

Surficial geology of Manitoba

Compiled by
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2007

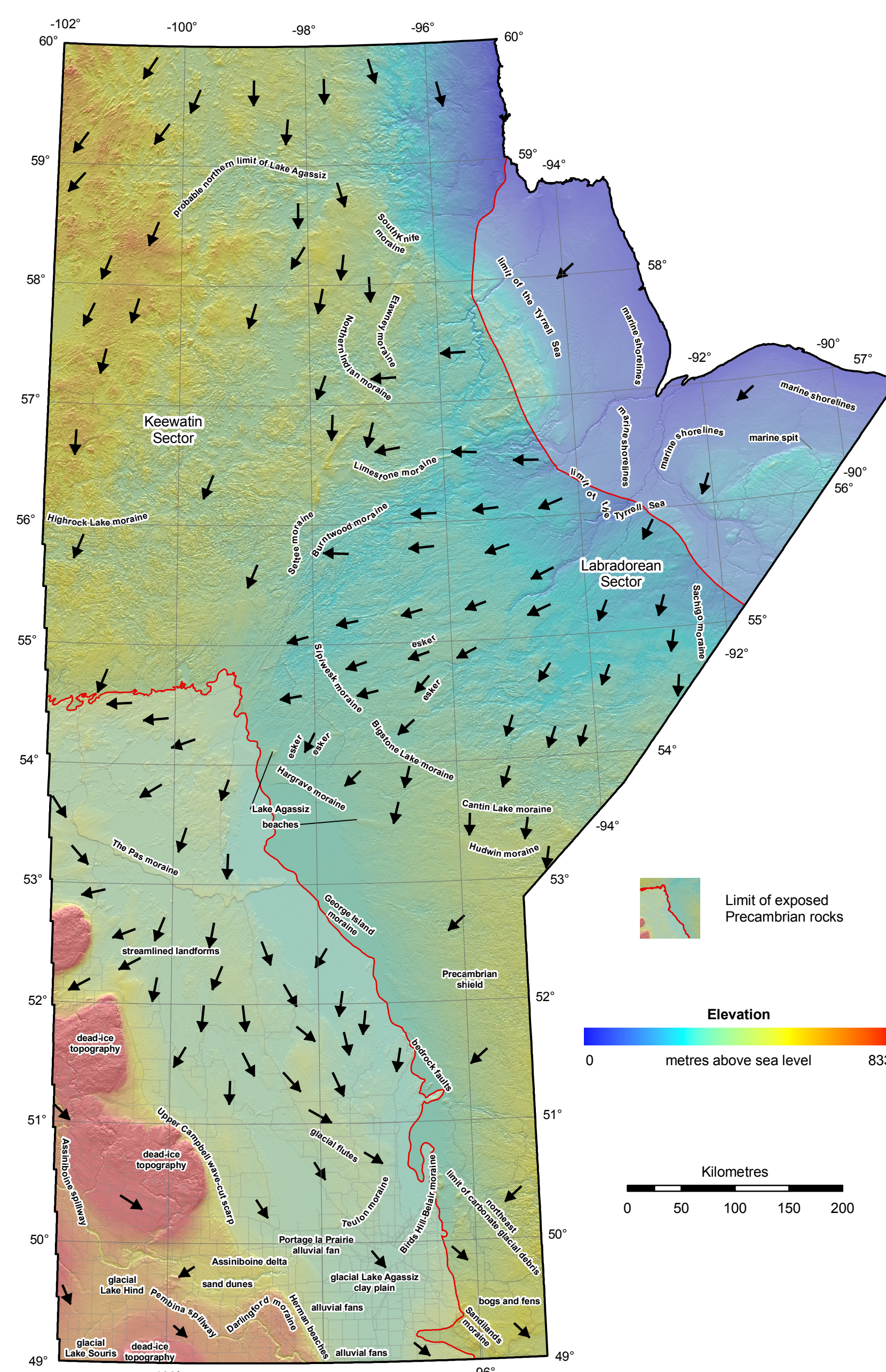
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Manitoba



Major landforms and ice-flow directions



The Quaternary landscape of northern Manitoba

The Precambrian shield is dominated by discontinuous sediment cover with numerous bedrock outcrops, whereas the Phanerozoic rock terrain tends to have a thicker sediment cover with limited bedrock outcrop. The thickest package of Quaternary sediment is found in the Hudson Bay Lowland (HBL), where large sections along major rivers, such as the Nelson and Hayes rivers, expose multiple glacial tills and interglacial sediments that date back hundreds of thousands of years to before the last glaciation. On the Precambrian shield, Quaternary sediments are commonly thick but discontinuous, in places completely infilling the bedrock lows. Older sediments and saprolites (decomposed rock) were often preserved in the bedrock lows, where they were protected from glacial erosion. Bedrock structures, such as faulting and folding, is commonly visible through the sediment cover on the digital elevation model (DEM).

The Elbow, Northern Indian and Settee moraines clearly mark the confluence between the Keewatin (to the west) and Labradorean (to the south and east) sectors of the Laurentide ice sheet. Glacial sediments to the west of this moraine system are predominantly noncalcareous and sand rich and were deposited by glaciers flowing southward. In contrast, glacial sediments to the south and east are predominantly calcareous and silt rich, and were deposited by glaciers flowing southward. The terrain in the Keewatin Sector is strongly streamlined parallel to the ice flow by turbulent subglacial meltwater and punctuated by regularly spaced major and tributary eskers composed of sand and gravel.

The Labradorean Sector is dominated by landforms which define a major ice stream that carried carbonate-rich debris west from the HBL to at least as far as The Pas Moraine. The retreat of this ice lobe is punctuated by numerous moraines, including The Pas, Hargrave, Hudson, Carlin, Lake, Bigstone Lake and Sipewake moraines. Patches of streamlined landforms (parabolic drumlins) can be found, but much of the area is buried by clay that was deposited in the deep water of glacial Lake Agassiz, thereby masking the glacial landscape. Drumlinoid ridges in the Labradorean Sector of the Laurentide ice sheet south and west of the HBL contain a large proportion of carbonate glacial debris from the HBL, the resultant dilution of local debris makes these ridges a poor medium for till prospecting.

As the glaciers retreated, glacial Lake Agassiz expanded northward, progressively covering most of northern Manitoba. The probable northern extent of glacial Lake Agassiz is marked by an anomalously large area of littoral sand (light blue on the main map) north of Southern Indian Lake. Within the limits of the Tyrrell Sea, the HBL is primarily peatland interspersed with numerous sandy shoreline features.

The Quaternary landscape of southern Manitoba

Eastward-facing bedrock escarpments, culminating in cuestas which form the Manitoba Escarpment, provide a foundation for the present-day landscape of southern Manitoba. To the east, the landscape is dominated by Precambrian rocks where bedrock structure, such as faulting, is commonly visible on the DEM.

Above the Manitoba Escarpment, the landscape is dominated by hummocky moraine (dead-ice topography), streamlined topography and glacial spillways. Many areas are covered by thick sequences of glacial till that represent numerous glacial episodes dating back more than 100,000 years. The most recent glacial advances were from the northwest. Glacial till tends to be clay rich.

The interlake is dominated by streamlined landforms and, in topographically lower areas, by glacioclastic depositional basins. Quaternary sediments are relatively thin and the preservation of older sediments is uncommon, limited to bedrock-protected areas such as escarpments. Bedrock outcrops are common. Glacial advance was generally from the northwest, parallel to the streamlined landforms. Glacial till is typically silt rich. Glacial retreat occurred in a series of steps marked by moraines: the Darlingford Moraine (~11,000 years old); the Sandilands Moraine, which represents the intermediate position of the Ramby lobe from the northeast and the Red River lobe from the northwest; the Birds Hill-Belair Moraine; the Teulon Moraine; and The Pas Moraine (~8,000 years old). The George Island Moraine, contemporaneous with and to the east of The Pas Moraine, is another ice margin of the retreating Ramby lobe.

On the Precambrian shield, rock outcrops dominate the landscape. Quaternary sediments are commonly thick but discontinuous, rarely completely infilling the bedrock lows. Older sediments and saprolites are often preserved in the bedrock lows, where they are protected from glacial erosion. Glacial advance was generally from the northeast. Glacial till is typically sand rich.

As the glaciers retreated, glacial lakes Souris and Hind formed and drained, and glacial Lake Agassiz expanded northward, progressively covering the entire area below the Manitoba Escarpment. Major landforms of Lake Agassiz include the Assiniboine Delta, which formed as glacial meltwater flowed from the Assiniboine spillway, and clay plains composed of tens of metres of clay and silt. The Herman beaches indicate the highest level attained by Lake Agassiz in southern Manitoba. The Upper Campbell beach is the best developed of the Lake Agassiz beaches and is evident along the base of the Manitoba Escarpment.

Holocene modifications to the landscape include eolian activity (sand dunes), primarily in the Assiniboine Delta and the Sandilands Moraine; the Portage la Prairie alluvial fan, from which fluctuating Assiniboine River flow directions, over the last 7,000 years, have been derived; smaller alluvial fans that have developed along the Manitoba Escarpment; large landslide areas (colluvium) that are active along the northern part of the Manitoba Escarpment; and organic accumulations (bogs and fens) with basal radiocarbon dates of approximately 6,000 years, which occur in the northeast and extend westward into the northern and eastern interlake and southward into southeastern Manitoba.

Copies of this map can be obtained from
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Legend

(To aid the reader, a shadow effect has been added
to exaggerate the topographic relief)

Quaternary

- ORGANIC DEPOSITS:** peat, muck; <1–5 m thick; very low relief wetland deposits; commonly in low-lying areas; accumulated in fen, bog, swamp, and marsh settings; in permafrost areas, commonly includes permafrost features such as patterned ground and peat palsas
- SHORELINE SEDIMENTS:** sand and gravel; 1–2 m thick; beaches; formed by waves at the margins of modern lakes
- COLLUVIUM:** landslide debris, eroded slopes, mass-flow deposits associated with steep slopes
- EOLIAN:** sand and minor silt; dunes, blowouts and undulating plains; generally overlies deltaic sediments, coarse lacustrine sediments, or glacioluvial deposits
- ALLUVIAL SEDIMENTS:** sand and gravel, sand, silt, clay, organic detritus; 1–15 m thick; channel and overbank sediments; reworked by existing rivers and deposited primarily as bars
- MARGINAL GLACIOMARINE SEDIMENTS:** littoral sand and gravel; 1–10 m thick; beach ridges, spits, bars; formed by waves at the margin of the glacial Tyrrell Sea and present-day Hudson Bay
- OFFSHORE GLACIOMARINE SEDIMENTS:** clay, silt, minor sand; 1–20 m thick; very low relief massive and laminated deposits, commonly overlain by peat; deposited from suspension in the offshore deep water of the glacial Tyrrell Sea and present-day Hudson Bay
- MARGINAL GLACIOLACUSTRINE SEDIMENTS:** sand and gravel; 1–20 m thick; beach ridges, spits, bars, littoral sand and gravel; formed by waves at the margin of glacial Lake Agassiz and other proglacial lakes primarily in the southwestern portion of the province
- OFFSHORE GLACIOLACUSTRINE SEDIMENTS:** clay, silt, minor sand; 1–20 m thick; low-relief massive and laminated deposits; deposited from suspension in offshore deep water of proglacial lakes, primarily glacial Lake Agassiz; commonly scoured and homogenized by icebergs
- DISTAL GLACIOLUVIAL SEDIMENTS:** fine sand, minor gravel, thin silt and clay interbeds; 1–75 m thick; subaqueous outwash fans; commonly deposited in glacial Lake Agassiz by meltwater turbidity currents; in places reshaped by wave erosion and reworked by wind
- PROXIMAL GLACIOLUVIAL SEDIMENTS:** sand and gravel; 1–20 m thick; complex deposits, belts with single or multiple esker ridges and kames, as well as thin, low-relief deposits; deposited in contact with glacial ice by meltwater
- TILL:** diamicton; unsorted glacial debris; 1–75 m thick; generally low-relief, commonly streamlined deposits; in Lake Agassiz basin areas, the till can be wave washed, covered discontinuously by a thin veneer of glaciolacustrine sediments and scoured by icebergs; thicker sequences, primarily above the Manitoba Escarpment and in the Hudson Bay Lowland, consist of multiple units of varying texture and provenance
- CLAY DIAMICTON:** calcareous, primarily composed of Mesozoic shale from above the Manitoba Escarpment
- SILT DIAMICTON:** calcareous, largely composed of Paleozoic rocks from the Hudson Bay Lowland and the interlake region of southern Manitoba
- SAND DIAMICTON:** non-calcareous, often bouldery, predominantly composed of Precambrian crystalline rocks

Pre-Quaternary

- ROCK:** 75% bedrock outcrop; generally subglacially eroded and unweathered; in areas of permafrost, includes frost shattered, angular, monolithic boulder fields (felsenmeer)
- MESOZOIC TERRANE:** shale-dominated rocks above the Manitoba Escarpment, exposed in the base of spillways and along the Manitoba Escarpment in association with colluvium
- PALEOZOIC TERRANE:** carbonate-dominated rocks in areas west of Lake Winnipeg, exposed typically as glacially striated, low-relief surfaces and along large river valleys in the Hudson Bay Lowland
- PRECAMBRIAN TERRANE:** intrusive, metasedimentary and metavolcanic rocks that have a glacially scoured irregular surface with high local relief

