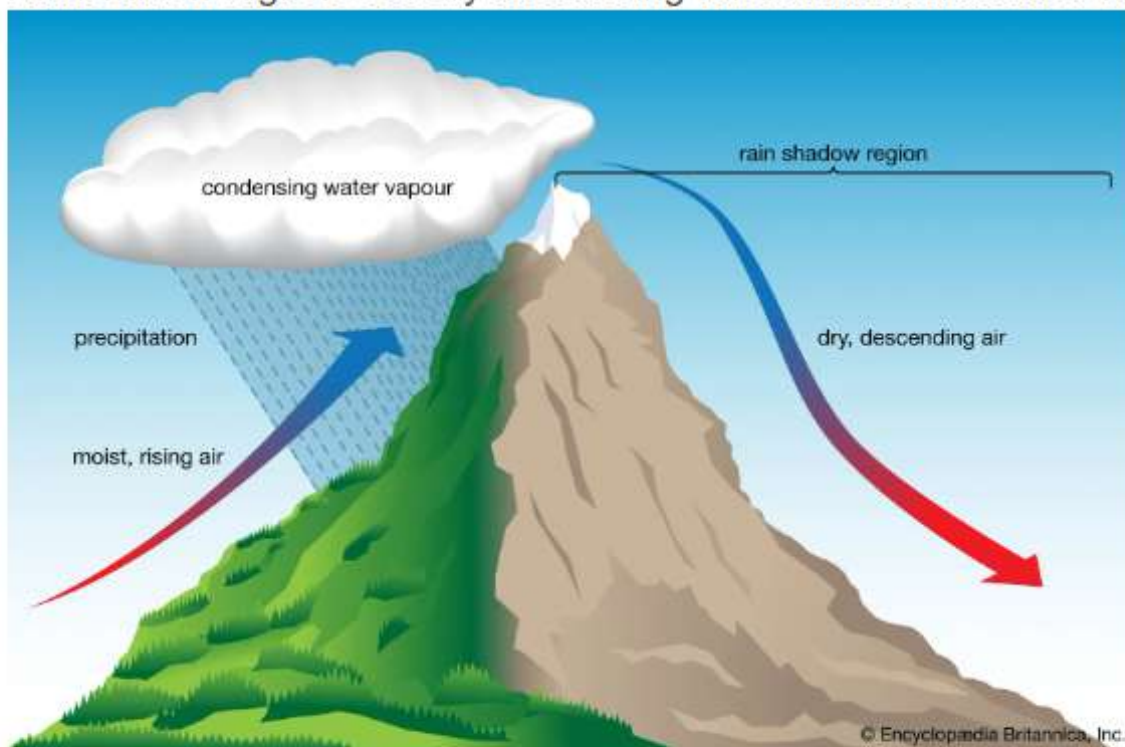


### Playa lakes:

- When seasonal streams with dissolved salts flow into the basin area( Bolson).
- These get accumulated in small areas to avoid depression.
- They are called playa lakes or Salina.
- When the water in the playa gets evaporated, it results in **blowouts**.

### Indian desert landforms:

- The **Marusthali desert** of the Thar region lies in the **rainshadow region** of the **Aravallis**.
- Rainshadow regions see dry descending winds that do not cause rainfall.



- Similar rainshadow regions of the **Karakoram and Ladakh ranges** and desert-like sand dunes can be found in the **Hunder** region of **Nubra Valley**.



- Double-humped camels are found in the region.

## Types of deserts:

### Hamada:

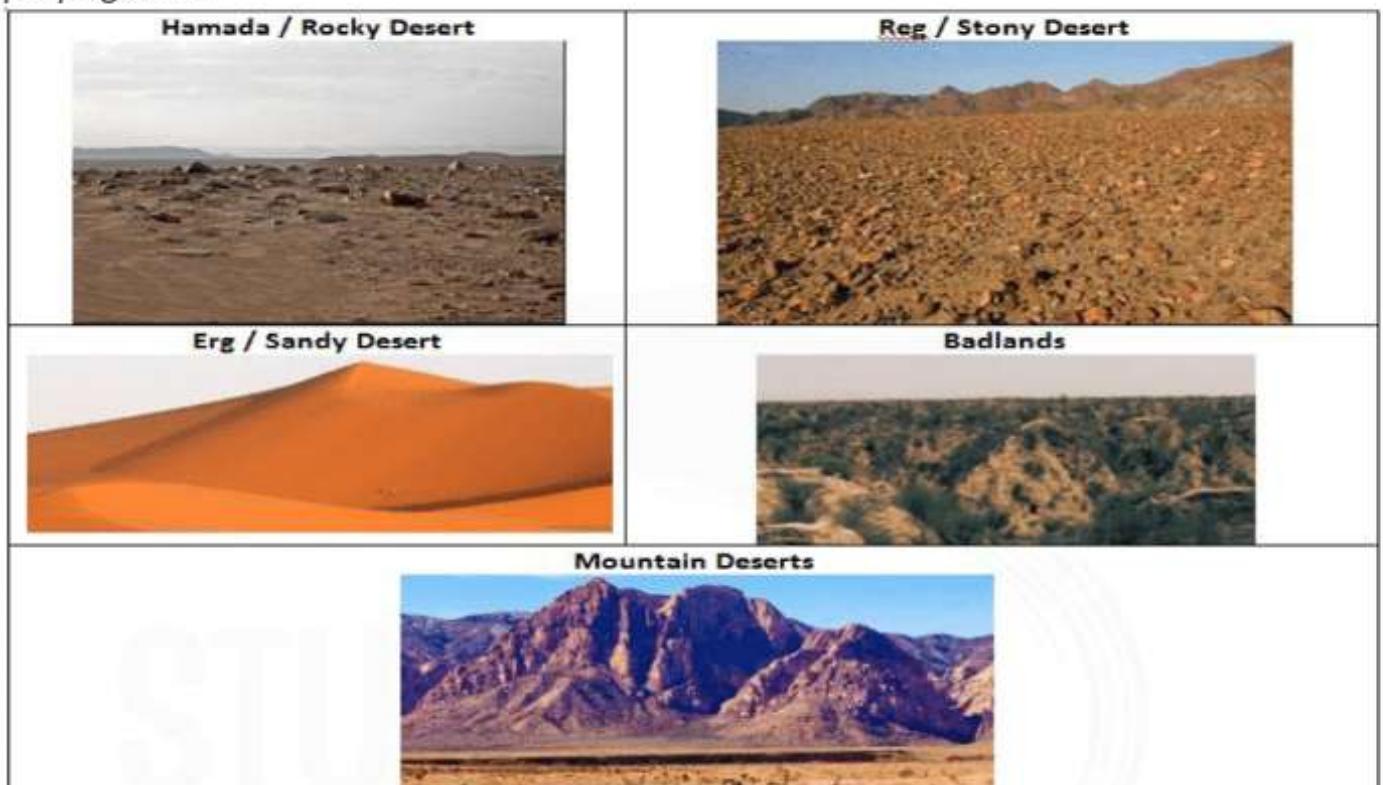
- These are rocky deserts primarily composed of bare rocks.
- These rocks are polished due to the action of abrasion.
- The sand and dust are swept off by the prevailing wind.

### Reg:

- These are the stony deserts majorly composed of gravels, pebbles, and angular stones which are too heavy to be carried away by the winds.

### Erg:

- These deserts are dominated by vast stretches of shifting sand.
- Wind plays a major role in picking up and depositing the sand in the direction of propagation.



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## GLACIAL TOPOGRAPHY:(10:55 AM):

### Glaciers:

- They are the huge mass of ice that moves slowly on the land.
- These move at the rate of a few centimeters per year.
- Glaciers are formed due to the accumulation and compaction of the snow.

### Glacial landforms

Topography	Agent	Processes/Conditions	Erosional Features	Depositional Features
Glacial landforms	Glacier	<ul style="list-style-type: none"><li>◦ Abrasion</li><li>◦ Plucking</li></ul>	<ul style="list-style-type: none"><li>◦ Cirque</li><li>◦ Arete</li><li>◦ Horn (Cirque on all sides)</li><li>◦ Col.</li><li>◦ U-shaped valley.</li><li>◦ Hanging Valley</li><li>◦ Fjords</li></ul>	<ul style="list-style-type: none"><li>◦ Glacial till.</li><li>◦ Moraines.</li><li>◦ Drumlins.</li><li>◦ Eskers</li></ul>



## **Mechanisms of erosion:**

### **Plucking:**

- When the meltwater of the glacier freezes in the gaps of the surface soil or rocks, they loosen up and becomes easier for the glacier to tear them.

### **Abrasion:**

- The glacial debris scratches the valley floor and the side walls

## **Erosional landforms:**

### **Cirques:**

- These are also called **corrie**.
- The downward movement of the alpine glaciers from the peaks shall result in plucking and abrasion along the mountain walls.
- Further movement of the glacier over the same surface shall deepen the landform into a trough-shaped landform called cirque or corrie.

### **Arete:**

- These are the structures resulting from the formation of the cirque.
- The elevated and long ridge down the mountain between two consecutive cirques is known as arête.
- When the glacial erosion is very intense, it shall even break the arête in between, forming a pass-like structure called **Kol**.

### **Cirque lake:**

- As the glacier moves down the cirque region, water gets accumulated in the depressions on the floor of the cirque forming lakes called tarn lakes/cirque lakes.

### **Paternoster lake:**

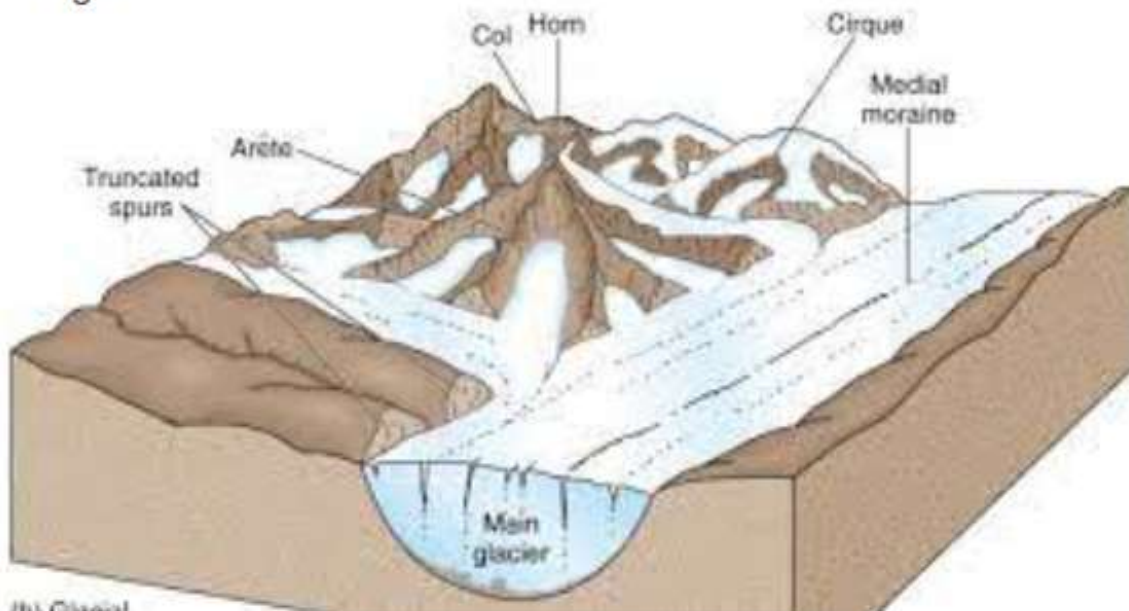
- When the series of lakes are formed in a linear fashion that resembles an arrangement of pearls.
- These lakes are called paternoster lakes.

### **Pyramidal peak/horn:**

- When the mountain walls are eroded by the glaciers from all sides and form a cirque basin and arête.
- At the top of the mountain, these arêtes seem to join to form a pointed peak called a horn.

### **Glacial trough and hanging valleys:**

- As the glaciers move downward, they have the movement of accumulation of glaciers from all the cirques into the valley region which looks like a tributary valley that feeds the main valley.
- The glacier in the main valley has more mass, thus resulting in a more effective erosion than the tributary valleys.
- It seems like the glacier and the melted water falls into the main valley like a waterfall.
- These tributary valleys are called hanging valleys while the main valley with a greater mass of glacier engages in active abrasion to form a U-shaped glacial trough.

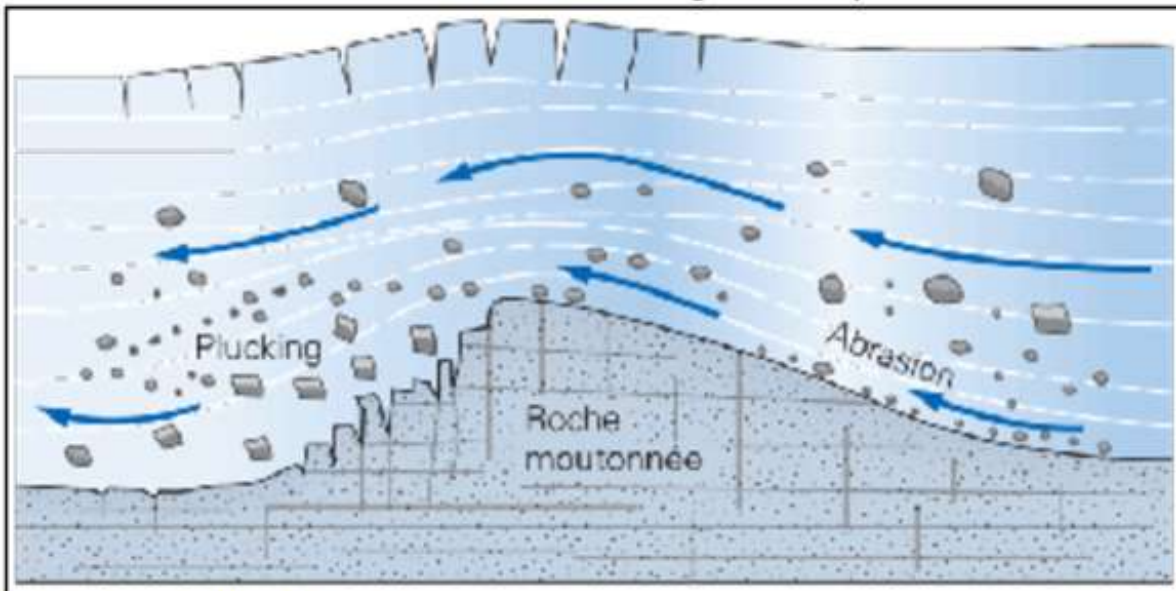


### Truncated spurs:

- As these glaciers move, the point of the confluence between the hanging valley and the U-shaped valley leads to the breaking of the U-shaped valley and polishing it. It causes truncated spurs.

### Roche Moutonnee:

- When the resisted rock is subjected to glacial movement, it shall result in the formation of a steep rough-sided slope on one side.
- While on the other side, it will result in a gentle slope.



### Glacial depositional landforms:

#### Glacial till:

- These are the unsorted varying proportions of rocks boulders and clay.

#### Moraines:

- The fragments of rocks are majorly due to plucking or freeze and thaw action.
- These moraines with the movement of the glaciers get deposited.
- Based on where they are deposited, they are further classified into lateral moraine, medial moraine, and terminal moraine.



### Lateral moraine:

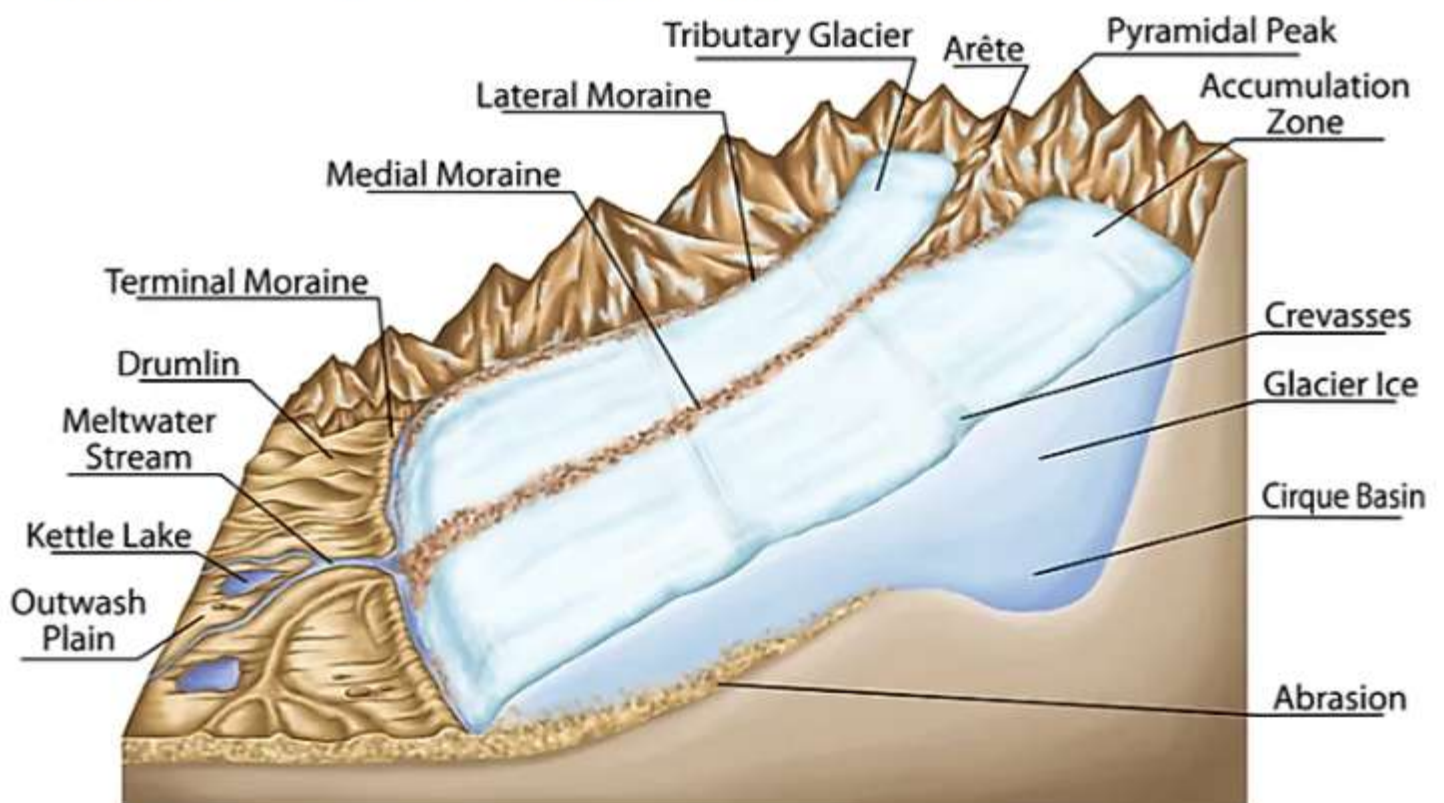
- When the moraines are deposited on the sides of the glacier, they form lateral moraines.

### Medial moraines:

- When two large glaciers converge, the inner sides (lateral moraines) join together to become medial moraines.

### Terminal moraine:

- At the ablation zone where the glacier melts near the foot of the mountains, a pile of moraine gets deposited as terminal moraines.





**Drumlins:**

- These are loosely compacted inverted boat-shaped fluvioglacial deposits.
- They stretch about 1-2 km in length but have very minimal height.
- These are formed in multiple numbers and resemble to be like a basket of eggs.
- Thus called “Egg-Basket” topography.

**Eskers:**

- These are the fluvial glacial deposits carried by the streams of water from the ablation zone.
- These are long sinuous ridges of the fluvial glacial deposits that run for several kilometers.

**Kames:**

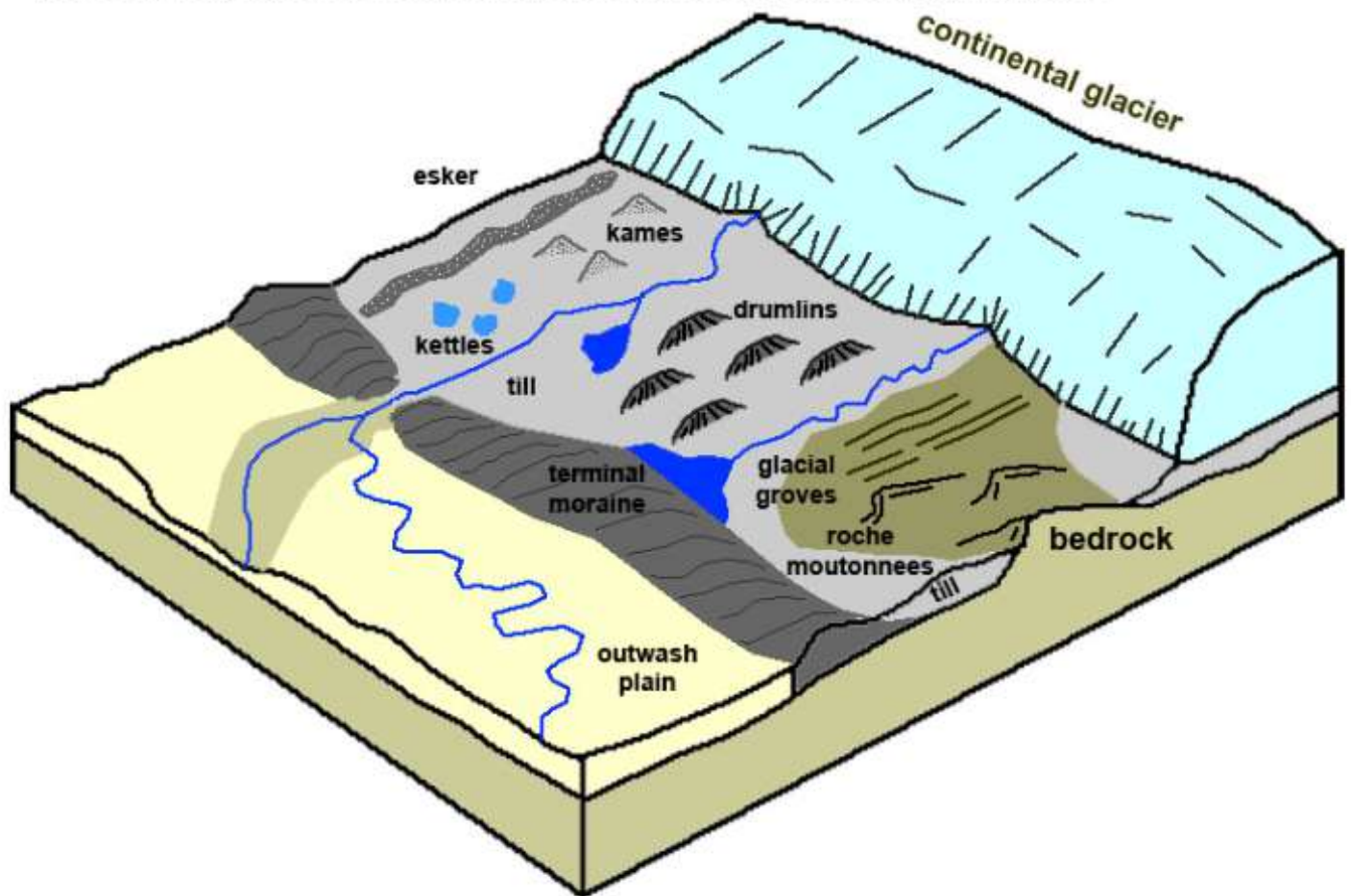
- These are small mounds of fluvial glacial deposits in the outwash plains region.

**Outwash Plains:**

- As the glacier moves to the lowest point, it starts to melt and abandon or leave behind the sediments which include rock debris, clay, sand, and gravel.
- This layered surface is called outwash plains or till plains.

### Kettle lakes:

- These are the lakes formed due to the deposition of water in the depressions of the outwash plains.
- These plains are the depositions beyond the terminal moraines which are carried and deposited by the melt waters.
- These fine grains of sediment make it more suitable for agriculture.



### CLIMATOLOGY (11:36 AM):

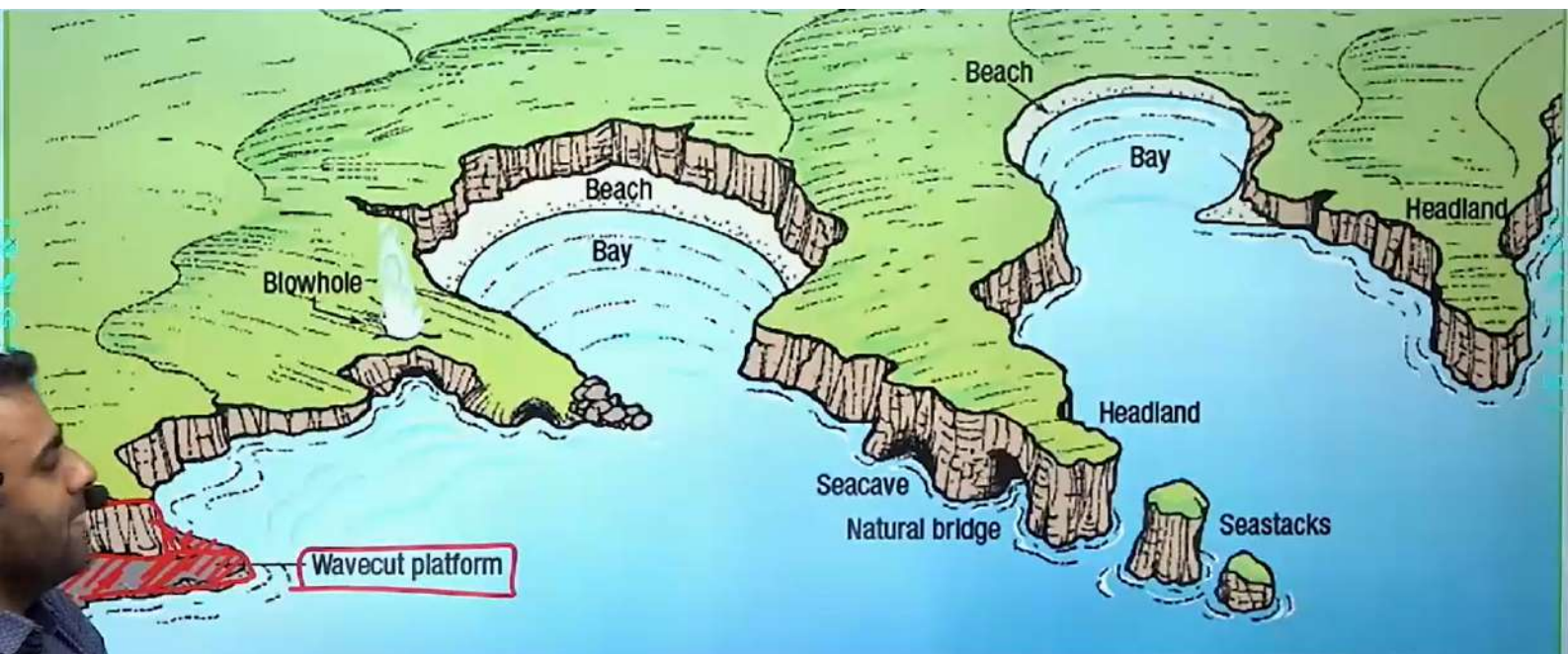
- **Weather** describes the day-to-day atmospheric conditions.
- **Climate** describes the atmospheric conditions of a place calculated over a period of 30 years.
- The atmosphere is the envelope of gases enveloping the earth's surface and is held to it by gravity.

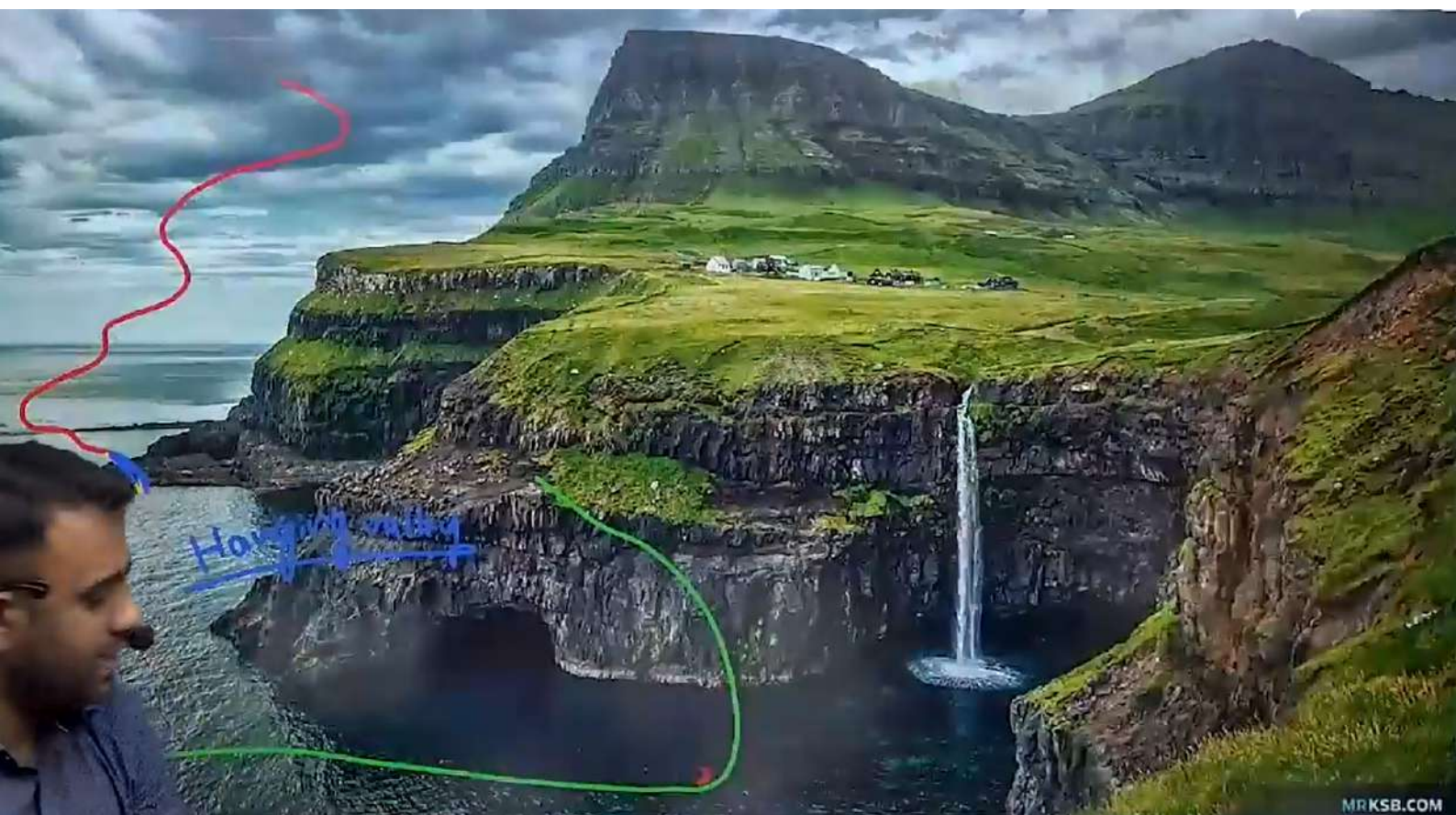
Gas	Percentage by volume
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon Dioxide	0.04
Neon	0.002
Helium	0.005
Methane	0.0001
Krypton	in traces
Xenon	in traces
Hydrogen	in traces
Radon	in traces

- **Nitrogen** is the largest constituent of the atmosphere.
- It is not very reactive.
- We are not biologically evolved to directly utilize nitrogen.
- Nitrogen is required for protein synthesis.
- **Oxygen** is much more prevalent in the earth's crust than in the atmosphere.
- **Carbon Dioxide** is a greenhouse gas that absorbs heat.
- Every living being releases carbon dioxide during respiration.
- Some plants release more carbon dioxide like the **Tamarind tree**.
- Hydrogen is very less in the gaseous form.
- Most of the hydrogen is present in the form of **Water Vapor**.
- All weather phenomena happen only due to the evaporation and condensation of water.
- **Dust particles** are very small components present in the atmosphere.
- They are **hygroscopic nuclei** - water droplets will remain suspended around them.
- Even **Silver iodide** can be a hygroscopic nucleus, hence they are used for artificial rains.
- Both water and dust particles are essential for cloud formation.
- 99% of all water and dust particles are present up to 18 km height of the atmosphere (**Troposphere**).

**The topics for the next class are the continuation of atmosphere, insolation, heat budget, albedo, etc.**









Encyclopedia Britannica  
Sea arch - natural bridge | Britannica



Popular Science  
the life cycle of a sea arch



All Things Nature  
What is a Sea Arch? (with pictures)



AccuWeather  
Darwin's Arch Collapses Into Pacific...

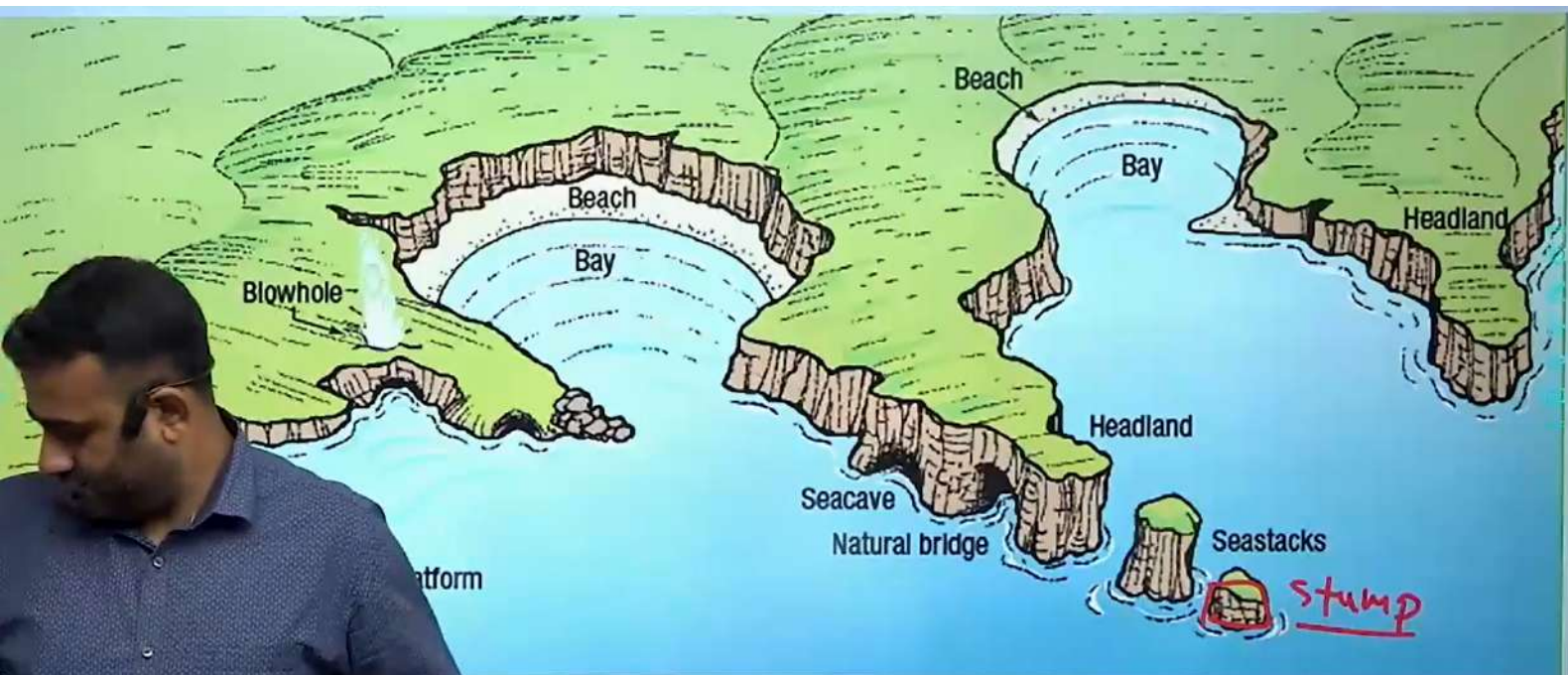


15 Incredible Sea Arches

HelloTravel  
15 Incredible Sea Arches around the...

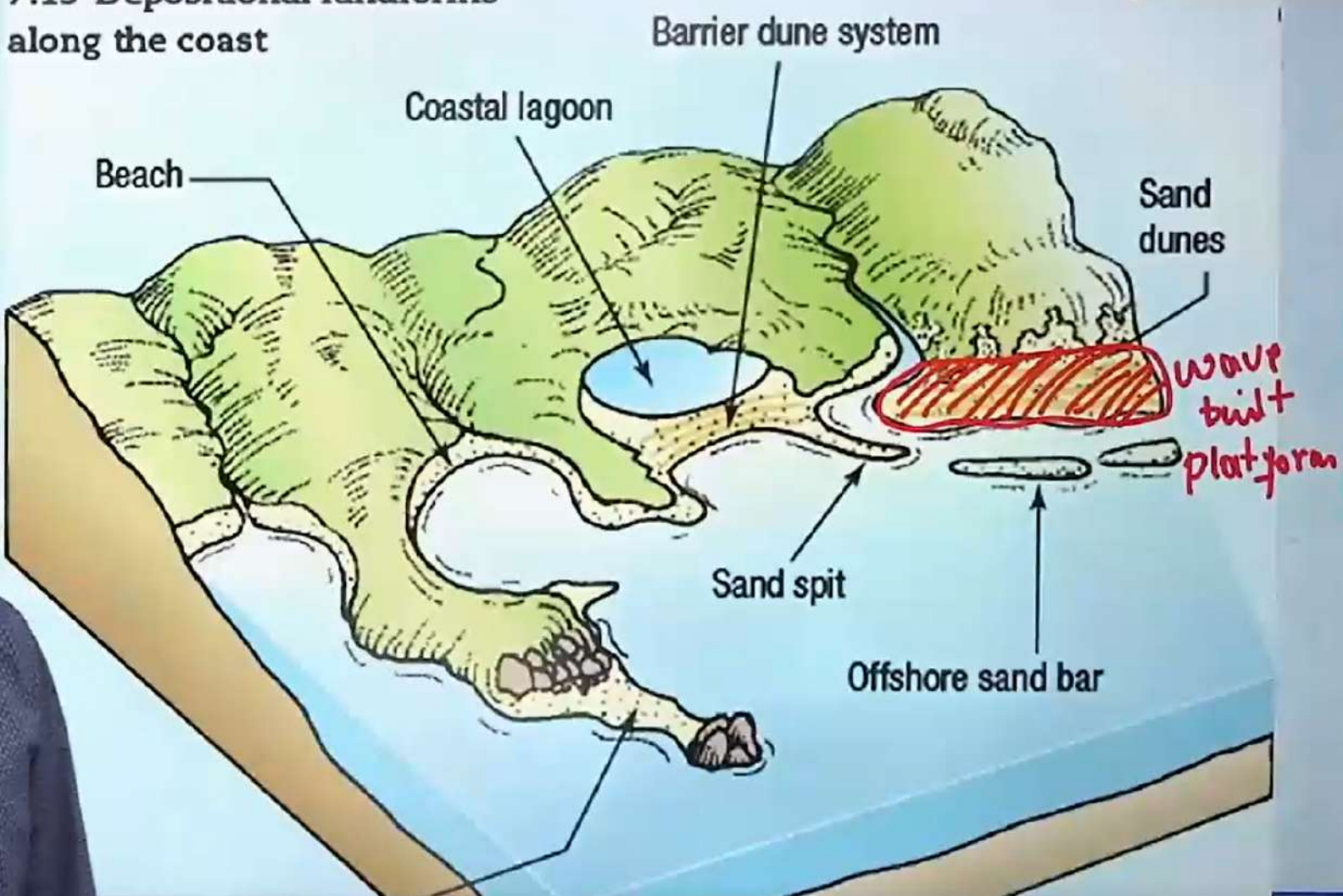




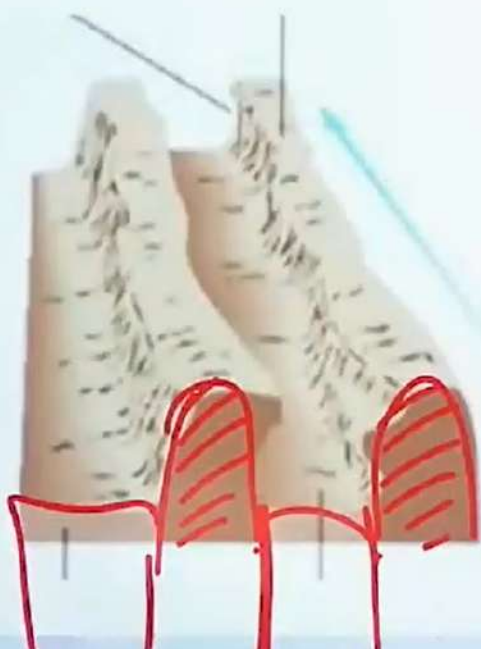




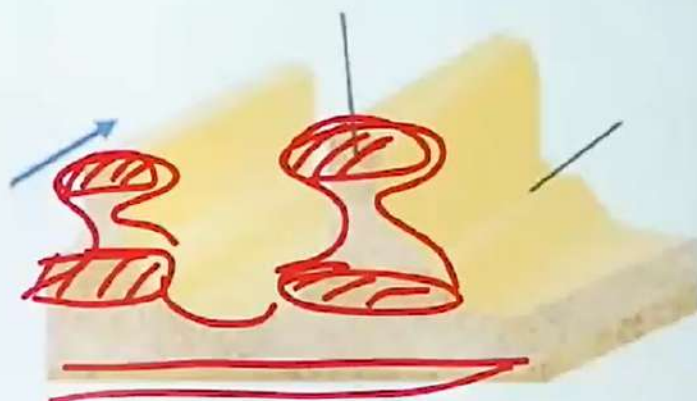
### 7.13 Depositional landforms along the coast

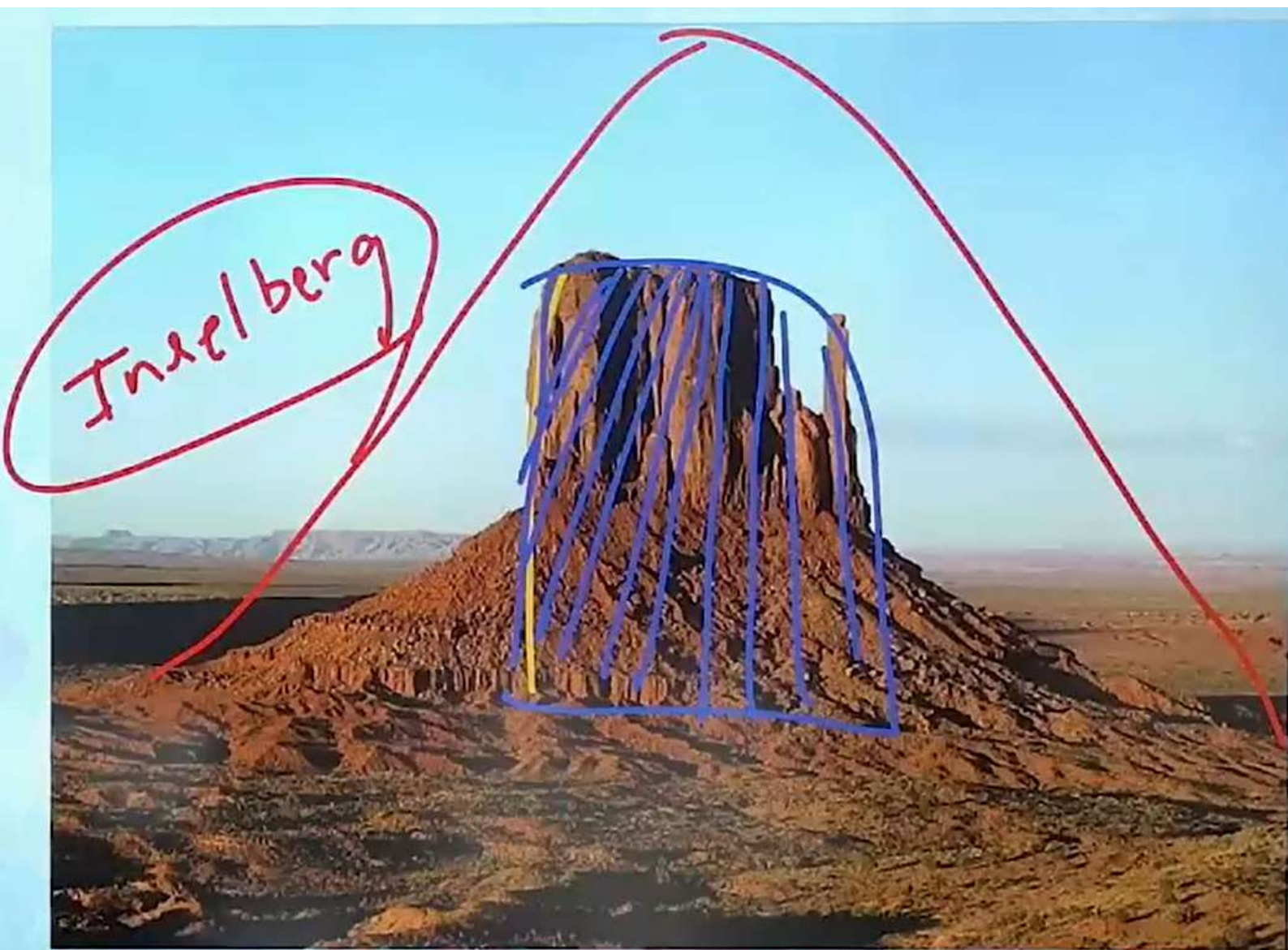


Zeugen

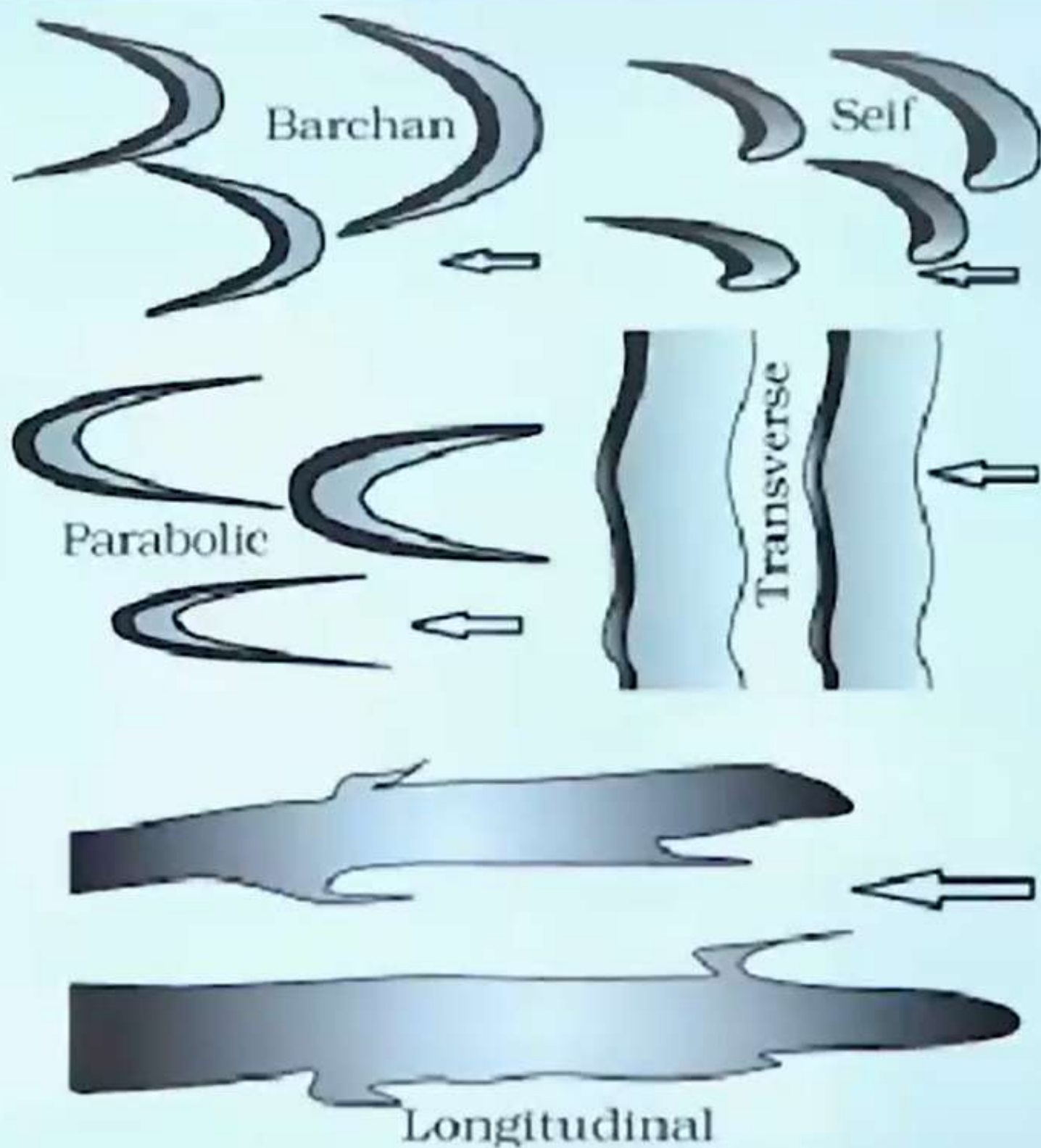


Yardang





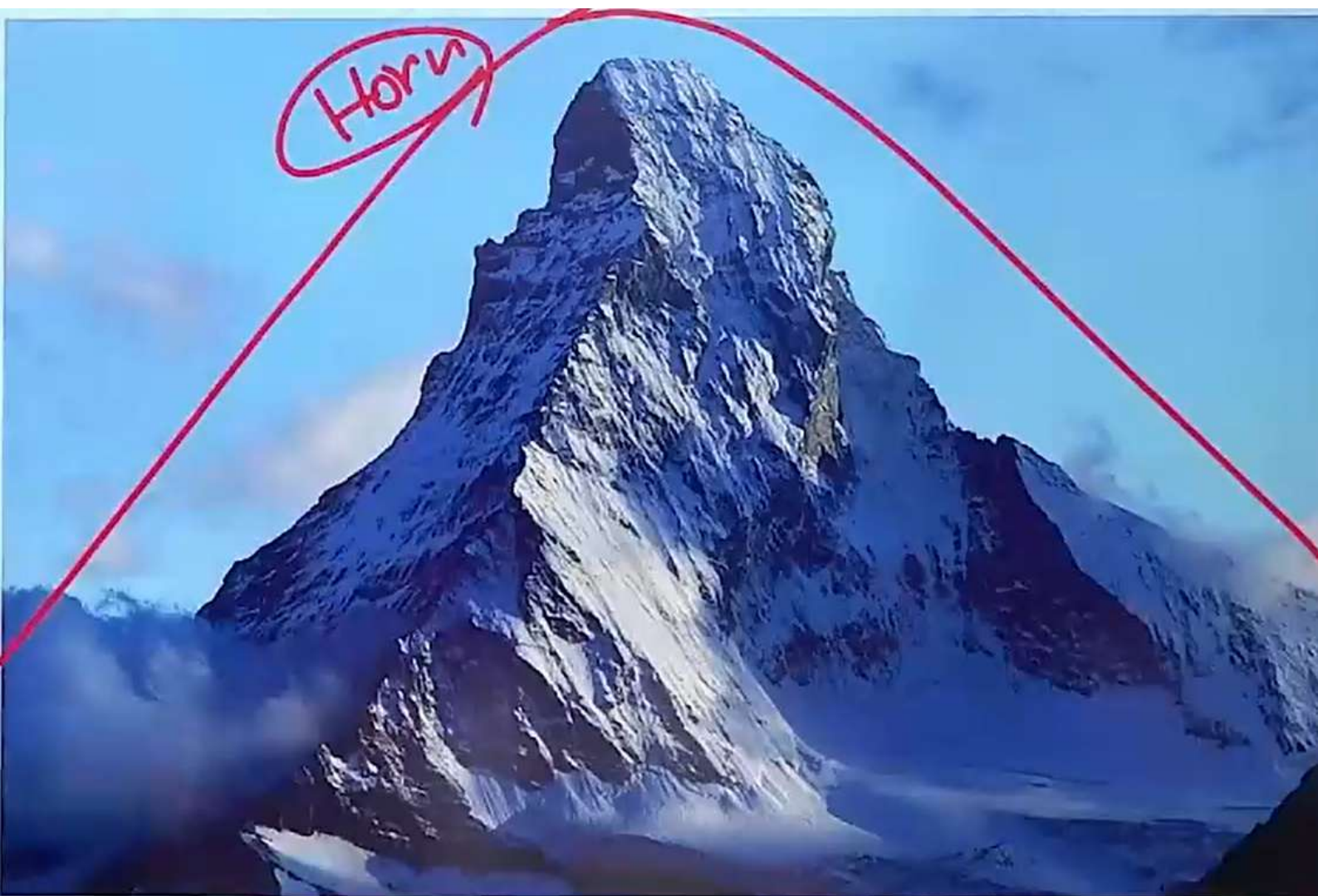


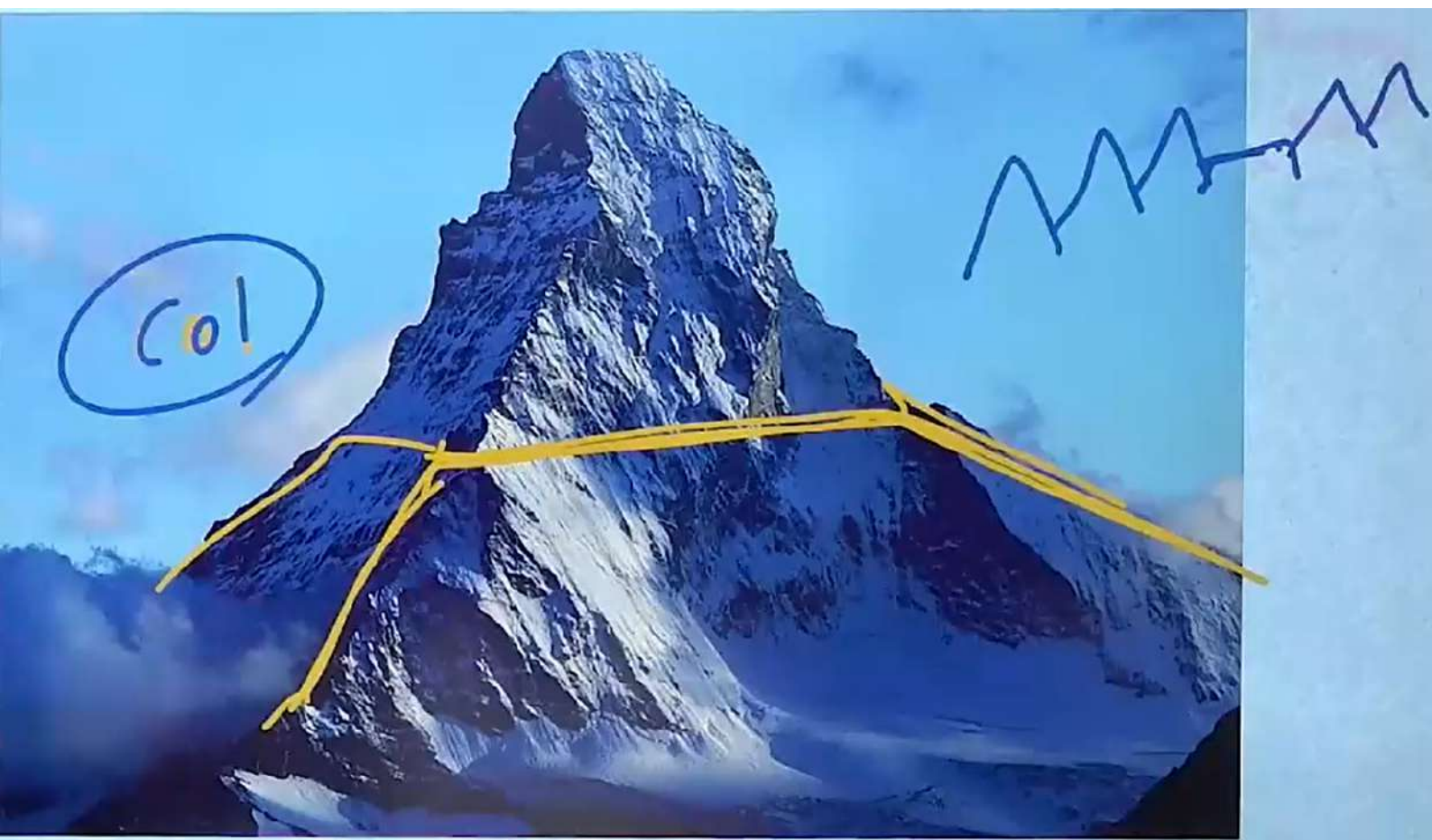


**Figure 7.16 : Various types of sand dunes**  
**Arrows indicate wind direction**

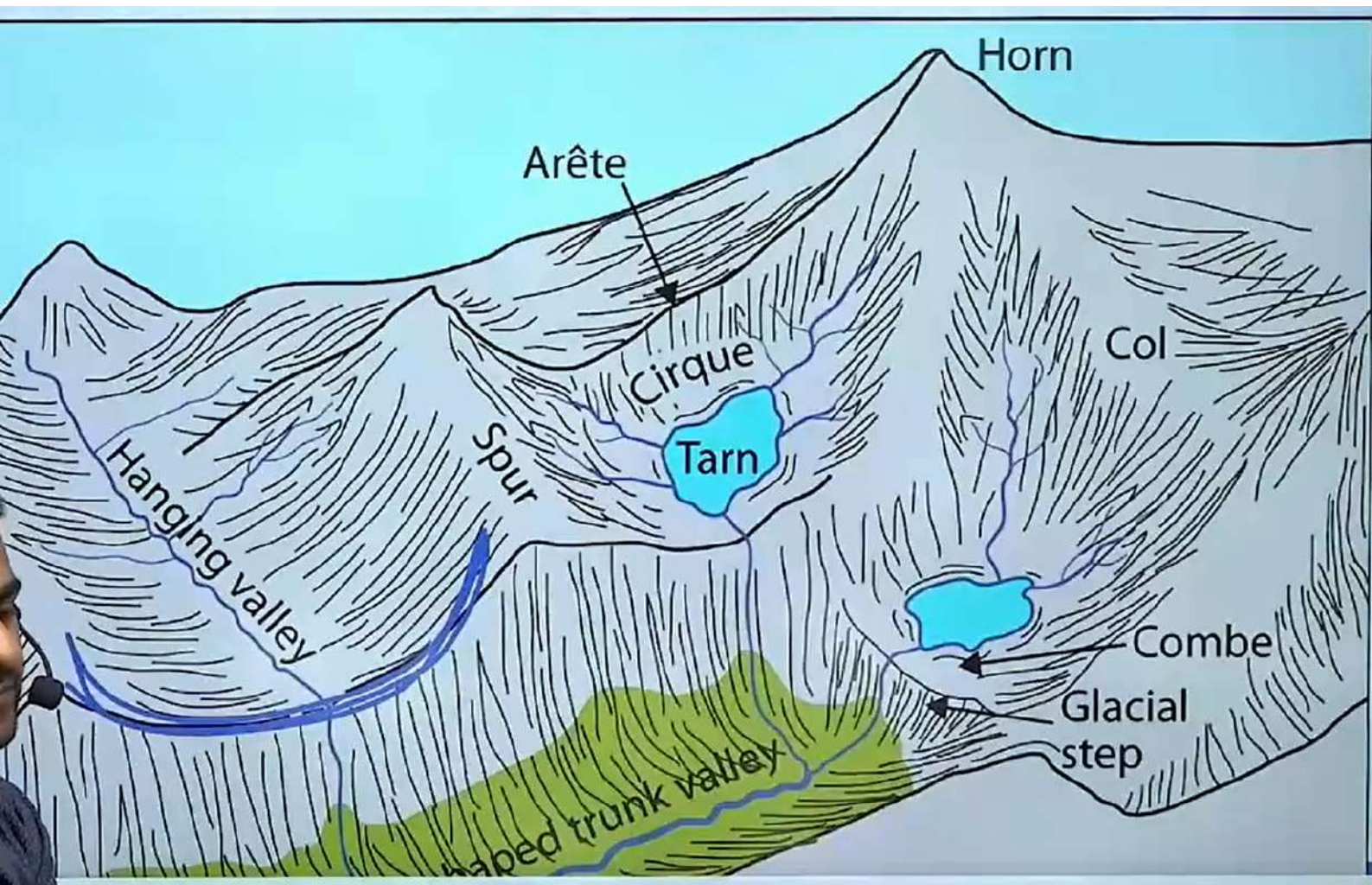
















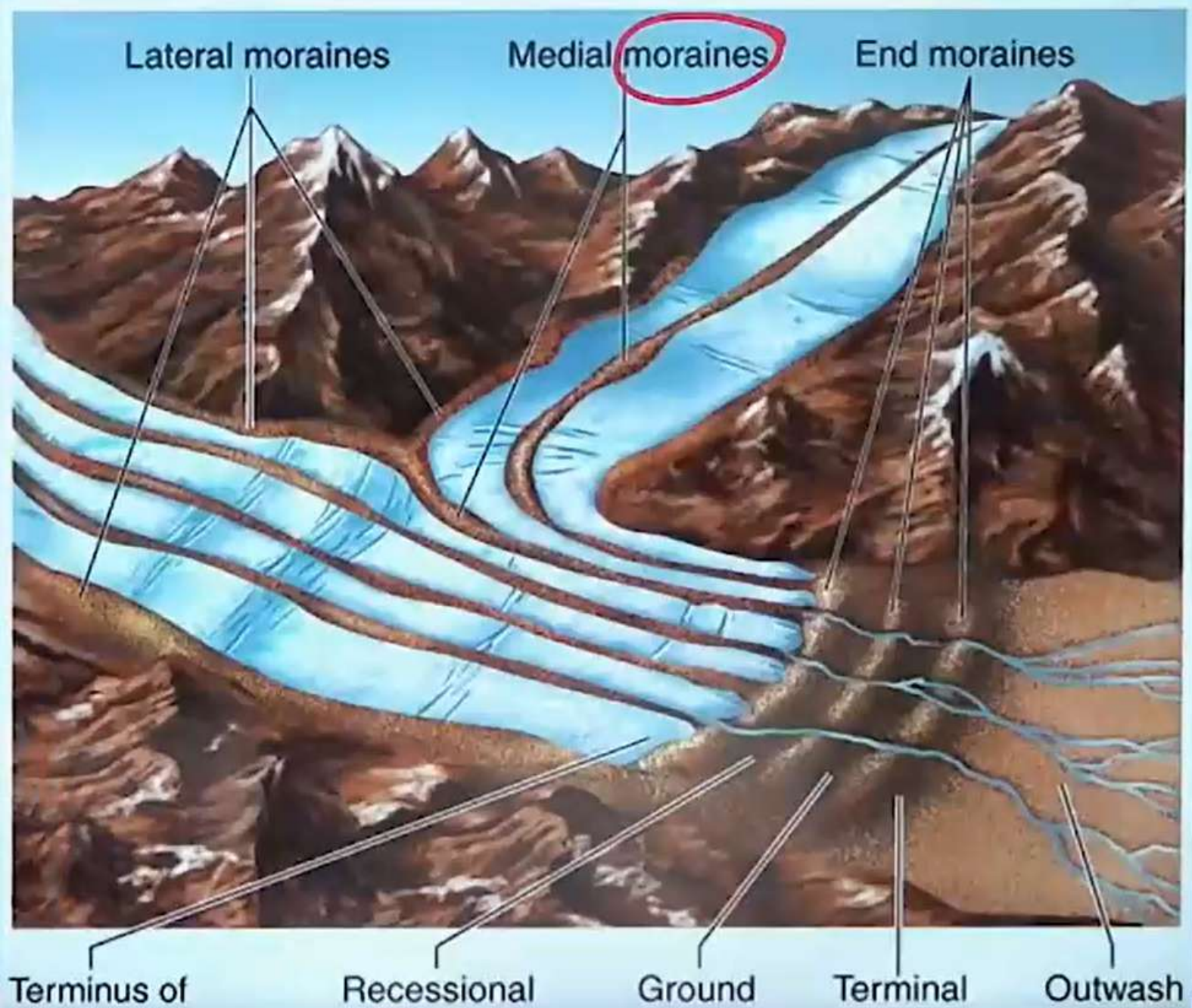
Fjords



Lateral moraines

Medial moraines

End moraines



Terminus of

Recessional

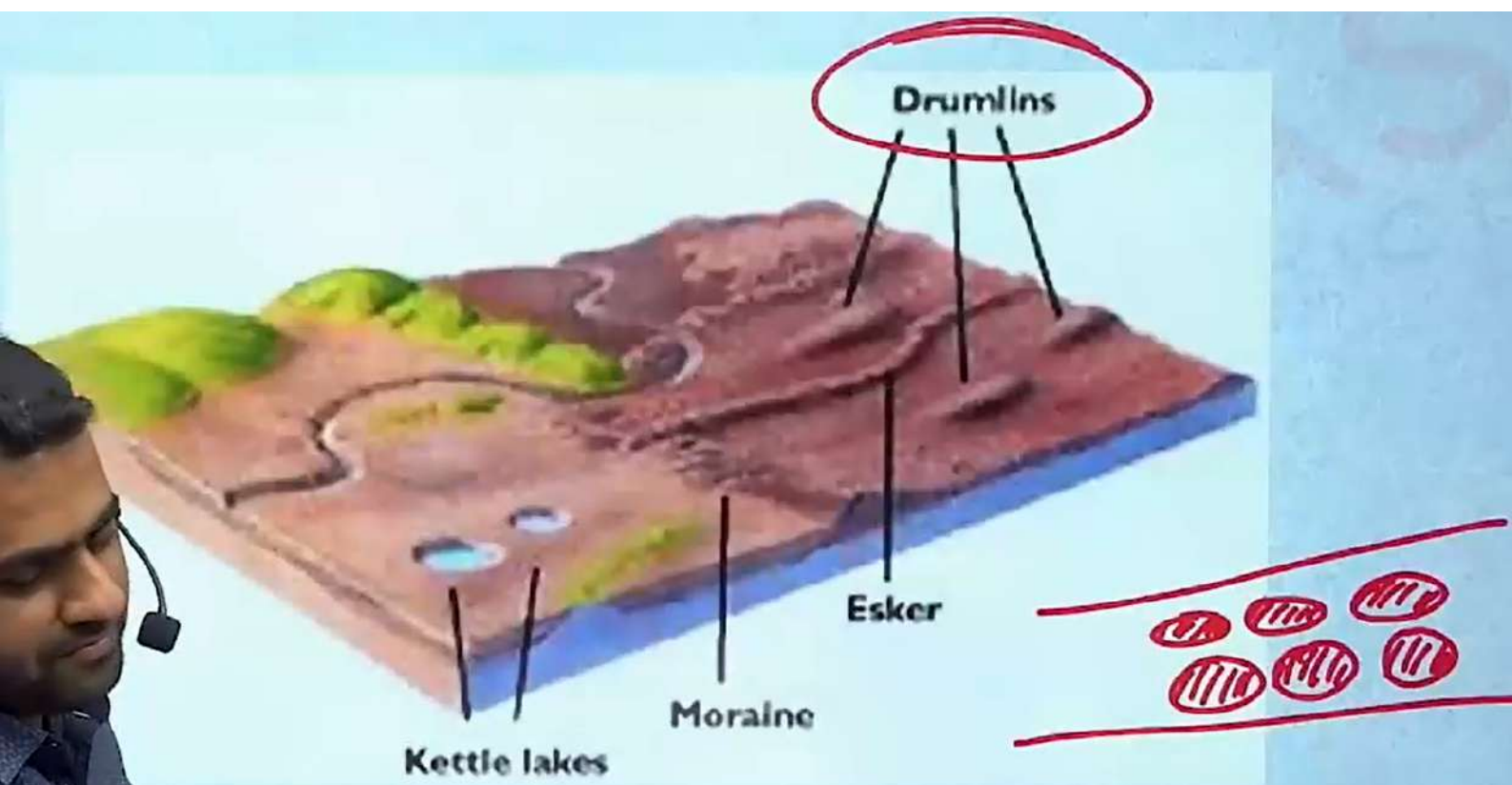
Ground

Terminal

Outwash









# Climatology

✓ Weather and climate

✓ Composition of atmosphere

✓ Structure of atmosphere

\* Insolation, Heat Budget & Albedo

Temperature & Inversion of temperature

Pressure

\* Planetary winds

Seasonal winds & Local winds

\* Humidity, Evaporation & Condensation

Types of clouds & Precipitation

Jet Streams

Air masses

\* Temperate Cyclones & Tropical Cyclones

\* Climatic regions