Geology 12

# Glaciers

Glacier

- A mass of ice and surficial snow that persists throughout the year and flows downhill under its own weight (force of gravity).
    - **Valley Glacier** (or alpine glacier) – a glacier that flows mainly along a well-defined valley in a mountainous regions.
    - **Continental Glacier** (or ice sheet) – a continuous, thick glacier covering more than 50 000 $km^2$, moving independently of minor topographic features.

Glacier Formation

- Low Temperatures – temperatures must be low enough to keep snow on the ground year-round. Usually at high latitude or high altitude locations.
- Adequate Snow – must be sufficient snowfall (ex BC Coast Mountains where abundant moist air from the Pacific falls as snow).

Glacial Growth – Accumulation

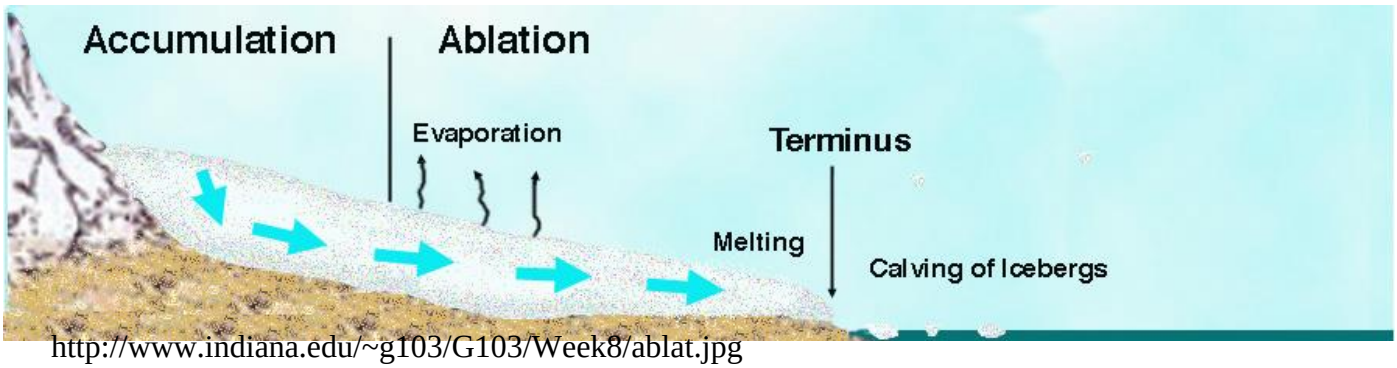
- Fresh snow falls as a fluffy mass of loosely packed snowflakes. On the ground they shrink to become grains. Over time, and due to pressure from burial, the grains recrystallize to become ice (usually 5 – 20 years).
- The amount of new snow added to the glacier each year is its accumulation.

Glacial Shrinkage – Ablation

- Gravity causes the glacier to flow downhill, bringing it into warmer temperatures where it loses mass.
    - Melting – ice turns to water.
    - Iceberg calving – pieces of ice break off into the ocean.
    - Sublimation – ice changes directly from solid into gas (water vapour).
    - Wind erosion – strong winds can erode the ice by melting and sublimation.

Glacial Budget – Accumulation minus Ablation

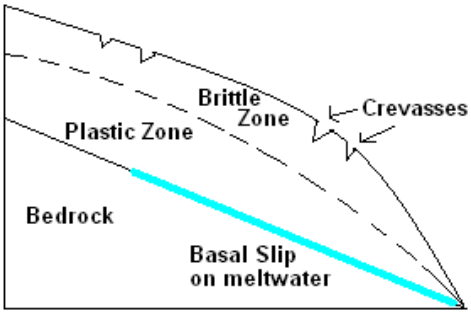
- If Accumulation = Ablation → glacier size remains constant
- If Accumulation < Ablation → the toe of the glacier will shrink back
- If Accumulation > Ablation → the toe will move forward.



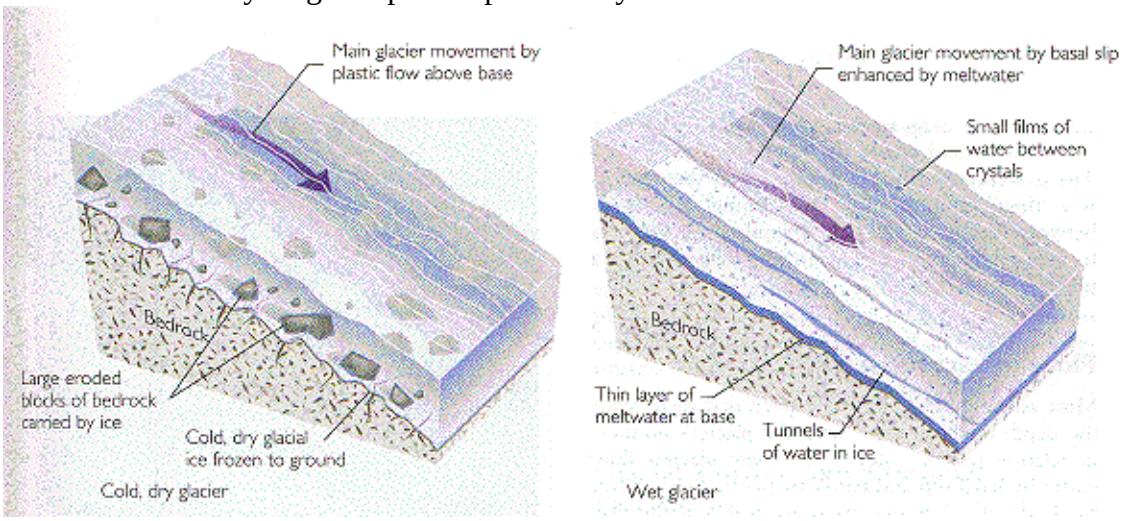

http://www.indiana.edu/~g103/G103/Week8/ablat.jpg

Glacier Movement

- **Plastic Flow** – occurs in cold, dry glaciers where individual ice crystals slip tiny distances ($10^{-7}$ mm). The total adds up to a sizable amount of movement.
- **Basal Slip** – in warmer glaciers, the ice at the base may melt from the pressure forming a lubricating layer of water. The glacier can then slide downhill.
- **Crevasses** – in the upper 50 m of a glacier, the ice is a brittle solid which can crack and form crevasses. Deeper in the glacier plastic flow prevents crevasses from forming.




- **Glacier Speed** – Glaciers move fastest at the surface in the centre of the glacier. Speed decreases towards the sides and the bottom. Speeds vary from 10 m/y to 75 m/y. In circumstances which are not fully understood, some glaciers may occasionally surge at speeds up to 6 km/y.

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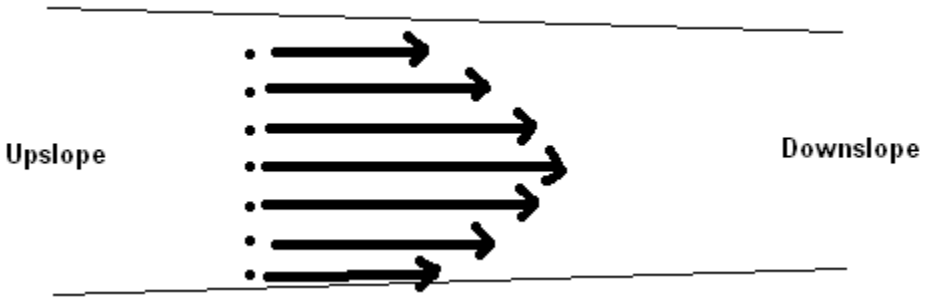

Glacial Features

- Glaciers produce many geological features. The features can be classified as either erosional or depositional.
    - **Erosional** – formed when glaciers remove rock material.
    - **Depositional** – formed when glaciers deposit rock material.

Erosional Features

- **U-Shaped Valleys** – formed because the glacier erodes both the bottom and the sides of the valley
- **Hanging Valleys** – form where the bottom of a tributary glacier is much higher than the bottom of the main valley glacier. When the glaciers melt, a waterfall plunges over the steep cliff.
- **Cirque** – bowl shaped depression at the head of a glacier. Formed as the glacier erodes its way into the mountain.
- **Arete –** Sharp, jagged ridge where glaciers meet between adjacent valleys.
- **Horn** – Formed when 2 or more (usually at least 3) glaciers form around a mountain, and their cirques move towards each other. A horn is a pyramid shaped mountain top.
- **Glacial Striations** – linear scrapes and grooves left where glaciers have eroded the rock. Their direction can show the way that the glacier moved. Formed because glaciers carry rocks with them and they act like 'tools' to scrape the bedrock.
- **Fjord** (or fiord) – a glaciated U-shaped valley that has been flooded by seawater.

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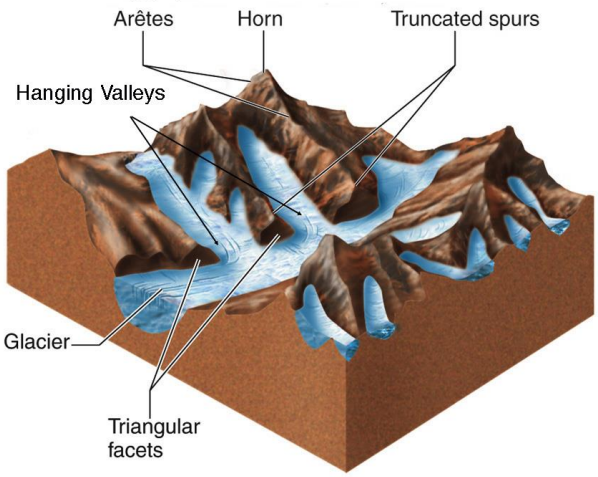
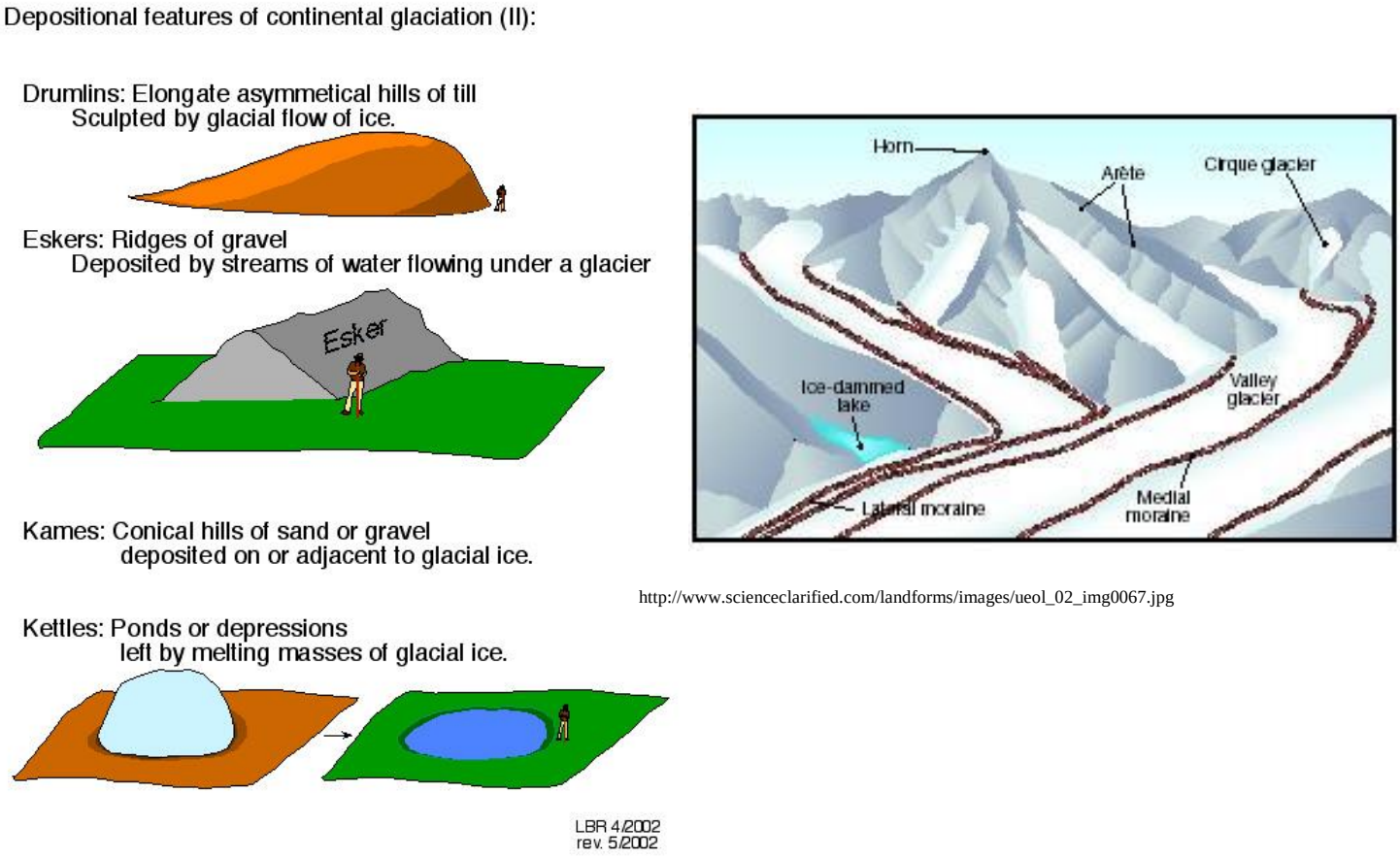



Depositional Features

- **Till** – unstratified, poorly sorted sediment deposited directly by the melting ice.
- **Moraines** – a variety of landforms made of till
    - Ground moraine – broad blanket of till with no particular form.
    - Lateral Moraine – a moraine along the sides of a glacier, either eroded by the glacier itself or fallen from the valley walls above.
    - Medial Moraine – Where glaciers join in a valley, their lateral moraines join as a ribbon of moraine within the ice.
    - Terminal Moraine – A moraine deposited by the farthest advance of the glacier.

    - Recessional Moraine – a moraine deposited during glacier retreat when the ice front was temporarily stable.
- **Erratic** – an isolated large boulder deposited by a glacier in an area having a different type of bedrock.
- **Drumlin** – large streamlined hills of till and bedrock (usually found in groups) that parallel the direction of the ice movement. They can be 25 – 50 m high at up to a kilometer long. Their formation is not fully understood, but they may be the result of ice over riding previously deposited moraines, dragging them out into streamlined mounds.
- **Kame Terrace** – Small hills of sand and gravel dumped at or near the edge of the ice. Some kames are deltas built into lakes at the ice edge, and when the lake drains, these deltas are preserved as flat-topped hills. Kames are often used as commercial sand and gravel pits.
- **Esker** – long, narrow winding ridges of sand and gravel found in the middle of ground moraines. The can run for kilometers in a direction roughly parallel to the ice movement. They were deposited by melt water streams, flowing in tunnels along the bottom of a melting glacier.







http://www.scienceclarified.com/landforms/images/ueol_02_img0067.jpg

http://www.gly.uga.edu/railsback/1121GlacnContlFeaturesD2.jpeg

**Please read: Pg 357 -376 in your new textbooks "Glaciers"**