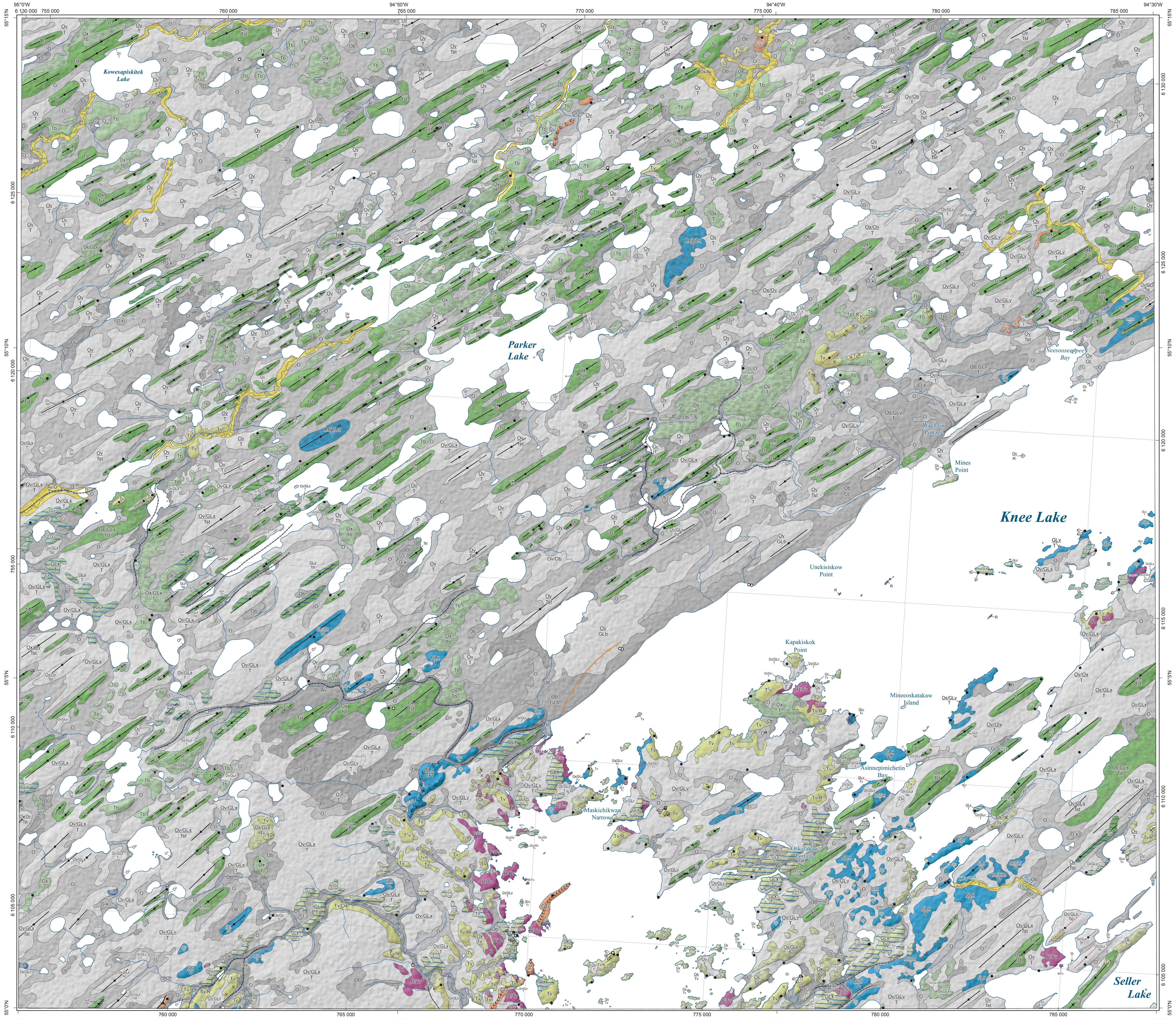
Surficial geology of the Mines Point map area, Manitoba (NTS 53M2)

Geoscientific Map MAP2013-7



Scale 1:50 000

0 5 000 10 000
metres

NAD 1983 UTM Zone 14N

QUATERNARY

SURFICIAL DEPOSITS

HOLOCENE

NONGLACIAL ENVIRONMENTS

ORGANIC DEPOSITS: peat and muck; formed by the accumulation of plant material in various stages of decomposition; generally occurs as flat, wet terrain (swamps and bogs) over poorly drained substrates; fibric fens are present mainly along water channels though also occur throughout very poorly drained areas; permafrost is commonly present underlying/within organics >30 cm thick; peat mantles most geological features

Ox — **Organic thin veneer:** very thin accumulations of peat, 15—30 cm thick; unless otherwise noted, bedrock is assumed to be the underlying material

Ov — **Organic veneer:** thin accumulations of peat, >30—100 cm thick

Ob — **Organic blanket:** thicker accumulations of peat that locally obscure underlying units, 1—3 m thick; some polygons include hummocky mounds and plateaus underlain by discontinuous permafrost

O^1 / O^1k — **Organic wetland — bog:** thick accumulations of peat that mask the underlying topography, >3 m thick; some polygons include hummocky mounds and plateaus underlain by discontinuous permafrost; **O^1k** includes thermokarst terrain related to melting ground ice

O^2 — **Organic wetland — fen:** thick accumulations of fibric, often floating, vegetation that mask the underlying topography, >3 m thick

ALLUVIAL DEPOSITS: sorted sand, silt and clay with minor gravel and organic detritus; commonly stratified; deposited along and/or within all modern rivers and streams

Av — **Floodplain deposits:** sorted sand, silt, clay, minor gravel and organic detritus >1 m thick; forming active floodplains close to river and stream level

Af — **Alluvial fan deposits:** sorted sand, silt, clay, minor gravel and organic detritus; forming active fan where small streams enter larger lakes

sL — **LACUSTRINE DEPOSITS:** massive to stratified sand, and minor gravel, deposited along the modern lakeshore, 0.2 to >1 m thick

LATE WISCONSINAN

PROGLACIAL AND GLACIAL ENVIRONMENTS

GL — **GLACIOLACUSTRINE DEPOSITS:** noncalcareous, massive, very well sorted, moderately dense, 'milk-chocolate' brown clay, and rarer sand (**sGL**); offshore sediments deposited in glacial Lake Agassiz; these deposits are of variable thickness (0.1—3 m), and drape both till deposits and bedrock; around some of the larger lakes, the glaciolacustrine sediments have been removed from the shoreline by Holocene wave-washing, and thickness increases inland; at a few sites, glaciolacustrine clay was observed underlying a veneer of till; the sediment thickness, as mapped according to the detailed field site data, serves as a guide but the user should note that the occurrence of glaciolacustrine sediments is highly variable and unpredictable

GLx — **Glaciolacustrine thin veneer:** 15—30 cm thick, thin discontinuous cover, underlying topography is discernible; where thin glaciolacustrine veneers overlie tills, the two materials are often permafrost-mixed near the contact zone (up to 1 m of mixing); unless otherwise noted, bedrock is assumed to be the underlying material

GLv — **Glaciolacustrine veneer:** >0.31 m thick, moderately well to imperfectly drained, underlying topography is discernible; unless otherwise noted, bedrock is assumed to be the underlying material; where glaciolacustrine veneers overlie tills, the two materials are often permafrost-mixed near the contact zone (up to 1 m of mixing)

GLb — **Glaciolacustrine blanket:** >1 to 3 m thick, moderately well to poorly drained, continuous cover forming flat to undulating topography that locally obscures underlying geomorphology

GF — **GLACIOFLUVIAL DEPOSITS:** light grey, moderately to poorly sorted, silt, sand, gravel and diamicton deposited behind or at the ice margin by flowing glacial meltwater

GFb — **Glaciofluvial blanket:** >2 m thick, continuous sand and gravel cover forming flat to undulating topography that locally obscures underlying units and associated geomorphic patterns

GFh — **Ice-contact glaciofluvial sediments:** undifferentiated deposits; poorly sorted sand and gravel with minor diamictons; deposited by glacial meltwater in direct contact with the glacier; 1 to >10 m thick; forming gently undulating to hummocky topography related to melting of underlying ice; features include kettles, kames and ridges; typically overlain by a veneer or blanket of glaciolacustrine sediments

GFr — **Eskers and esker systems:** stratified sand and gravel with minor diamicton, deposited by meltwater flow within tunnels beneath or within the glacier; present as 1—8 m high segments; the esker ridges are below lacustrine limit and in most places are overlain by a veneer or blanket of glaciolacustrine sediments; smaller esker segments are interpreted as beaded eskers, deposited into glacial Lake Agassiz

T — **GLACIAL DEPOSITS:** unsorted to poorly sorted diamictons (till) deposited in subglacial environments; the predominant widespread till is beige, sparsely fossiliferous, has a silty-sand matrix, and is calcareous (till matrix 24—53 wt. % total carbonate, 10.8—22.5 ppm CaO, and 11—17% Ca; with 30—70 ct. % calcareous pebbles); there is a wide range in the composition of the calcareous till, with significant variable proportions of eastern-and/or northeastern-sourced (calcareous), locally sourced (greenstone belt), regional (granitoid) and northern-sourced (Dubawnt supergroup) clast concentrations; as such, the regional calcareous till is a hybrid till that contains a mix of inherited and overprinted detritus; weakly calcareous (till matrix <30 wt. % total carbonate, <10 ppm CaO, and <10% Ca; with <35 ct. % calcareous pebbles) and noncalcareous (till matrix <5 wt. % total carbonate, <5.4 ppm CaO, and <4% Ca; with <7 ct. % calcareous pebbles) tills were encountered at 3.3 and 2.9% of field sites, respectively (see Trommelen, 2014); the occurrence of weakly calcareous till is noted as T^1 and noncalcareous till as T^2 but these units have not been coloured separately

Tst — **Streamlined till:** >2 m thick, subglacial till moulded beneath the glacier into linear ridges and/or furrows parallel to ice flow; drumlins, drumlinoid ridges, flutings; ridges are typically 0.1—3 km long and 1—10 m high

Th — **Hummocky till:** supraglacial meltout (ablation) tills deposited by melting of stagnant ice; loose, texturally variable sandy to gravelly matrix, some sorting; angular to subangular clasts; locally includes poorly sorted sand and gravel; gently undulating to hummocky topography

Tv — **Till veneer:** >0.15—1 m thick, discontinuous till cover; underlying topography is discernible; unless otherwise noted, bedrock is assumed to be the underlying material

Tb — **Till blanket:** >1 m thick, continuous till cover forming flat to undulating topography that locally obscures underlying units and associated geomorphological patterns; occasional thinner patches of till may occur

PRE-QUATERNARY

BEDROCK

R — **Precambrian rocks:** metasedimentary, metavolcanic rocks and associated intrusive rocks; may be overlain by a thin, discontinuous veneer of till and or glaciolacustrine clay in upland areas

NOTE: In areas where the surficial cover forms a complex pattern, the area is coloured according to the dominant unit and labelled in descending order of dominance (e.g., R/Tv). Where underlying stratigraphic units are known, areas are coloured according to the overlying unit and labelled in the following manner:

$\frac{O}{Tb}$

For example, $\frac{Ox/GLv}{Tst}$ means thin organic veneer and less dominant glaciolacustrine veneer, all overlying streamlined till

Symbols

- Roche moutonée
- Kettle
- Outcrop
- Field site with till sample
- Field site without till sample
- Striae, direction known, poorly preserved
- Striae, direction known, well preserved
- Trimline (wave-cut bench)
- Streamlined bedrock
- Crag-and-tail landform
- Drumlinoid ridge or fluting
- Iceberg scour
- Meltwater channel
- Meltwater channel corridor
- Minor moraine, undifferentiated
- Esker, direction known
- Esker, direction unknown
- Esker, washed, direction known
- Esker, washed, direction unknown

DESCRIPTIVE NOTES

Surficial geology of the Knee Lake area (NTS 53L14, 15, 53M1, 2)

Introduction

This map, one of four surficial geology map sheets (NTS 53L14, 15, 53M1, 2), is complemented by a field-based ice-flow indicator data repository (Trommelen, 2012a), and geological papers that focuses on till composition (Trommelen, 2014; Trommelen and Ross 2014). This work builds on previous 1:250 000 scale mapping (Klassen and Netterville, 1979; Clarke, 1988) and till geochemistry data collected at 1 km spacing during Manitoba Geological Survey's Operation Superior project undertaken from 1999 to 2001 in the same area (Fedikow et al., 2001, 2002, 2009).

Methods

The surficial geology of the Knee Lake area was interpreted from 1:60 000 scale black and white airphotos, obtained from Natural Resources Canada. Aspects of the regional surficial geology were also gleaned from Shuttle Radar Topography Mission imagery (30 and 90 m resolution, United States Geological Survey, 2002) and SPOT orthoimages (Geobase®, 2005-2010). Field studies were conducted by helicopter and jet boat in August 2012. Helicopter landing sites were generally limited to open fens, and skid shutdown sites were rare. This project includes data from 198 field sites visited in 2012, and archival data from 695 Operation Superior field sites.

Bedrock geology

The underlying bedrock consists predominately of the Oxford Lake–Knee Lake greenstone belt (Barry, 1959; Gilbert, 1985; Syme et al., 1998). These rocks are surrounded by intrusive granitoid rocks of several ages, which have not been subject to significant geological study.

Ice-flow history

Erosional ice-flow indicators, the orientations and relative ages of which were documented at 27 sites in the study area (Trommelen, 2012a), include micro-scale nondirectional indicators (striations and grooves) and directional indicators (chattermarks, crescentic gouges and stoss-lee relationships). The Knee Lake area contains evidence of at least five different ice-flow phases (Figure 1). The old, rare, ice-flow phase trending to the southeast (between 150 and 160° azimuth, phase I), and the more widespread old phase trending to the west (between 255 and 280°, phase II) are likely correlative to the pre-Illinoian Sundance and Illinoian Amery glaciations (Nielsen et al., 1986; Dredge et al., 1990; Dredge and McMartin, 2011). Late Wisconsinan ice-flow phases include a rare but widespread southward-trending ice-flow phase (between 180 and 194°, and toward 200°, phase III), followed by a major southwest-trending phase (between 230 and 248°, phase IV). There is also a young, presumably late deglacial, south-southwest-trending phase (between 212 and 220°, phase V). At one site, a rare young westward -trending ice-flow phase (phase VI?) may correlate to the young westward-trending drumlinoid ridges situated between the town of Gillam and city of Thompson, approximately 130 km northwest of the study area.

Till composition

The composition of the surface till was studied in detail (Figure 2) and the reader is referred to Trommelen (2014) and Trommelen and Ross (2014) for more information. Generally, the widespread regional till is beige, calcareous and sparsely fossiliferous. This heterogeneous till sheet was likely formed during ice-flow phases II and/or IV and V, when the large component of allochthonous calcareous detritus was transported at least 125 km (west or southwest) from the Paleozoic carbonate platform in Hudson Bay. Patchy, weakly-calcareous, grey or beige till was encountered at 3.3% of field sites. Patchy, noncalcareous, brown, red-brown, grey or beige till was encountered at 2.9% of field sites. These heterogeneous weakly calcareous to noncalcareous till samples were likely deposited during southerly ice-flow phase III, and protected from dilution/reworking during the later southwesterly and/or westerly ice-flow phases.
All three till-types occur within streamlined landforms, as well as in till blankets or veneers over bedrock. This diverse geomorphology indicates that the process of southwesterly drumlinization within the deglacial Hayes lobe (300 by >400 km) was by subglacial modification/cannibalization of pre-existing inherited sediment. As such, in the Knee Lake area, the formation of these widespread streamlined landforms may have occurred between or after ice-flow phases IV and V, but is not directly related to sediment transport.

Drift exploration

There is mineralization potential within the Knee Lake area. Gold potential occurs throughout, especially at the historic Knee Lake Gold mine and Johnson Knee Lake mine gold-silver occurrences (Southard, 1977). Massive sulphide–type mineralization was investigated near upper Knee Lake and at Cinder Lake (Gale et al., 1980). Rare-earth-element–bearing minerals have been observed in the fine-grained silica-undersaturated syenite, the metasomatized pegmatite and within calcite veining at Cinder Lake (Kressall et al., 2010). Unfortunately, there are no obvious glacial dispersal patterns from any of the field sites with elevated till-matrix concentrations of multiple metals. In large part, this is because the widespread regional calcareous till is partially masking the local bedrock signature. The detailed data clearly shows that elevated metal concentrations within till matrix, presumably derived from the underlying greenstone belt, are predominately detectable within the noncalcareous or weakly calcareous tills (<10 ppm CaO, inductively coupled plasma–emission spectrometry [ICP-ES], <10 wt. % Ca, instrumental neutron activation analysis [INAA], or <30 wt. % total CO3 [Chittick or calcium-magnesium method]). Thus for most greenstone-belt derived elements, low concentrations within the till matrix should not be taken as indicative of a lack of local mineralization. Even a small difference in carbonate content (7 versus 10 wt. % Ca) may lead to drastically different element concentrations. As such, detailed attention must be paid to Ca wt. %, total CO3 wt. % and/or CaO ppm concentrations during drift exploration analyses.
The till within the Knee Lake area contains a mixture of inherited and overprinted subglacial detritus, and thus the transport directions of older ice-flow phases should not be ignored.

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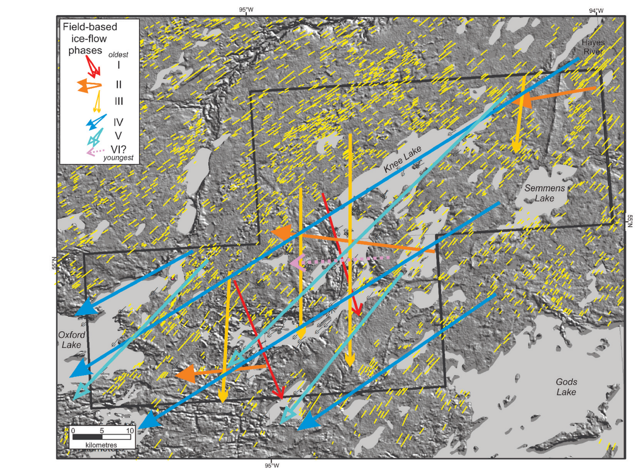


Figure 1. Generalized ice-flow history for the Knee Lake project area, interpreted from field-based micro-scale ice-flow indicators and shown in comparison to streamlined landform orientation (yellow lines).

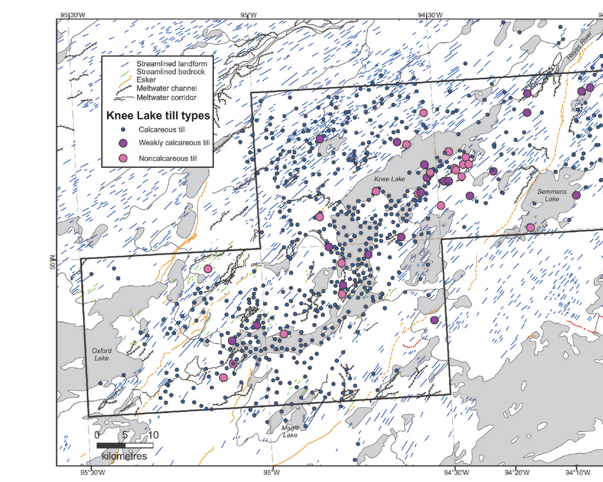
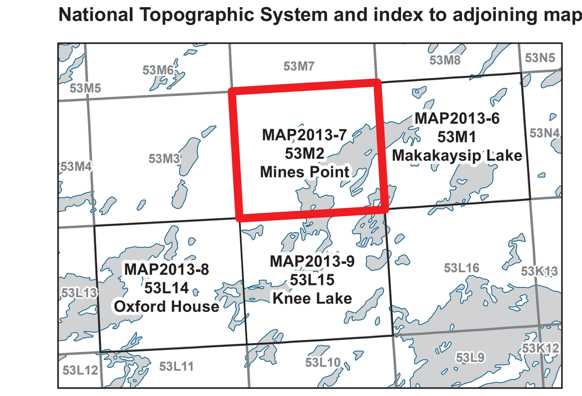
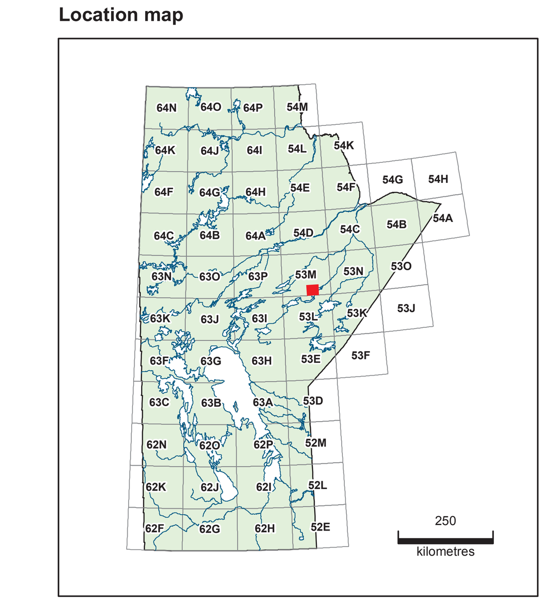


Figure 2. Simplified till composition at sampled sites within the project area. It should be noted that within these three classes the till is not homogenous. There is considerable variation in the lithologic composition between sites with no spatial correlation.

National Topographic System and index to adjoining maps



Location map



Geology by M.S. Trommelen (2012)

Airphoto interpretation onto 1:50 000 scale airphotos by M.S. Trommelen.
Cartography by B.K. Lenton and P.G. Lenton (2012–2013).

Recommended reference:
Trommelen, M.S. 2014: Surficial geology of the Mines Point map area, Manitoba (NTS 53M2); Manitoba Mineral Resources, Manitoba Geological Survey, Geoscientific Map MAP2013-7, scale 1:50 000.

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This publication includes digital versions of the point, line and polygon datasets portrayed on the map.

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