Natural Resources Canada
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GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA

NATMAP
CARTNAT
Canada's National Geoscience Mapping Program
Le Programme national de cartographie géoscientifique du Canada

DESCRIPTIVE NOTES

The Hargrave Lake map area straddles the Paleozoic/Precambrian boundary in central Manitoba, which results in marked differences in physiography, drift thickness, and till composition on either side of the Shield margin. The northwestern part of the area is underlain by Precambrian metamorphosed volcanic and sedimentary rocks and associated intrusive rocks of the Flin Flon greenstone belt (Manitoba Energy and Mines, 1993). These rocks are structurally overlain by metamorphosed turbidites of the Kisseynew Domain, which outcrop in the northeast corner of the area. Rocks of the Churchill-Superior Boundary Zone also outcrop along the eastern edge of the area east of Ponton. South of the Shield margin, the Precambrian rocks are overlain by Paleozoic carbonate rocks, increasing in thickness up to 125 m at the southern edge of the area (Leclair et al., 1997).

The physiography of the map area is defined primarily by bedrock relief and by the presence of a glaciolacustrine basin in the eastern half of the area (Fig. 1, 2). On the Precambrian terrane, relief is flat to gently undulating, and the surficial cover is thin (< 3 m) and discontinuous. Till rarely outcrops through the glaciolacustrine cover, and the thickest till accumulations occur on the down-ice side of small bedrock irregularities and bedrock highs. On the Paleozoic cover, relief is low, forming a northeast-sloping plain interrupted by isolated dolostone mesas, and the overburden is generally thicker and more continuous. In the north-south trending glaciolacustrine belt east of Hargrave Lake, vast regions of open water and peatlands form a monotonous landscape. Grass River, Mitishto River, Hargrave River, and Minago River all drain into Nelson River to the east. The map area is located within the discontinuous permafrost zone and forest cover is a mixed coniferous deciduous boreal community.

Previous work

Bell (1978) proposed a sequence of glacial and deglacial events in the Wekusko Lake area, based on observations of surficial sediments and striae collected while mapping the bedrock. The surficial geology of the Wekusko Lake area was compiled at a regional scale by Klassen (1980). Klassen (1983, 1986) described the surficial sediments and outlined the history of deglaciation, as part of a regional study of north-central Manitoba. Current studies conducted as part of the NATMAP Shield Margin Project have concentrated on surficial mapping (McMartin, 1993, 1994a), drift prospecting and till provenance (McMartin 1994b; McMartin and Pringle, 1994; McMartin et al., 1996), surficial sediment geochemistry (Henderson and McMartin, 1995; Henderson et al., in press; McMartin et al., in press), and Lake Agassiz history (McMartin, 1996). Other studies were aimed at providing information for use in aggregate resources and land use planning activities (Ringrose, 1977; Mihychuk, 1988).

Ice flow history

The map area lies in a zone influenced by ice flowing from two dispersal centres during the Late Wisconsinan (McMartin et al., 1996). Around Wekusko Lake, the predominant direction of ice flow indicators is towards the south-southwest, indicating glaciation from a Keewatin dispersal centre (Fig. 3). Approximately south of Mitishto River, predominant ice flow indicators have a west-southwestward orientation, indicating ice flow from a Labrador Sector dispersal centre (Fig. 3). Several minor ice flow events have also been recognized across the area. The oldest event was westward from an ice lobe centered east of the project area. The oldest Keewatin advance was southeastward and probably postdates the early westward flow. A southwestward readvance of Keewatin ice in Lake Agassiz was recognized in the Wekusko Lake area, overprinting completely the previous major events at several sites. This readvance caused a confluent and parallel ice flow between the two major lobes along the shield margin south of Wekusko Lake (Fig. 3). Late SSW striae in the Minago River area, WNW striae northwest of Hargrave Lake, and SSE striae west of Wekusko Lake are evidences for minor deglacial events.

Surficial geology

The composition and texture of till vary across the map area depending on the depositing ice (Keewatin versus Labrador) and lithology of the underlying bedrock (McMartin et al., 1996). Three distinct surface till units have been recognized in the area. Over the Flin Flon greenstone belt, the most pervasive unit consists of a locally derived till overlying bedrock striated by the predominant Keewatin south-southwestward ice flow (unit 1a). Till matrix is sandy (up to 70% sand), and noncalcareous (Fig. 4). Clast composition reflects bedrock lithologies found immediately up-ice (Fig. 5). South of Wekusko Lake, the composition and texture of this unit grade into a sandy silty (up to 40% silt), weakly to moderately calcareous till (unit 1b, 2b) (Fig. 4), as the Shield component becomes diluted by Paleozoic debris (Fig. 5). The Paleozoic cover is overlain by a grey to light reddish brown, moderately to strongly calcareous (Fig. 4), and relatively clast-poor till of eastern provenance (unit 1c, 2c). This unit is silty sandy (up to 65% silt), and variably enriched in Paleozoic carbonate pebbles (Fig. 5). East of the Paleozoic cover, over the Churchill-Superior Boundary zone, the carbonate content and clast composition of this till unit suggest an important component from a more distal source in the Hudson Bay Lowlands (McMartin et al., 1996; Matile and Thorleifson, 1997).

Stratified glaciofluvial deposits were formed in three areas. East of Hargrave River, ice-contact gravelly sands occur in several corridors which extend to the northeast outside of the map area as eskers and crevasse-filling kames (unit 3). These deposits occur as low, discontinuous ridges, and formed within Labrador retreating ice. Two other small glaciofluvial deposits display sedimentary structures and stratigraphy indicating deposition in Lake Agassiz (unit 4). Well sorted fine sand, deformed and faulted, interbedded with clay, gravel and diamictic units, occur as an outwash fan south of Monette Lake, and as a lee-side deposit southeast of Wekusko Lake.

Glacial lake deposits are widespread, diverse, and in places very thick. Fine grained sediments deposited in the deep water environment of Lake Agassiz occur at all elevations, draping topographic highs and filling topographic lows (unit 5a, 5b). They consist of noncalcareous to weakly calcareous silt, clay, and minor sand, commonly massive in the upper metre. The thickness of these deposits generally increases from west to east, masking both the Shield and Paleozoic terranes with up to 45 m of sediment in the eastern half of the map area (Fig. 2). Surfaces are locally inscribed by iceberg scours, particularly west of Ponton and between William Lake and Hargrave Lake. Discontinuous permafrost is present in thicker deposits, as evidenced by thermokarst depressions. Nearshore and littoral sediments are relatively abundant in the map area (unit 5c). These deposits formed as the level of Lake Agassiz dropped during the Morris Phase. Nearly continuous sandy ridges occur along Highway 6, forming the Ponton beaches (McMartin, 1996), and flights of shingle beaches occur along dolomitic bedrock escarpments. Nearshore sediments occur as a blanket of sand, grading basinward into finer sediments.

Alluvial deposits occur in the abandoned channel of Saskatchewan River, as calcareous silty floodplain and channel-fill sediments (unit 6). At the Ponton level, Saskatchewan River entered Lake Agassiz via the Minago River channel, which now consists of a series of lakes and a valley occupied by the Minago River. The Minago River channel was abandoned in mid-Holocene time due to isostatic uplift (McMartin, 1996).

Organic deposits include fen peat (unit 7b) and bog peat (unit 7a), widespread in poorly drained areas, primarily overlying offshore glaciolacustrine deposits. Isolated palsa and peat plateaus, thermokarst depressions and ponds, and collapse scar fens are indicators of permafrost.

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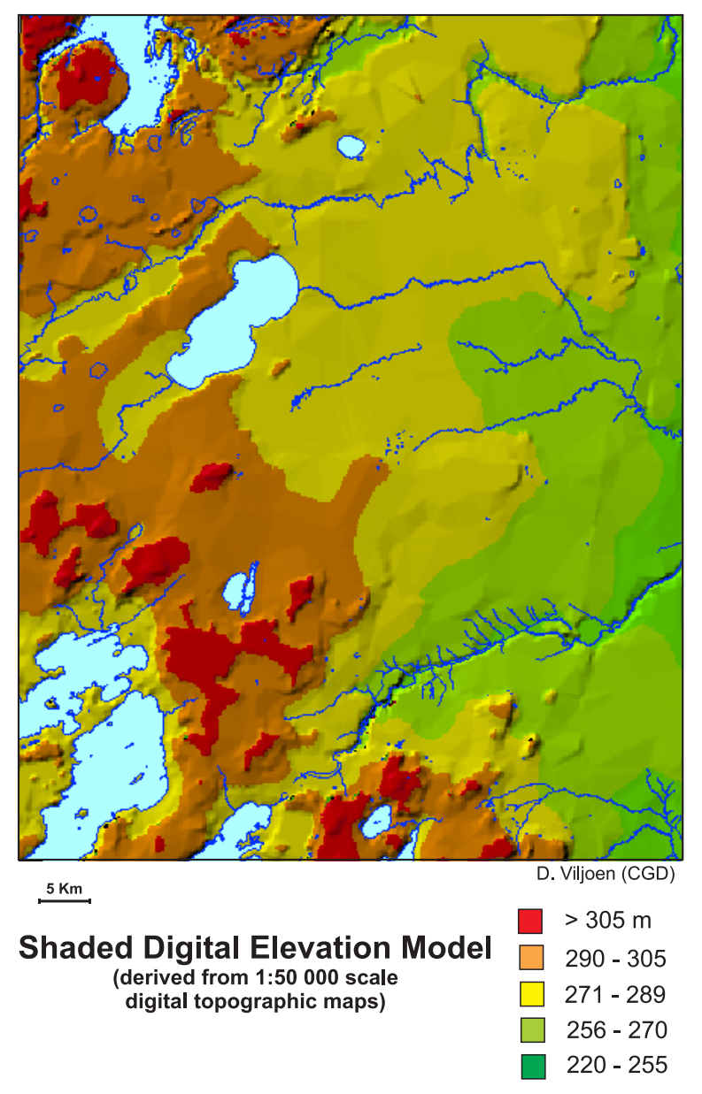


Figure 1. Digital elevation model

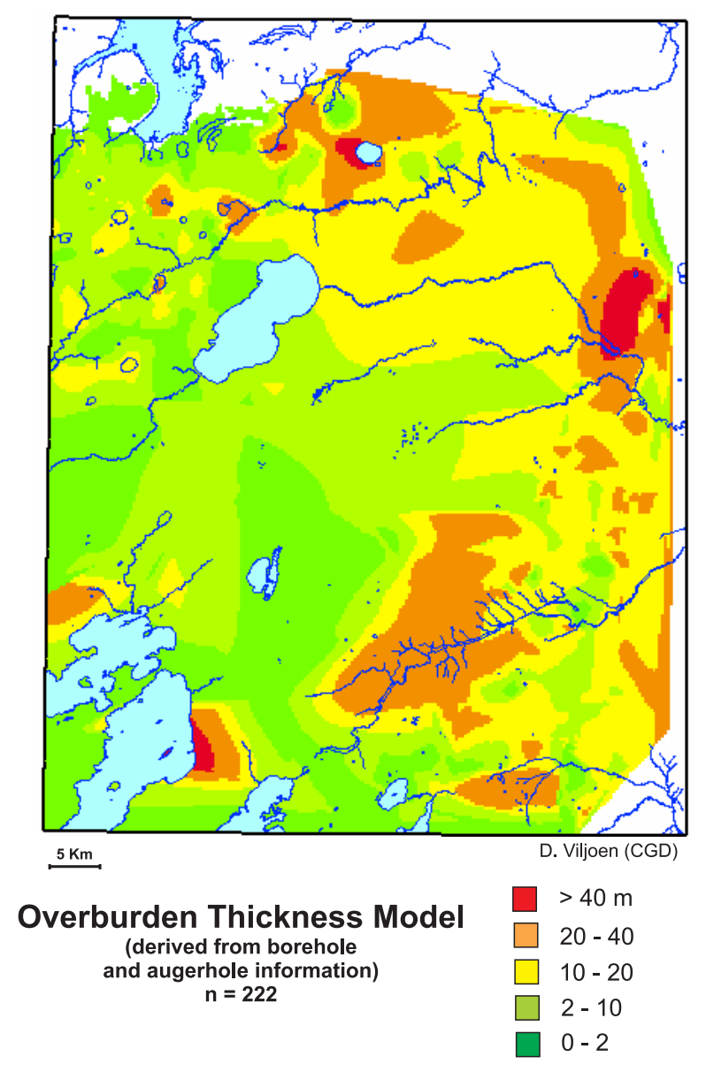


Figure 2. Thickness of overburden

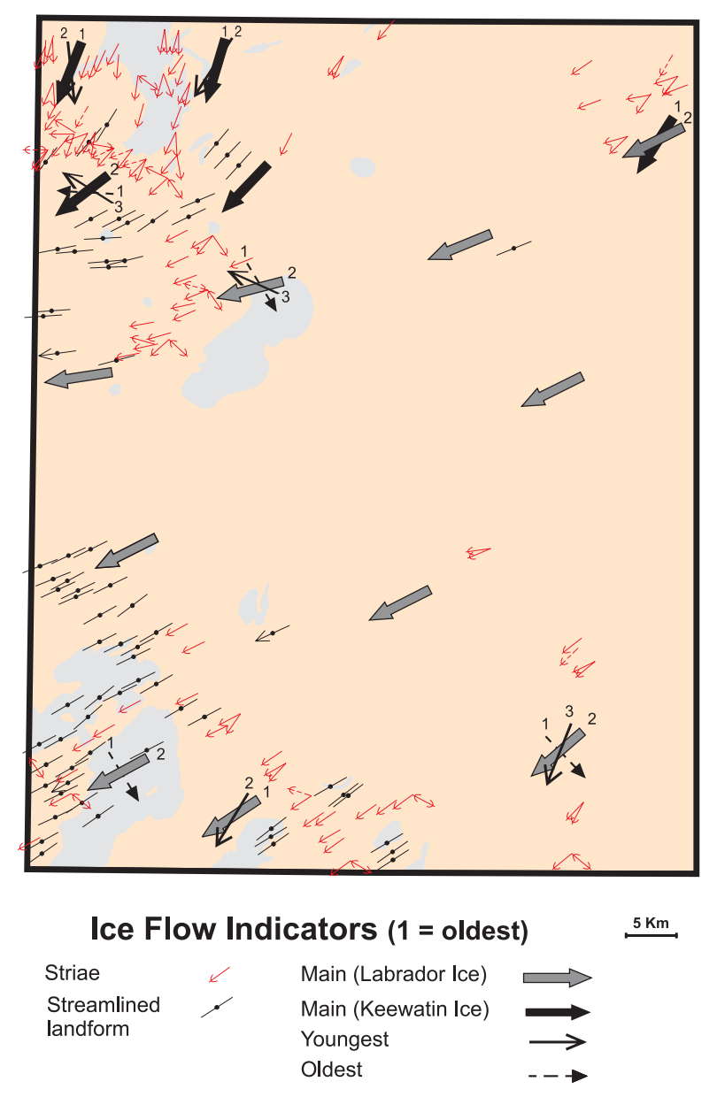


Figure 3. Striae (in red) and streamlined landforms (in black). The legend shows generalized ice flow sequences

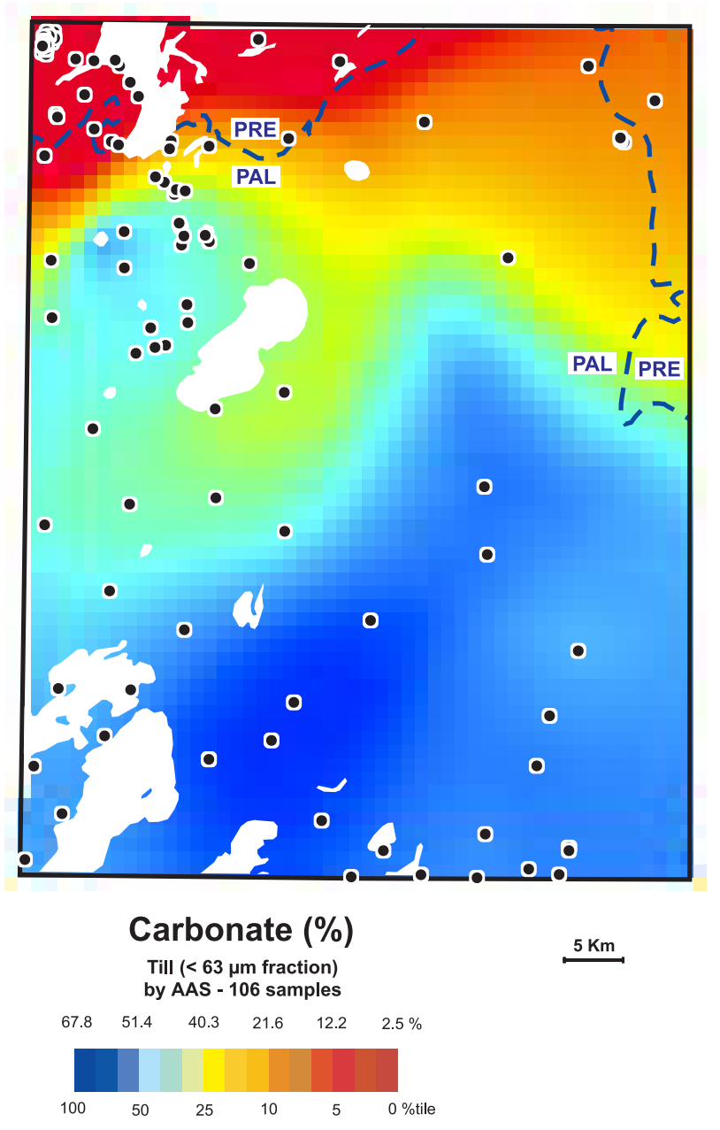


Figure 4. Gridded percentages of carbonate content in till (< 63 µm), using inverse distance weighting technique. Dots show sample location

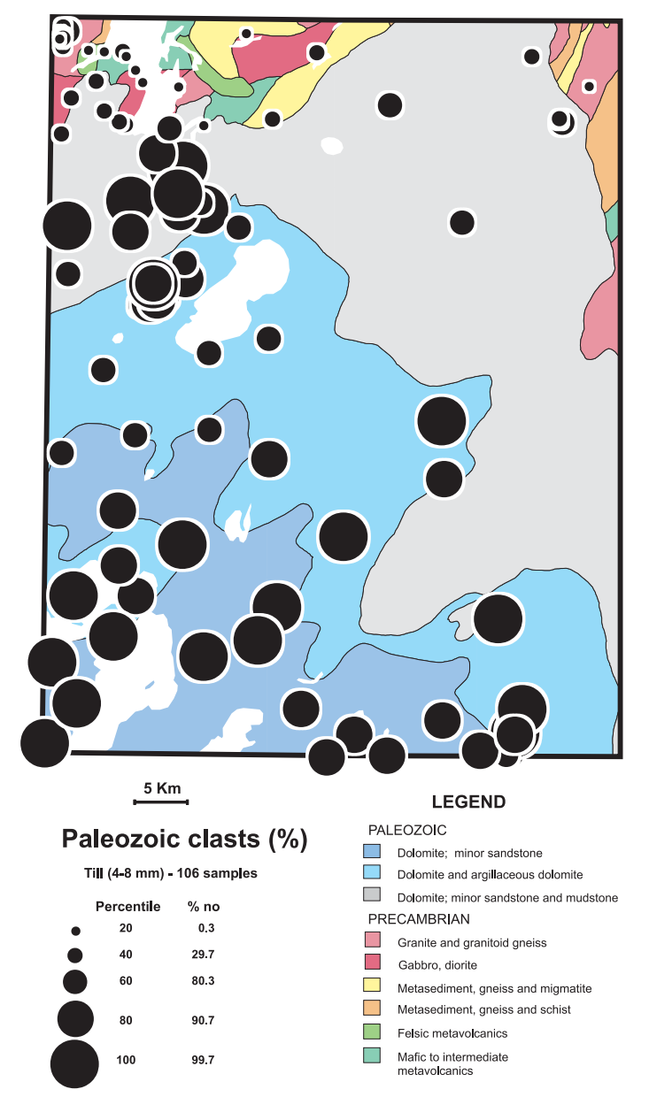
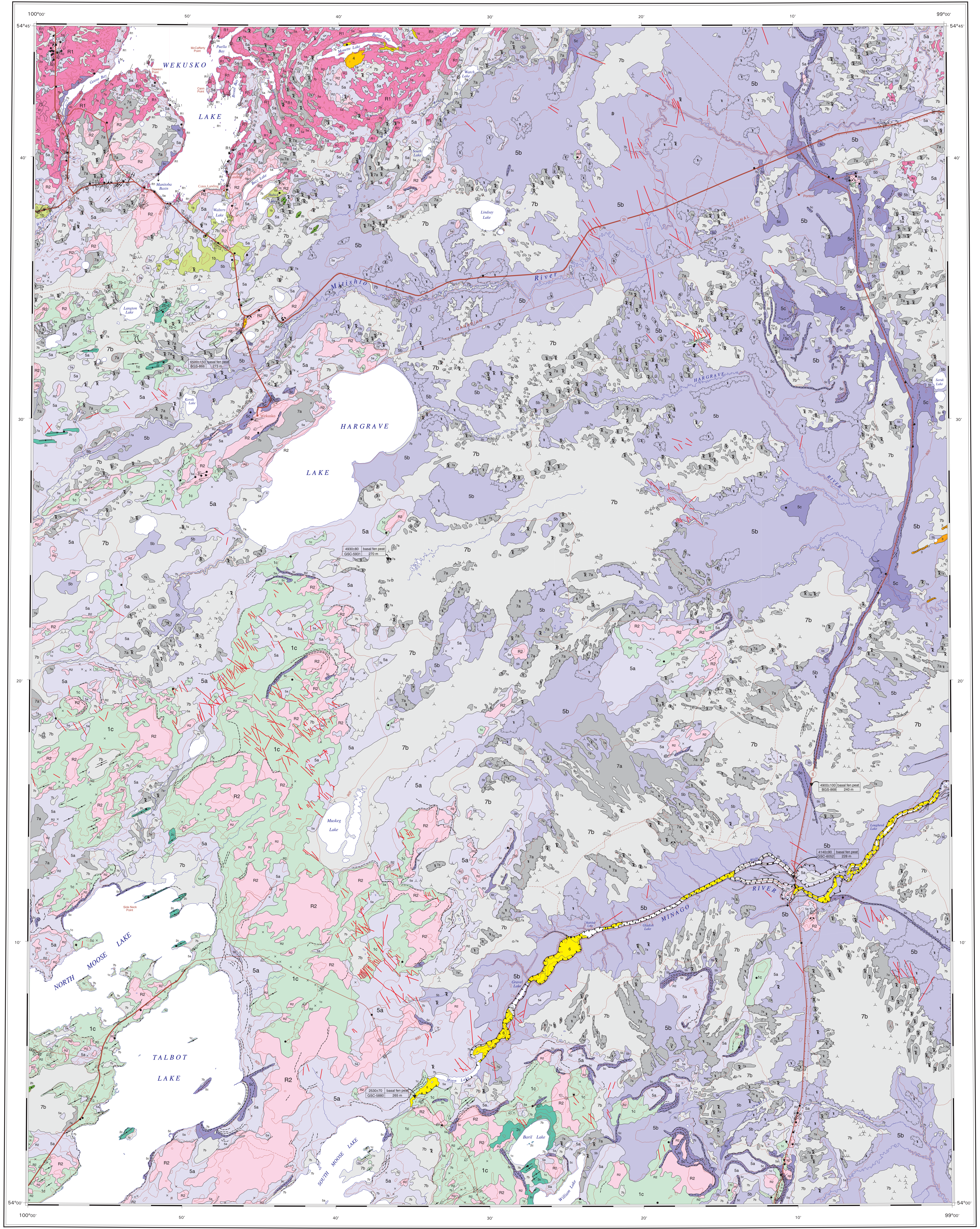


Figure 5. Paleozoic clast distribution in till (4-8 mm) over simplified bedrock map. Dot sizes are proportional to percentages



Published 1999

LEGEND

Coloured legend blocks indicate map units that appear on this map

SURFICIAL DEPOSITS
QUATERNARY

NONGLACIAL ENVIRONMENT

ORGANIC DEPOSITS: *peat, muck; 1 to 3 m thick; commonly underlain by fine glacial lake deposits; mantles extensive areas on the Paleozoic terrain or occurs in more confined, low-lying, poorly drained parts of the Shield*

7b ***Fen peat:*** *wet sedge and moss peat; includes string fen, floodplain and riverine marshes; occurs as flat grassy surfaces with few trees, and commonly visible surface waters; permafrost present in isolated palsa or small peat plateaus which occur within the fen*

7a ***Bog peat:*** *moss and woody peat; occurs as raised irregular surfaces with an open to closed tree cover; derived from spruce forest vegetation; thermokarst depressions and ponds, wooded palsa and forested peat plateaus are common; contains some areas of collapse scar fens*

6 ***ALLUVIAL DEPOSITS:*** *silt, sand, and minor gravel, 1 to 30 m thick; floodplain and channel-fill sediments deposited in the abandoned drainageway of Saskatchewan River within the Minago River channel*

PROGLACIAL ENVIRONMENT

GLACIAL LAKE DEPOSITS: *massive to stratified clay, silt, sand, and gravel; thickness ranges from a thin veneer to tens of metres; glacial sediments reworked by wave action in glacial Lake Agassiz, or carried to the basin in large part by glacial meltwater and deposited in deep water of Lake Agassiz*

5c ***Nearshore and littoral sediments:*** *sand, gravel, or rock shingle, moderately well sorted and commonly horizontally bedded; occurs as isolated or series of ridges, 1 to 3 m in height, including beaches, bars, and spits; flights of shingle beach deposits occur along carbonate bedrock escarpments; blankets of sand, commonly less than 2 m thick, grade basinward into finer sediments*

5b ***Offshore sediment blanket:*** *clay, silt, and silty sand, minor sand, gravel and diamicton; fine grained deep water sediments are noncalcareous to weakly calcareous and commonly massive near surface; 2 to 45 m thick; forms flat plains in low relief areas, mantled with peat; surfaces locally inscribed by iceberg scours*

5a ***Offshore sediment veneer:*** *clay, silt, and silty sand; less than 2 m thick; forms a discontinuous blanket mimicking underlying glacial and bedrock topography; includes undifferentiated glaciolacustrine sediments deposited in deep water beyond or near the ice margin; surfaces locally inscribed by iceberg scours*

GLACIAL ENVIRONMENT

GLACIOFLUVIAL DEPOSITS: *stratified sand and gravel, minor diamicton; sorted coarse grained sediment deposited by flowing glacial meltwater in contact with or near the glacier*

4 ***Subaqueous outwash sediments:*** *well sorted fine sand; commonly rippled and/or crossbedded; interbedded with clay, gravel, and diamictic units of variable thicknesses; 1 to 20 m thick; deformation and faulting common; deposits occur as outwash fans or down-ice of bedrock highs; sediments deposited in glacial Lake Agassiz at or near the retreating ice front by meltwater turbidity currents*

3 ***Proximal glaciofluvial sediments:*** *moderately to well sorted and well rounded interstratified sand and gravel, minor diamicton; 3 to 25 m thick; forming eskers and crevasse fillings; deposited by subglacial or englacial meltwater streams*

GLACIAL DEPOSITS: *unsorted to poorly sorted diamictons deposited at the ice margin or beneath the glacier. The area has been glaciated by ice originating from two dispersal centres, the Keewatin Sector to the north, and the Labrador Sector to the east. Deposits have been subdivided into three units based on provenance and underlying bedrock: a) till of northern provenance overlying Precambrian rocks is generally sandy, permeable, noncalcareous to slightly calcareous, and locally derived; b) till of northern provenance but underlain by Paleozoic bedrock is sandy silty, moderately permeable, weakly to moderately calcareous, and moderately enriched in debris derived from Shield terrane; c) till of eastern provenance is silty sandy, weakly permeable, moderately to strongly calcareous, and contains few Shield clasts*

2a
2b
2c

Till blanket: *forms a continuous cover, 2 to several metres thick, locally up to 20 m thick in streamlined landforms, masking underlying bedrock topography; deposits form drumlinized till plain and minor DeGeer moraines;* 2a *- till of northern provenance underlain by Precambrian rocks;* 2b *- till of northern provenance underlain by Paleozoic rocks;* 2c *- till of eastern provenance*

1a
1b
1c

Till veneer: *forms a moderately discontinuous cover, 1 to 2 m thick, reflecting underlying bedrock structure; commonly occurs on the down-ice side of Precambrian bedrock outcrops or forms a thin but continuous cover over the Paleozoic bedrock, interspersed with isolated areas of drumlinized till plain; surface may be covered by a thin veneer of Lake Agassiz offshore sediments or littoral sand and gravel;* 1a *- till of northern provenance underlain by Precambrian rocks;* 1b *- till of northern provenance underlain by Paleozoic rocks;* 1c *- till of eastern provenance*

Note: Till units labelled 1c-b *or* 2c-b *are located in a zone of confluence between Keewatin and Labrador ice flows and have undetermined provenance*

BEDROCK
PRE-QUATERNARY

R2 ***Paleozoic sedimentary rocks:*** *primarily dolostone and dolomitic limestone, minor sandstone and shale; surfaces are commonly pitted and frost shattered, but glacially polished and striated surfaces are preserved locally; occurs as flat-lying outcrops with patches of thin drift*

R1 ***Precambrian rocks:*** *metavolcanic and metasedimentary rocks, associated intrusive bodies; glacially scoured outcrops forming abundant roches moutonnées and striated or grooved surfaces; gently rolling topography with thin patchy drift cover*

Geological boundary
Thermokarst depressions (small, large)
Palsen and peat plateau
Beach ridge, spit, or bar
Iceberg scour
Esker (direction of flow known)
Abandoned river channel (small, large)
DeGeer moraine
Paleocurrent direction
Drumlin, drumlinoid ridge, fluting; undifferentiated
Crag and tail landform
Roches moutonnées (where observed)
Striae (ice flow direction known, unknown, poorly defined, unknown and poorly defined)
Crossed striae (1 = oldest) 1 2
Small bedrock outcrop
Rock escarpment
Gravel pit (active)
Quarry
Ground observation point
Radiocarbon date

Date	Material
Lab no	Elevation (m)

Geology by I. McMartin, 1992-1993

Co-ordinated by I. McMartin through the auspices of the Shield Margin NATMAP Project

Digital cartography by E. Everett, Geoscience Information Division

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada, modified by the Geoscience Information Division

Mean magnetic declination 1999, 7°42′E, decreasing 7.3′ annually. Readings vary from 7°8′E in the SE corner to 8°16′E in the NW corner of the map

Elevations in feet above mean sea level

MAP 1954A

SURFICIAL GEOLOGY

HARGRAVE LAKE

MANITOBA

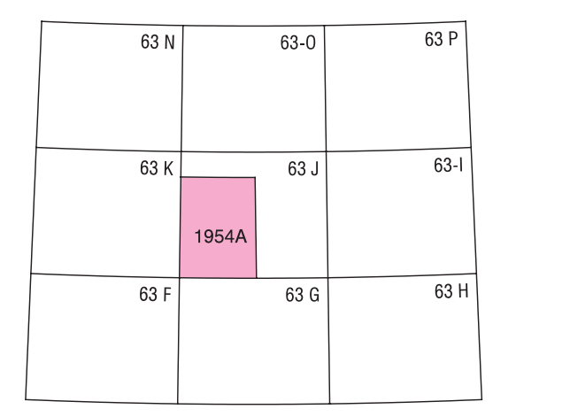
Scale 1:100 000/Échelle 1/100 000

kilometres 2 0 2 4 6 8 kilomètres

Universal Transverse Mercator Projection

Projection transverse universelle de Mercator

LOCATION MAP



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

Recommended citation:
McMartin, I.
1999: Surficial geology, Hargrave Lake, Manitoba; Geological Survey of Canada, Map 1954A, scale 1:100 000.

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