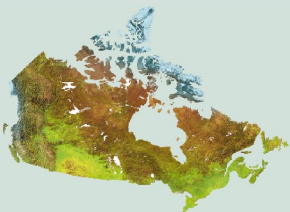




Canadian Landscapes Fact Sheets

Glacial Meltwater Landforms

A melting ice sheet produces a huge amount of water that runs off the ice or forms lakes in front of it. Several distinctive landforms and sediments are produced by meltwater.



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What are meltwater landforms?

Meltwater landforms are topographical features composed of glacial drift that was transported and deposited, or reworked, by the meltwater running off glacier ice or filling a glacial lake. These types of landforms are generally composed of stratified drift (its particles sorted by size and/or density).



Landforms left by glaciers

STUDY SITE: Fort St. James, Central British Columbia.

Climatic fluctuations during the Pleistocene Epoch (2 000 000 to 10 000 years ago) caused glaciers to grow and decay. As the last ice sheet that covered British Columbia retreated at the end of the Pleistocene, it left behind many distinctive landforms and sediments.

During the last glaciation, east-flowing glaciers scoured the bedrock and deposited **till**, a poorly sorted sediment containing stones up to boulder size. Till blankets flat to moderately sloping terrain above the valley floor. Elongate and spoon-shaped hills of glacial debris (**drumlins**) are oriented parallel to the direction of glacier flow.

Streams of meltwater flowed through tunnels within, beneath, and on the glaciers. Sand and gravel accumulated in these tunnels, forming long, narrow, sinuous ridges (**eskers**). The ridges are an excellent source of sand and gravel. Where meltwater streams flowed away from the ice front, they deposited sand and gravel as **outwash fans** and **outwash plains**. Isolated and buried ice blocks in the outwash melted to form depressions known as **kettles**. Meltwater was also dammed in places by ice or sediments, forming **glacial lakes**. When the ice sheet disappeared, the lakes drained, leaving behind nutrient-rich silty and clayey sediments that form some of the best agricultural land in central British Columbia.

Figure 1. End of glaciation (12 000 years ago)

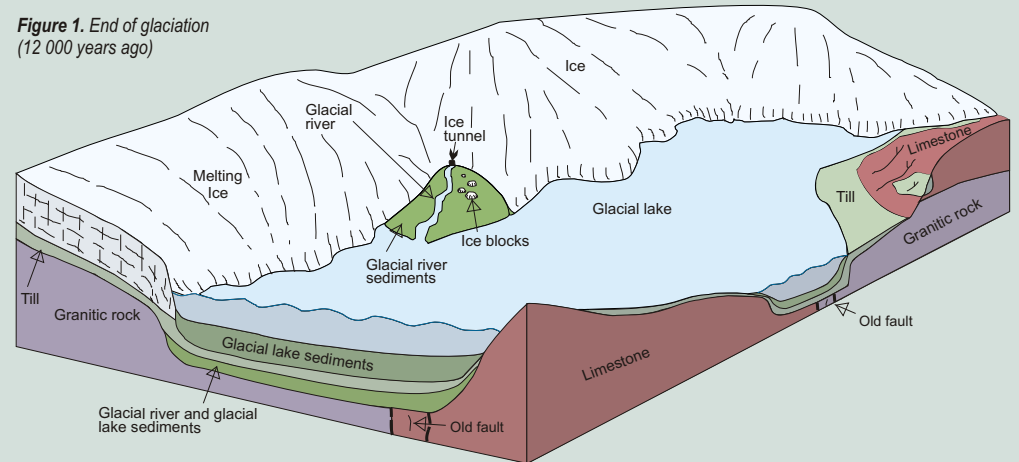
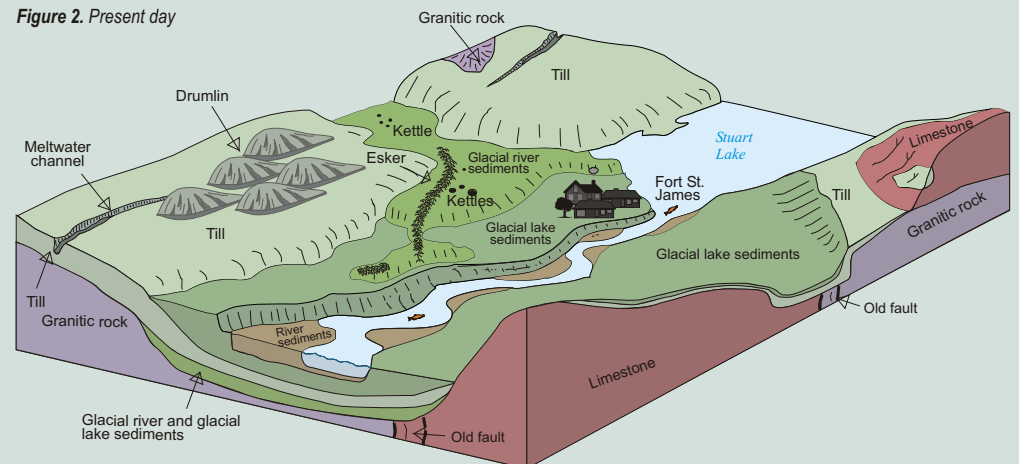
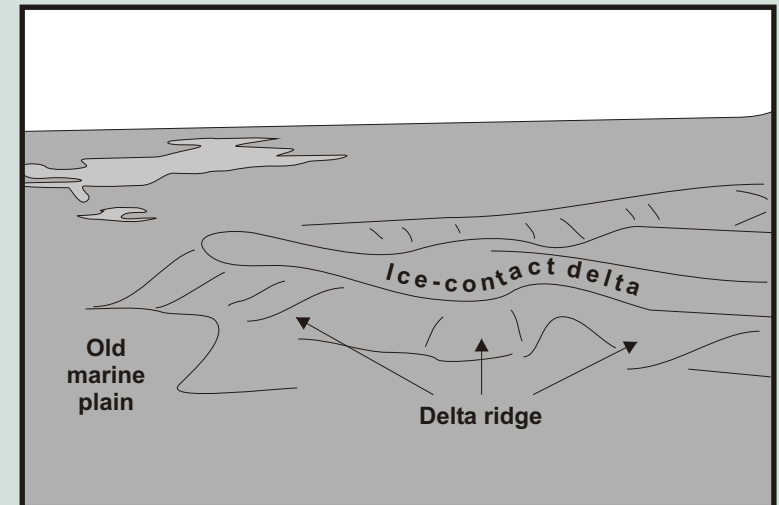


Figure 2. Present day



Kame delta

A kame delta is a flat-topped, steep-sided hill of well-sorted sand and gravel deposited by a meltwater stream flowing into an ice marginal lake or sea.

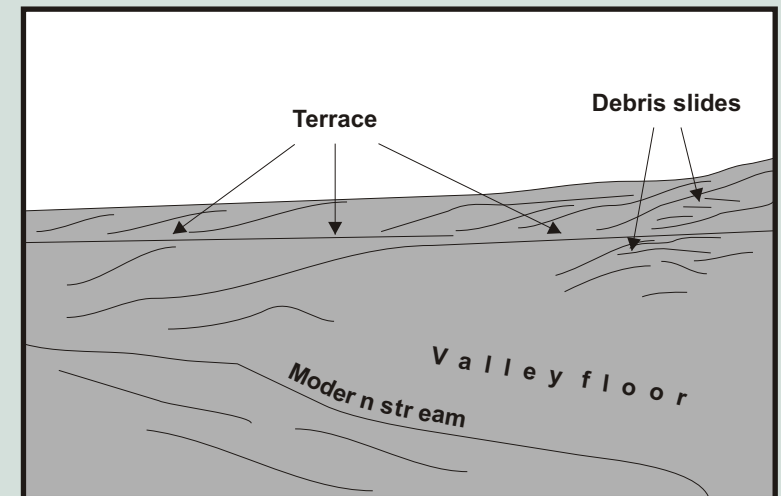


Ice-contact delta, Tree River, Nunavut.

The flat-topped curving feature in the centre of the photo is a gravelly delta that formed where meltwater, issuing from the front of a receding glacier, deposited sediment in a sea that was about 160 m higher than present, about 9600 years ago. The melting ice front once filled the depression encircled by the arcing delta ridge. Lower areas to the left of the delta are old marine plains, comprised of fine-grained sediments.

Stream terrace

A stream terrace is generally one of a series of level surfaces in a stream valley, flanking and more or less parallel to the stream channel. These surfaces originally occurred at or below the level of the stream, but are now higher than the present stream. They represent the dissected remnants of an abandoned flood plain, streambed, or valley floor produced during a former stage of erosion or deposition.

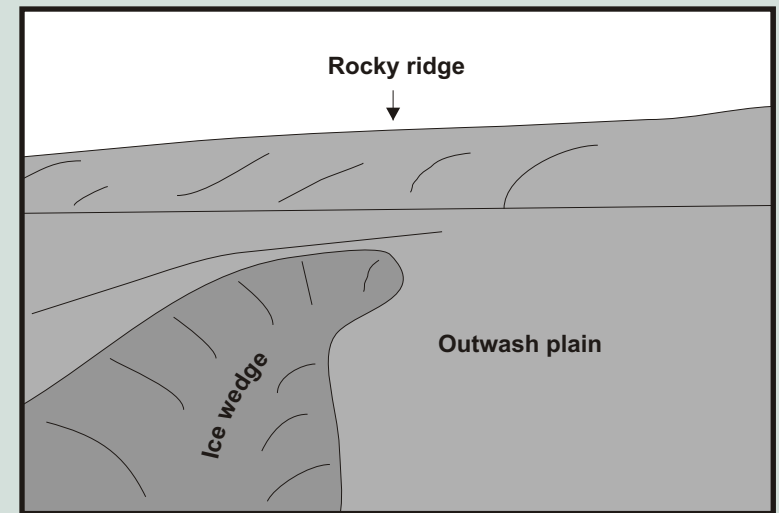


Glaciofluvial terrace, south of the West Block of the Cypress Hills, southwest Saskatchewan.

The grass-covered terrace (level area) on the far side of the valley marks the bed of the stream that carried water and coarse sediments from melting glacier ice. The powerful meltwater stream formed this glacio-fluvial terrace when it flowed away from the retreating Laurentide Ice Sheet at the end of the Wisconsinian, approximately 14 000 years ago. First, the meltwater carried immense amounts of sediment: clay, sand, gravel, and rock fragments. It deposited these sediments, creating a riverbed at the height of the terrace. As the glacier ice receded further north, the river transported less sediment; instead it began downcutting and created the present valley within its own riverbed. The terrace is approximately 50 m above the valley floor. The modern stream has become so small that it is barely visible in the photograph. It winds along a small track in the deepest sections of the former streambed. Note the small, superficial debris slides that occur along the banks. Prairie grasses, sagebrush, and briar rose bushes grow in patches over this gravelly ground.

Outwash plain

This feature is a broad, gently sloping sheet of outwash deposited by meltwater streams flowing in front of or beyond a glacier, and formed by coalescing outwash fans. (Outwash is stratified sediment (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. The coarser material usually is deposited nearer to the ice.)

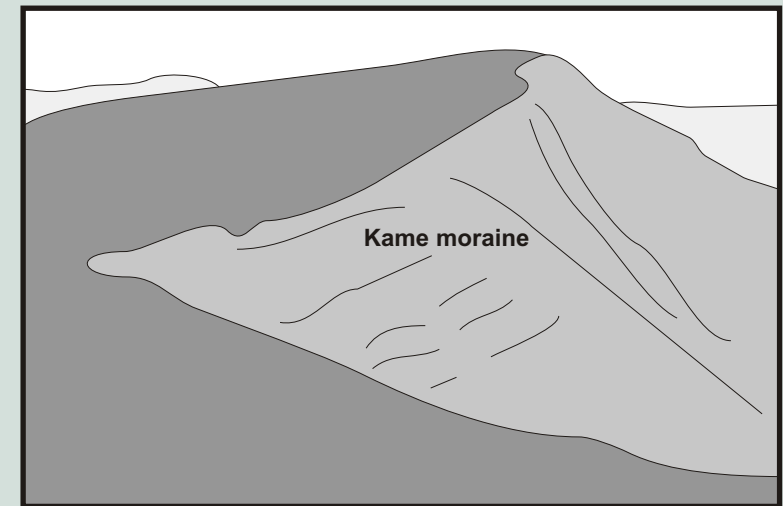


Ice wedge crack and glacial outwash plain, Melville Peninsula, Nunavut.

This photo shows a rocky ridge in the background, and a gravelly glacial outwash plain with a sharply defined fissure through the left side in the foreground. This large crack in outwash gravel is a permafrost feature and marks the location of a massive ice wedge. The top of the wedge has melted out, leaving a ‘gutter’ in its place. However, ice remains in the substrate below at a depth of about 1 m, and extends down for another 3 m.

Kame

A kame is a low mound, knob, hummock, or short irregular ridge, composed of stratified sand and gravel. It is deposited by a subglacial stream as a fan or delta at the margin of a melting glacier, by a supraglacial stream in a low place or hole in the surface of the glacier, or as a ponded deposit on the surface or at the margin of stagnant ice.

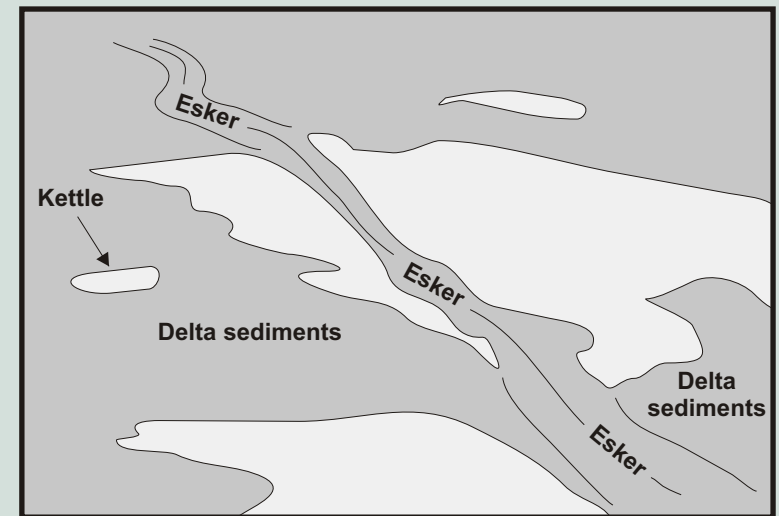


Kame moraine, La Bluff, Ile de la Grande Entrée, Québec.

This great mass of contorted, gravelly sand is a prominent feature on the eastern coast. Most of the material derives from the granitic rocks of the Precambrian Shield far to the north. This feature, a kame moraine, was deposited against glacier ice during the main stage of the last glaciation, when the Laurentide Ice Sheet filled the Gulf of St. Lawrence. These sandy glacial deposits, and not the local sandstone bedrock, are the main source of the modern coastal beaches.

Esker

An esker is a long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel. It was deposited by a subglacial or englacial stream flowing between ice walls or in an ice tunnel of a stagnant or retreating glacier. It may branch and is commonly discontinuous. Eskers range in length from less than 100 m to more than 500 km (if gaps are included), and in height from 3 m to more than 200 m.

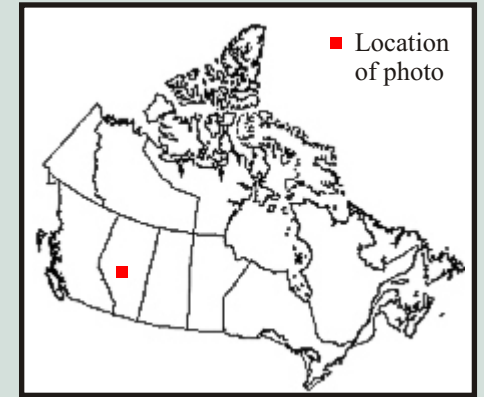


Esker ridge, with deltas deposited into a former glacial lake, northwestern Manitoba.

A sinuous, gravelly esker ridge in the boreal forest is seen in the centre of the photograph. This ridge marks the course of a meltwater conduit that formed within a former glacier whose margin retreated toward the foreground of the photograph. The light-toned triangular areas flanking the esker are sandy delta sediments that were deposited from the mouth of the esker conduit into a glacial lake as the ice front receded. The small ponds on the sandy delta were created where ice blocks from the glacier were buried in the sediment, and later melted out; these are called kettle holes because of their shape.

Varves

Varves form a sedimentary bed or lamina or sequence of laminae deposited in a body of still water within one year's time. They consist of thin pairs of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.



Glacial lake varves, north side of the Athabasca River, Alberta.

This photograph shows glacial lake varves lying on glacial till. The till is composed of rocks in a gravel, silt, clay, and sand matrix. It was deposited at the base of the Laurentide Ice Sheet during the Wisconsinan (23 000 to 10 000 years before present). Once the glacier had retreated (melted) to a point further east, glacial Lake Leduc occupied this section of the valley, and the varves were deposited in this lake. Glacial Lake Leduc is part of a sequence of lakes that covered north central Alberta. The varves represent a year of the lake's history: a pale coloured layer of silty sand deposited in summer, and a dark clay layer deposited in winter. During the summer, more water and sediments flowed into the glacial lake; therefore, the coarse, heavy material, like sand and silt, was deposited on the lake bottom. During the winter, the lake was covered with ice and little, or no, sediment flowed into the lake, allowing clay, very fine silt, and organic particles to settle to the bottom. Varves afford geologists an opportunity to calculate the age of the lake, similar to counting the rings of a tree trunk. At the bottom of the lakebed, near the till, the varves are faint and wide; near the top, they are defined and thin. This difference is related to the depth of the glacial lake. As the lake became deeper, the sediment source grew further away; therefore, less sediment settled during each season.

Need More Information?

A collection of photos of Canadian Landscapes and landforms is presented, on the internet, as a public service to illustrate the great diversity of Canadian scenery at <http://landscapes.nrcan.gc.ca>. Brief geological explanations provide insight on how the features developed. The photos were taken by scientists of the Geological Survey of Canada.

Bibliography

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