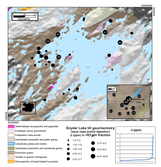
Quaternary geology updates for 2013

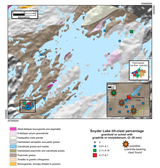
M.Trommelen
Manitoba Geological Survey

New and upcoming releases

Geoscientific Paper GP2013-1
Till composition and ice-flow indicator data, Snyder Lake area, northwestern Manitoba (parts of NTS 64N5)

Quaternary geological investigations were undertaken in the Snyder–Grevstad lakes area, situated in the far northwestern corner of Manitoba, as part of the Manitoba Far North Geomapping Initiative. In conjunction with detailed bedrock mapping, this work provides a modern geoscience knowledge base tailored toward current and future mineral exploration and/or infrastructure development. This report includes all till sample analyses (major- and trace-element matrix geochemistry, carbonate, grain size, colour, clast lithology) and a re-release of the mapped ice-flow indicators (formerly DRI2011002). Emphasis in the discussion is placed on drift-exploration results, including a study of uranium dispersal from a known occurrence.



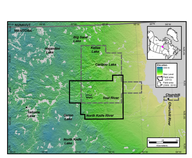


Geoscientific Paper
Surficial geology, till composition, stratigraphy and ice-flow indicator data, Seal River to North Knife River region, Manitoba (parts of NTS 54L, 54M, 64I, 64P)

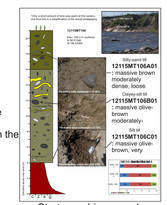
Quaternary geology investigations, including 1:50 000 scale mapping of surficial materials and ice-flow indicators, and regional till sampling surveys, were undertaken in the Seal River region (parts of NTS 54L, 54M, 64I, 64P) in the summer of 2012, in partnership with De Beers Canada Exploration Inc. Geological observations, sampling of glacial sediments (till), and/or measurements of ice-flow indicators were recorded at 87 field sites and 63 remote sites within a 7770 km^2 area in this far-northeastern part of Manitoba. Four stratigraphic sections along the North Knife River were also investigated. These observations supplement data from the Manitoba Geological Survey's Far North Geomapping Initiative, undertaken in 2009 and 2010 in the same area. A series of 1:50 000 scale surficial geology maps are released, which extend the regional detailed mapping . New ice-flow indicators were found that better delimit an old ice-flow phase to the west and northwest (270-338°), in addition to known ice-flow indicators trending towards the north-east, east, east-southeast, south-east, south, south-west and west-southwest. These new ice-flow indicators are commonly rare and protected features. New data confirms that most E-W trending fine striations on top of outcrops, that signify the youngest regional flows, are oriented to the ESE and E (90-130°) and are widespread across the entire study area. A new minimum deglacial radiocarbon age is provided for the study area, taken from a shell within a section along the North Knife River.

To determine the composition and regional heterogeneity of the till, the <63 µm fraction of the sampled till-matrix was analyzed for total-carbonate (Ca-Mg); inorganic carbon, organic carbon and sulphur (LECO, LOI), and trace-element and major-element geochemistry (ICP-ES and MS; partial and near-total digestion) at the Saskatchewan Research Council Geoanalytical Laboratory. Additionally, clasts (2-30 mm fraction) were separated from the till matrix, and classified according to lithology. Noncalcareous, weakly-calcareous and calcareous hybrid tills are recognized within the study area.

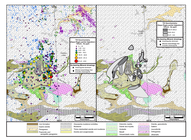
The dispersal of local- and regional-scale transported Canadian Shield subglacial detritus within the noncalcareous till is amoeboid over short distances (< 20 km). The tail-end of a continental-scale (> 600 km) Dubawnt Supergroup dispersal fan is noted across the study area, within all till-types. Carbonate dispersal (< 34% concentration), from the Paleozoic Hudson Carbonate Platform, is recognized south of the North Knife River at distances up to 60 km.



Calcareous, weakly calcareous and non-calcareous till in the area



Stratographic example



Arsenic (Aqua Regia ICP) dispersal pattern in till matrix

Geoscientific Paper
Glacial history and till composition, Knee Lake area, Manitoba (NTS 53L14, 15; 53M1, 2)

In 2012, the Manitoba Geological Survey (MGS) commenced Quaternary fieldwork in the Knee Lake area of northeastern Manitoba. The project builds on an already substantial amount of Quaternary data for this area, collected during the MGS Operation Superior project (1999-2001). The new research focuses on: i) providing a better understanding of the glacial history of the region, ii) adding data to the till geochemistry and kimberlite indicator mineral sampling surveys, and iii) conducting lithology analyses of clasts within till to assist mineral exploration in this region underlain by prospective bedrock but mantled by deposits of varying thicknesses.

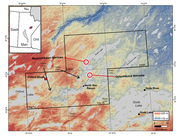
Beige, calcareous, sparsely fossiliferous, silty till is widespread throughout the study area. The calcareous subglacial detritus within this till was sourced from either the east or northeast, and transported (c.f. 100 km) to the study area during the penultimate glaciation and/or south-westerly ice flow in the Late Wisconsinan. Sparse Omar erratics, and a lone Kipalu clast, were also transported west-southwest, presumably from the Belcher Island Group (c.f. 940 km) during these ice-flow phases.

More work needs to be completed in the surrounding regions, but it appears that till between Knee Lake and Semmens Lake generally contains an elevated component of inherited Shield-derived subglacial detritus (>95th percentile of granitoid, exotic granitoid and Dubawnt Supergroup erratics) than the surrounding region. These clasts were transported south and south-easterly to the study area, during early ice-flow phases in the Late Wisconsinan or the penultimate glaciation. This high-inheritance hybrid till is brown, red-brown, grey or beige, non-calcareous or weakly-calcareous, and has a silty-sand matrix. These sites were protected (not diluted or reworked) from the ice-flow phases that transported substantial calcareous subglacial detritus to the area.

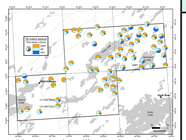
There are also non-calcareous tills that are enriched in greenstone-belt clasts (presumably locally-derived) or consist of a mixture of greenstone-belt and Shield-derived clasts.

Within the regional calcareous till, till-matrix geochemistry does not depict any spatial patterns or obvious dispersal trains of metals from known mineralized source outcrops. While regional variation of most element concentrations is masked, there are several sites with elevated gold concentrations (up to 560 ppm; background is 2 ppm) and other multi-element highs (>99th percentile). Weakly-calcareous (3.3% of sites) and non-calcareous (2.9% of sites) tills are 'more prospective' and may be 'truer' indications of local mineral potential. Ten sites exhibit multi-element highs (>99th percentile) of metals (As, Co, Cr, Fe and REEs). As such, detailed attention must be paid to Ca% (INAA), total CO3% (chittick or calcium-magnesium) and/or CaO% (ICP total digestion) concentrations during drift exploration analyses. Consequently, calcareous till samples with moderate to elevated metal concentrations may be more prospective than non-calcareous till samples with high metal concentrations, and the two populations should not be statistically treated as one dataset.

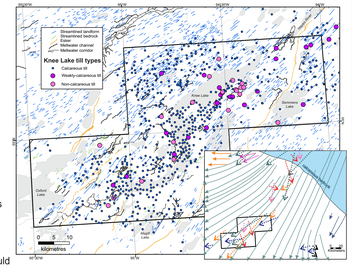
All three till-types occur within streamlined landforms, as well as till blankets or veneers over bedrock. This diverse geomorphology indicates that the process of drumlinization within the deglacial Hayes Lobe (300 by >400 km) was by subglacial erosion, modification, or cannibalization of pre-existing inherited sediment. As such, in the Knee Lake area, the orientation of these widespread streamlined landforms should not be used as an indicator of ice-flow transport direction for drift exploration. The study area is also draped by a variable thickness of glaciolacustrine clay, which must be avoiding during drift exploration programs.



Knee Lake field area



Knee Lake till matrix texture



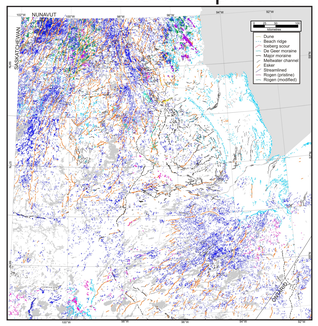
Heterogenous yill composition

Glacial Map of Manitoba, north of 54°

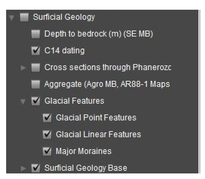
Surficial geology compilation map series
Up-to-date, queryable surficial-geological data are essential for the successful interpretation of ice flow and glacial history in Manitoba. These data are also used by the agriculture, land-use, aggregate, groundwater, environment, hazard and exploration industries, which require current knowledge to make effective decisions. The objectives of this project are to:

- •digitize point and line features from all pre-existing Quaternary geology maps in Manitoba;
- •achieve consistency with the existing digital compilation completed for northwestern Manitoba; and
- •update mapping at a more detailed scale using remotely-sensed imagery.

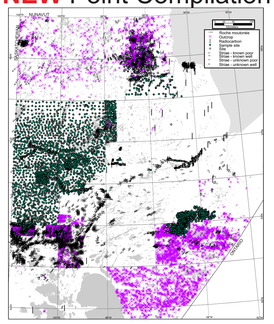
NEW Line Compilation



Will be available on
1:250 000 scale maps (PDF format)
as well as
a free download from the
Manitoba Map Gallery



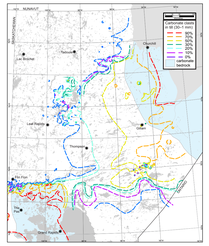
NEW Point Compilation



Ongoing till composition analyses: Carbonate
If we know where the source of carbonate is, we can work backwards to determine the direction(s) and distance(s) of transport.

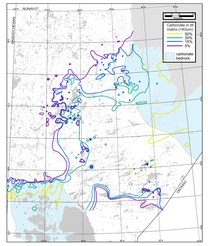
This is complicated in Manitoba because the till clast composition is a resultant net effect of erosion, transportation and deposition; over a very long time period.

Problematic because carbonate till can mask the prospective geochemistry of the underling bedrock.



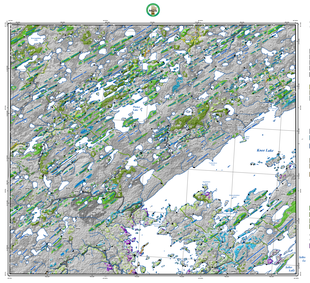
carbonate-rich far-travelled till

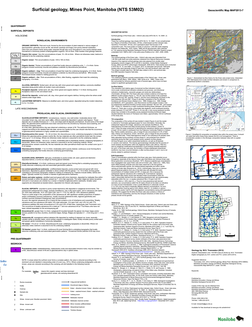
granitoid-rich less-travelled till from the same area



Geoscientific Maps (MAP2013-1 to -5)
Surficial geology, Thuykay Lake, Parts of NTS 64P2, 3, 6 and 7; Geoscientific Map MAP2013-1, 1:50 000
Surficial geology, Kuytoocho Lake, Parts of NTS 64I10, 11, 14 and 15; Geoscientific Map MAP2013-2, 1:50 000
Surficial geology, Dechanhooledezay River, Parts of NTS 64I 9, 10, 15 and 16; Geoscientific Map MAP2013-3, 1:50 000
Surficial geology, Pady Lake, Parts of NTS 54L 12, 13 and 64I 9, 16; Geoscientific Map MAP2013-4, 1:50 000
Surficial geology, Schoenthaler Lake, Parts of NTS 54M4, 5; Geoscientific Map MAP2013-5, 1:50 000

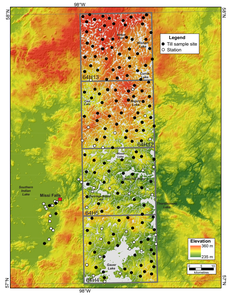
Geoscientific Maps (MAP2013-6 to -9)
Surficial geology, Makakysip Lake, Manitoba, NTS 53M1
Surficial geology, Mines Point, Manitoba, NTS 53M2
Surficial geology, Oxford House, Manitoba, NTS 53L14
Surficial geology, Knee Lake, Manitoba, NTS 53L15





2013 Fieldwork

Gauer Lake to Wishart Lake (NTS 64H4, 5, 12, 13)

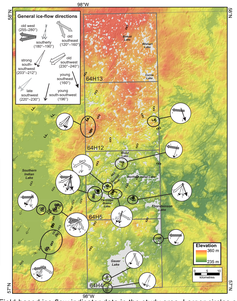


Study area, with fieldwork based out of a camp at the Manitoba Hydro station at Missi Falls, Southern Indian Lake.

Washed till surface with a wave-washed esker in the background (white and yellow areas).

Multiple orientations of striations

Permafrost mud boils in an area of thick sediment



Field-based ice-flow indicator data in the study area. Larger circles are a compiled summary of the relative ages (1, oldest) and trends of ice-flow indicators for a single site or sites in close proximity to each other.

Assistance provided by A. Vanjecek is greatly appreciated

Assistance provided by B. Clayton is greatly appreciated

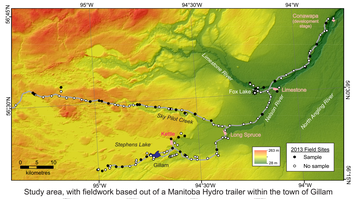
Bedrock-cored ridges with thin till cover

Partially burnt thick organic bog

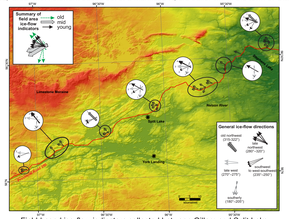
Rocky shore reveals till buried beneath thin organics

Thin till veneer over a bedrock-controlled upland

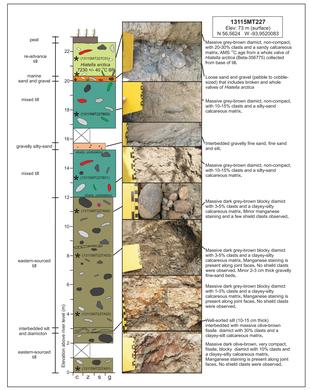
Gillam area (parts of NTS 54D5, 6, 7, 8, 9, 11 and 54C12)



Study area, with fieldwork based out of a Manitoba Hydro trailer within the town of Gillam



Field-based ice-flow indicators collected between Gillam and Split Lake



One of the many stratigraphic sections in the area

Thick till section that shows the mixed (Canadian Shield, Paleozoic and Proterozoic) clast types

Thick fossiliferous sandy gravel is common between Limestone and Conowapa dam sites

Using an extendable auger (3 m depth)

Thick Quaternary sediments cover most of the region

Small creek flows over an area of thick clay

Rare reddish till that underlies a grey-brown till

Northeast Manitoba
Once again, the MGS conducted reconnaissance fieldwork in northeastern Manitoba, supported by De Beers Canada Exploration.

Collection of ice-flow indicators continue

Marine sand with a small bed of fossiliferous gravel

Clayey silt calcareous till creates numerous unstable river banks

Two curious wolves