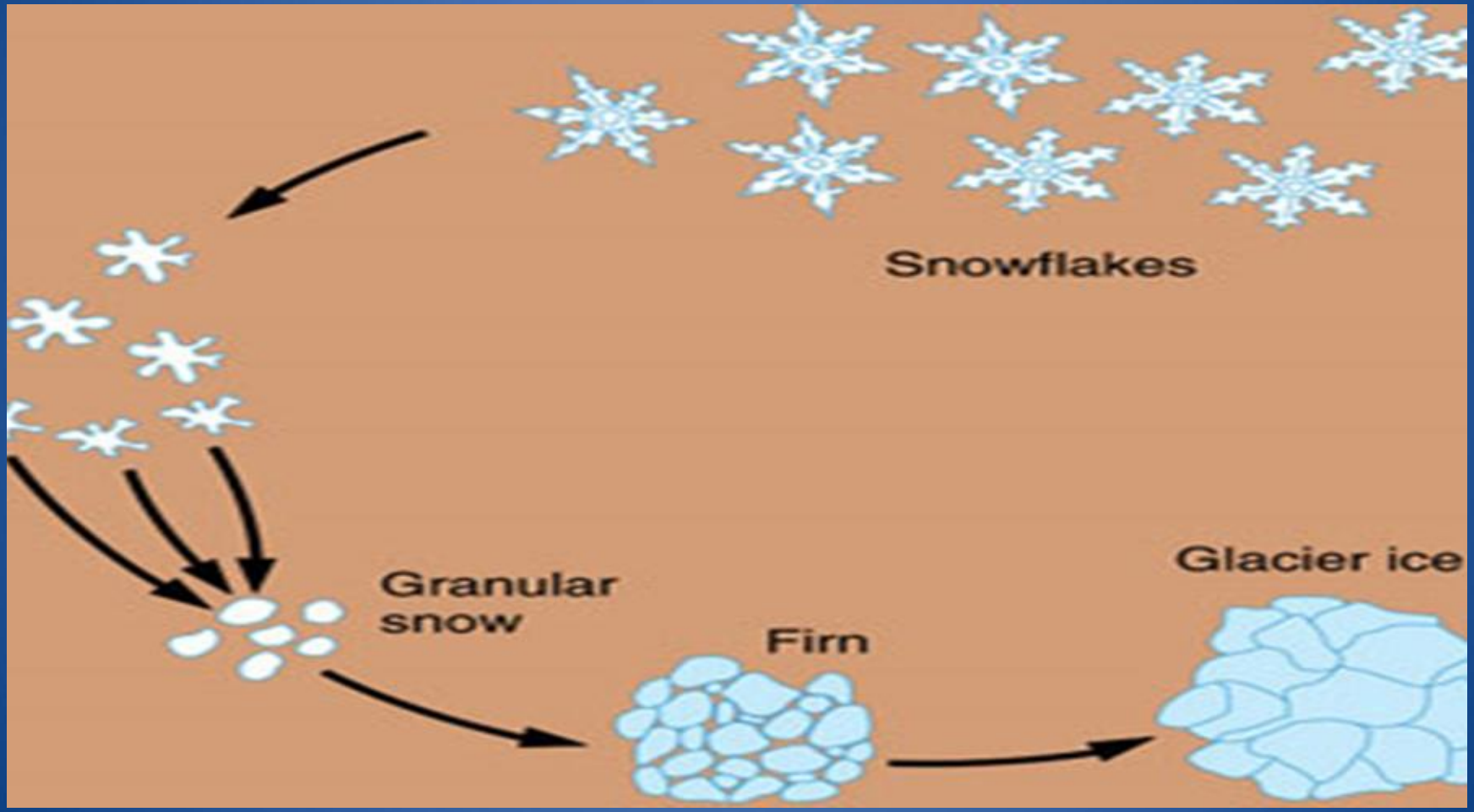
Glaciers

What is a Glacier?

- A large mass of moving ice that exists year round is called a glacier.
- Glaciers are formed when snowfall exceeds snow melt year after year
- Snow and ice remain on the ground turning into a permanent mass of almost motionless ice, creating a snowfield.

How do glaciers form?

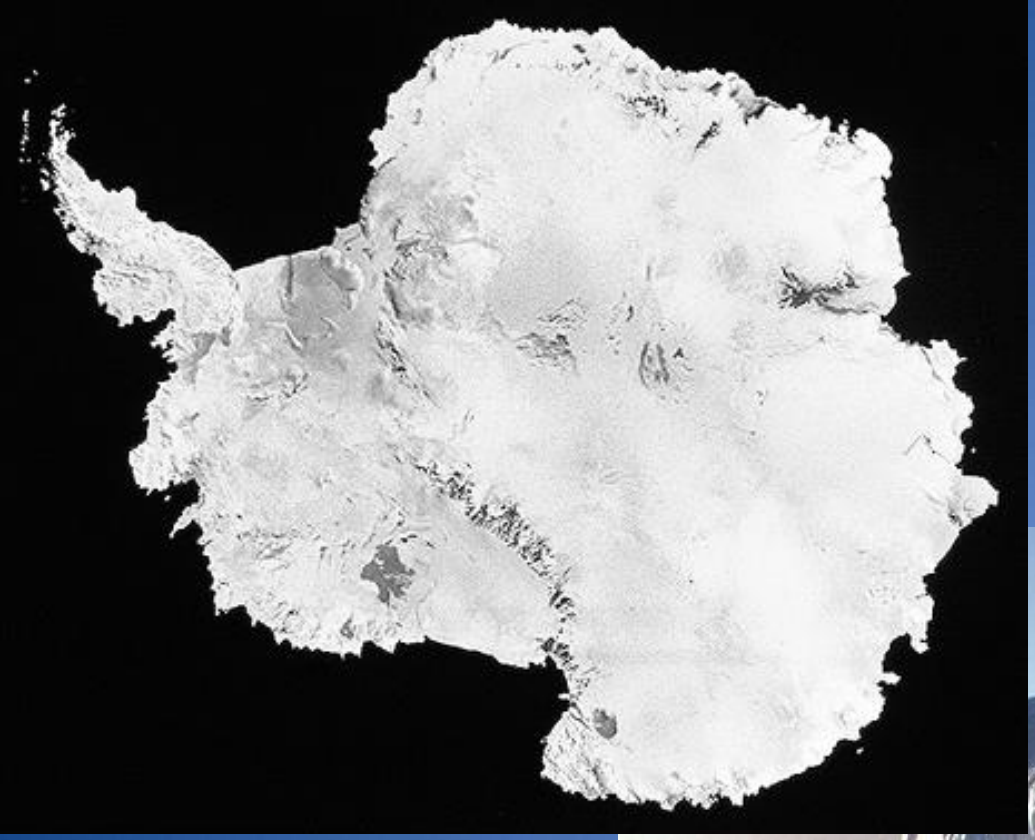


Two types of glaciers

- Alpine:
- narrow, wedge-shaped mass of ice that forms in mountainous regions and is confined to a small area
  - Ex. Alaska, Himalayan Mountains, the Andes, the Alps, New Zealand

- Continental:
- massive sheet of ice that may cover millions of kilometers^2, may be thousands of meters thick, and is not confined by surrounding topography
- Called *ice sheets*- only in Greenland and Antarctica
  - Contain enough water to raise the world's sea level by more than 80m.

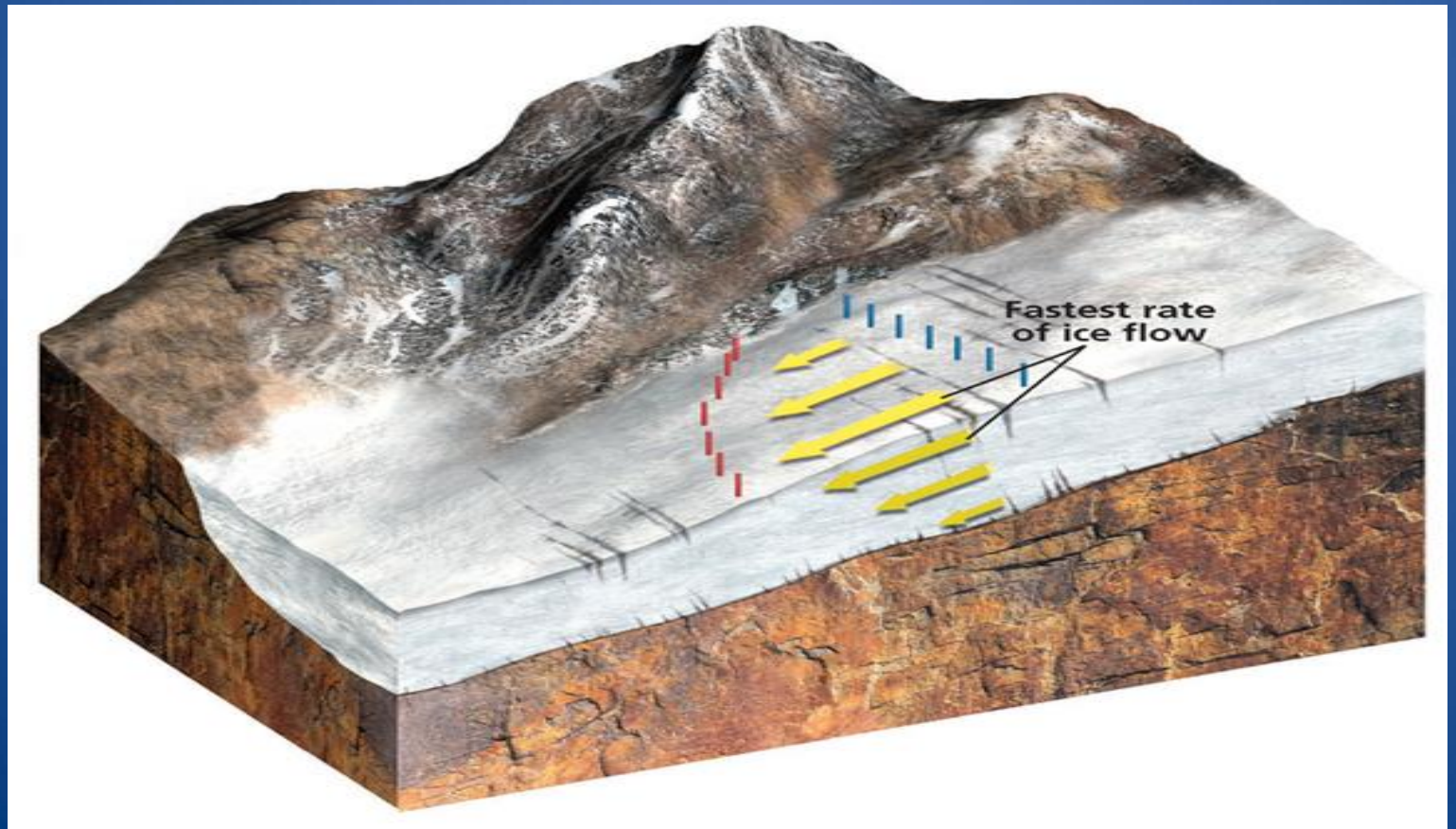
Alpine Glacier in Alaska



Continental Glaciers

Movement of Glacier

- Gravity causes glaciers to flow downward, but at a very slow rate: only a few centimeters to kilometers per year



Two types of Movement:

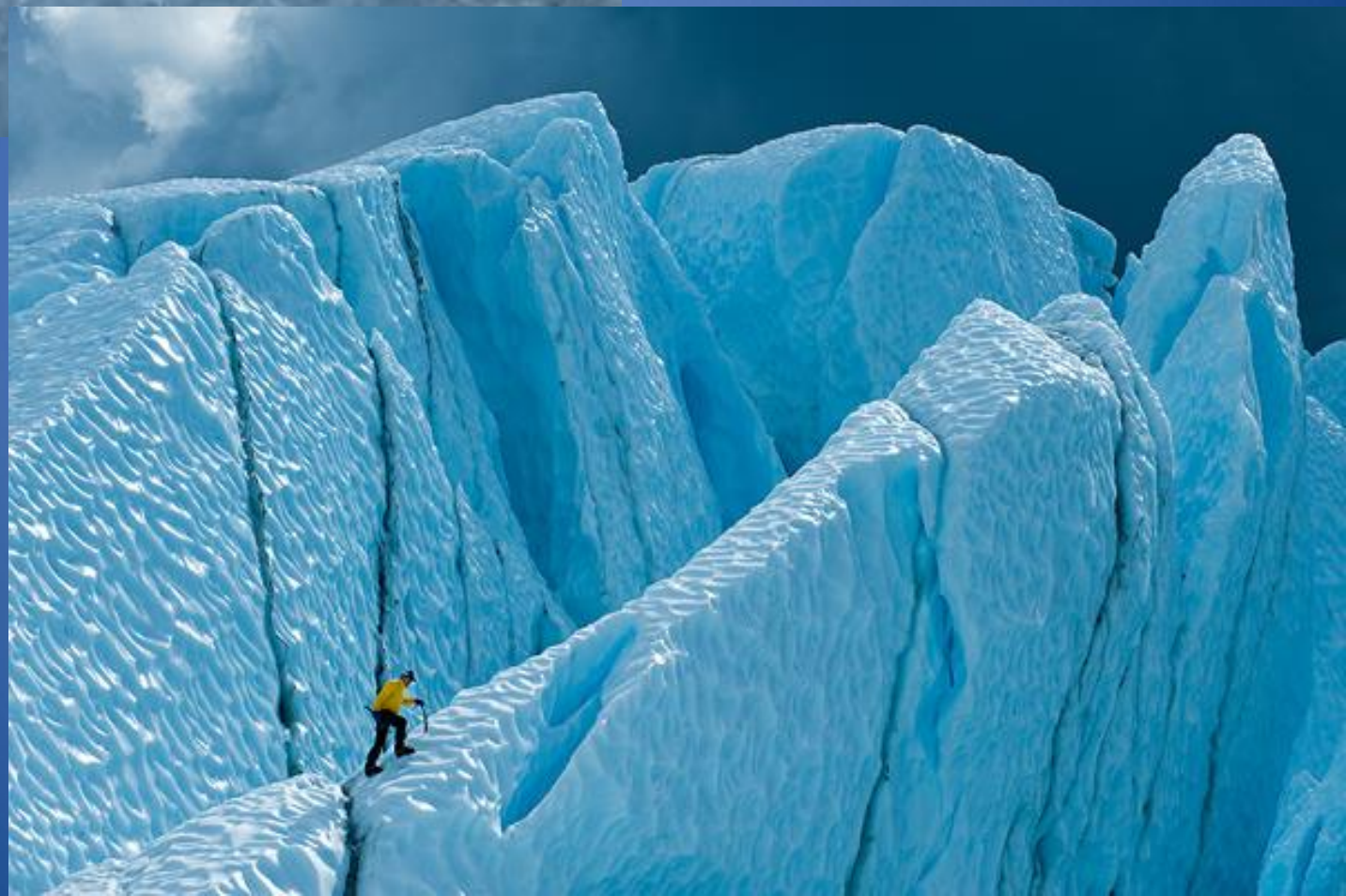
Internal Plastic Flow:

- Pressure deforms grains of ice, causing them to slide over each other
- Rate of flow depends on:
  - Slope, thickness of ground, temperature of the ice
- Center moves the fastest because there is less friction

- **Basal Slip:**
- Pressure from weight of ice melts the ice just above the ground.
- The water and sediment mix and allows the ice to slide downward.
- Move over periods of melts and freezes.

Features of Glaciers

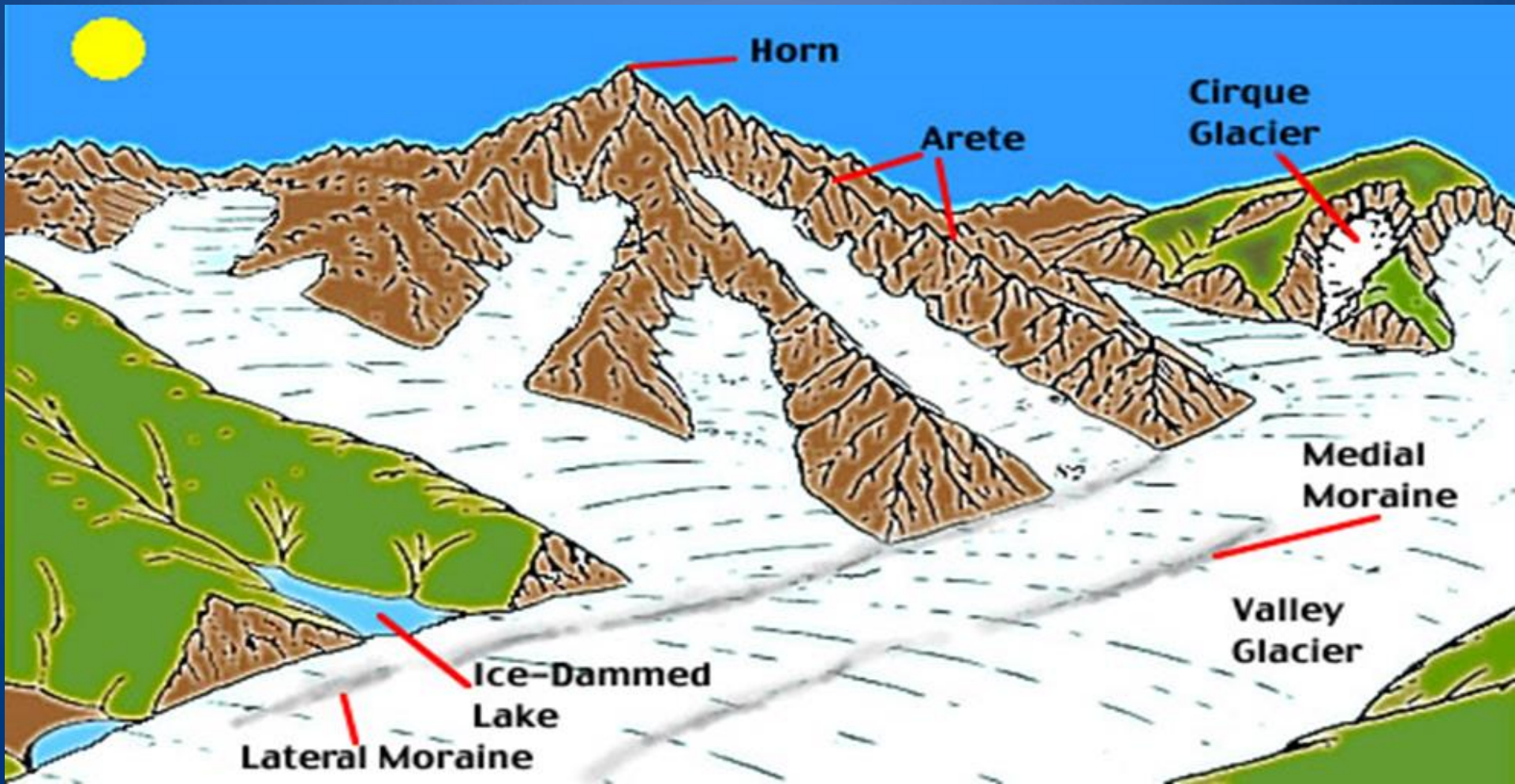
- The surface of a glacier is very brittle from the uneven flow beneath the surface.
- This causes tension below to create large cracks and fissures called crevasses.



Glacial Erosion

- Glaciers create distinct landforms as the glacier moves from the top of the mountain and through the valley.
- Glaciers break rock as it travels through the valley, creating steeper sides.
- As glaciers move, they may create deep bowl-like depressions called a cirque.

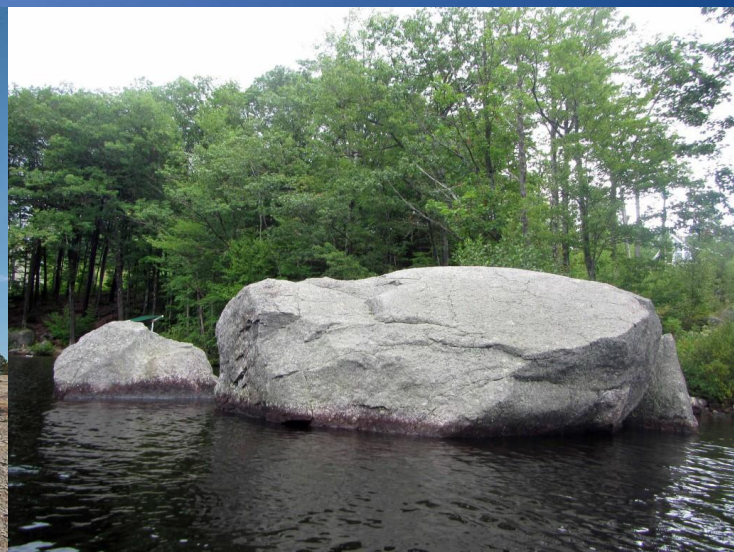
- The horn is a sharp peak that forms from erosion of cirques.
- Arêtes may form between cirque as sharp jagged ridges.



Glacial Erosion: Cirque

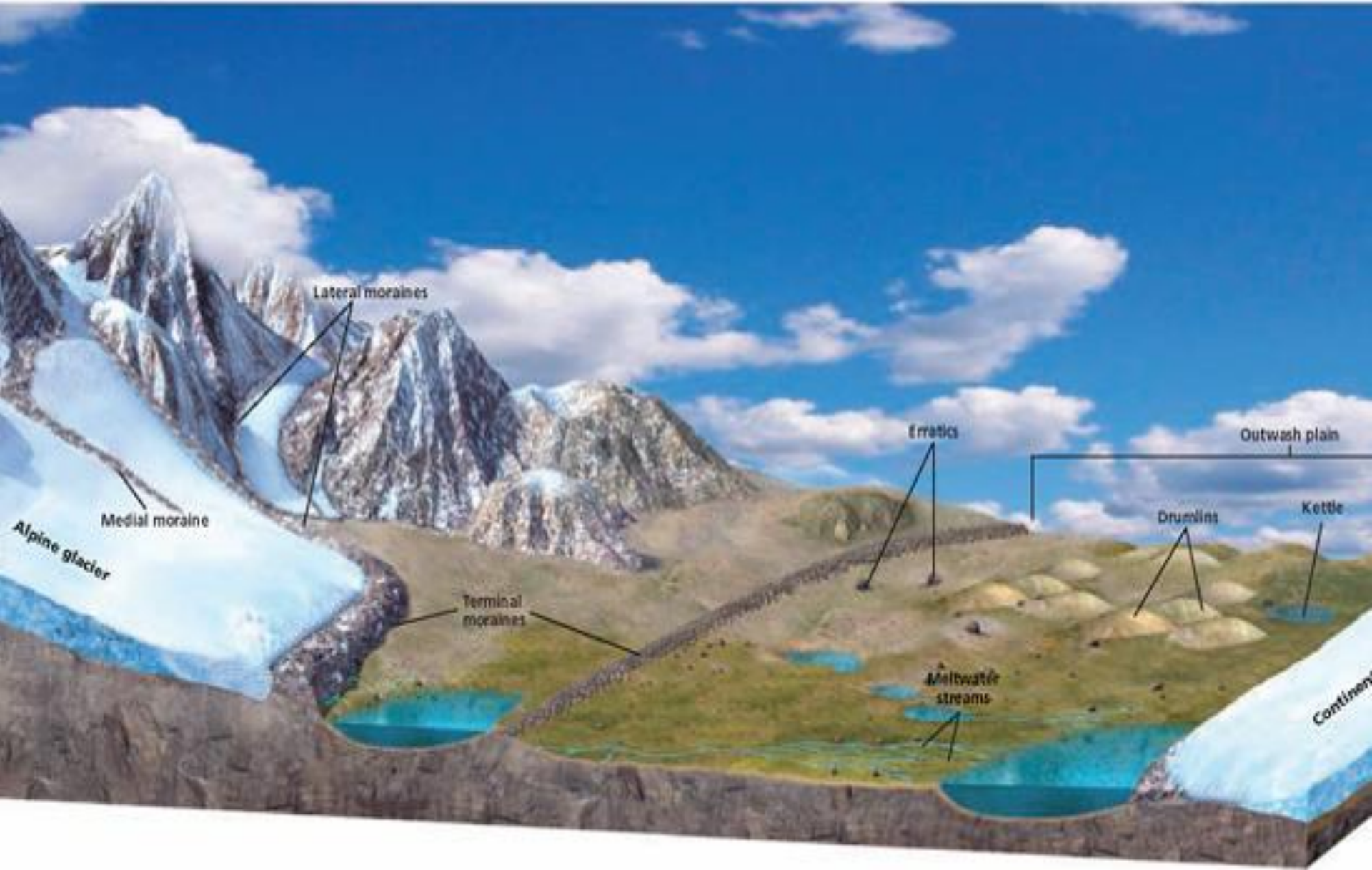
Glacial Deposition

- Deposition occurs when glaciers melt, depositing all material that has accumulated.
- Glacial drift is the term for all material that is deposited by glaciers.
- Erratics are large rocks that a glacier has transported. They are usually carried long distances.



Glacial Deposition

- Stratified drift is material that has been sorted and deposited in layers by streams flowing from the melted ice, or meltwater.
- Till deposits are unsorted sediments that have been deposited as the glacier moves and melts.
- Eskers are long winding ridges of gravel and sand.


Lateral moraines
Medial moraine
Alpine glacier
Terminal moraines
Erratics
Outwash plain
Drumlins
Kettle
Meltwater streams

Glacial Lakes

- Lake basins are common when glaciers erode surfaces, leaving depressions in bedrock.
- Long, narrow finger lakes like in upstate New York, or areas like “The Land of 10,000 lakes” in Minnesota may form from glacial erosion.

Salt Lakes

- In some lakes, water leaves only by evaporation.
- This leaves behind salt that was dissolved in the water.
- These lakes are found in dry climates with low precipitation and high evaporation.

The Great Lakes

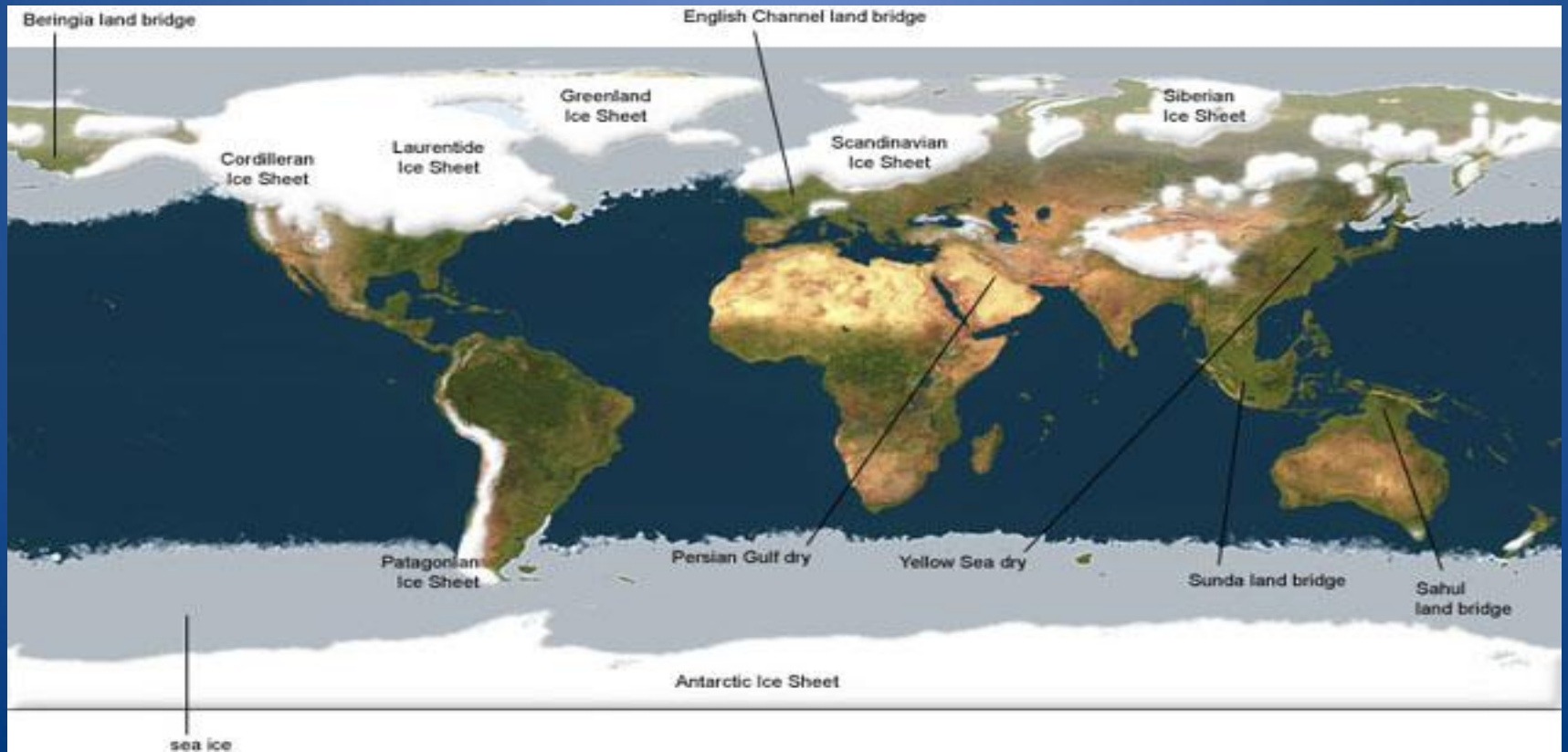
- Formed from erosion and deposition by a continental glacier.
- Valleys were widened and deepened from the glacier, and meltwater was trapped in depressions.

Ice Ages

- An ice age is a period of climate cooling during which the continents are glaciated repeatedly.
- Ice ages begin with long, slow decreases in average temperatures: with just 5° C drop per year being enough to start an ice age.
- A period with cooler climates that is characterized by the advancement of glaciers is called a glacial period.
- Periods of warmer climate when glaciers retreat are called interglacial periods.

Ice Ages

- During the last Ice Age, glaciers covered 1/3 of the Earth's surfaces.
- Sea level was 140 meters lower than it in today.
- Most of North America and Eurasia were covered.



Little Ice Age

- The last big freeze, known as the Little Ice Age, was between 1650 and 1850.

  “The last global decrease of temperature (the most cold phase of the Little Ice Age) was observed in Europe, North America and Greenland.

- By the definition, we are in an interglacial period—the holocene—of the ice age that began 2.6 million years ago at the start of the Pleistocene epoch, because the Greenland, Arctic, and Antarctic ice sheets still exist.[2]
- Next Ice age is expected to happened in 10,000 to 100,00 years from now.

The Milankovitch Theory

- A Serbian Scientist proposed the theory that climate change occurs in cycles dependent on the Earth's orbit and tilt of the Earth's axis.
- He calculated how three factors, the shape of the Earth's orbit, the tilt of the axis, and the circular motion or precession, affect the distribution of the solar energy from the Sun.
- A precession causes the axis to change position, or wobble.

Biological Evidence of Glaciatoin

- Evidence of past glaciation has been found in the shells of dead marine animals.
- Temperature affects the amount of dissolved oxygen in the ocean, which affects the way organisms created their shells.
- Other ways: Ice ages may have started when volcanic dust blocks the sun's rays, preventing heat reading the Earth and a global average temperature to drop.