

Surficial Materials

Abstract

Most unconsolidated materials covering the Canadian landmass have glacial origins. Some sediment were entrained by glaciers and deposited at a distance without being sorted. Other sediments were picked up and reworked by glacial melt water, or transported and deposited by river or wind action. Some sediment are organic or volcanic in origin. Sediments are classified according to the manner in which they were transported and deposited.

Most unconsolidated material covering the Canadian landmass has a glacial origin and was deposited during the most recent glaciation as the glaciers either removed or buried previous deposits. Some sediment were entrained by glaciers and deposited at a distance without being sorted; others were picked up and reworked by glacial meltwater, or transported and deposited by river or wind action; still others are organic or volcanic in origin. Sediments are classified according to the manner in which they were transported and deposited. The following describes the various types of sediments shows on the map.

Glacial Deposits

Glacial deposits are deposits that were transported by glaciers. The glaciers eroded outcrops as they encountered them, striating and polishing their surfaces. As they advanced, they pried up and carried away fragments of rock as well as most of the loose earth, which they later deposited as they melted. This type of glacial material is called "till." Till is any sediment that is transported and deposited by a glacier without being sorted by meltwater. It consists of clay, sand and large rock fragments that are deposited in irregular sheets or in ridges called moraines. Moraines are accumulations of till constructed by direct action of the glacier.



Figure 1: Till of a moraine in Pontneuf area, Quebec

Source: Geological Survey of Canada (photo number A92S0034)

Fluvioglacial Deposits

Fluvioglacial deposits are glacial sediments that have been reworked by glacial meltwater. These features are produced by meltwater and ice. As the glacier recedes, the ice breaks into stagnant masses separated by lakes or flowing water. Sediments accumulate on, under and within these ice masses and are reworked by the meltwater to produce various features such as eskers, drumlins, kames, sheet deposits, terraces and deltas. In general, fluvioglacial sediments consist of sorted sand and gravel.

When meltwater flows through the interior of a glacier, the sediments it deposits will eventually form eskers and drumlins. Eskers are the sinuous ridges composed of glacial material deposited by meltwater currents in englacial tunnels. Their orientation is generally parallel to the direction of glacial flow, and they sometimes exceed 100 kilometres in length.

Drumlins are elongated hills oriented in a direction parallel to the line of flow of the ice. Drumlins are always found in large groups. They are composed of glacial materials and shaped by the passage of the overriding ice.



Figure 2: One of Nova Scotia's 5000 drumlins, Gaetz Head (near Halifax), Nova Scotia

Source: Geological Survey of Canada (photo number A94S0065).

When meltwater circulates in the crevasses of stagnant ice or between the ice and the walls of a valley, it leaves deposits that form gravel hills called kames once the ice disappears. As the ice floor or walls melt, the hills collapse and become deformed.

Other fluvioglacial features related to kames include kame-and-kettle topography (relief characterized by mounds and depressions), kame deltas or ice-contact deltas, kame moraines (composed primarily of fluvioglacial materials deposited near the front of an inactive glacier), and kame terraces or ice-contact terraces.



Figure 3: Esker in the central District of Mackenzie

Source: Geological Survey of Canada (photo number A89S54)

Glaciolacustrine Deposits

Sediments deposited in glacial lakes are called glaciolacustrine deposits. Glacial lakes form when meltwater is trapped between the front of a glacier and a moraine or rock wall that prevents drainage. Glaciolacustrine deposits consist primarily of well-stratified fine sand, silt and clay.

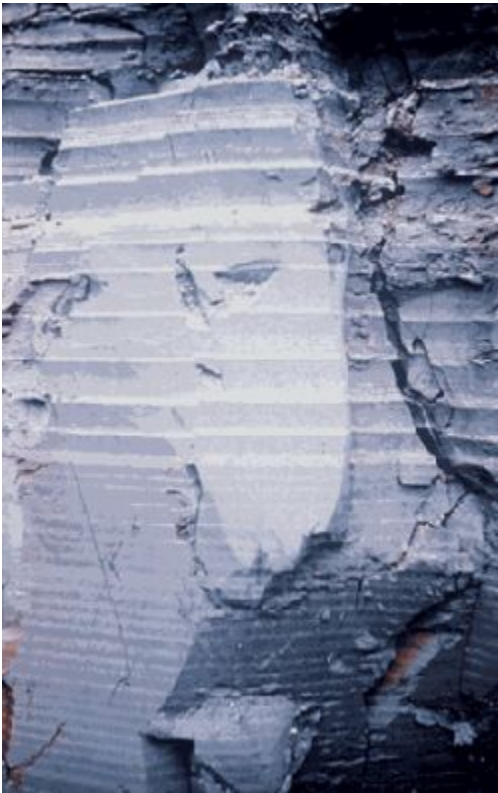


Figure 4: Detail of varves

Source: Geological Survey of Canada (photo number kgs156)

Glaciomarine Deposits

Glaciomarine sediments are materials that are deposited on the sea floor by glacial meltwater, by debris flows from the surface of a glacier or by melting icebergs. However, glacial seas were not the same as the seas of today. In fact, during glaciation the weight of the ice cap was sufficient to depress the surface of the continent to a level below that of the ocean. As the ice cap disappeared, the ocean invaded the lower parts of the continent, creating seas. It was at this time that the Champlain Sea formed in the St. Lawrence valley, and the Tyrrell Sea in the area of Hudson Bay.

Once the continent was relieved of the weight of the ice, it gradually rebounded and the ocean waters withdrew to form the shoreline we are familiar with today. As a result of this rebound effect, which is still a factor today, glaciomarine deposits are now exposed at places which may be far from the nearest modern-day oceans.

Colluvium or Colluvial Deposits

Colluvial deposits consist of material that is produced by the erosion of rock walls and accumulates at the base of slopes under the action of gravity. These sediments may descend the slopes rapidly, as in the case of a rock fall, a landslide or solifluction, or slowly, as a result of freeze-thaw cycles, in a phenomenon known as creep.

Alluvium or Fluvial Deposits

Alluvium is sediment that is deposited by running water. It is comprised primarily of gravel, sand and silt. Alluvial sediments are sorted and sometimes stratified. They are found along current and ancient watercourses, in channels, alluvial plains, terraces, alluvial fans and deltas. These sediments are not glacial in origin.

Marine and Lacustrine Deposits

These deposits have undergone the same sedimentation processes as glaciolacustrine and glaciomarine deposits but have accumulated in a non-glacial environment. Silts and clays are found in deep water, and gravels and sands in littoral zones. Coarse sediments (gravel and boulders) are deposited where currents are stronger, whereas fine sediments (sand, silt, clay) are characteristic of weaker currents.

Organic Deposits

Organic deposits are rich in partially decomposed plant matter. They usually form and accumulate in poorly drained environments such as swamps and peat bogs.

Eolian Deposits

Eolian deposits are sediments that have been transported by wind. When the wind's speed drops and it can no longer hold sediment grains suspended in the air, the too-heavy grains are deposited in dunes or in a blanket over the surface of the ground.

Volcanic Sediments

Sediments of volcanic origin include ash, lava and coarser debris ejected by erupting volcanoes. Sediments of this type were deposited in Canada thousands of years ago during the eruption of volcanoes in western Oregon, in Washington state, in southwestern British Columbia and in Alaska.

Map Sources

Surficial Materials

This map was generalized from 'Surficial Materials of Canada - Map 1880A', Geological Survey of Canada. It portrays broad generic categories of surface material such as alluvial, lacustrine, marine and glacial. The units are subdivided according to different characteristics: texture, thickness and landform. Fulton, R.J. 1995. Surficial Materials of Canada, Geological Survey of Canada, Map 1880A.

References

Fulton, R.J. (ed.). 1984. Quaternary Stratigraphy of Canada. A Canadian Contribution to IGCP Project 24. Geological Survey of Canada, Paper 84-10.

Fulton, R.J. (Scientific editor). 1989. Quaternary Geology of Canada and Greenland. Geological Survey of Canada, Geology of Canada Series; no. 1. Geological Society of America, Geology of North America Series; VOL. K-01.

Sibrava, V., D.Q. Bowen and G.M. Richmond (eds.). 1986. Quaternary Glaciations in the Northern Hemisphere. Quaternary Science Reviews, The International Multidisciplinary Review Journal, Volume 5. Oxford: Pergamon Press.

Related Web sites (1999 – 2009)

Federal Government

Natural Resources Canada. Earth Sciences Information Centre Catalogue

<http://geoinfo.gsc.nrcan.gc.ca/screens/opacmenu.html>

The Earth Sciences Information Centre (ESIC) holds Canada's largest collection of books, journals, maps and photos in the earth sciences, in print and electronic formats.

Natural Resources Canada. Geological Survey of Canada. Canadian Landscapes

http://gsc.nrcan.gc.ca/landscapes/index_e.php

This collection of photos of Canadian landscapes and landforms is presented as a public service to illustrate the great diversity of Canadian scenery.

Natural Resources Canada. Geological Survey of Canada. Geoscape Vancouver. The Fraser River delta

http://geoscape.nrcan.gc.ca/vancouver/fraser_e.php

An attractive and colourful presentation of important geological phenomena in the Vancouver area. The poster uses over 30 diagrams, maps, and photographs to tell the story of how earthquakes, landslides, volcanoes, local rock types and mineral resources, floods, and groundwater affect the lives of Vancouver residents.

Natural Resources Canada. Geological Survey of Canada. Surficial Geology of the Oak Ridges Moraine

http://gsc.nrcan.gc.ca/hydrogeo/orm/index_e.php

This compilation is based on 1:50 000 mapping by the Geological Survey of Canada and the Ontario Geological Survey.

Natural Resources Canada. Geological Survey of Canada. Surficial Materials of Canada

http://gsc.nrcan.gc.ca/map/1880a/index_e.php

Surficial Materials of Canada - Map 1880A. This map shows the distribution of surficial materials in Canada, on land and in extensive offshore areas, and portrays broad genetic categories of surface materials (alluvial, lacustrine, marine, glacial) and bedrock.