

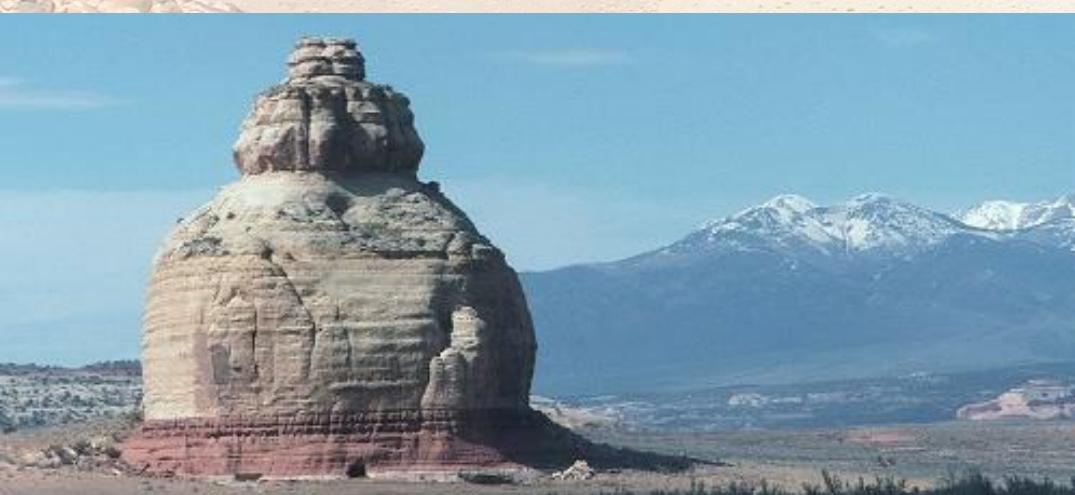
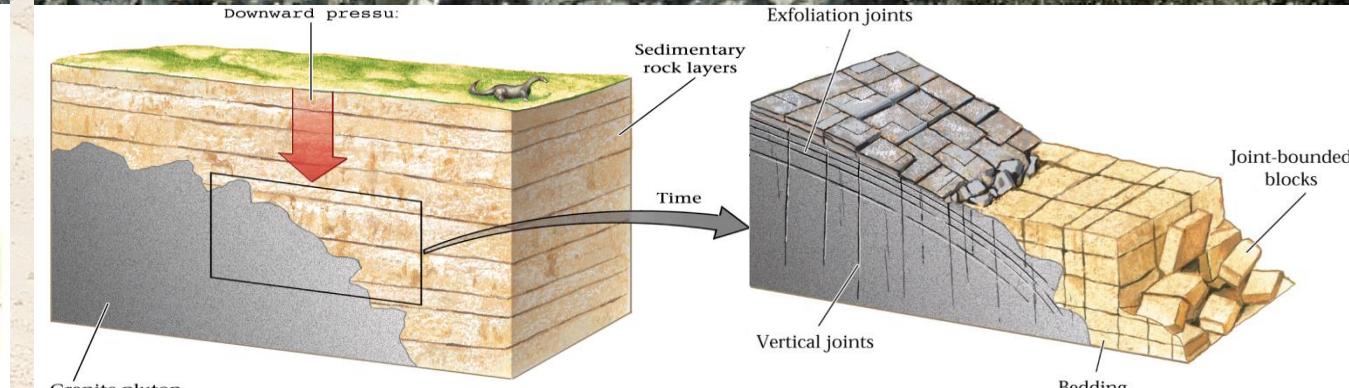
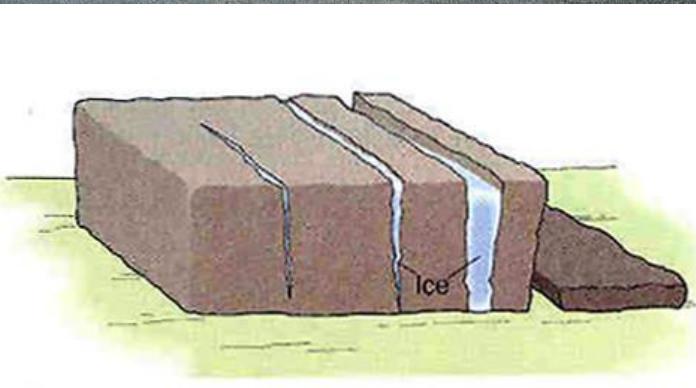
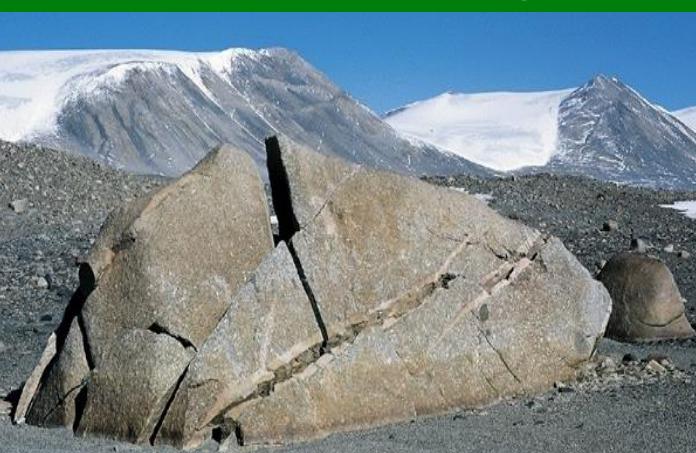
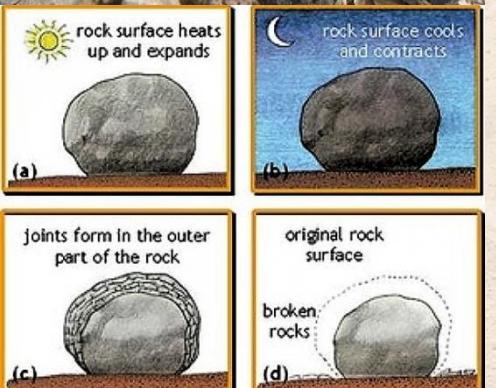


# Landscape Evolution

## *Glacial Landscapes*

# Weathering | Mechanical weathering

## GY4027: Landscape Evolution



# Weathering | Chemical Weathering

GY4027: Landscape Evolution





**Residual minerals**

e.g. grains of quartz: sand



**New minerals**

e.g. clays



**Solutes**

e.g. sea salt

# Transport and Deposition | Transport Agents

GY4027: Landscape Evolution

Gravity



Water

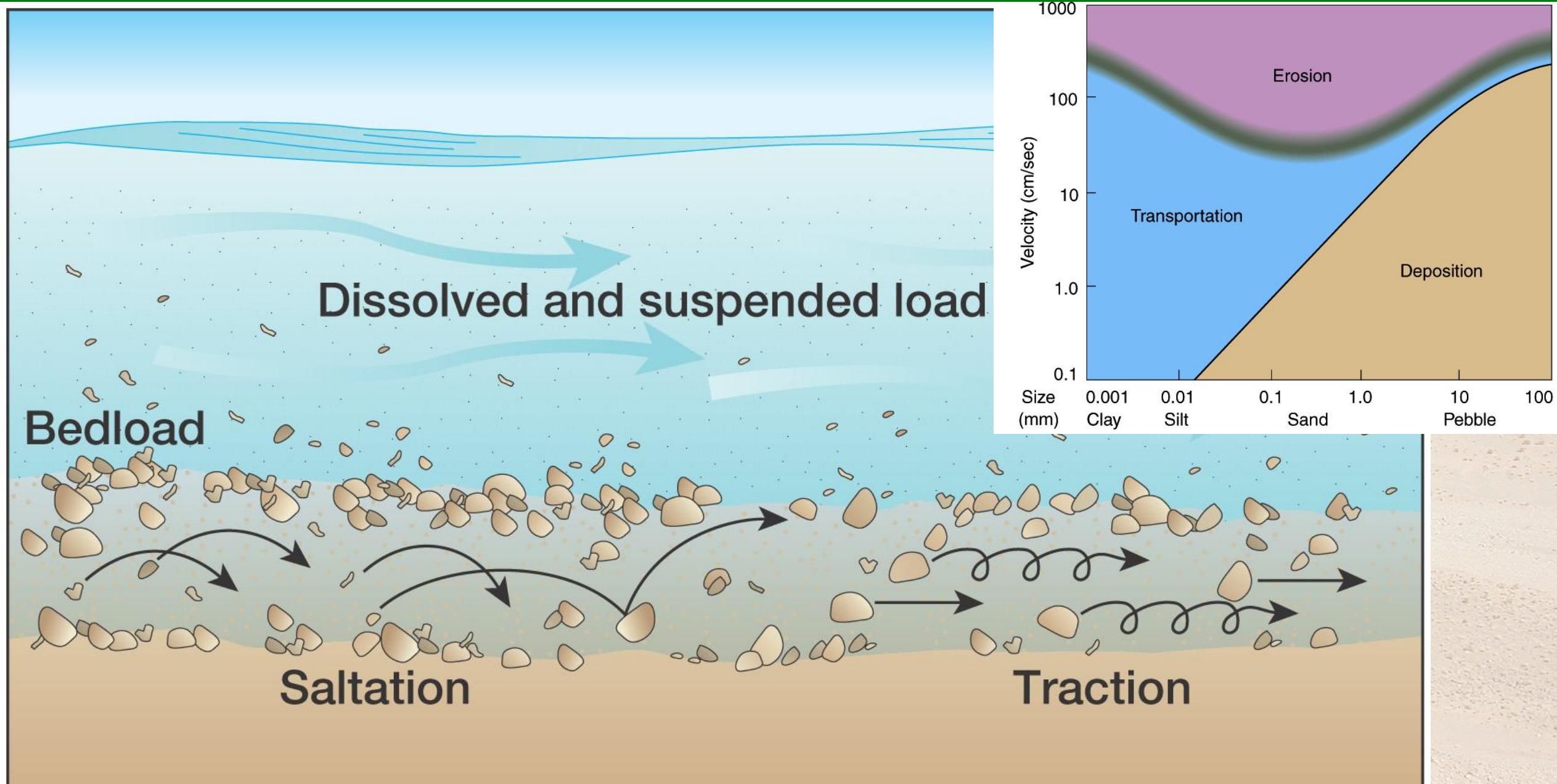


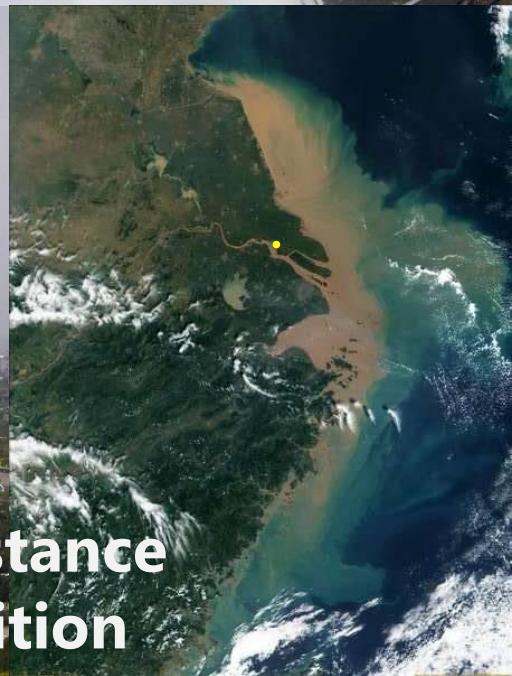
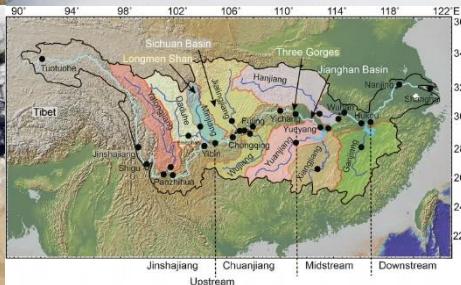
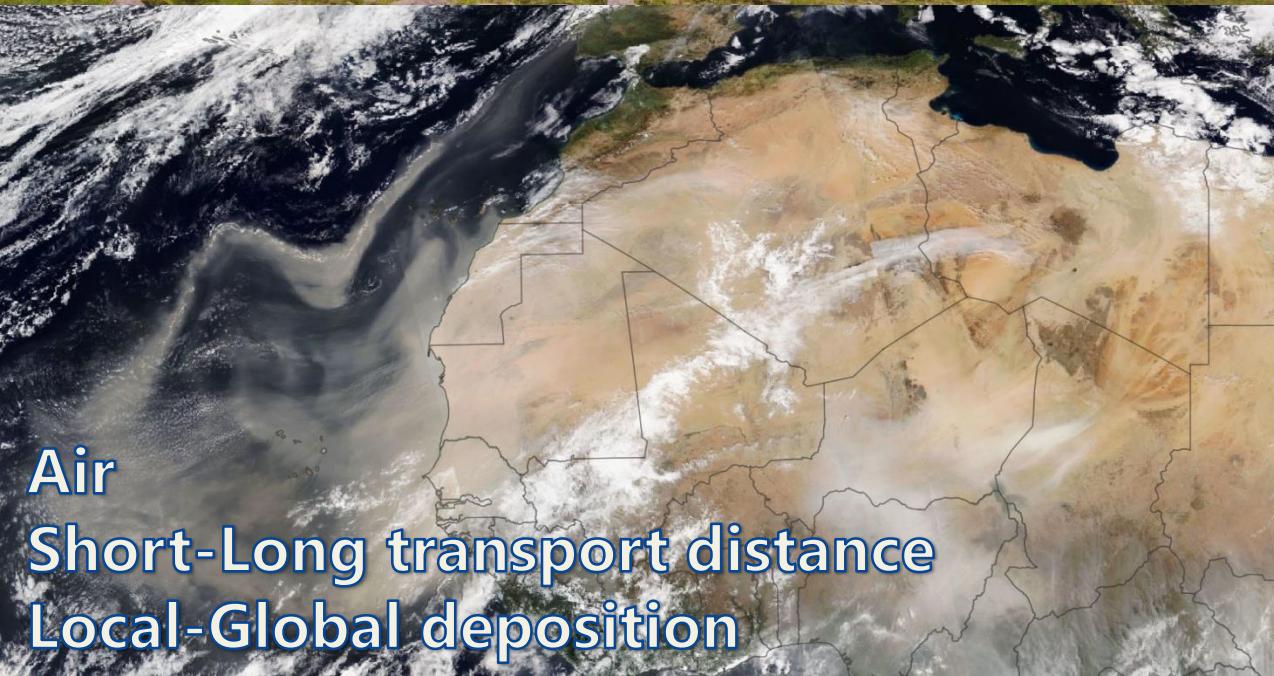
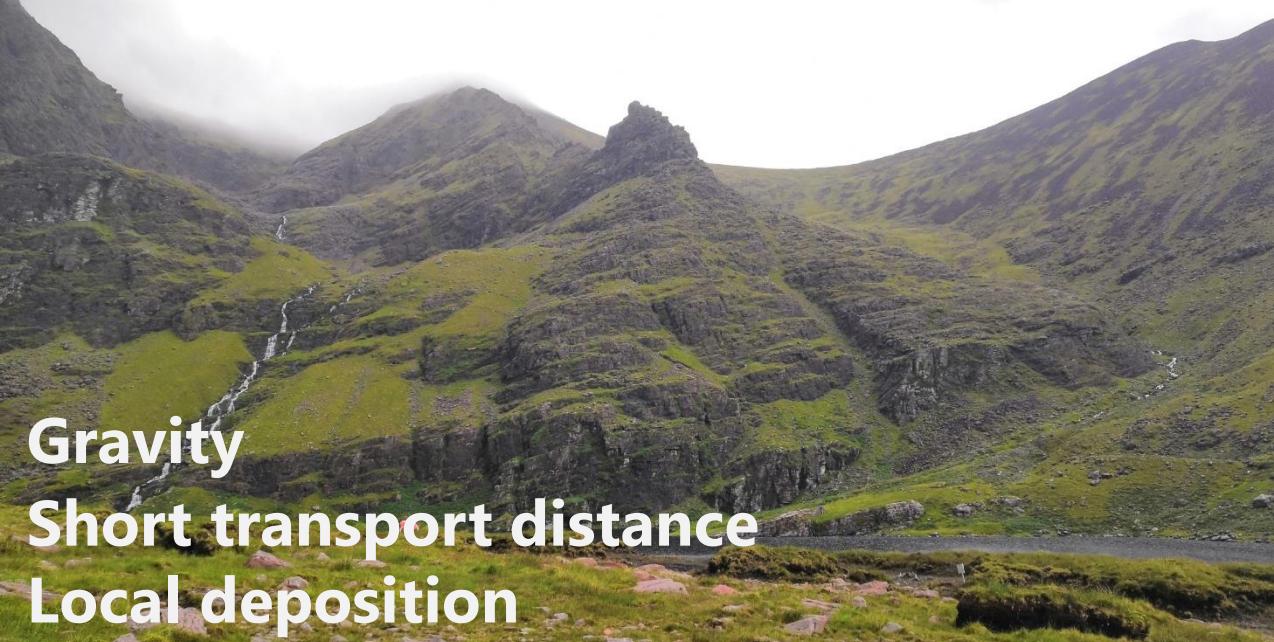
Ice

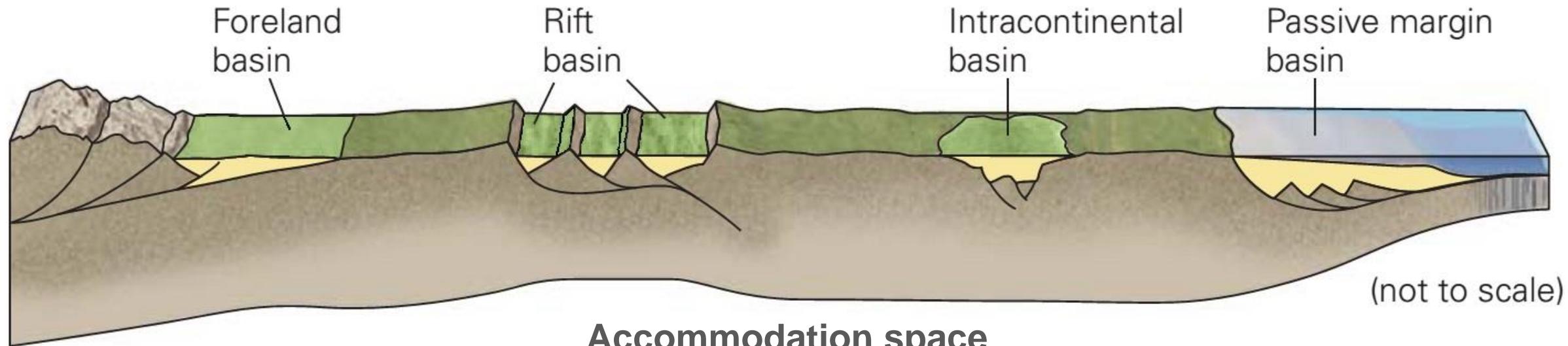


Air









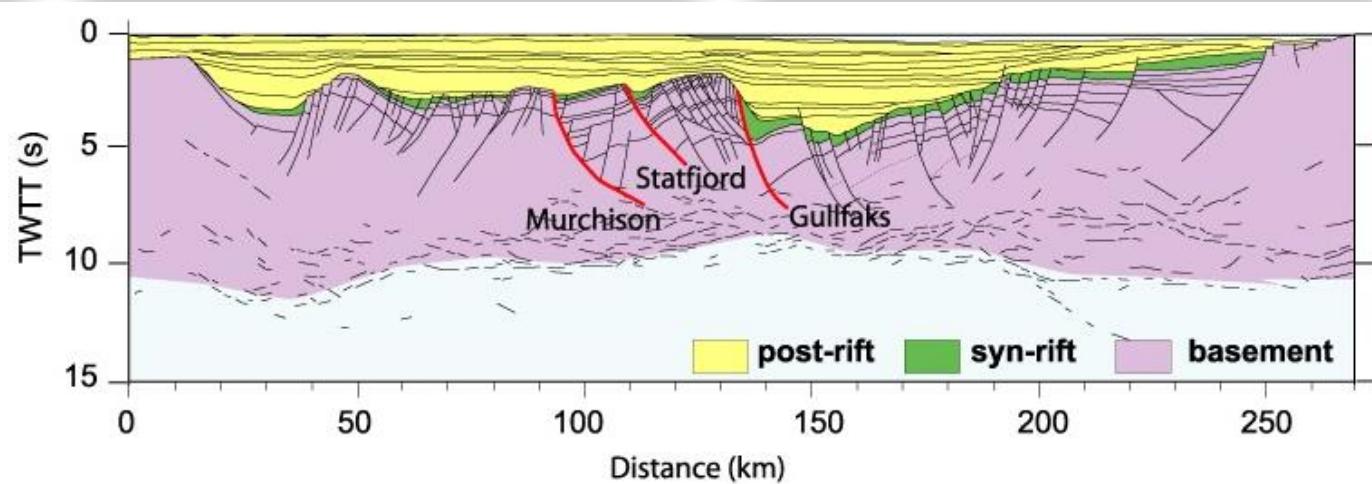
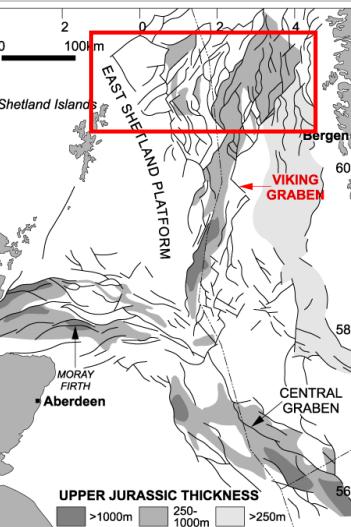
### Accommodation space

Weight of the mountain belt pushes down the crust's surface.

Downward slip on faults produces narrow troughs.

The basin forms in the interior of a continent, perhaps over an old rift.

Subsidence occurs over thinned crust at the edge of an ocean basin.



## Glacial Landscapes | Outline

- Weathering and Erosion
- Transport Agents
- Transport Processes
- Erosional Landforms
- Deposition
- Depositional Landforms
- Accommodation Space and Landscape Evolution

# Weathering

- Mechanical weathering
- Chemical weathering
- Biological weathering



### Mechanical Erosion | Stordalen, Norway

- Freeze-thaw
- Unloading - stress release
- Coarse angular shattered debris



## Mechanical Erosion

- Abrasion and gravity
- Coarse angular shattered debris

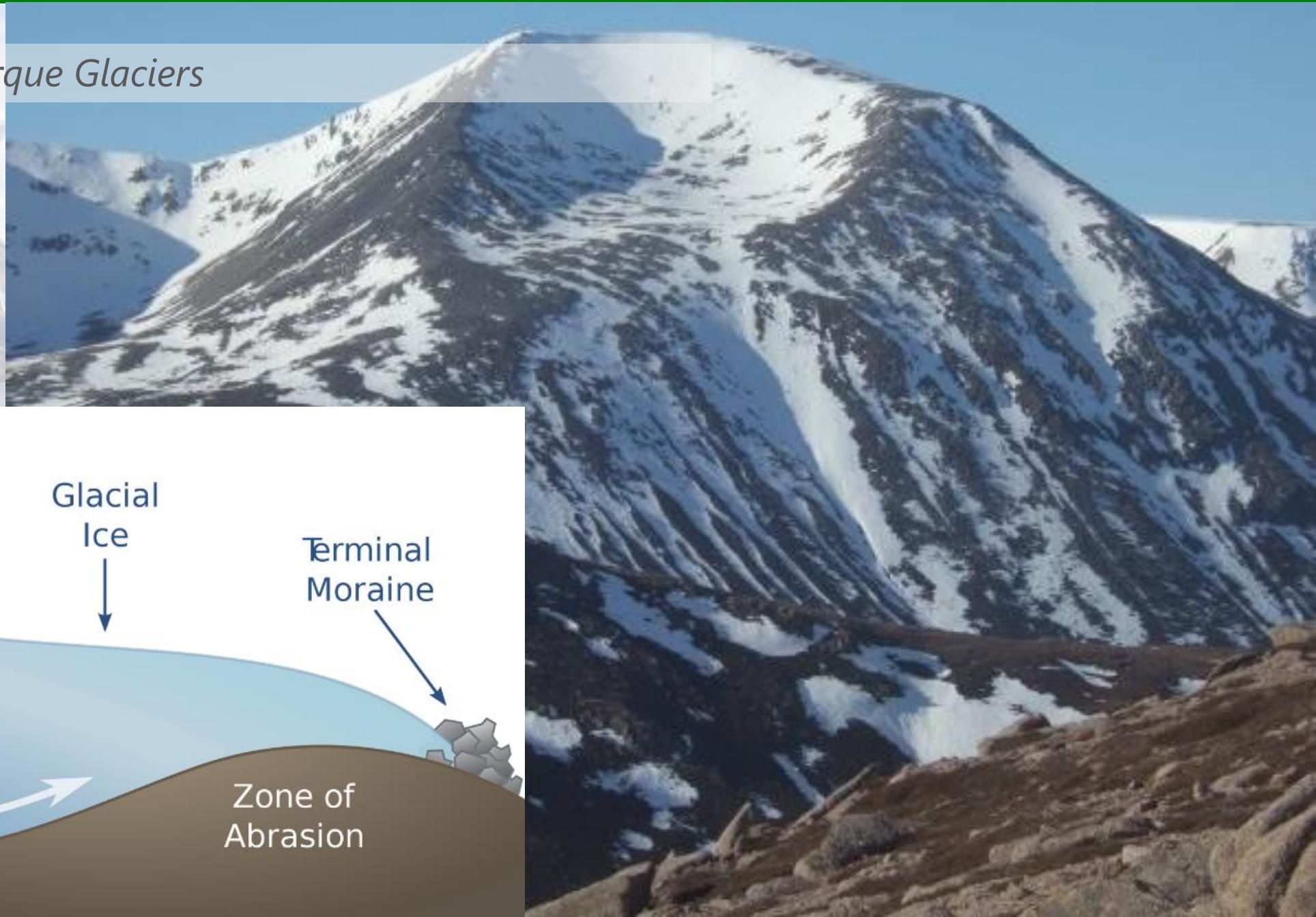
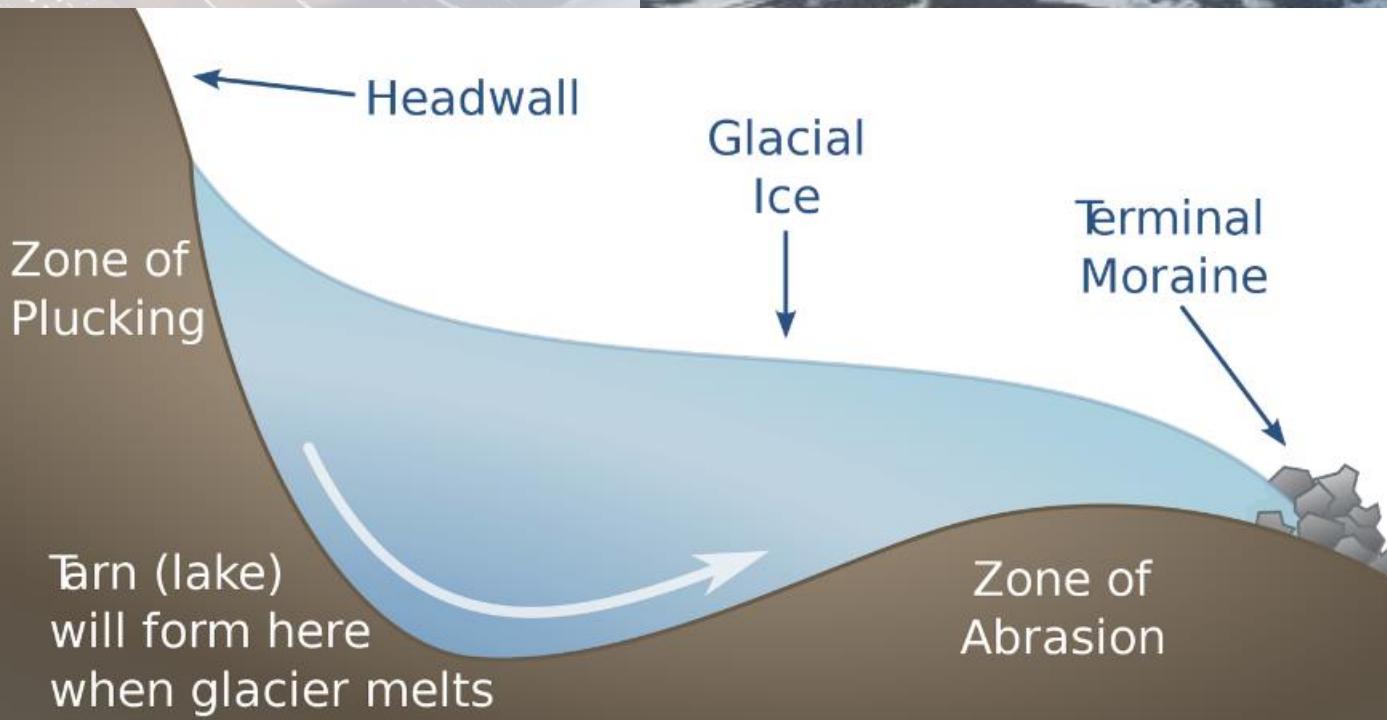


## Transport - agents

- Gravity
- Water
- Ice



## Snow Compaction | Cirque Glaciers





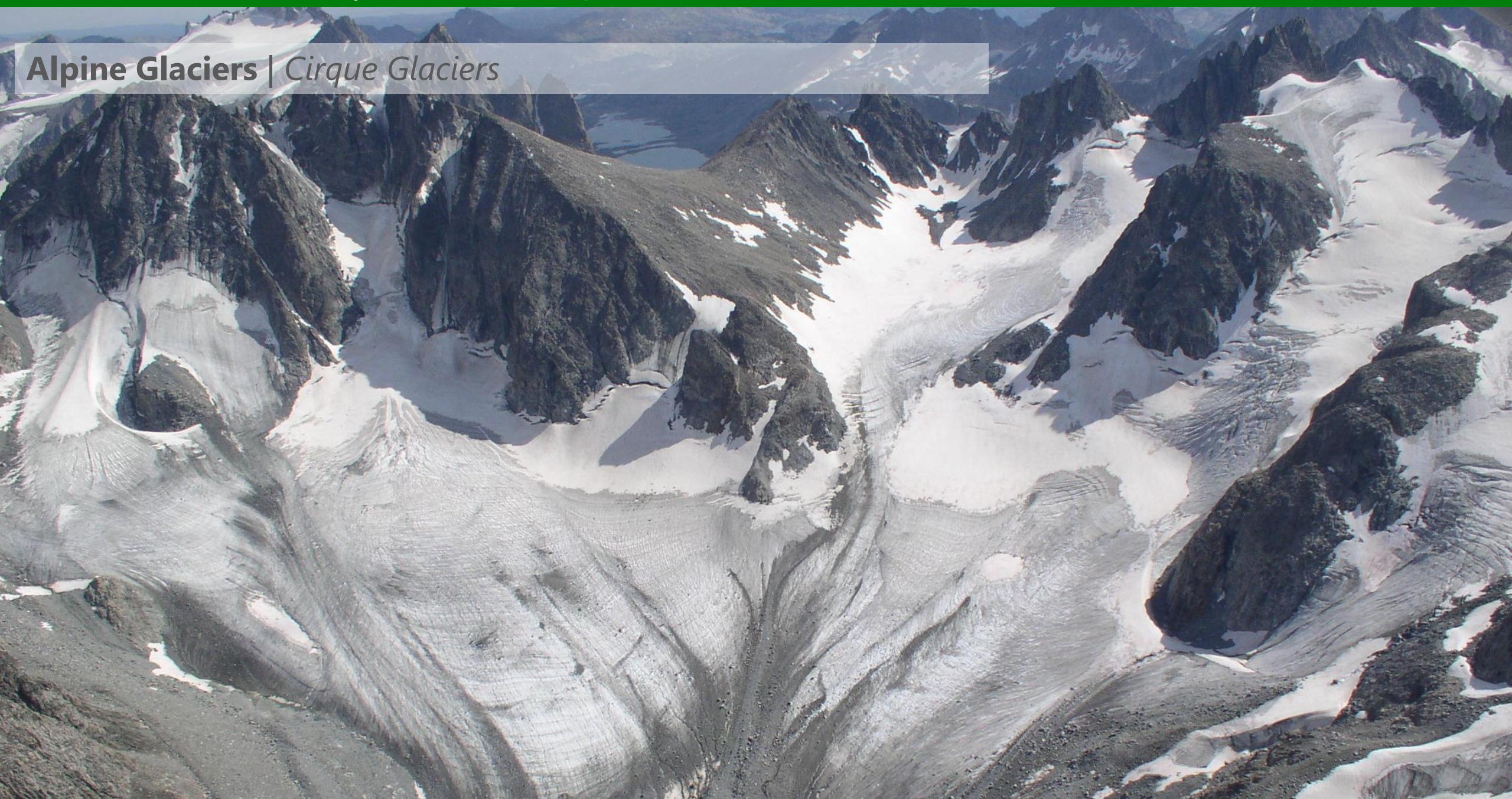
Snow Compaction | Malbun, Liechtenstein



**Snow Compaction** | Malbun, Liechtenstein

**Snow Compaction** | *Malbun, Liechtenstein*





Alpine Glaciers | Cirque Glaciers

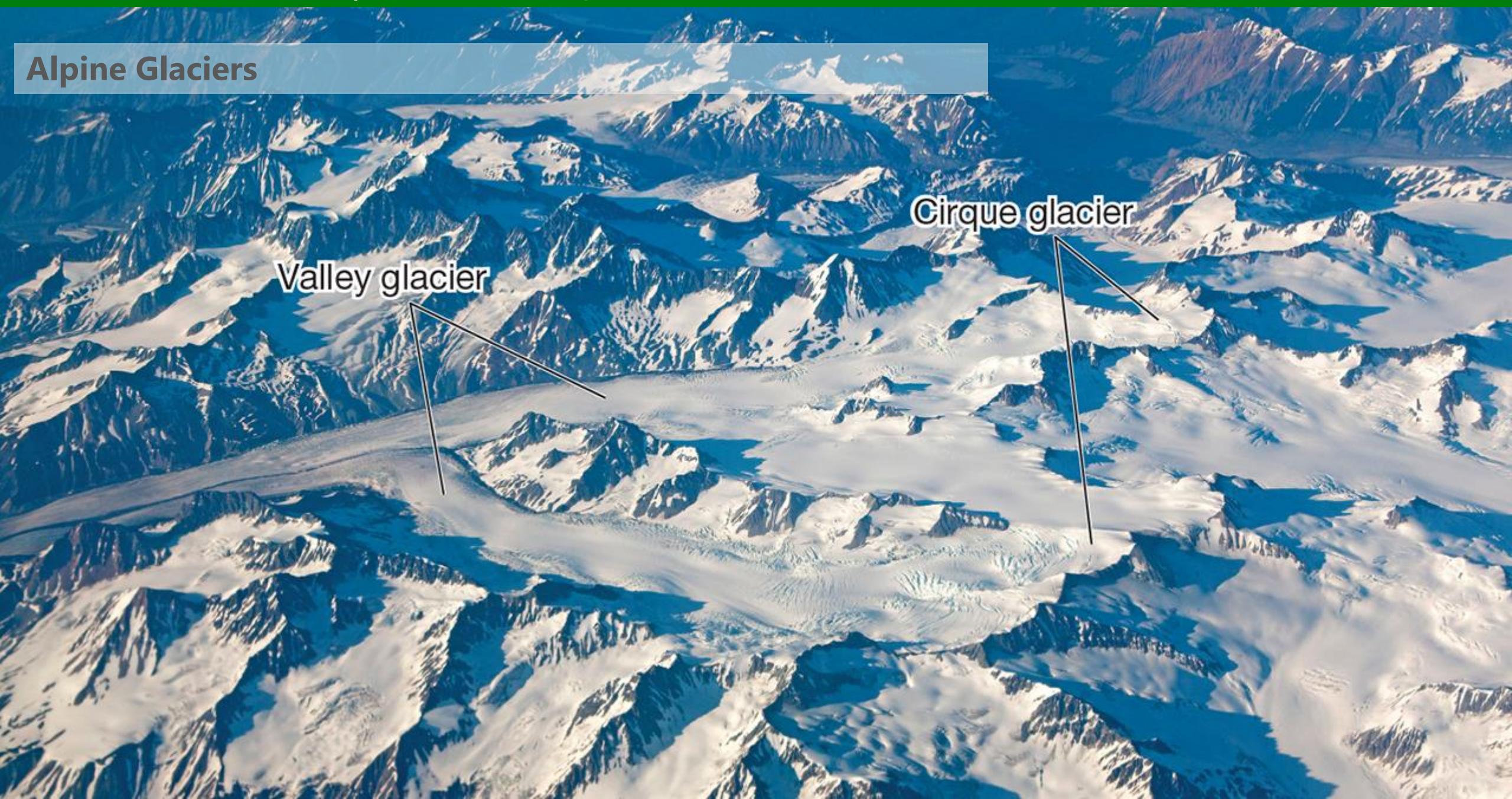
## Alpine Glaciers | Cirque Glaciers



## Alpine Glaciers | Valley Glaciers



## Alpine Glaciers

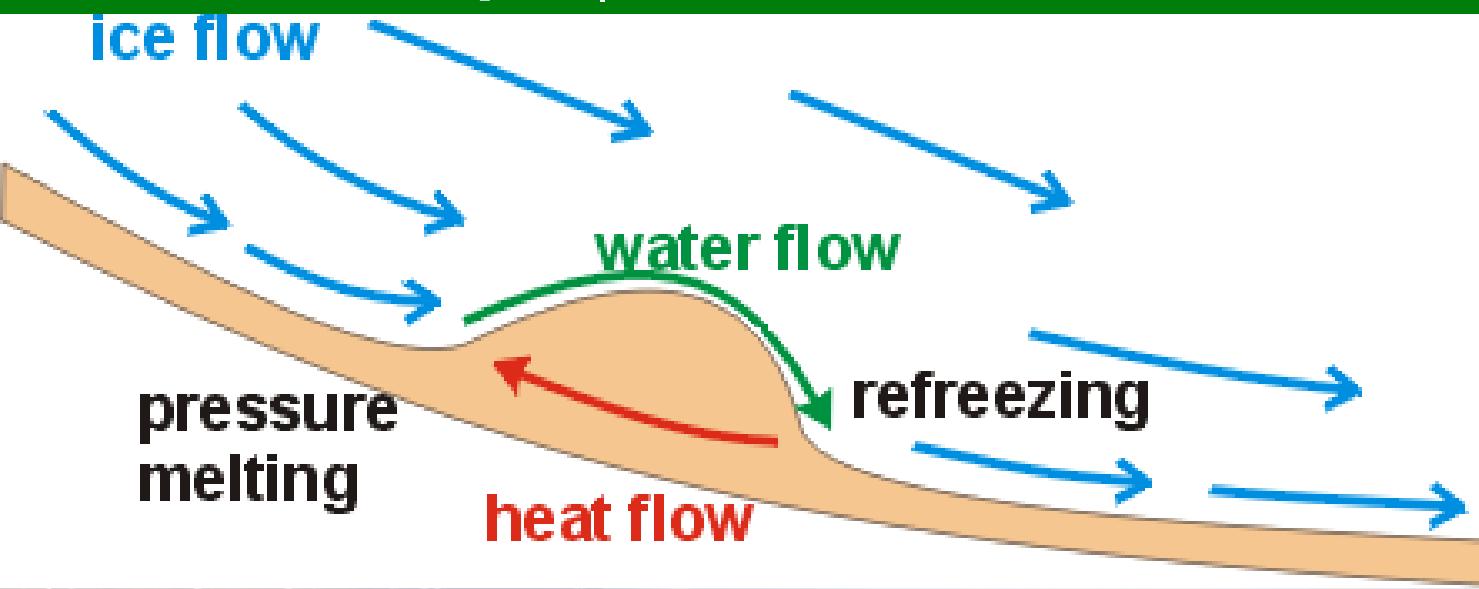


## Alpine Glaciers | Piedmont Glaciers

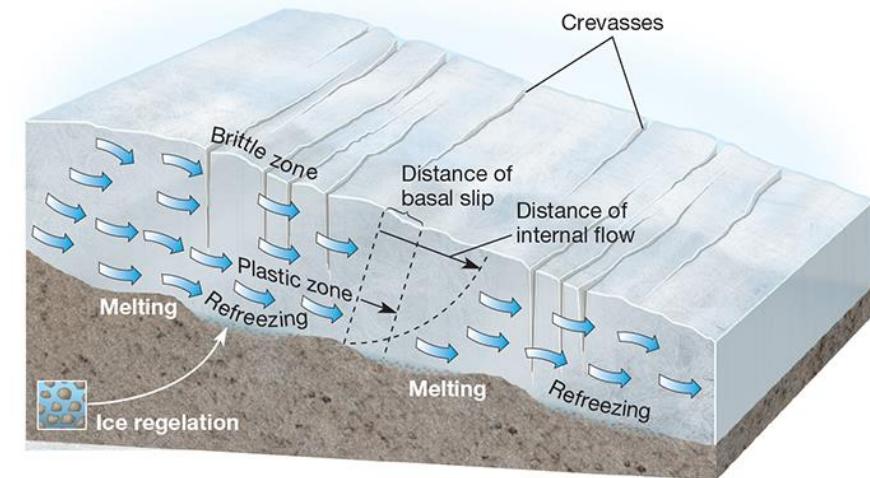




Alpine Glaciers | Piedmont Glaciers



- Internal plastic flow
  - Deformation of ice crystal structure - creep
- Basal sliding
  - Meltwater at the base of the glacier
- Zone of fracture
  - Upper 50m
  - Crevasses



(a) Cross section of a glacier, showing its forward motion, brittle cracking at the surface, and flow along its basal layer.

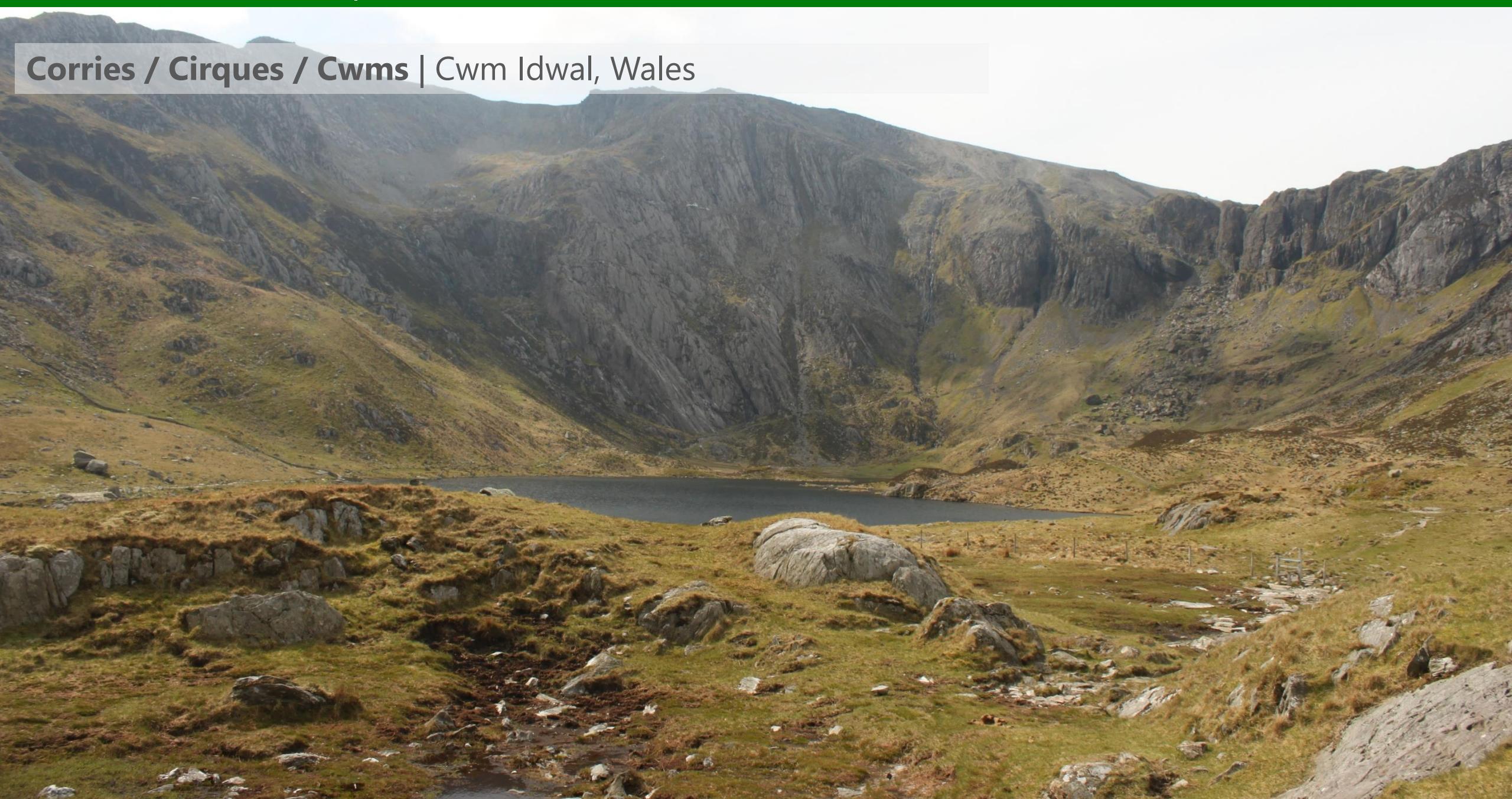


(b) Surface crevasses are evidence of forward movement on the Fox Glacier, South Island, New Zealand.

### Corries / Cirques / Cwms | Coumshingaun, Waterford



Corries / Cirques / Cwms | Cwm Idwal, Wales

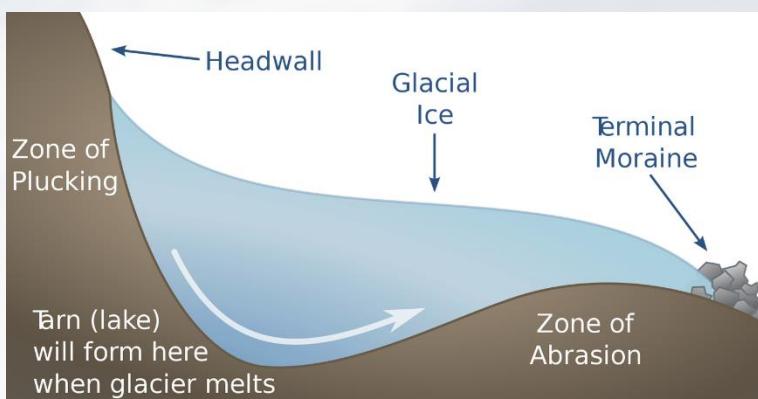


**Horn**



Source: <http://www.ivo.se/mike/matter.html>

**Horn** – 3 or more cirque headwalls leaves a sharp spire-shaped peak e.g. Matterhorn, Switzerland.



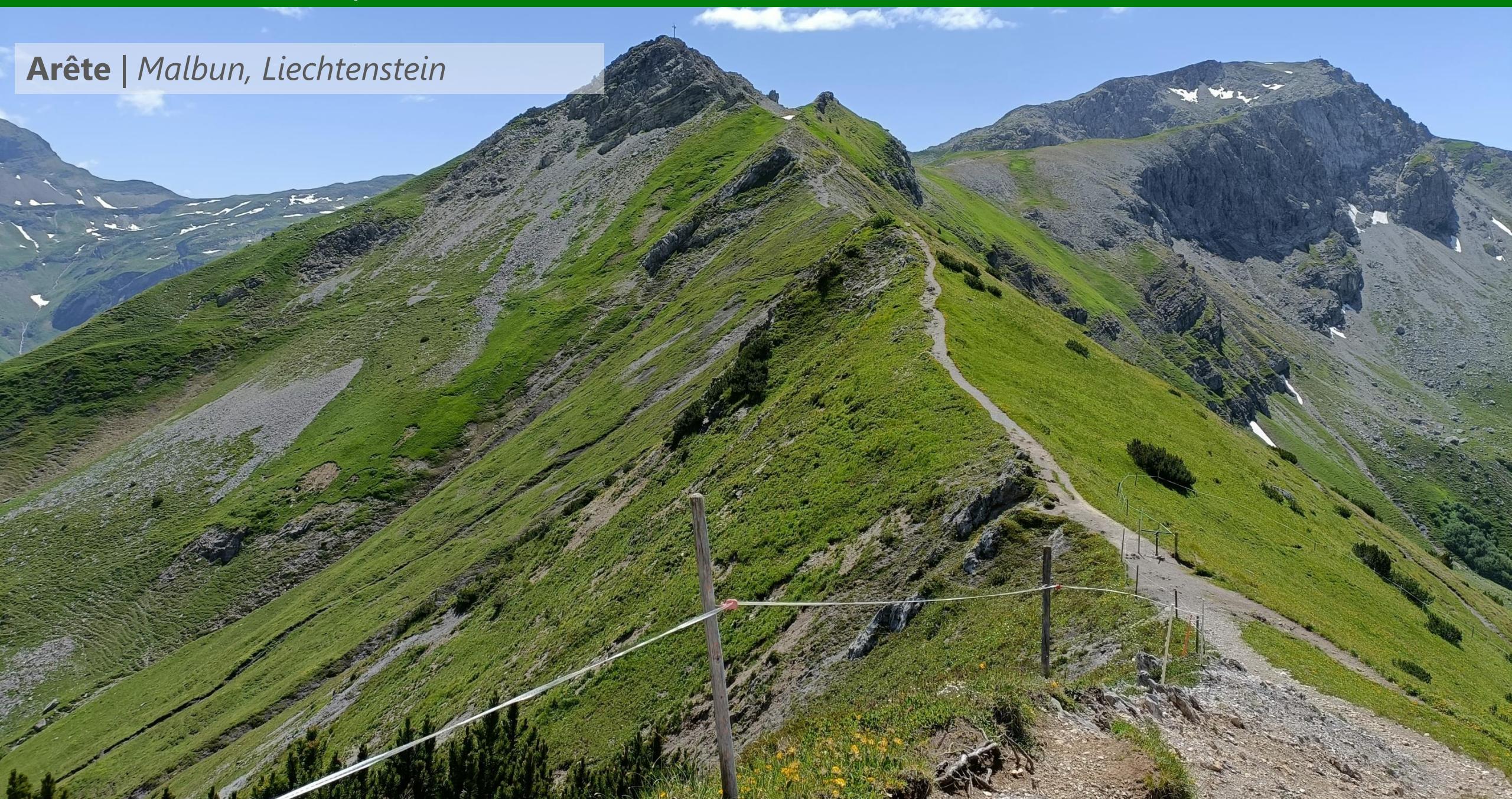
**Arête**



Source: <http://www.zephyrus.demon.co.uk/geography/resources/glaciers/arete.html>

**Arête** – divide between 2 cirque headwalls e.g. Striding Edge, UK

Arête | Malbun, Liechtenstein



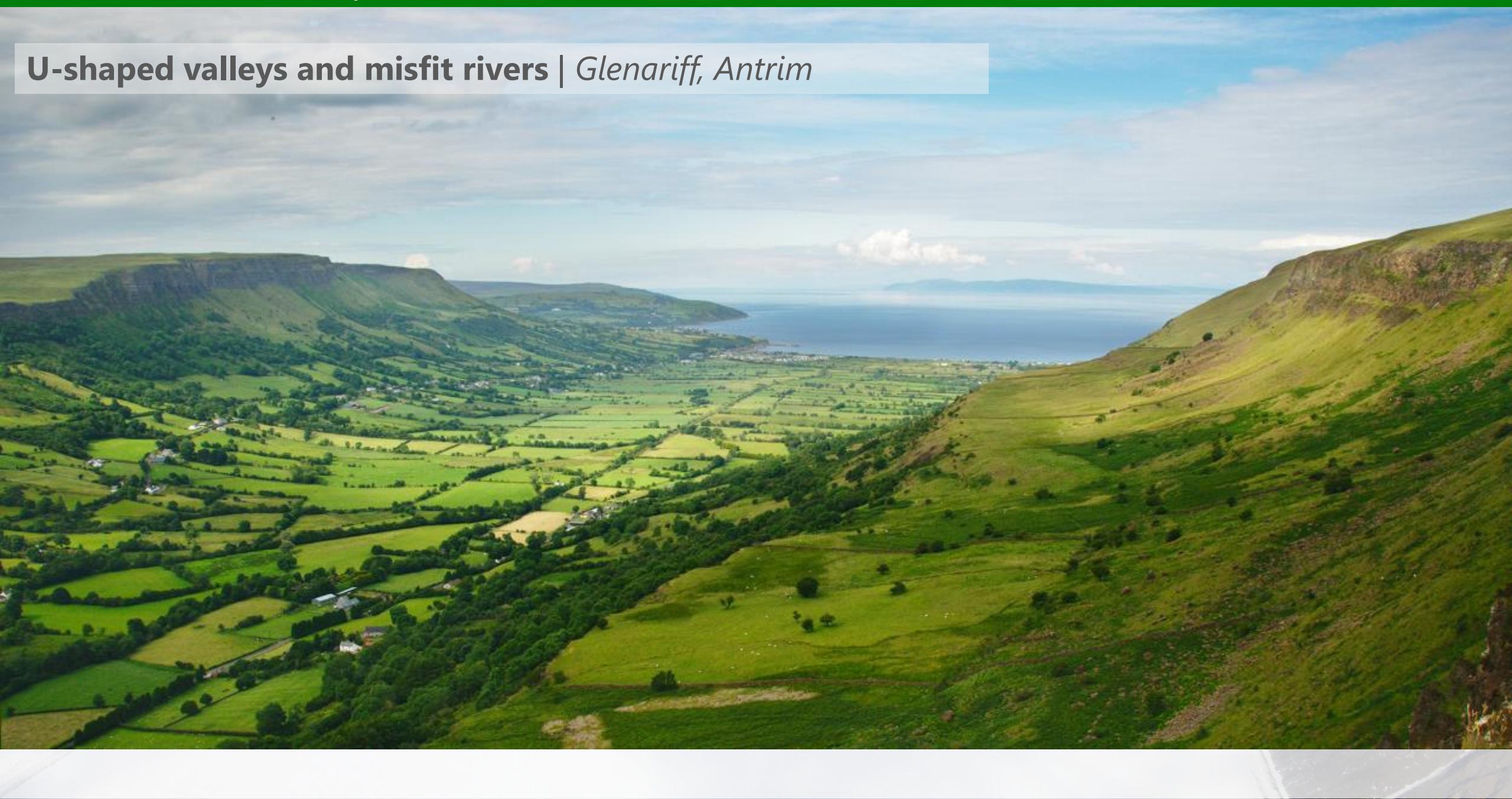
## U-shaped valleys and misfit rivers



U-shaped valleys and misfit rivers | Nant Ffrancon, Wales



**U-shaped valleys and misfit rivers | Glenariff, Antrim**



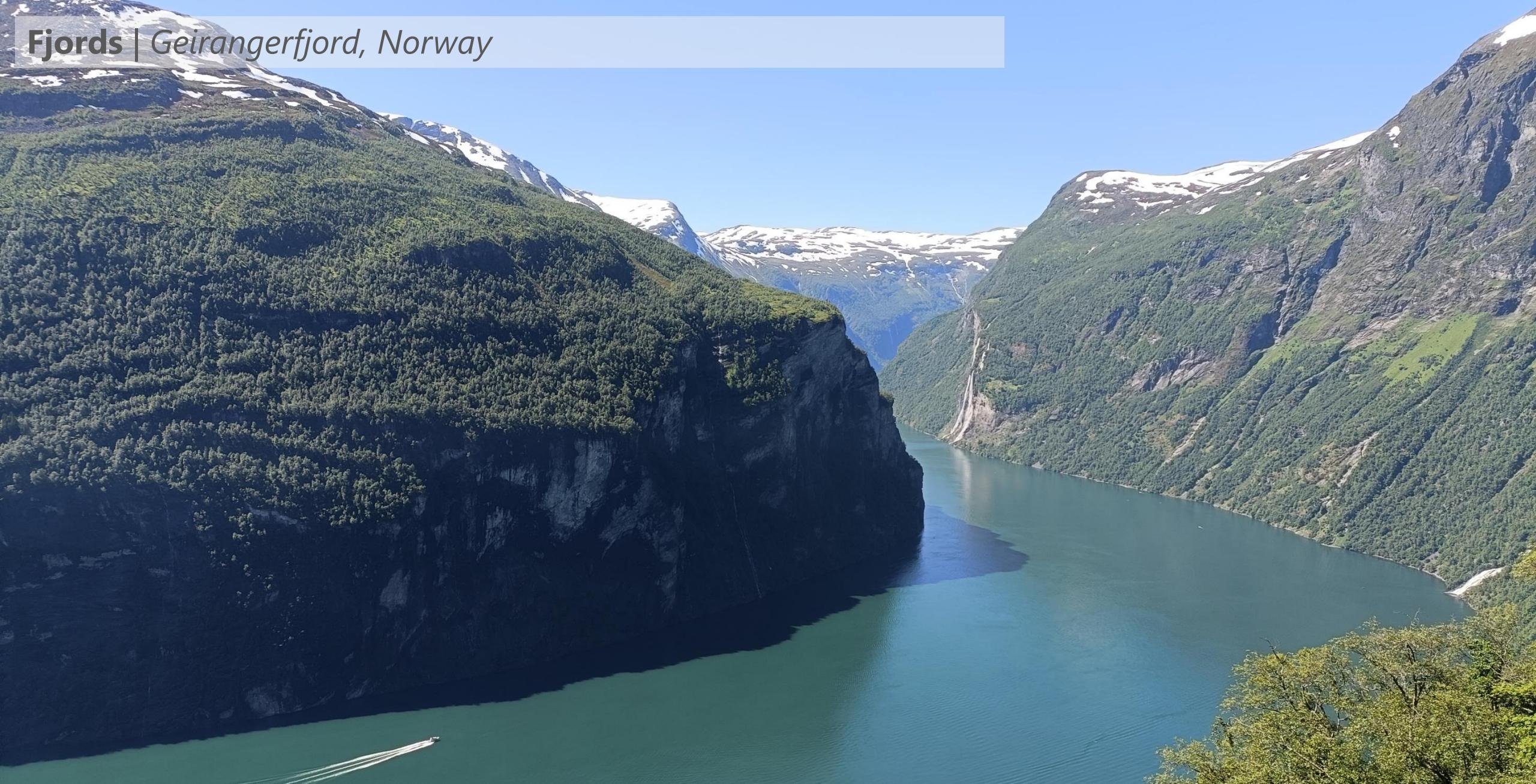
**U-shaped valleys and misfit rivers | Sylte, Norway**



U-shaped valleys and misfit rivers | Trollstigen, Norway



Fjords | Geirangerfjord, Norway



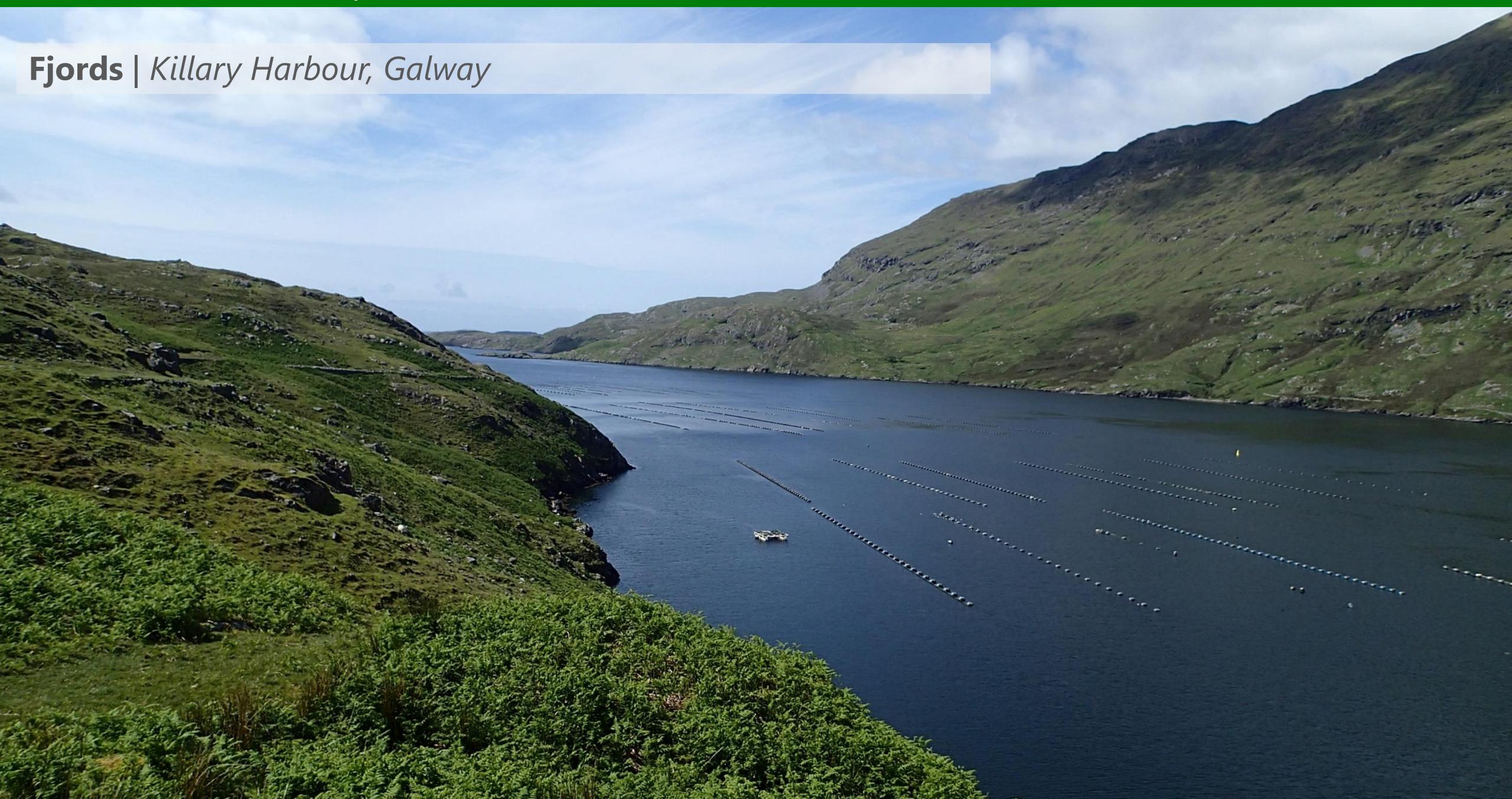
Fjords | Killary Harbour, Galway



Fjords | Killary Harbour, Galway



### Fjords | Killary Harbour, Galway



### Glacial Erosion | Pavements and Striations



#### Glacial pavements

- Surfaces smoothed by glacial erosion

#### Striations

- Linear grooves cut by glacial erosion

### Pavements and Striations | Killary Harbour



## Pavements and Striations | Killary Harbour

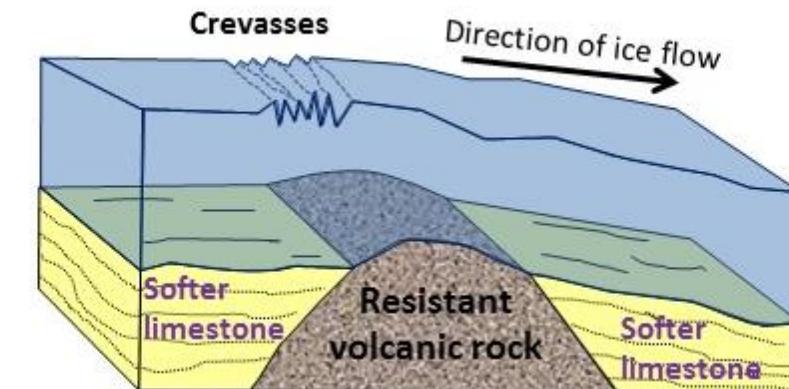


## Pavements and Striations | Killary Harbour

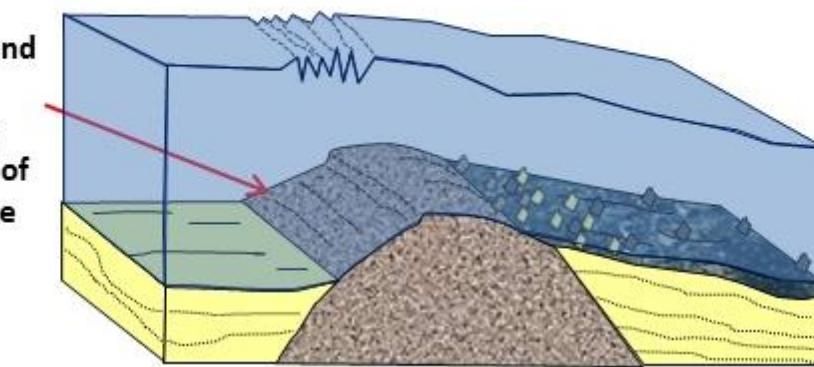


Pavements and Striations | Killary Harbour

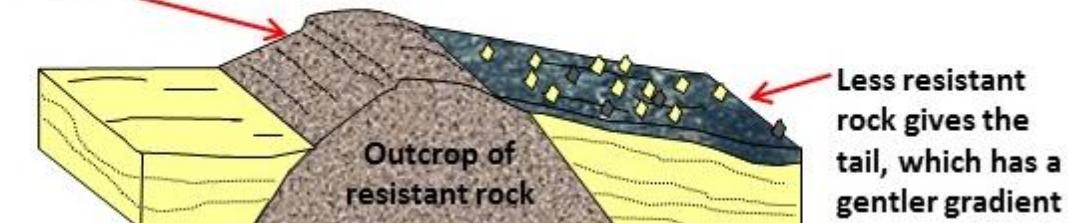




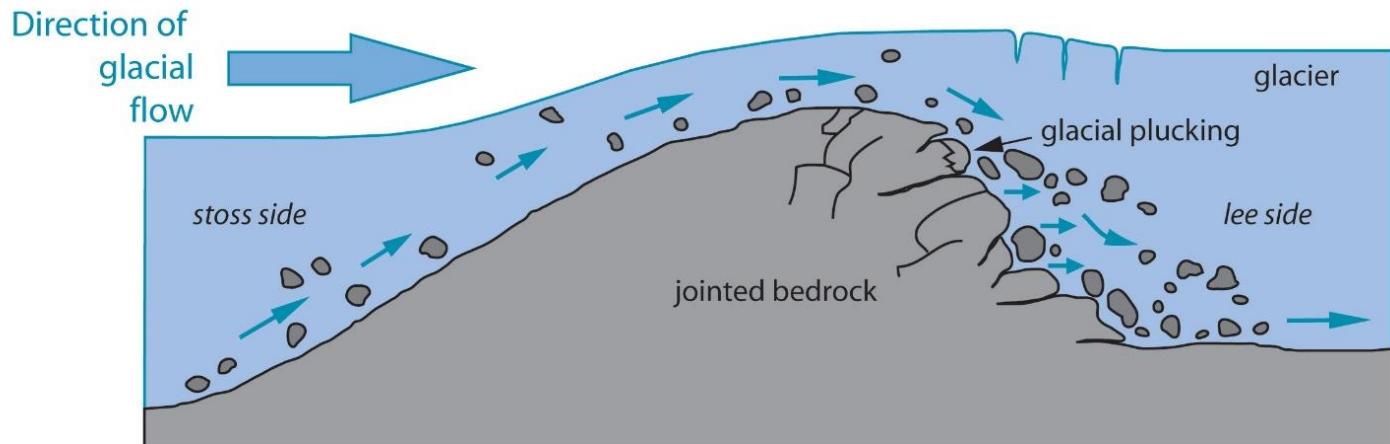
Plucking and abrasion erode the stoss side of the feature



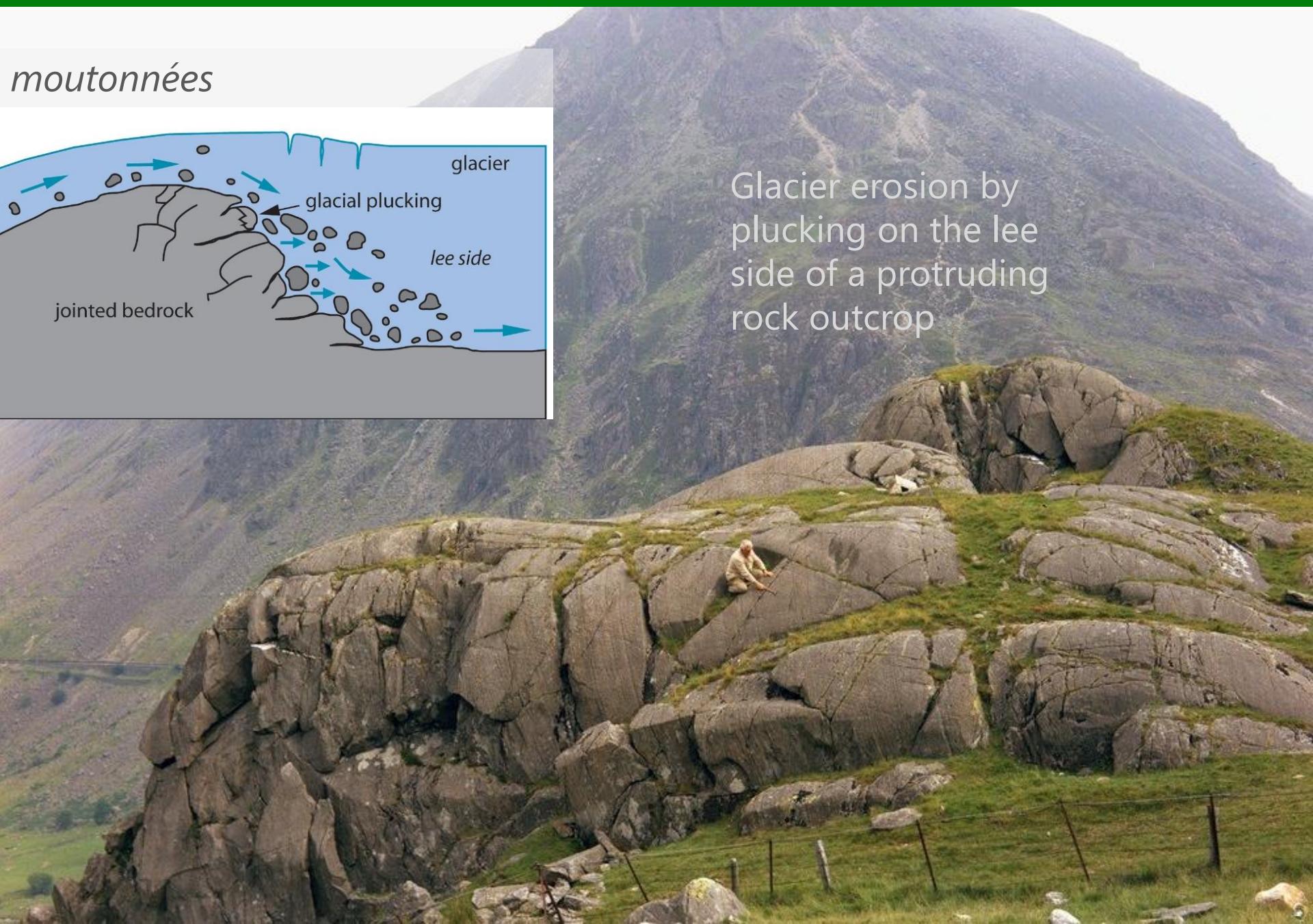
Crag is steep sided and has cracks in it from plucking



### Glacial Erosion | *Roches moutonnées*



Glacier erosion by plucking on the lee side of a protruding rock outcrop



# Glacial Deposition | Erratics



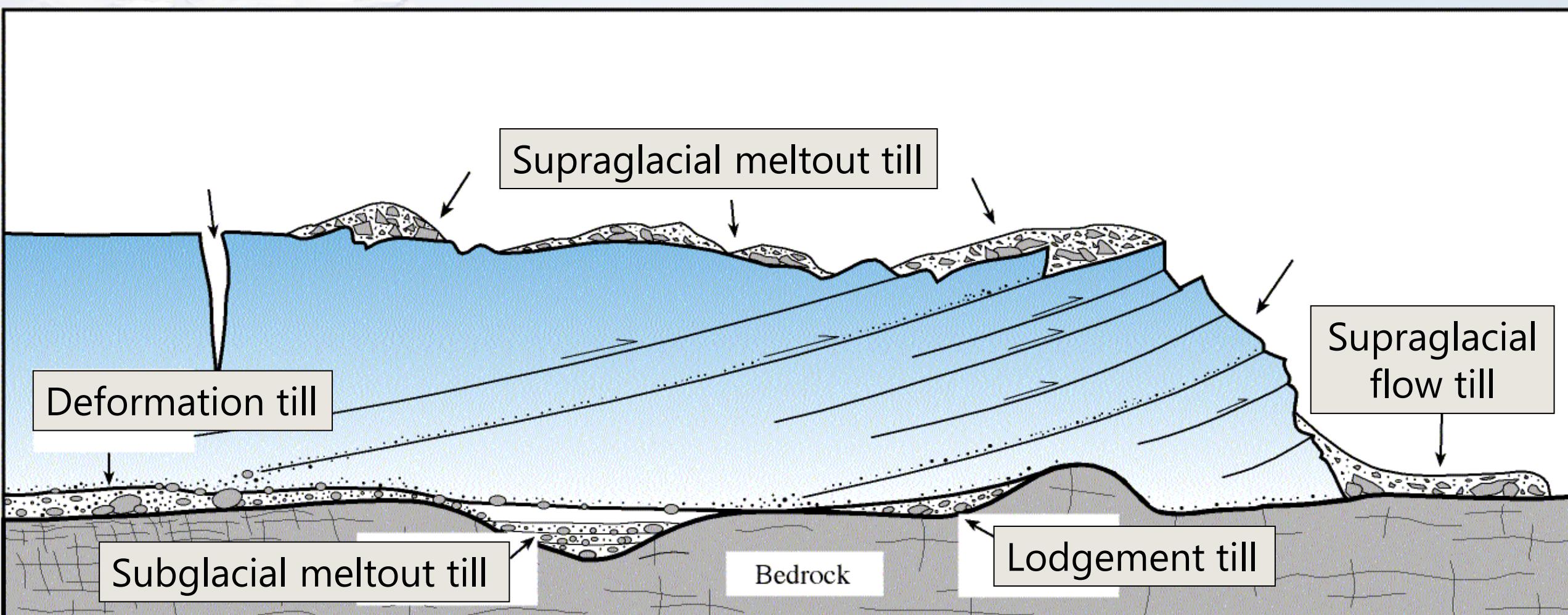
Clasts carried by  
glaciers a long  
distance from their  
provenance

Usually noted as large boulders, but also applies to small extrabasinal clasts

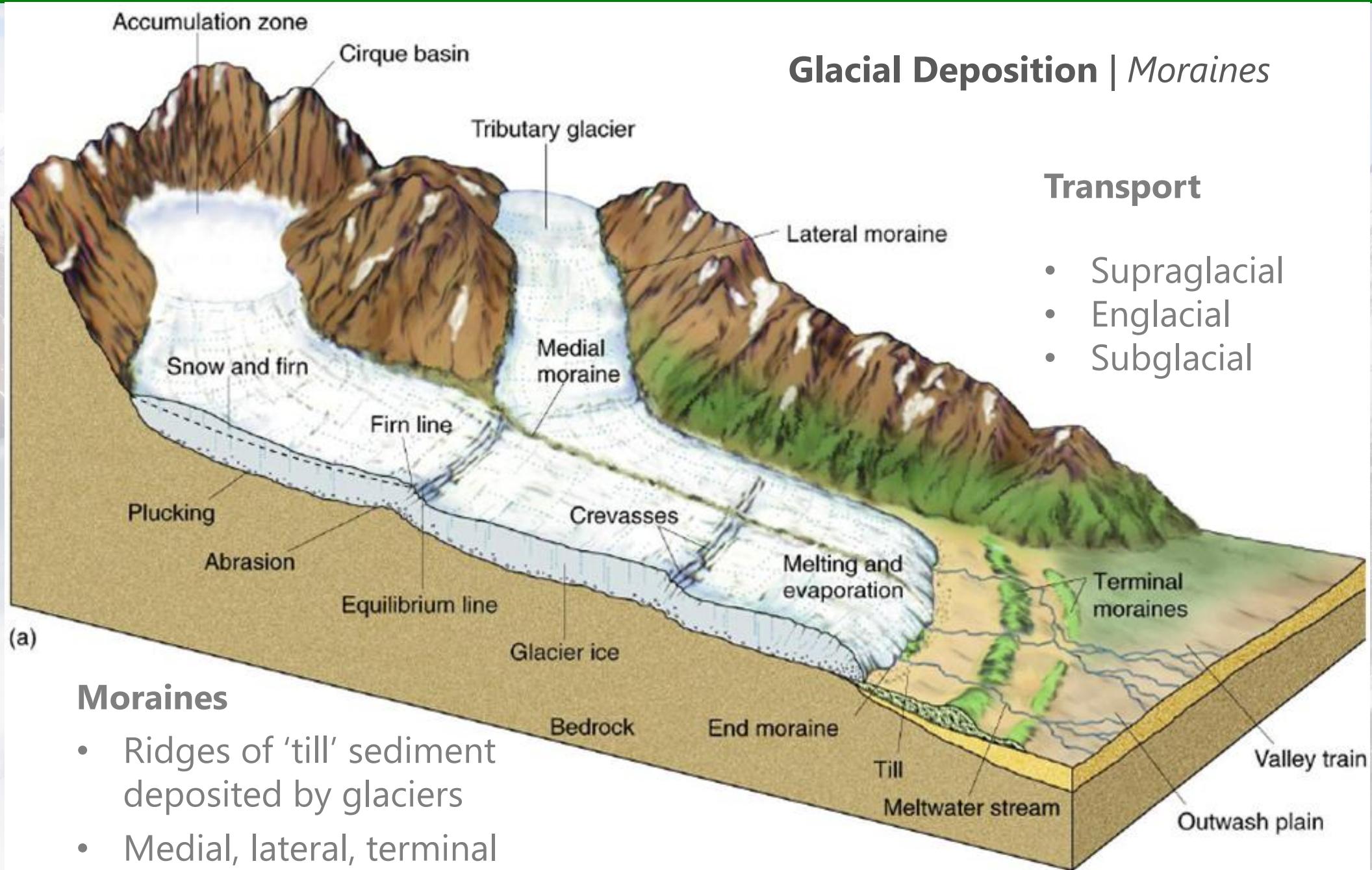


Erratics | Lumsdin's Bay, Wexford

### Glacial Deposition | Till



## Glacial Deposition | Moraines



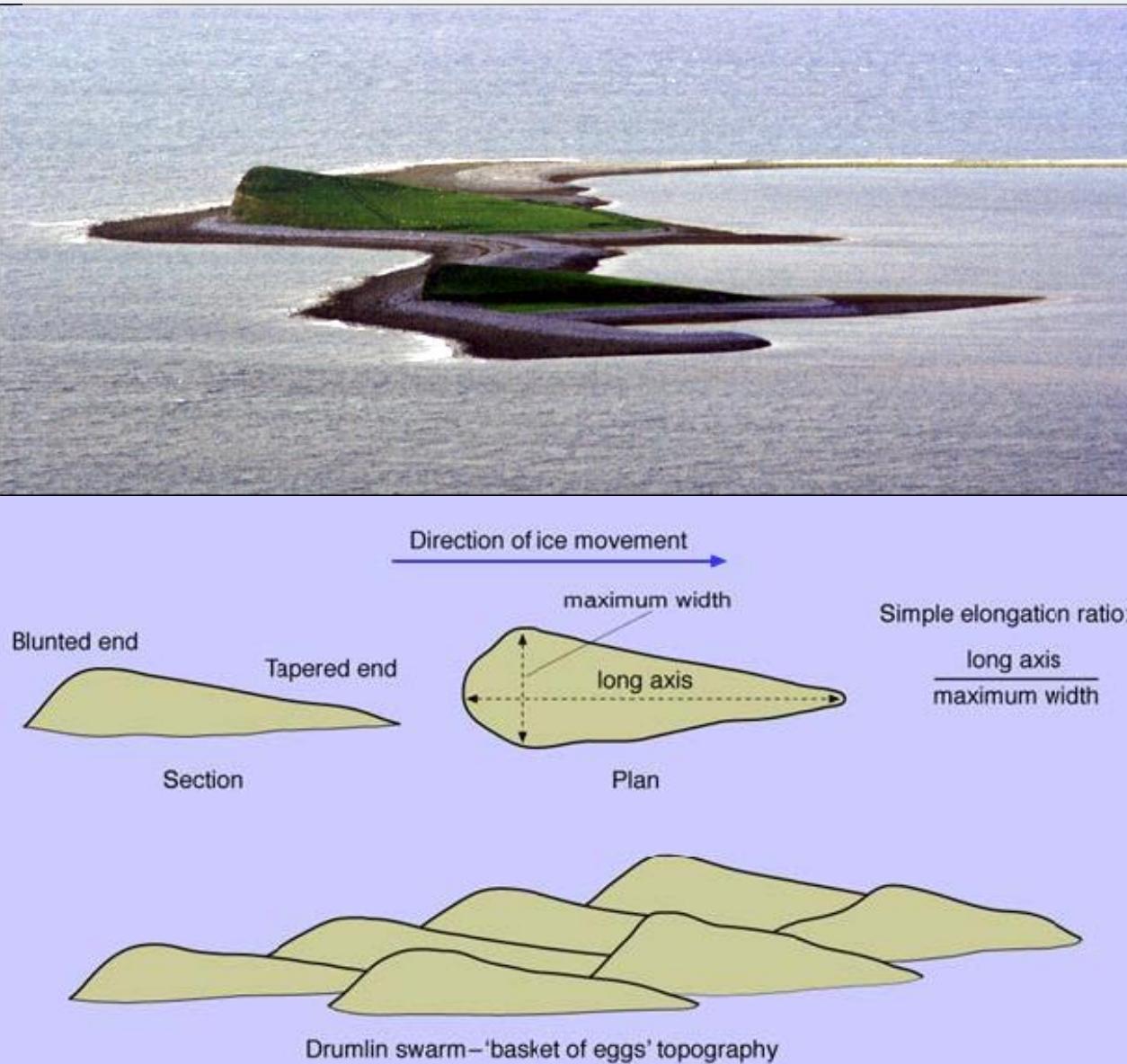
Glacial Deposition | Moiraine



## Glacial Deposition | Moraines

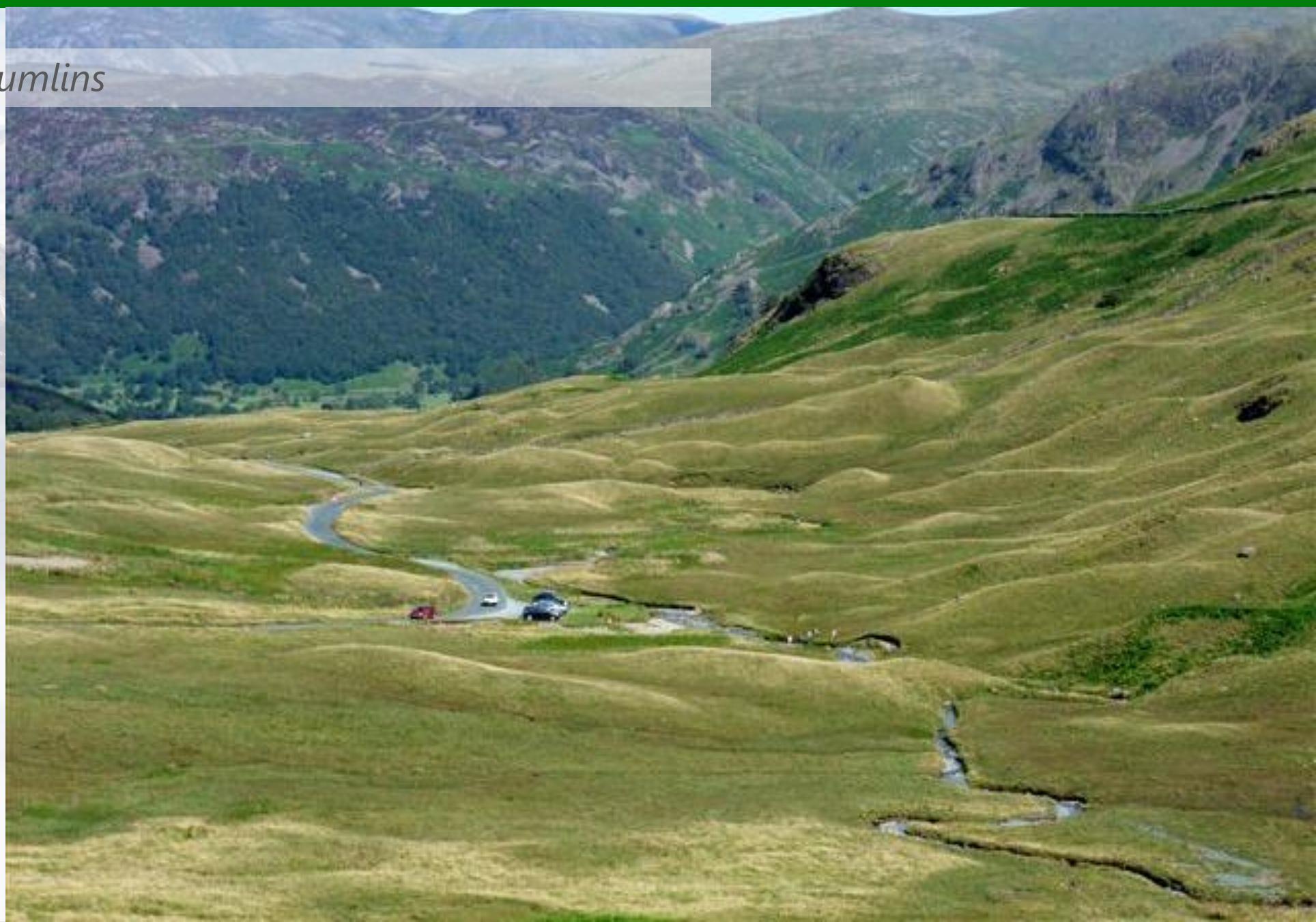


### Glacial Deposition | Drumlins



'Egg-shaped' hills of 'till' sediment shaped by movement of glaciers

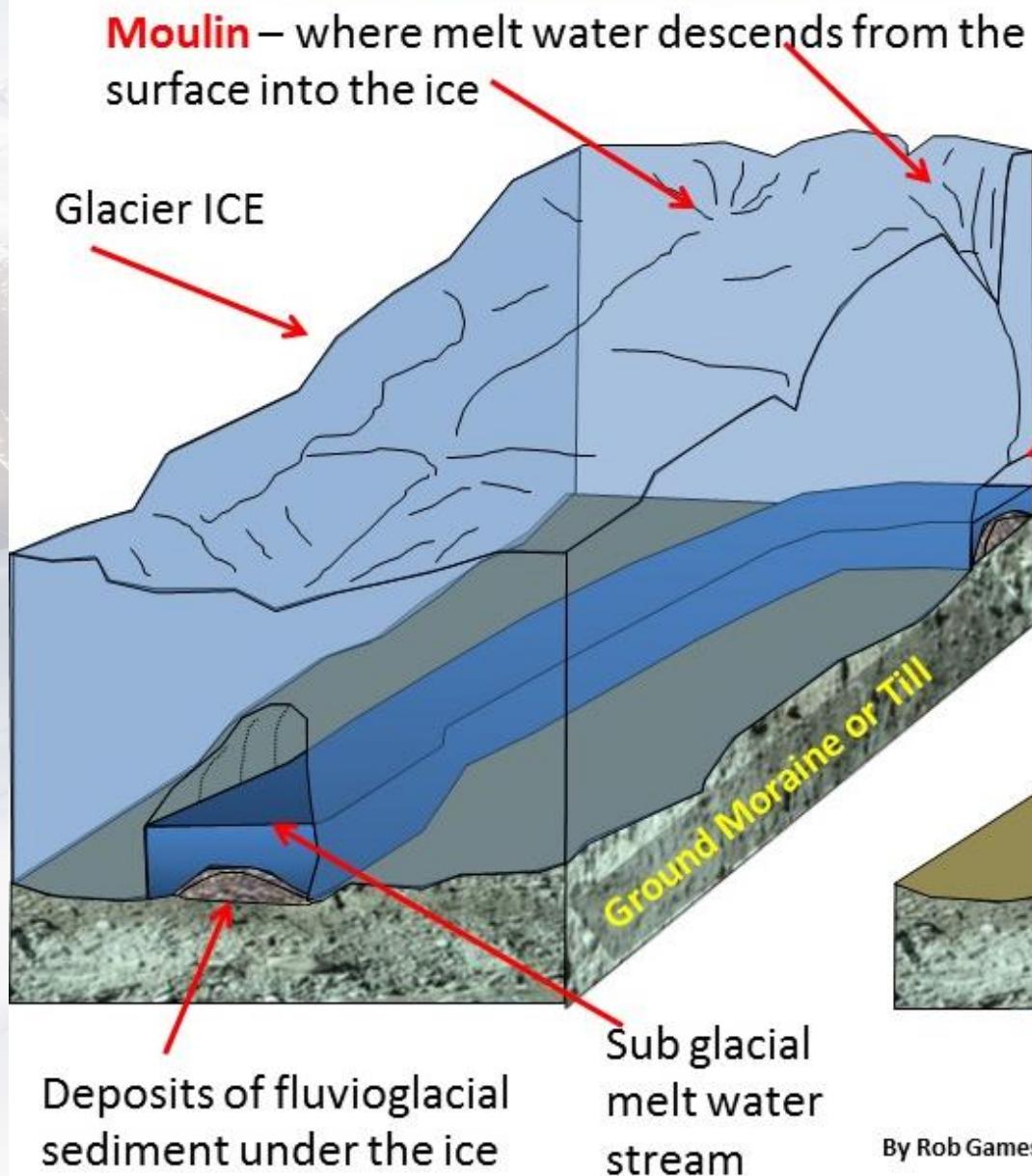
## Glacial Deposition | Drumlins



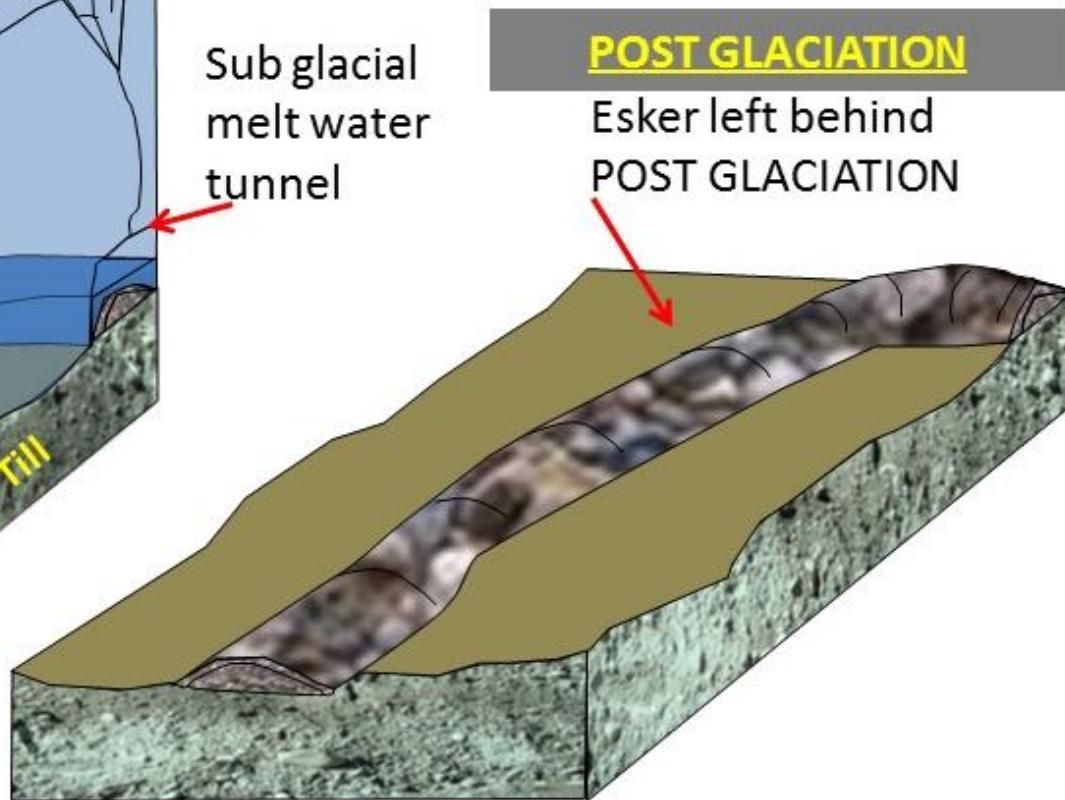
### Drumlins | Connemara



### DURING GLACIAL PERIODS



### Glacial Deposition | Eskers



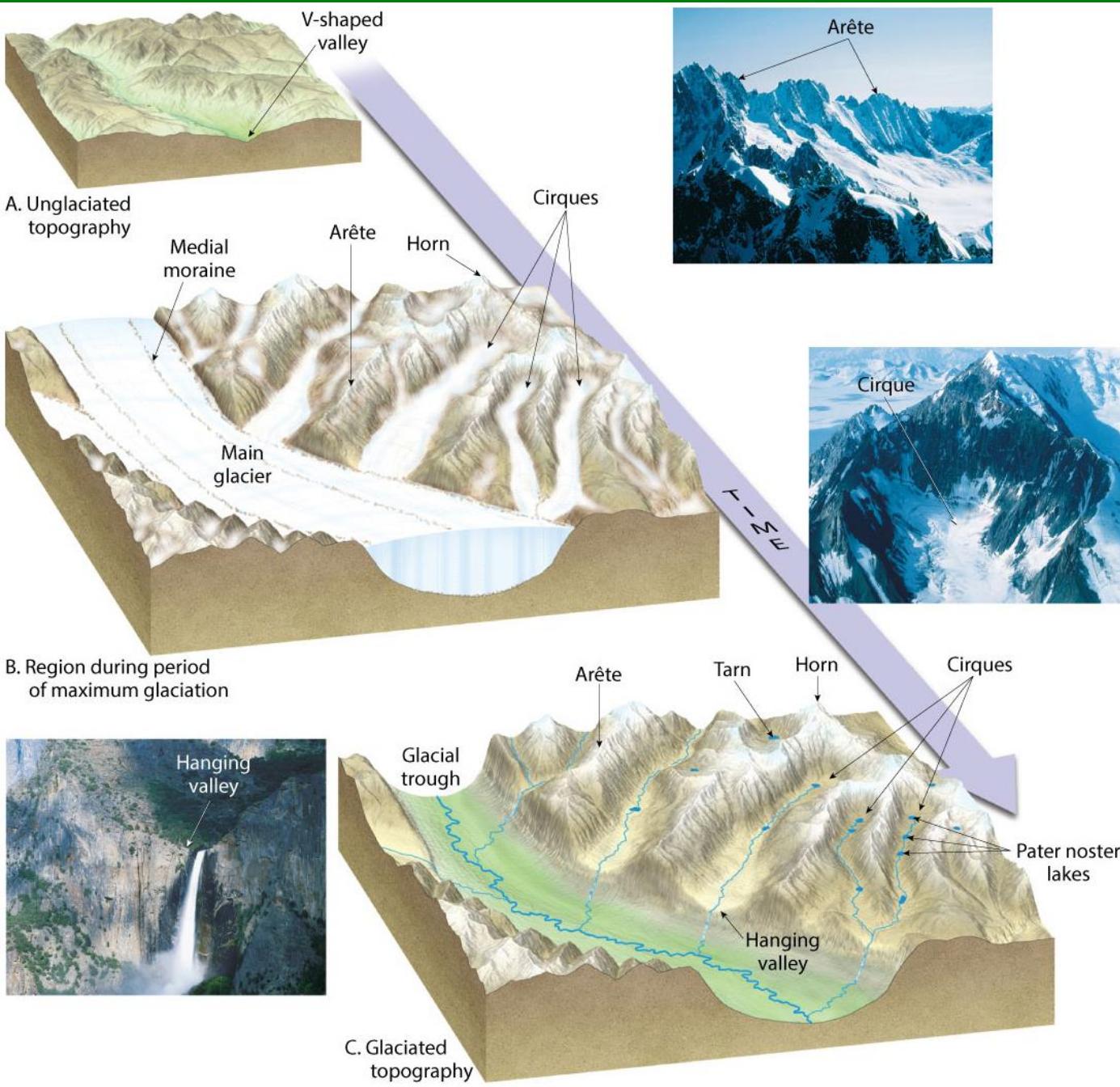
## Glacial Deposition | *Eskers*



# Glacial Landscapes | *Glacial Landscapes*

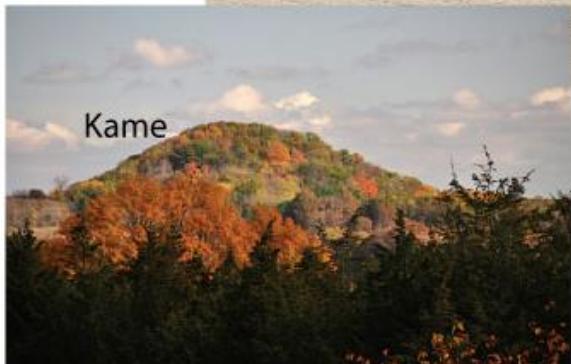
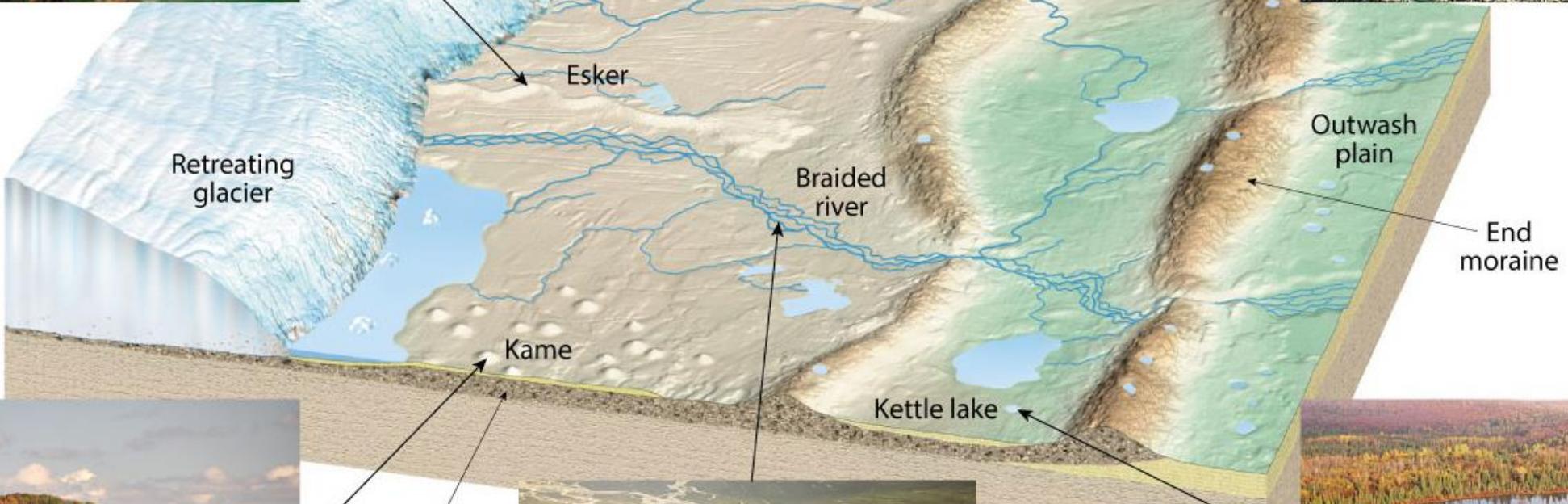
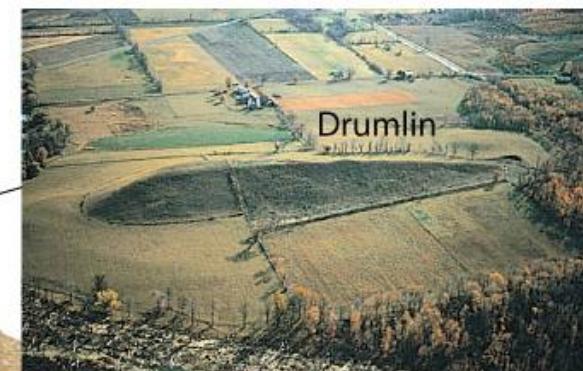
GY4027: Landscape Evolution

Erosional

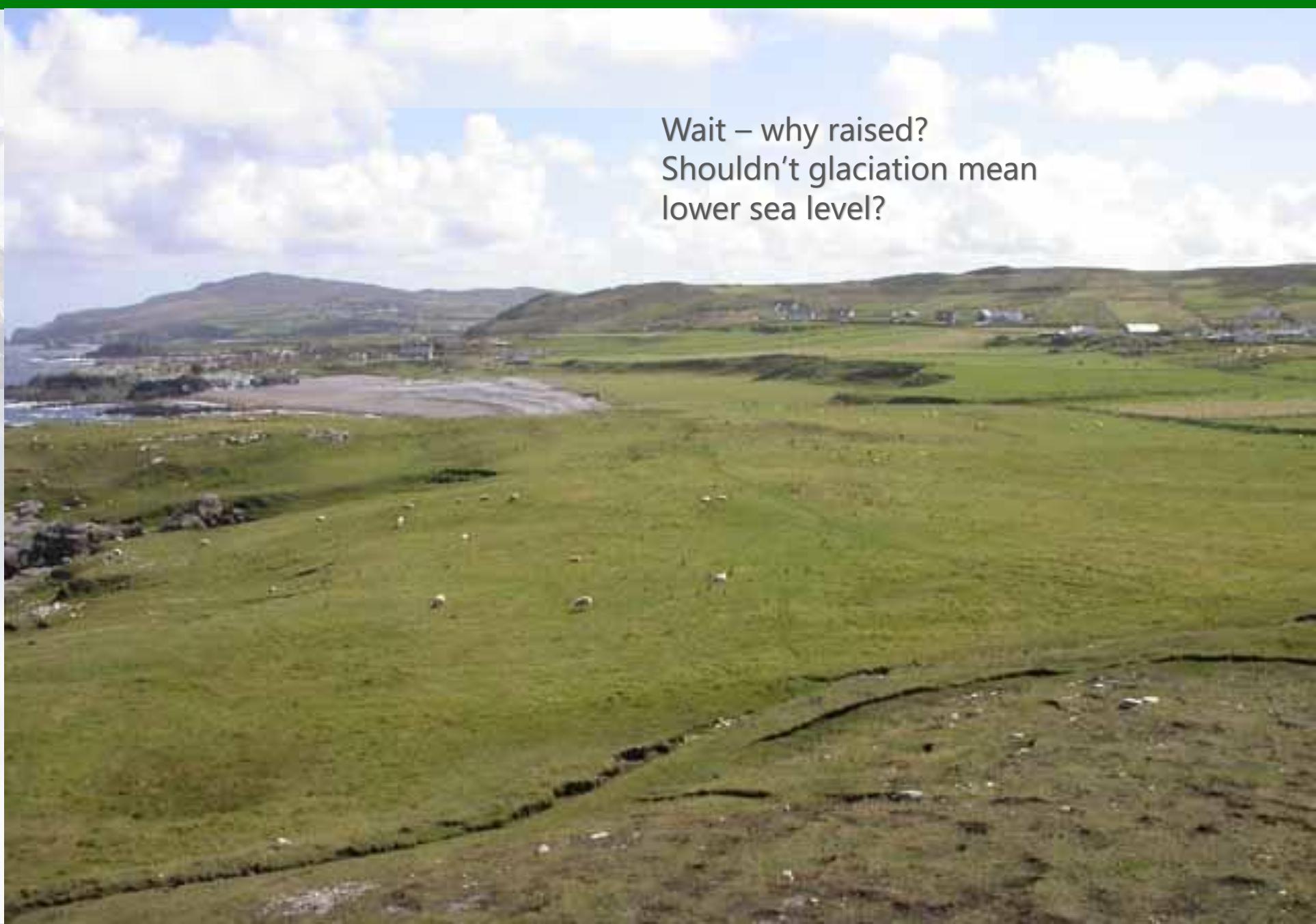




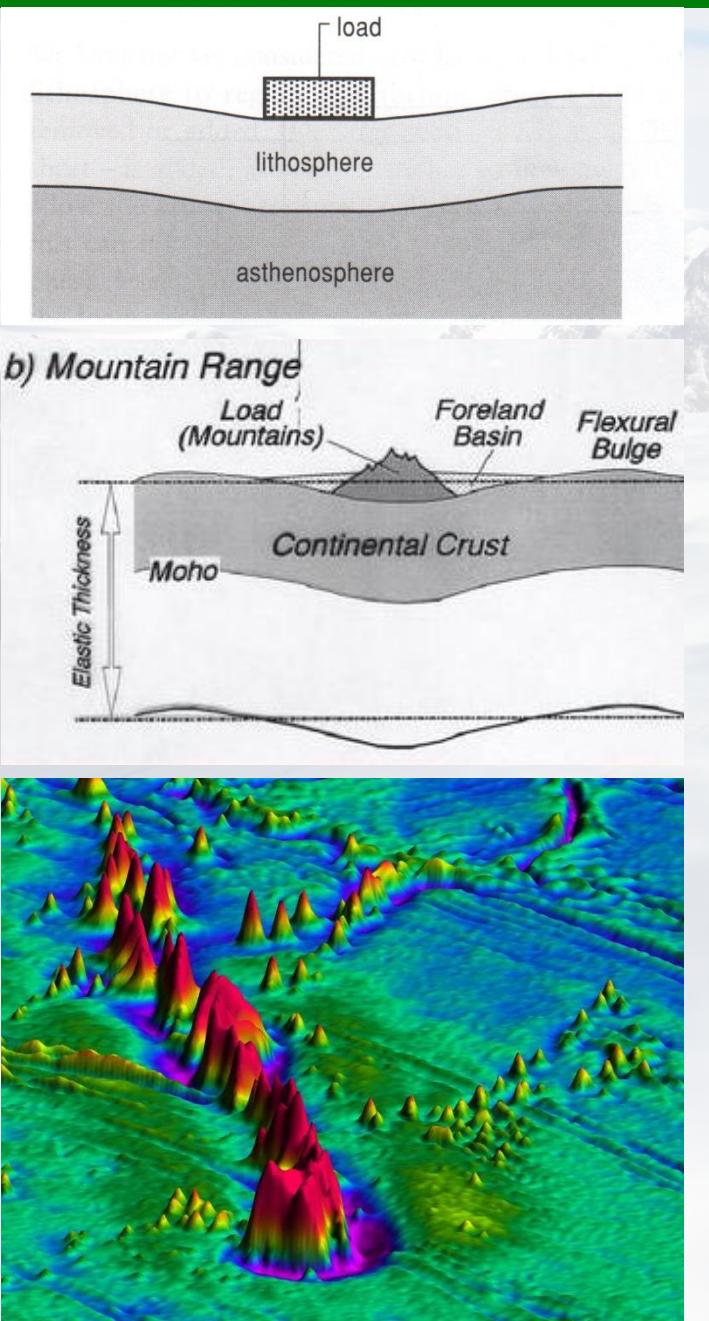
### Depositional



## Raised Beaches



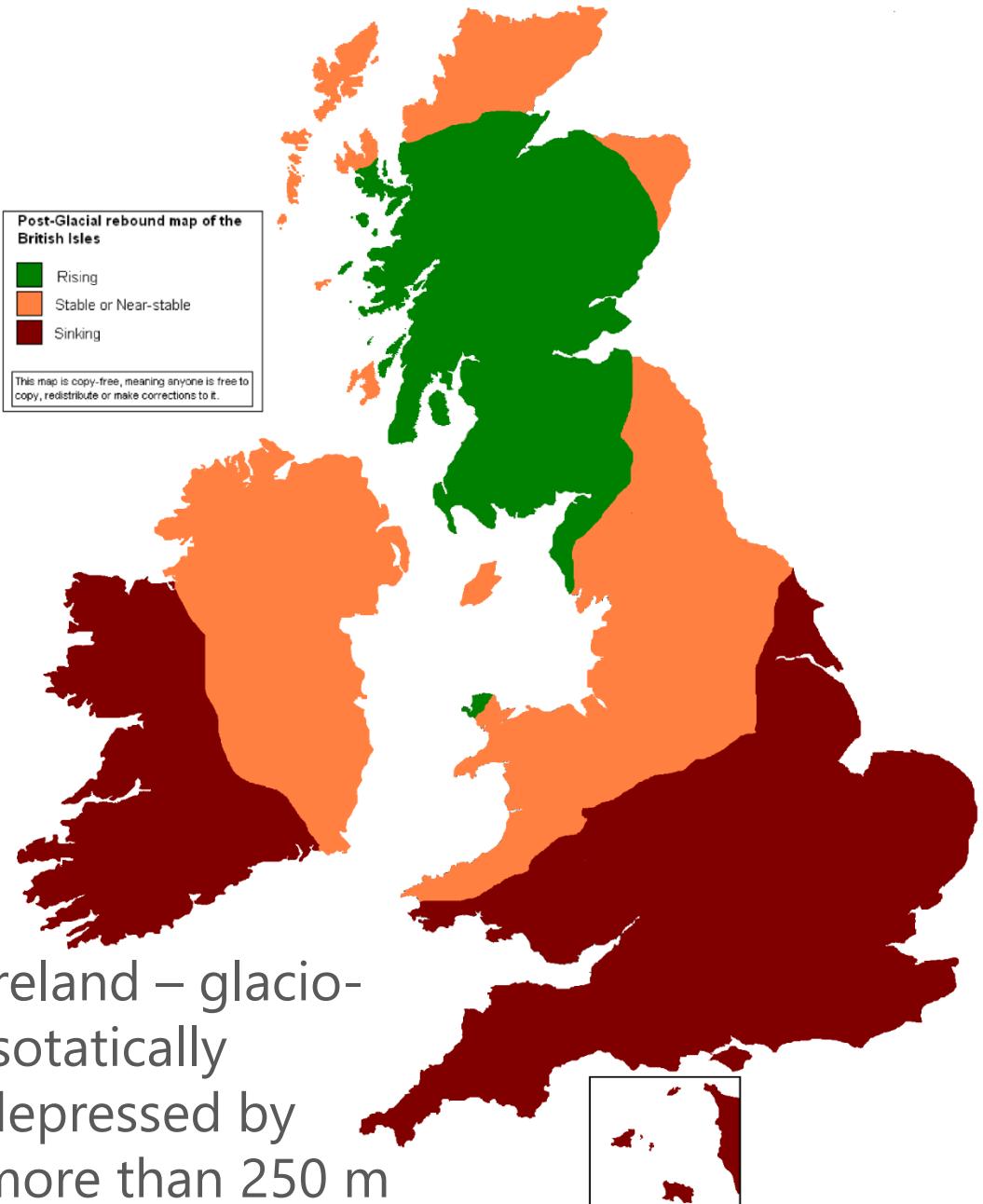
Wait – why raised?  
Shouldn't glaciation mean  
lower sea level?



Post-Glacial rebound map of the British Isles

- Rising
- Stable or Near-stable
- Sinking

This map is copy-free, meaning anyone is free to copy, redistribute or make corrections to it.



## Raised Coastlines



