

Physical Environments: Glaciation

A photograph showing a rocky, light-colored landscape with a prominent, bright blue meltwater pool. The pool is surrounded by jagged, light-colored rock formations. The water in the pool is a vibrant turquoise color, contrasting sharply with the grey and white rocks. The background shows a vast, flat, light-colored expanse, possibly a tundra or a large field of rocks, under a pale sky.

Landforms Made from Melting Ice

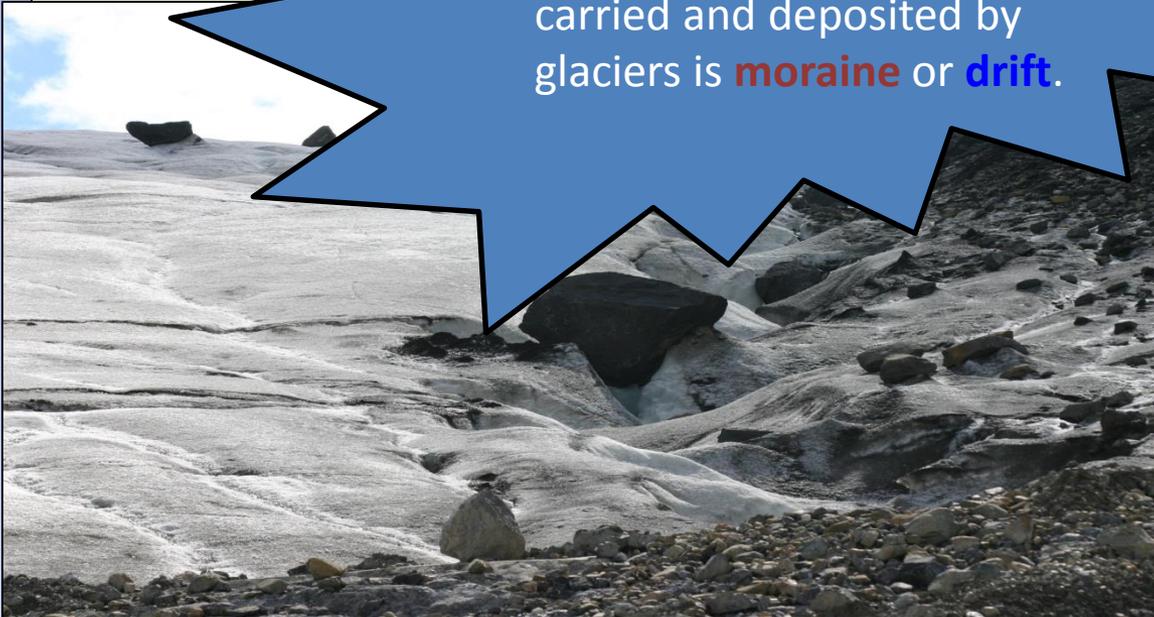
Glacial Deposition

Glaciation affected not only the major mountain or upland areas but also the great valleys and lowland plains.

Deposition = the material that the glacier carries.

The collective name for all the materials (boulders, sands, gravels, clays, etc.) carried and deposited by glaciers is **moraine** or **drift**.

Under what circumstances could a glacier drop the material it carries?



Glaciers transport materials in the following ways:

- **Subglacial debris** – moved along the floor of the valley either by ice (as ground moraine) or by melt water streams under the glacier.
- **Englacial debris** – carried within the glacier itself.
- **Supraglacial debris** - carried on the surface of the glacier.

Look at the photos below. Which type of transport is shown?



The types of Glacial Deposition

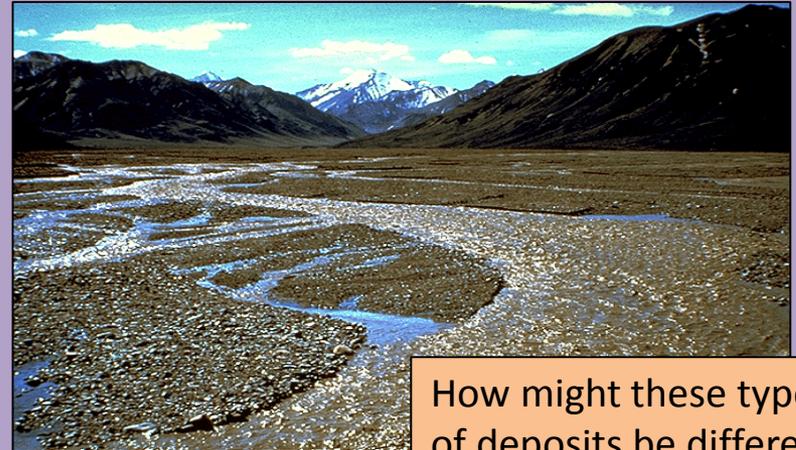
The deposits left behind by glaciers can be classified into 2 distinct types

Deposits left by the glaciers themselves (moraines):



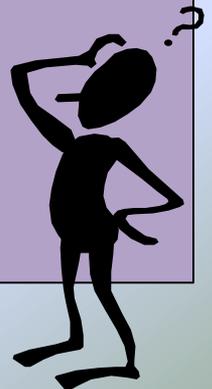
- Erratics
- Moraines (terminal, lateral, medial)
- Drumlins

Deposits left by melt water (fluvioglacial deposits):

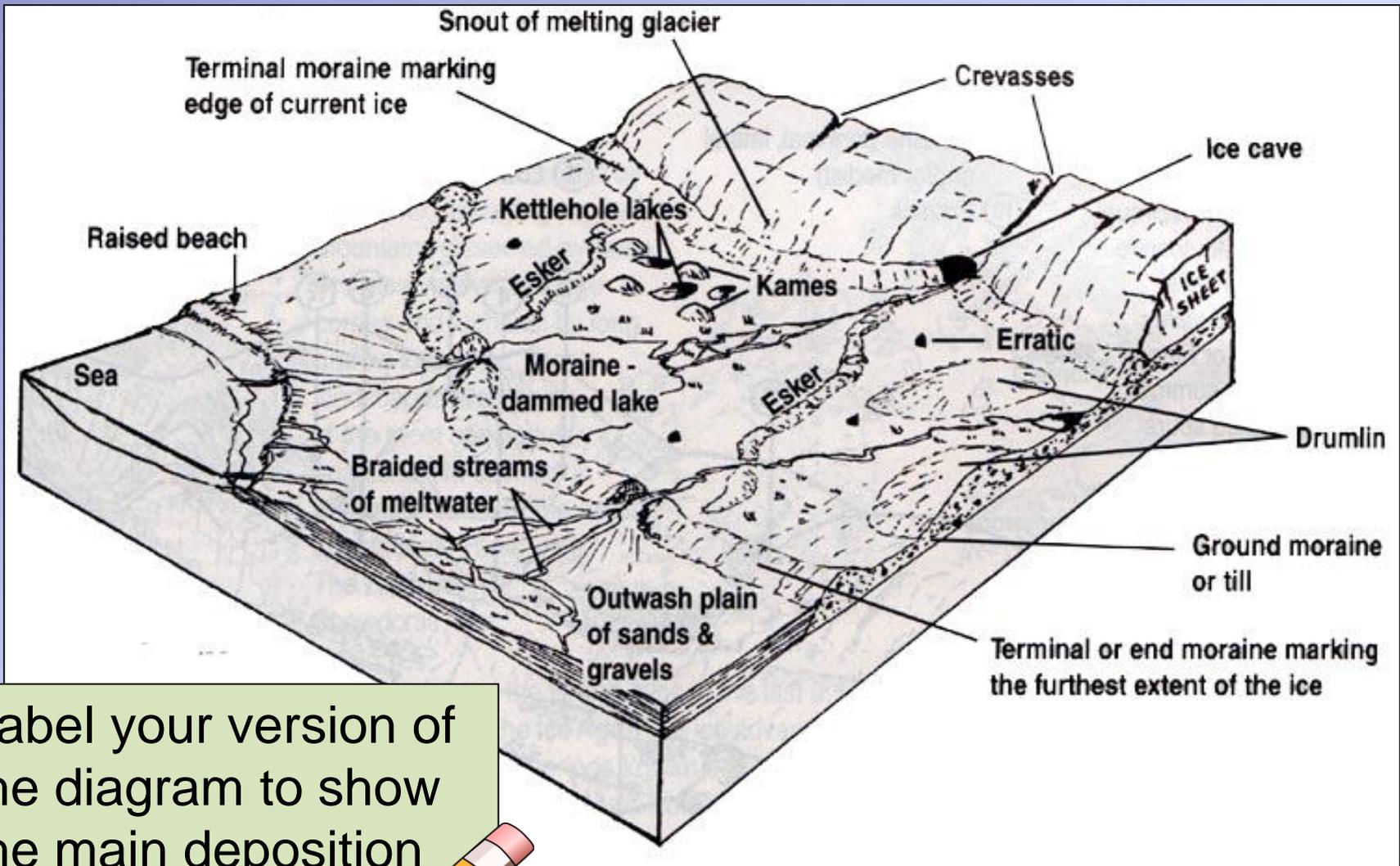


How might these types of deposits be different?

- Outwash plain
- Eskers
- Kames
- Kettleholes



A Deposition Landscape

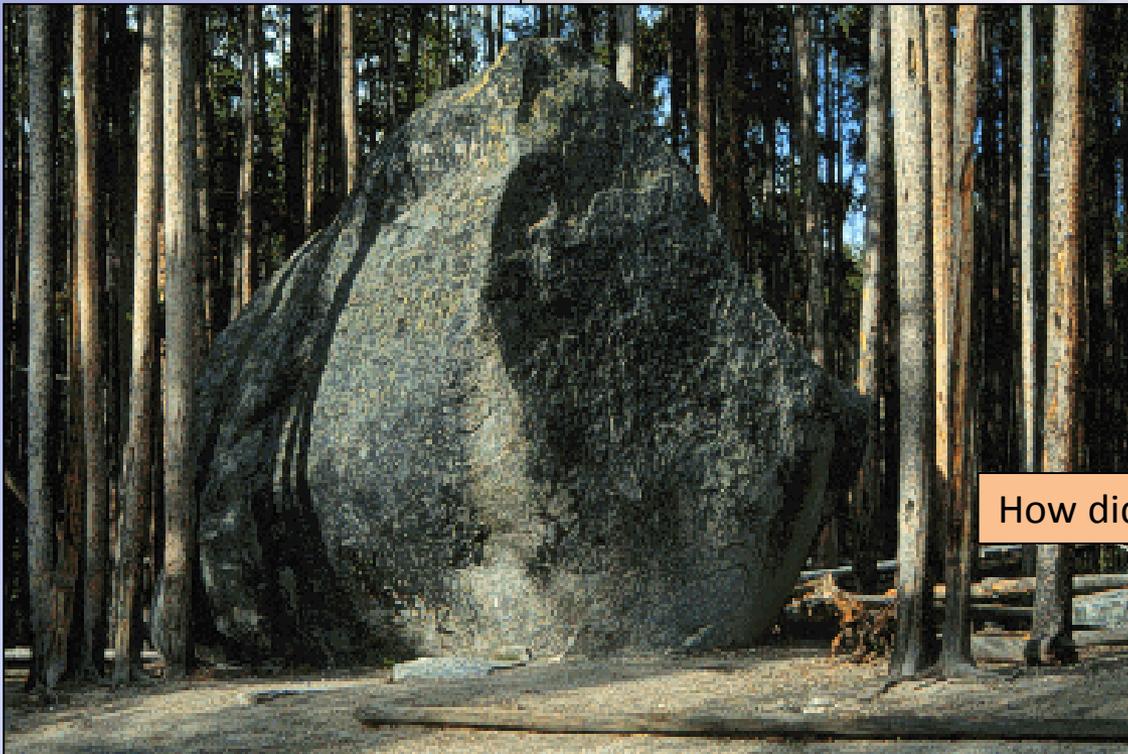


Label your version of the diagram to show the main deposition features



Landforms Resulting from Glacial Deposition

Erratics!



Describe the appearance and position of these Erratics. Write a definition in your notes

How did they form?



Explaining Erratics



Yeager Rock,
Washington, USA



An erratic, Eastern Sierra Nevada, USA

Erratics are large rocks that have been transported by glaciers.

Glaciers would have plucked them from mountains and valley sides during glacial erosion, then transported them as they moved downhill.

Some may have come from freeze-thaw weathering in the mountains which broke up rock, resulting in large sections falling onto the surface of glaciers.

As glaciers reach lower land and start to melt, the erratics are deposited, sometimes left balancing in precarious positions.

They often are a completely different rock type to their new surroundings which tells us that they must have been transported large distances from their source of origin.

Moraines



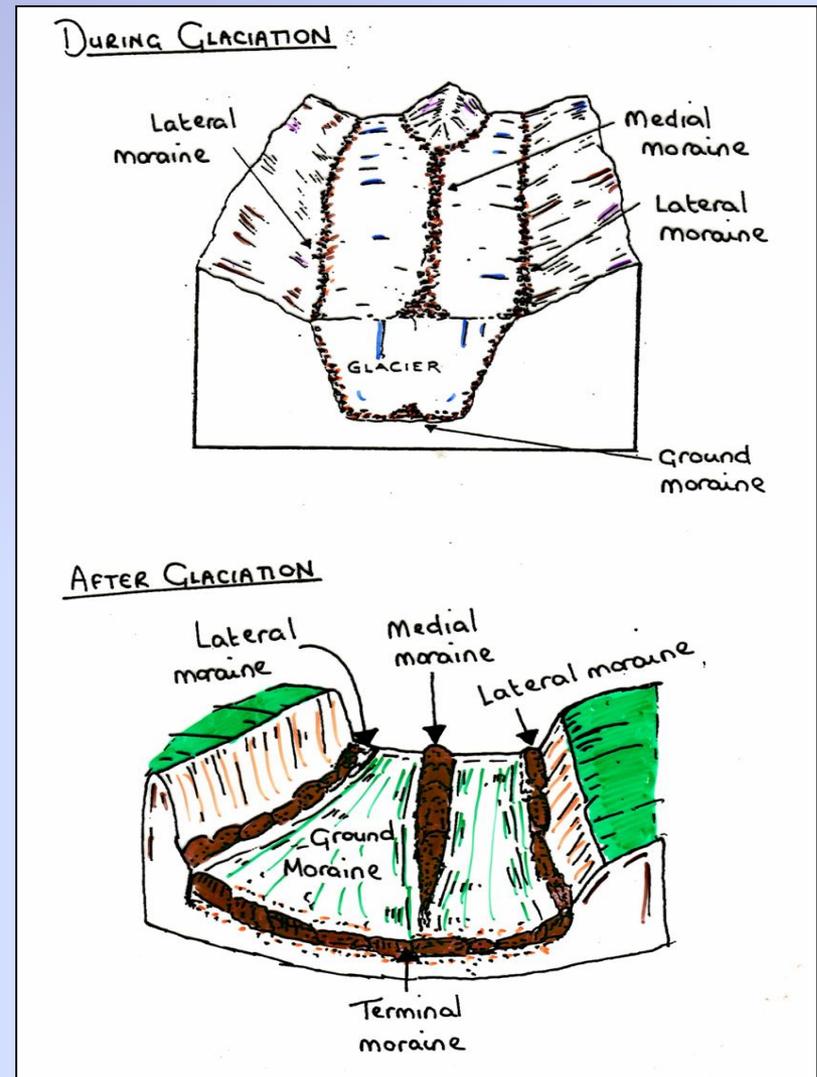
Moraines form due to:

1. The **dumping** of debris due to ablating (melting) ice.
2. The **pushing** of loose, ground material by the ice.

Types of moraine

- Terminal (or end) moraines
- Lateral moraines
- Medial moraines
- Ground Moraines

- 1) Glue and label your version of these diagrams to show the different types of moraine.
- 2) Write definitions for the different types of moraine (indicate where they are found both during and after glaciation)



Identify the types of Moraine shown in the following photos



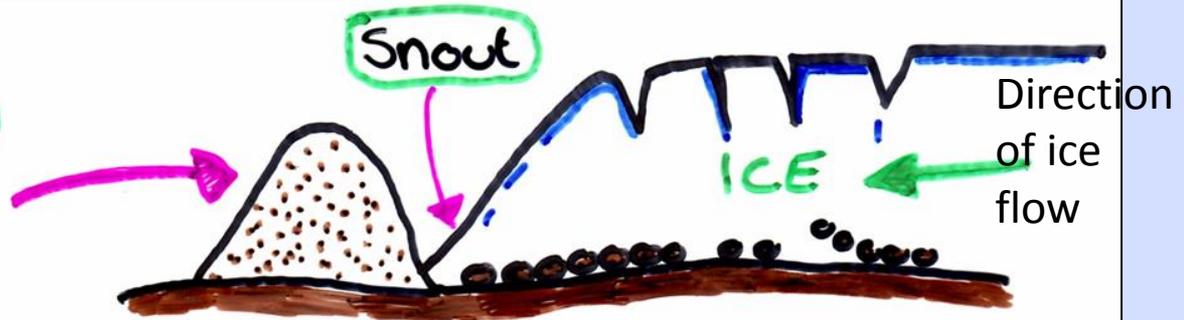
Terminal (or end) Moraines

Key points

- Ice bulldozes loose soil and rock in front of it as it moves through the valley.
- All the moraine is dropped where the ice melts, building up ridges across the valley floor.
- A terminal moraine builds up across the valley at right angles to the direction of ice flow.
- It consists of poorly sorted material.
- It mark the maximum extent that the glacier has advanced (the point it got to when it melted).

DURING GLACIATION

Material pushed in front of glacier as it moves.

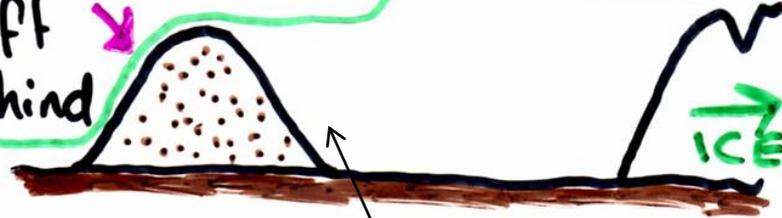


Glacier bulldozes its way across the valley floor

AS ICE RETREATS

Ridge of unsorted material left behind

Glacier melts



glacier melts and retreats

Marks the maximum extent of the glacier



Advancing glacier



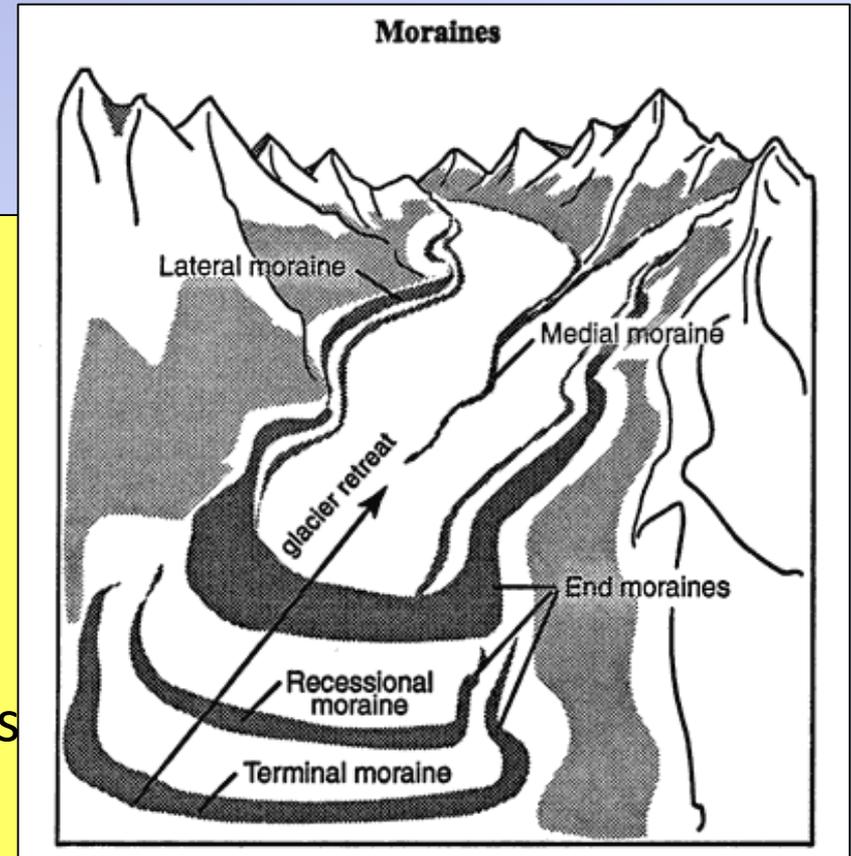
Terminal Moraine formation
in process as glacier shovels
material to its snout

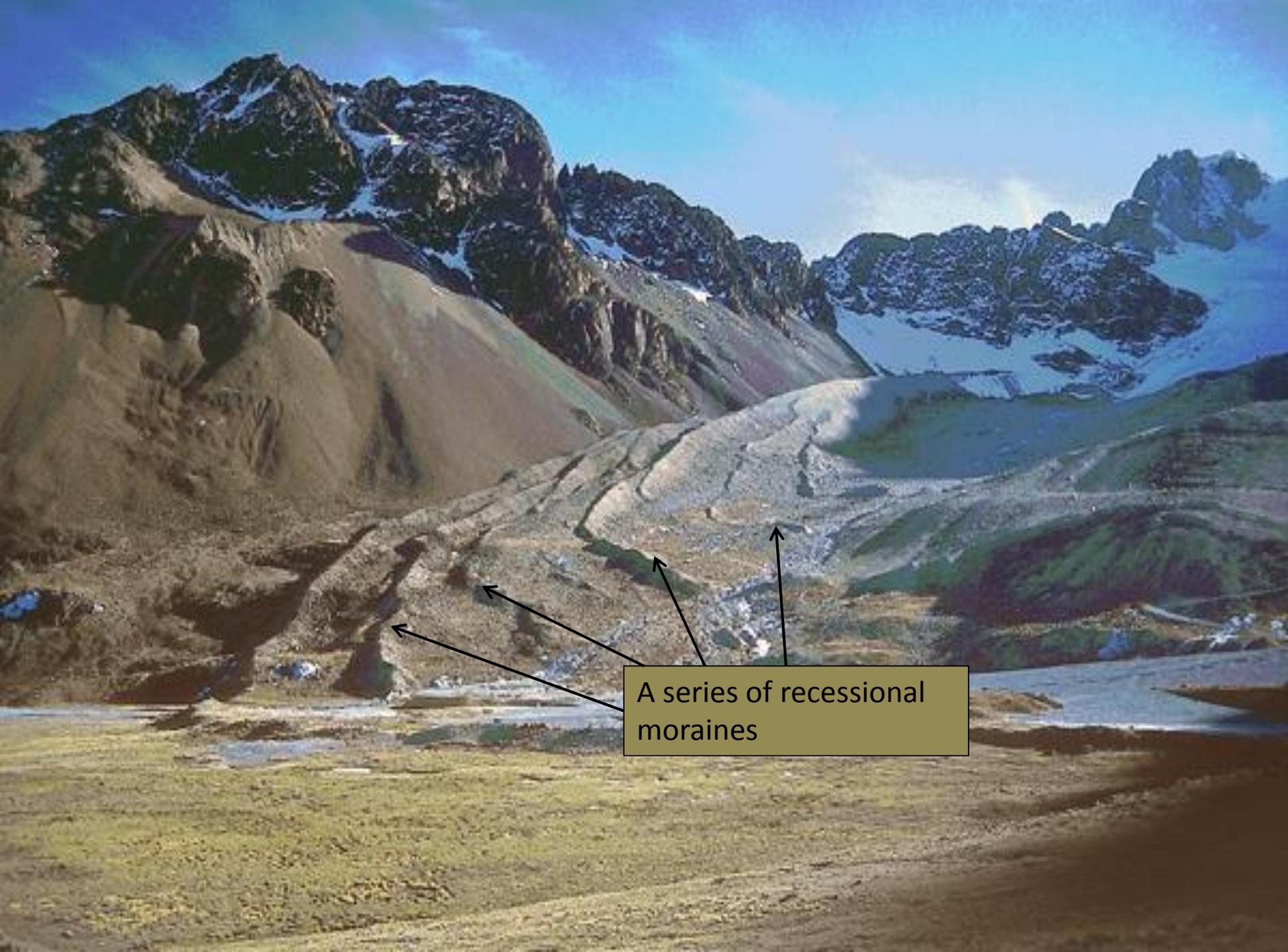


Recessional Moraines

Key points

Recessional moraines form at the end of the glacier so they are found across the valley, not along it. They form where a retreating glacier remained stationary for sufficient time to produce a mound of material. The process of formation is the same as for a terminal moraine, but they occur where the retreating ice paused rather than at the furthest extent of the ice.





A series of recessional moraines

Lateral Moraines

Key points

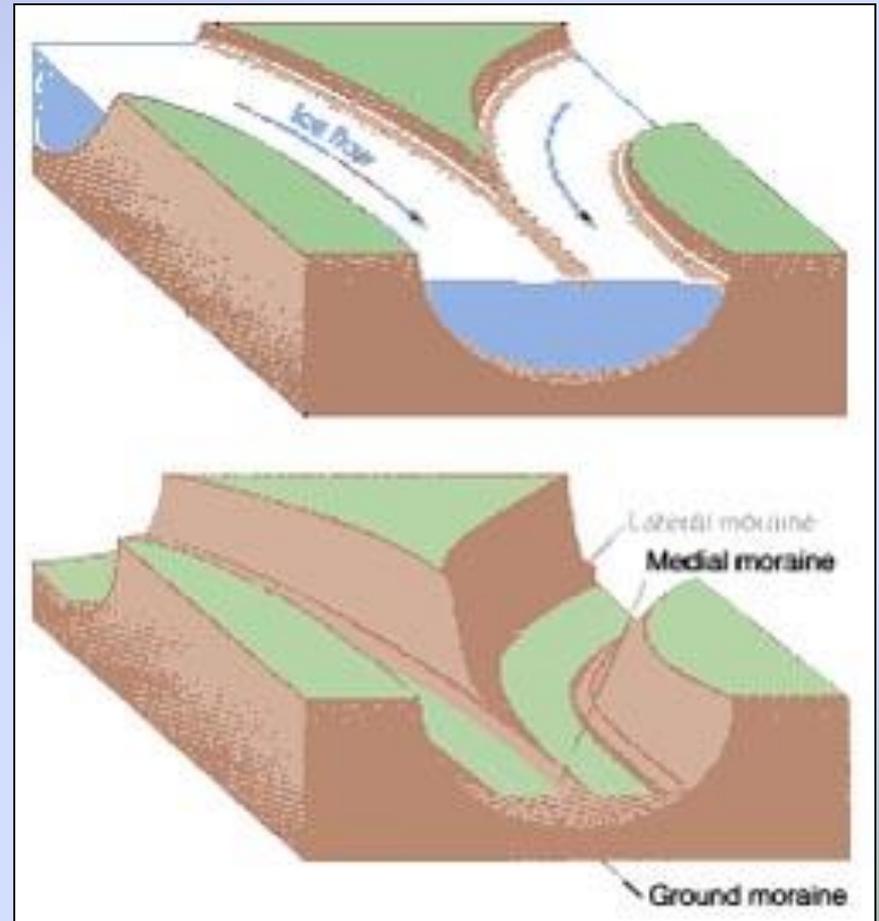
- Develop along the edge or sides of an advancing glacier.
- Form from debris eroded by the advancing ice and especially from frost-shattered material loosened from the valley sides (**explain the process of freeze thaw**) or from plucked material that the glacier has pulled from surrounding valley sides as it moved.
- When the supporting ice ablates, lateral moraines collapse to the sides of the valley floor.

Lateral moraine at glacier's side



Medial Moraines

Medial moraines form on active glaciers where two lateral moraines merge when two glaciers flow together.





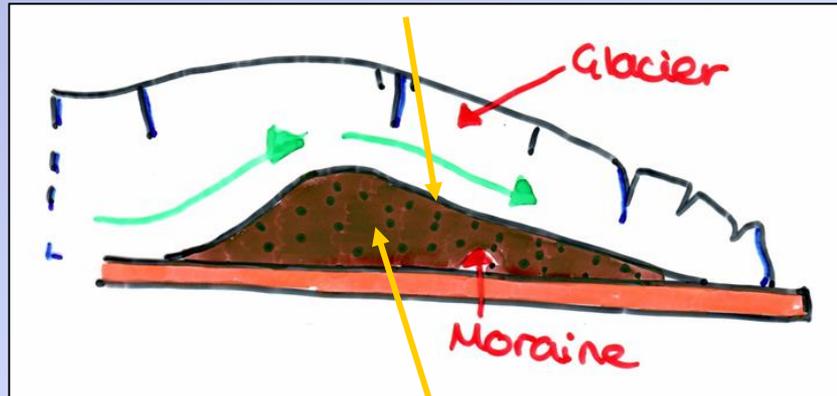
Medial Moraine
formed as two
glacier join and their
lateral moraines
combine

Drumlins

Formed in the following ways:

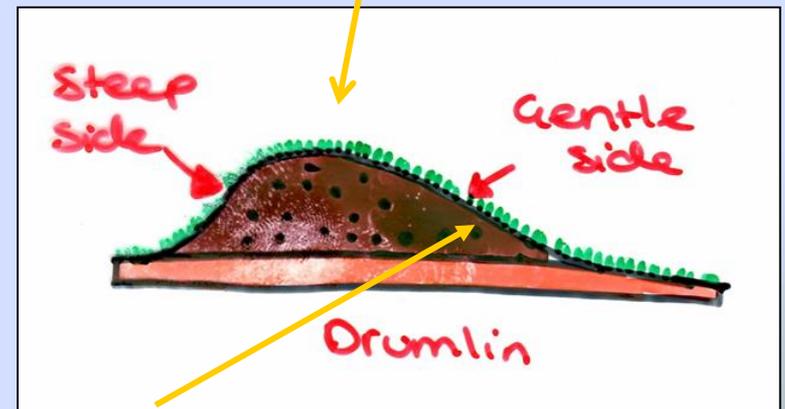
- Melting ice deposits large amounts of moraine during glacial retreat.
- If there is a subsequent glacial advance, forward movement of the ice moulds the moraine to form streamline mound as glaciers advance over the deposited moraine.
- This creates elliptical hills, made of boulder clay (ground moraine), with a steeper upstream side. They are called **drumlins**.
- Drumlins are often found in one area as 'swarms'.

Moraine is moulded into Mounds by the moving ice during a glacial advance

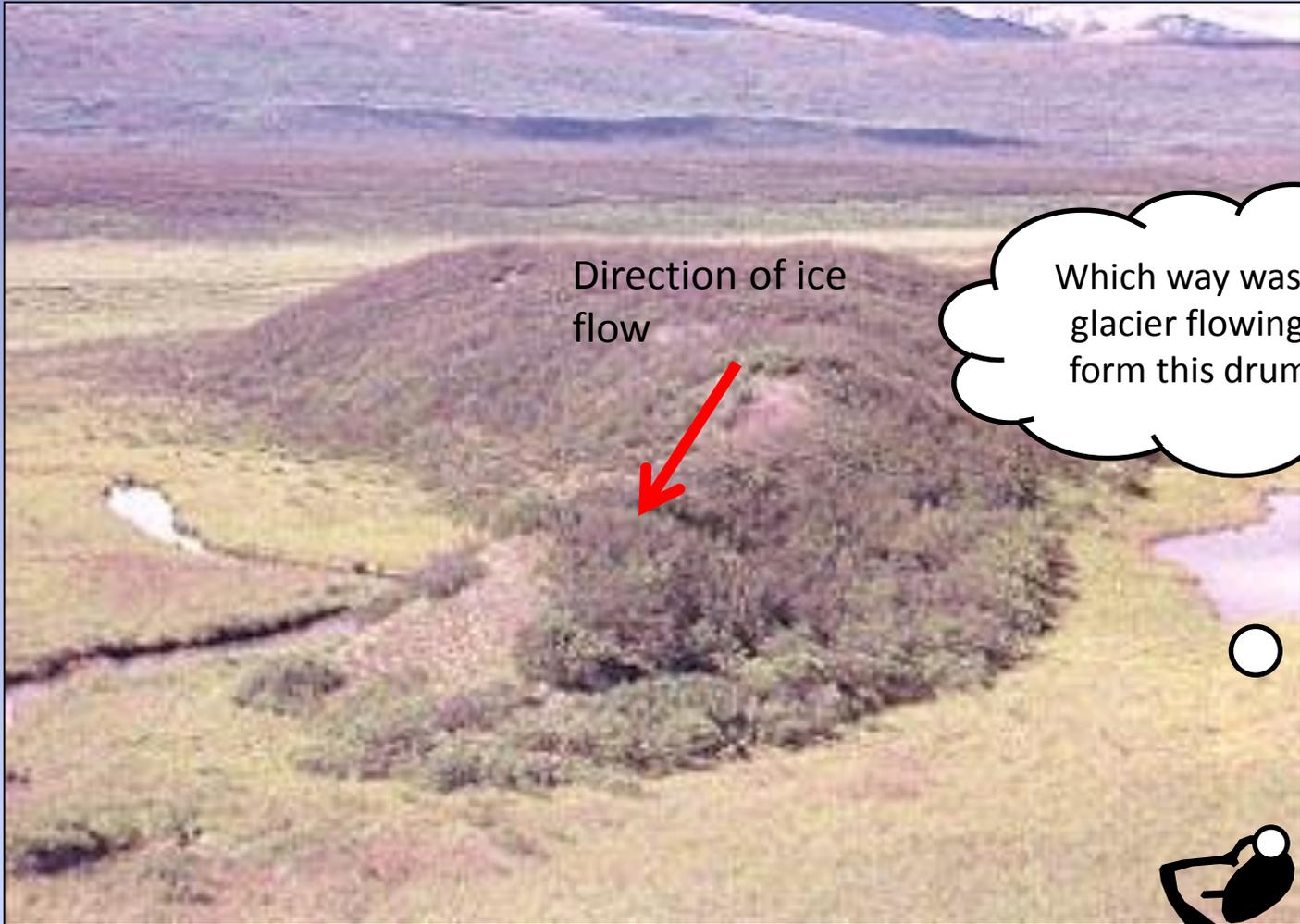


Moraine has been deposited by ablating ice

When the ice melts, drumlins are formed

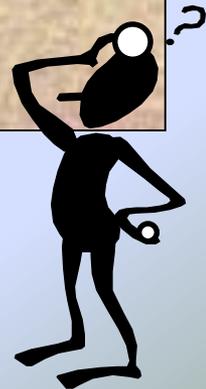


Gentle side or long axis points to the direction the ice was moving



Direction of ice
flow

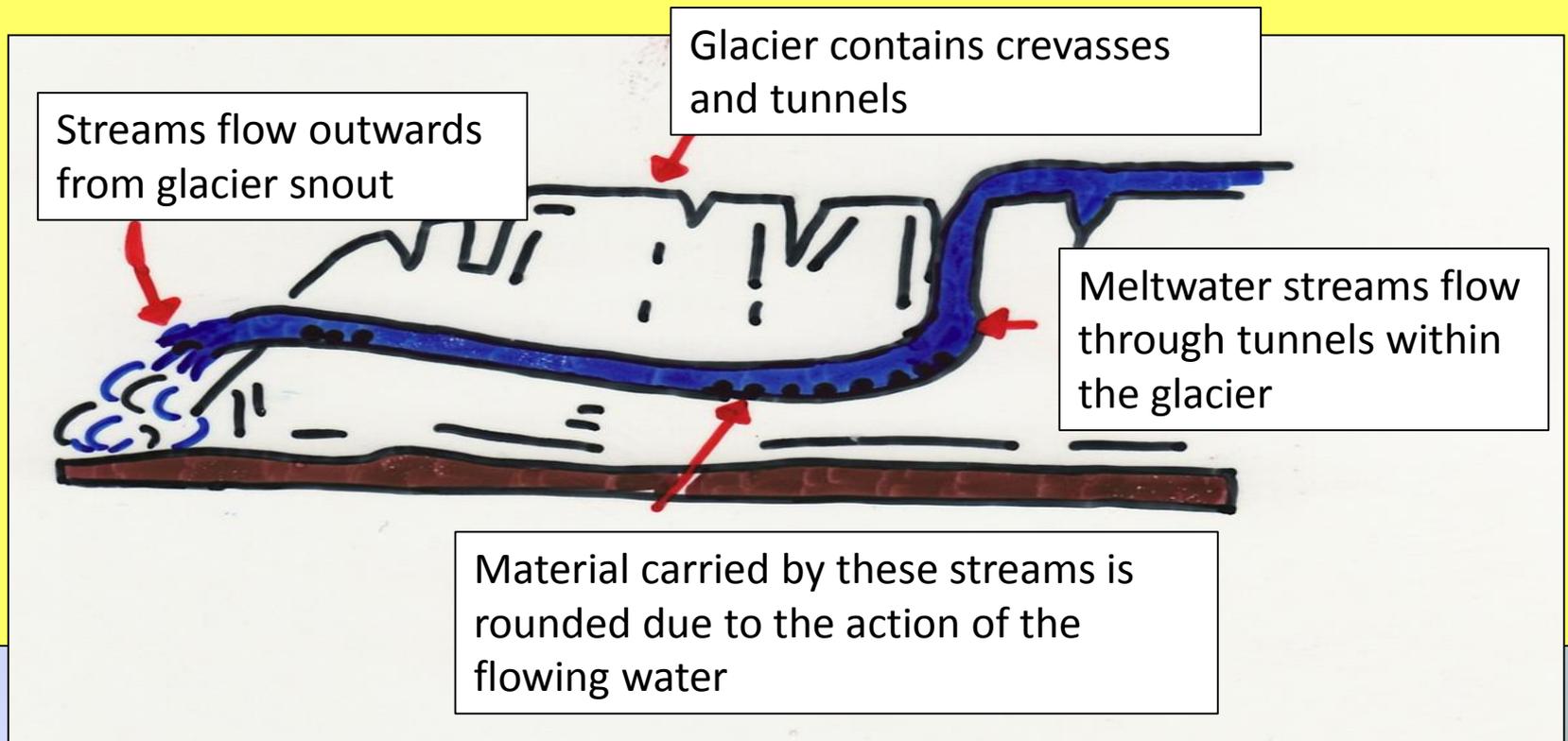
Which way was the
glacier flowing to
form this drumlin



Landforms Resulting from Fluvioglacial Deposition

Eskers and Kames

Eskers are elongated ridges of sand and gravels. They are thought to be the result of melt water flowing through tunnels in the ice. On the base of the tunnel rounded deposits are found due to the action of the flowing water.



When the ice melts these rounded deposits are laid down as long narrow “snake-like” ridges on the landscape.

KAMES may be found where the original waterfall came out of the glacier and deposited material where it fell.

A small mound of material is also deposited where the waterfall came out of the glacier snout. This is called a Kame.

The ice ablates resulting in the material being carried in the melt water streams dropping to and being deposited on the valley floor



A long narrow snake-like ridge called an Esker forms



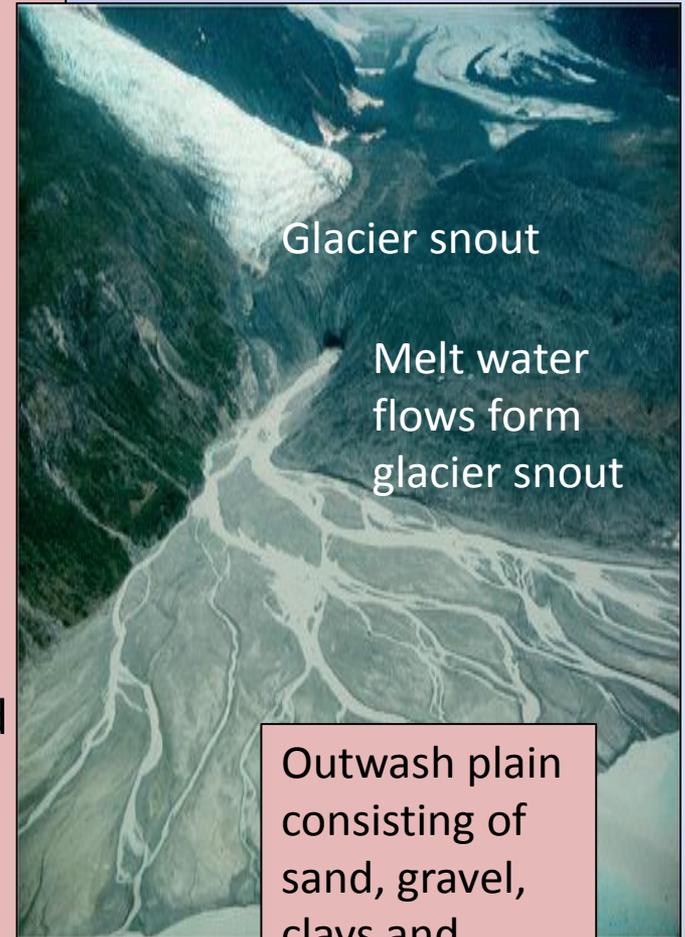
Esker: a long sinuous ridge of deposited material winds its way across the valley floor



Outwash Plains

These are large areas of glacial sediment deposited by melt water streams that flowed out of the glacier snout. They are formed from gravels, sands and clays which are deposited as the water loses energy, the clays being furthest away from the snout because the smaller particles are carried furthest.

They exist where quantities of melt water flowed out of the snout of the glacier as it retreated. Braided streams are often found in these outwash plain, because the highly variable discharge of the melt water streams and deposition cause the river to split into smaller streams. Outwash plains can be huge, many 10s of kms long and wide.

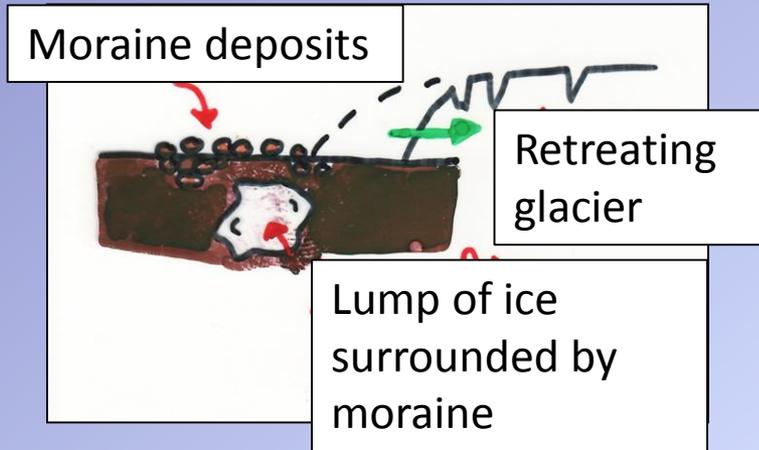


Glacier snout

Melt water flows from glacier snout

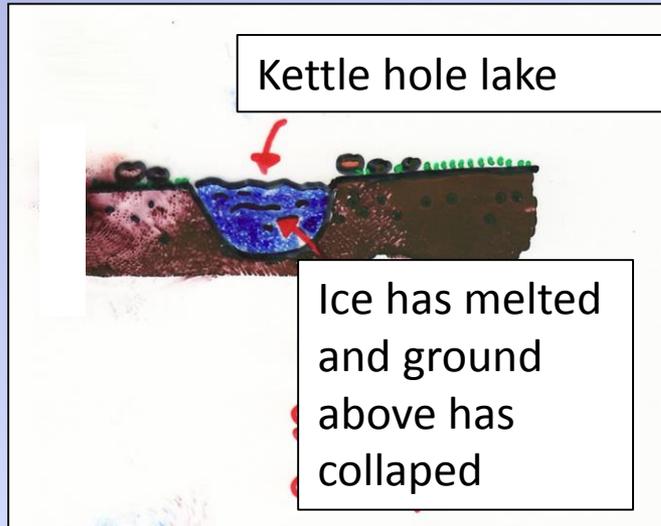
Outwash plain consisting of sand, gravel, clays and braided streams

Kettle Holes



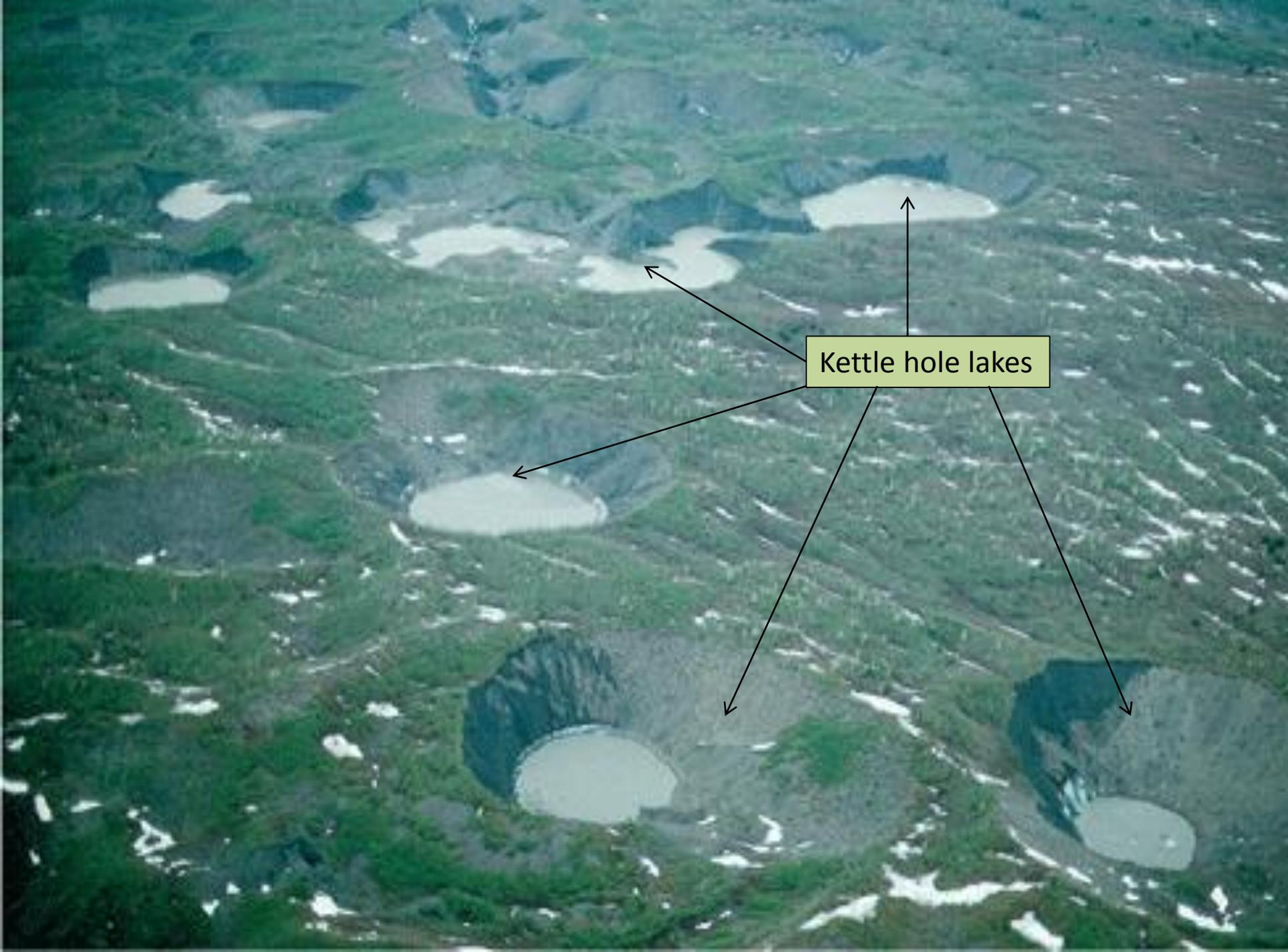
1. During Glaciation

A fragment of ice is left behind when the glacier retreats. It is covered over by moraine deposited by ice melt



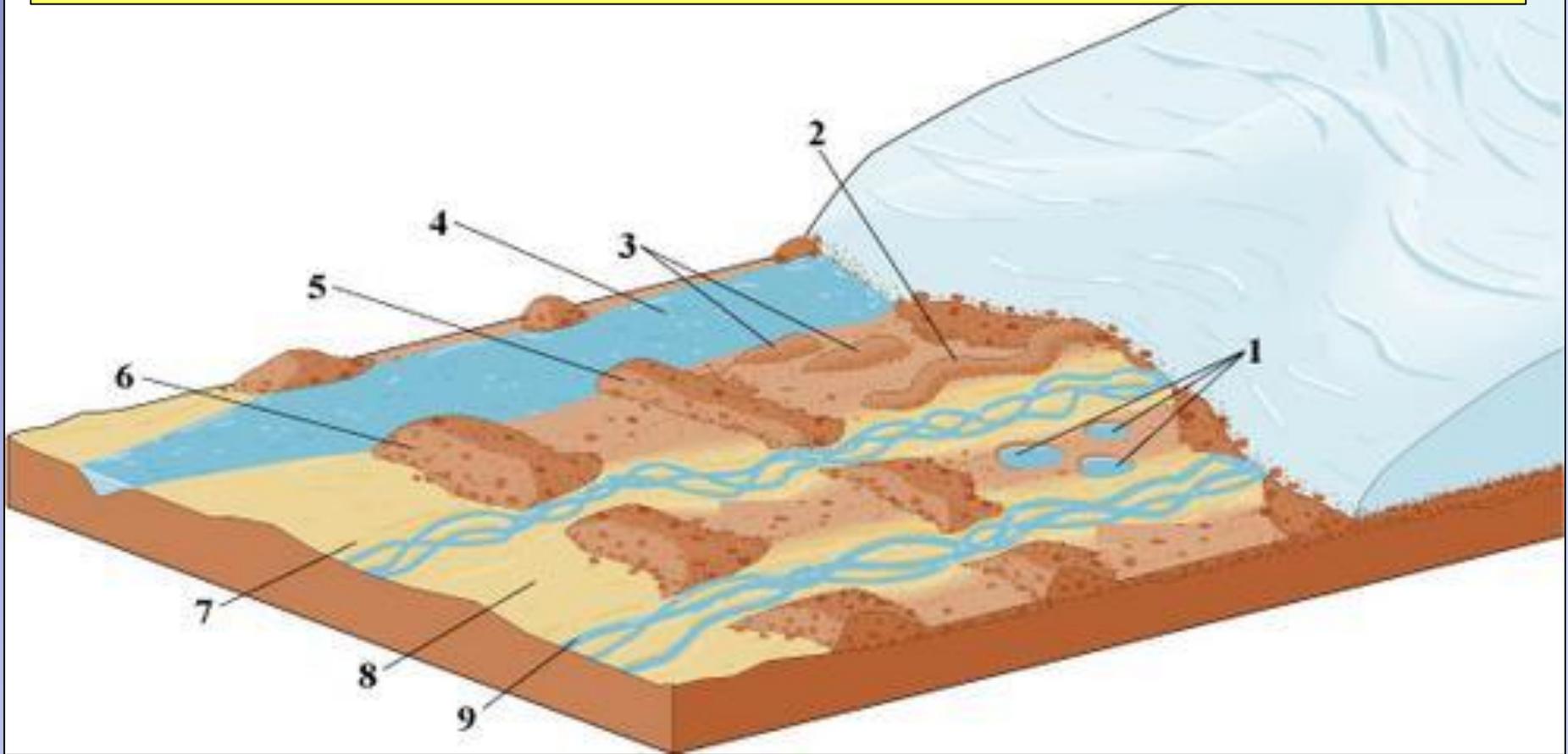
2. After Glaciation

The ice fragment melts so the ground above this lump of ice collapses and leaves a hole. The hole fills with melt water forming a Kettle Hole Lake



Kettle hole lakes

Terminal moraine, esker, kettle holes, recessional moraine, melt-water, outwash plain, braided stream, drumlin.



- 1) Identify glacial deposition features 1-9 (7 and 8 are the same landform) on the diagram above.
- 2) Choose **1** glacial deposition feature and **1** fluvio-glacial deposition feature and, with the aid of annotated diagram(s), explain the processes involved in its formation (12)