

Earth Science

Chapter 17

Section 2 – Glacial Erosion and Deposition

STANDARDS:

SES3. Students will explore the actions of water, wind, ice, and gravity that create landforms and systems of landforms (landscapes).

d. Relate the past and present actions of ice, wind, and water to landform distribution and landscape evolution.

Objectives

- **Describe the landscape features that are produced by glacial erosion.**
- **Name and describe five features formed by glacial deposition.**
- **Explain how glacial lakes form.**

Glacial Erosion

- **Like rivers, glaciers are agents of erosion.**
- **However, because of the size and density of glaciers, landforms that result from glacial action are very different from those that rivers form.**
- **For example, deep depressions in rock form when a moving glacier loosens and dislodges, or plucks, a rock from the bedrock at the base or side of the glacier.**
- **The rock plucked by the glacier is then dragged across the bedrock and causes abrasions.**



Alaska's St. Elias mountain range has been covered by vast ice fields and glaciers like these, leading to some of the fastest modern erosion rates on earth. Over the past few decades, the impact of climatically driven

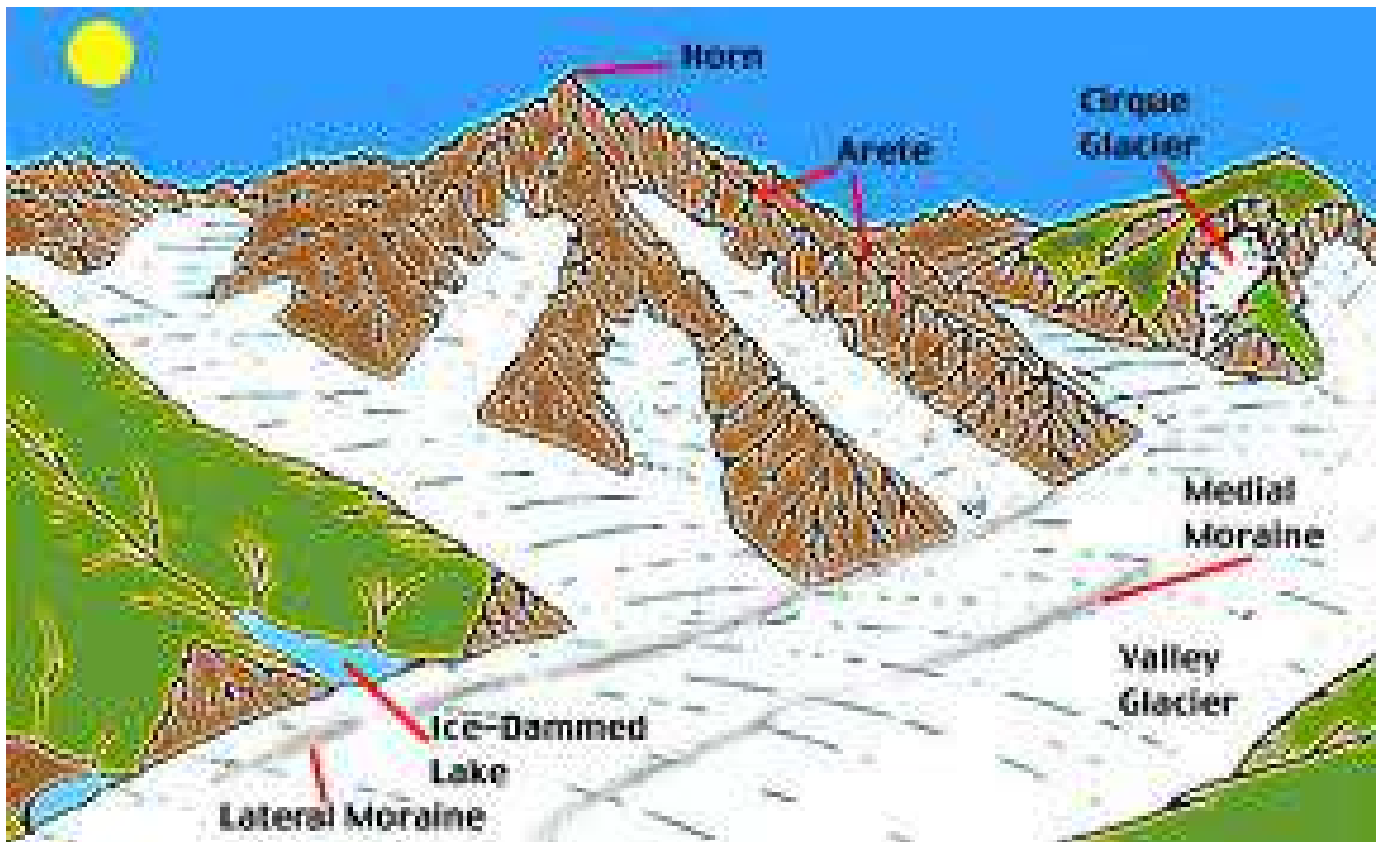
erosion on mountain formation and evolution has been a topic of considerable scientific debate. Photo by Aaron L. Berger.



Canada – A type of glacial erosion called glacial polish.

Landforms Created by Glacial Erosion

- The glacial processes that change the shape of mountains begin in the upper end of the valley where an alpine glacier forms.
- As a glacier moves through a narrow, V-shaped river valley, rock from the valley walls breaks off and the walls become steeper.
- The moving glacier also pulls blocks of rock from the floor of the valley.
- cirque a deep and steep bowl-like depression produced by glacial erosion
- arête a sharp, jagged ridge that forms between cirques
- horn a sharp, pyramid-like peak that forms because of the erosion of cirques
- Rock particles embedded in the ice may polish solid rock as the ice moves over the rock.
- Glaciers may also round large rock projections.
- The resulting rounded knobs are called *roches moutonnées*, which means “sheep rocks” in French.



READING CHECK

How does a glacier form a cirque?

A moving glacier forms a cirque by pulling blocks of rock from the floor and walls of a valley and leaving a bowl-shaped depression.

U-Shaped Valleys

- As a glacier scrapes away a valley's wall and floor, this original V shape becomes a U shape.
- Small tributary glaciers in adjacent valleys may flow into a main alpine glacier.
- When the ice melts, the tributary valley is suspended high above the main valley flow and is called a *hanging valley*.
- The landscape eroded by continental glaciers differs from the sharp, rugged features eroded by alpine glaciers.
- Continental glaciers erode by leveling landforms to produce smooth, rounded landscape.

- **Rock surfaces are also scratched and grooved by rocks carried at the base of the ice sheets.**



Tracy Arm, Alaska
Glacial Deposition

***erratic* - a large rock transported from a distant source by a glacier**

- **Deposition occurs when a glacier melts.**
- **As the glacier melts, it deposits all of the material that it has accumulated, which may range in size from fine sediment to large rocks.**
- **Because a glacier carries an erratic a long distance, the composition of an erratic usually differs from that of the bedrock over which the erratic lies.**



The Airdrie erratic is one of three sections of the Foothills Erratics Train that have been designated as Provincial Historic Sites under the Historical Resources Act. Dr A. M. Stalker, a geologist with the Geological Survey of

Canada, is standing in front of the erratic. Dr Stalker mapped the location of most of the Foothills Erratics Train across Alberta. The Airdrie erratic was carried and deposited by the same glacier that deposited the more famous "Big Rock" or Okotoks erratic.



glacial drift - rock material carried and deposited by glaciers

till - unsorted rock material that is deposited directly by a melting glacier

- Another type of glacial drift is stratified drift. ***Stratified drift*** is material that has been sorted and deposited in layers by streams flowing from the melted ice, or ***meltwater***.



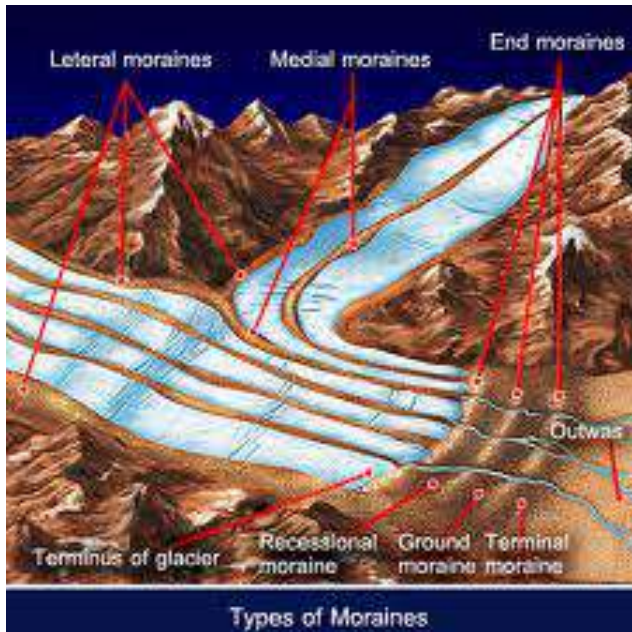
In this photo, polished and striated bedrock is shown at the margin of a receding glacier in Iceland. The glacier is melting back toward the right of the photo. A closer view of the bedrock surface may be viewed by clicking on this photo. Photo by A.K. Hansel.

Till Deposits

moraine - a landform that is made from unsorted sediments deposited by a glacier

- A ***lateral moraine*** is a moraine that is deposited along the sides of an alpine glacier, usually as a long ridge.

- When two or more alpine glaciers join, their adjacent lateral moraines combine to form a *medial moraine*.



- The unsorted material left beneath the glacier when the ice melts is the *ground moraine*. The soil of a ground moraine is commonly very rocky.
- An ice sheet may mold ground moraine into clusters of drumlins. *Drumlins* are long, low, tear-shaped mounds of till.
- *Terminal moraines* are small ridges of till that are deposited at the leading edge of a melting glaciers.



READING CHECK

Which glacial deposit is a tear-shaped mound of sediment?

A drumlin is a long, low, tear-shaped mound of till.

Outwash Plains

- When a glacier melts, streams of meltwater flow from the edges, the surface, and beneath the glacier.
- The meltwater carries drift as well as rock particles and deposits them in front of the glacier as a large outwash plain.
- An *outwash plain* is a deposit of stratified drift that lies in front of a terminal moraine and is crossed by many meltwater streams.

Kettles

kettles - a bowl-like depression in a glacial drift deposit

- A kettle forms when a chunk of glacial ice is buried in a drift.
- As the ice melts, a cavity forms in the drift. The drift collapses into the cavity and produces a depression.
- Kettles commonly fill with water to form kettle lakes.

Eskers

esker - a long, winding ridge of gravel and coarse sand deposited by glacial meltwater streams

- When continental glaciers recede, eskers may be left behind. These ridges consist of stratified drift deposited by streams of meltwater that flow through ice tunnels within the glaciers.
- Eskers may extend for tens of kilometers, like raised, winding roadways.

The image below shows the features of glacial deposition.



READING CHECK

How do eskers form?

Eskers form when meltwater from receding continental glaciers flow through ice tunnels and deposits long, winding ridges of gravel and sand.

Glacial Lakes

- Lake basins commonly form where glaciers erode surfaces and leave depressions in the bedrock.
- Many lakes form in the uneven surface of ground moraine deposited by glaciers.
- Long, narrow *finger lakes*, such as those in western New York, form where terminal and lateral moraines block existing streams.

Formation of Salt Lakes

- Because of topographic and climatic changes, outlet streams no longer leave these lakes.
- Water leaves the lakes only by evaporation. When the water evaporates, salt that was dissolved in the water is left behind, which makes the water increasingly salty.
- Salt lakes commonly form in dry climates, where evaporation is rapid and precipitation is low.

History of the Great Lakes

- **The Great Lakes of North America formed as a result of erosion and deposition by a continental glacier.**
- **Glacial erosion widened and deepened existing river valleys.**
- **As the ice sheets melted, the meltwater was trapped in the valleys by the moraines and lakes formed.**