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GEOLOGICAL SURVEY OF CANADA / COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

INTRODUCTION

The Quaternary geology component of the Slave Province National Mapping Program was designed to provide a regional framework for geologic interpretation, environmental management, and drift prospecting. As a contribution to the Slave Province NATMAP in 1994, Terrain Sciences undertook mapping three 1:250 000 map areas (NTS 86-I, 86H and parts of 76E). The project involved helicopter-assisted ground work including terrain mapping, till sampling, pebble provenance studies, and measurement of ice flow indicators. Field traverses and airphoto interpretation provided information on the nature and distribution of surficial sediments shown on the map. Approximately 190 till samples (2 kg) were collected from nonsorted circles (mudboils) in the Napaktulik Lake map area for textural analysis and trace element geochemistry; 45 additional 10 kg samples were collected for heavy mineral and kimberlite indicator analyses. A total of 190 pebble (2 to 4 cm diameter) samples were also collected to assess glacial transport distances and ice flow patterns. Surficial geology was plotted on 1:60 000 scale airphotos, and recompiled at 1:125 000 on a topographic base. These maps complement other Quaternary geology maps to the west (St-Onge, 1988, 1995), to the south (Dredge et al., 1996; Kerr et al., 1995c), to the southeast (Dredge et al., 1995; Ward et al., 1995; Ward et al., in press), to the east (Hart et al., 1989) and to the northeast (Rampton and Thomas, 1993).

PHYSIOGRAPHY AND DRAINAGE

The Napaktulik Lake map area lies in the north-central District of Mackenzie. Elevations range between 340 m and 640 m. Local relief varies between <10 m and 20 m in the eastern half of the map area where granitoid bedrock with little or no overburden predominates, and between 20 m and 80 m in the west where flat-lying and folded Proterozoic strata protrude through streamlined till blanket and veneer. Steep cliffs with relief up to 200 m are prevalent on the rocky Hinigaluk Peninsula dividing Napaktulik Lake. The map area encompasses the watershed of four drainage systems. The largest drainage basin is that of Napaktulik Lake which drains to the west via Fairy River to Coppermine River; in the southwest quadrant, White Sandy River also flows west to Coppermine River. The headwaters of Hood River in the northeast region form the third drainage system which flows east into Bathurst Inlet. In the north-central area, Kiglikavik Lake and the headwaters of Tree River form another drainage system which flows northward into Coronation Gulf. Throughout the map area, numerous small lakes occupy glacially scoured bedrock basins, as well as isolated depressions in till plains. Most drainage ways are shallow but several streams occupying major meltwater channels and rivers have cut into bedrock or surficial sediments. The meandering White Sandy River has banks of glaciolacustrine deposits up to 15 m or more high, and the Fairy River is incised several metres into bedrock exposing Proterozoic stratigraphy. The map area lies above the treeline except for a small area in the southwestern quadrant where spruce trees occupy parts of White Sandy River valley Elsewhere the landscape supports small, isolated clumps of low shrubs and tundra heath vegetation. Frozen ground was encountered at depths as shallow as 15 cm below the surface in peat in early to mid July. The active layer in till and glaciofluvial sediments was at least 90 cm deep in late summer.

BEDROCK GEOLOGY

The study area straddles the northeast-trending boundary between the Archean Slave Province and the Proterozoic sedimentary cover of the Wopmay Orogen to the west (Gebert and Jackson, 1994). Archean rocks underlie approximately the eastern half of the study area and consist of supracrustal rocks of the Yellowknife Supergroup, younger granitoid rocks, and more rarely granitoid and gneissic rocks pre-dating the Yellowknife Supergroup (see Figure 1). Archean volcanic rocks of predominantly mafic composition form a thin north trending belt dotted by numerous gossans referred to as the Napaktulik Lake volcanic belt. Felsic volcanic rocks are common in northeast-trending arms of the belt southeast of Napaktulik Lake. Supracrustal rocks are bordered by granitoid rocks, most commonly gneissic granite to granodiorite. Proterozoic rocks of the Coronation Supergroup comprise the western study area, and record two sequences grading from clastic to carbonate rocks (Epworth and Recluse groups), overlain by fine grained clastic rocks of the Takiyuak Formation in the south-central area. The region is transected by a variety of diabase dykes of which the north-northwest-trending Mackenzie swarm is most prominent. Thick diabase sheets (Morel Sills) lie along the Archean/Proterozoic boundary on Hinigaluk Peninsula. Numerous gossans and volcanogenic base metal prospects and deposits such as the Hood occur within the study area. Most rock outcrops show signs of glacial abrasion, faceting, and streamlining, but surfaces are weathered. All rock types have been subjected to postglacial frost shattering and heaving, notably in extensive granitic regions of the eastern map area.

SURFICIAL SEDIMENTS

Till deposits

As in the Winter Lake (86A), Lac de Gras (76D) Aylmer Lake (76C) and Point Lake (76E) areas to the south, till is the most extensive glacial sediment, although most of the east half of the map area is devoid of any surficial sediments (Kerr et al., 1995a). The till consists of a matrix-supported diamicton, with a sandy silt to sand matrix, and exhibits low to high compaction. Clasts are generally subrounded to subangular and average 2-4 cm in diameter. In many cases, the upper 0.5 to 1 m of till has been extensively modified by cryoturbation and solifluction. Organic matter has locally been incorporated to depths of 70-80 cm. Matrix grain size does not vary significantly according to bedrock source: till derived from both granitoid rocks and sedimentary and volcanic rocks has a silty sand matrix. Locally where meltwater was associated with deposition, a sandy matrix occurs, as noted by Dredge et al. (1994). In the eastern half of the map area, many of the fines were removed by meltwater, resulting in a lag consisting of pebble to boulder-sized clasts <2 m diameter. Till deposits are subdivided according to thickness and surface morphology: veneer, blanket, and hummocky.

Till veneer is generally <2 m thick, may extend over large areas, typically containing bedrock outcrops and felsenmeer, is loose in texture, and occurs throughout the study area. Its surface is commonly characterized by high concentrations of cobbles and boulders of local provenance. Till veneer conforms to underlying bedrock morphology and bedrock structures are normally visible on airphotos. Till veneers were deposited during glaciation and/or deglaciation, and subsequently modified.

Till blankets are >2 m thick and either drape the underlying bedrock, forming gently undulating till plains, or are low to moderate-relief drumlinoid and crag-and-tail features. These drumlinoid and crag-and-tail forms are extensive and well developed on areas of Proterozoic bedrock in the west. These tills are relatively compact, contain fewer boulders than till veneer and may represent a combination of lodgment and meltout till deposited by ice. A stark contrast in till thickness and landforms exists between regions underlain by Proterozoic cover and parts of the Slave Province. This is most noticeable in the eastern half of the Napaktulik Lake map area where granitoid bedrock is essentially devoid of any surficial sediment. In contrast, Proterozoic bedrock is covered by a more continuous and thicker till with numerous crag-and-tail and till drumlinoid features.

Hummocky till deposits occur only in isolated localities in the central and southwest regions. Hummocky till, associated with surface ablation and ice stagnation, is 5-30 m thick and forms hummocky topography of irregular mounds with relief up to 15 m. It has a loose, bouldery texture and a washed appearance and is commonly associated with glaciofluvial complexes and small rock outcrops.

Glaciofluvial deposits

Glaciofluvial deposits consist of eskers, kames, and proglacial outwash locally with kettle lake structures. The eskers are in the form of sinuous to linear complexes which trend west, northwest, and north (Figure 2). Meltwater-washed zones, characterized by cobble and boulder lags, are commonly found on either side of eskers or on bedrock surfaces between esker segments. Eskers range from small, sinuous ridges a few tens of metres long, common in the eastern half of the map area, to larger, more linear features up to 30 m high and over 25 km in length, such as those occurring north and southwest of Napaktulik Lake. Sandy to bouldery nodes may occur at intervals along their length. Sediment texture and internal structures are variable, and grain size may change rapidly over short distances within the same esker. Very fine to coarse-grained sand may be capped by a thin layer of gravel on the surface. Sedimentary structures consist predominantly of climbing ripples, planar bedding, and trough and planar crossbedding. Eskers generally trend northwest in the southwest regions, to a more northerly direction in the eastern and northern regions.

Flat-topped kame terraces and outwash plains scarred by braided channels are commonly associated with the esker complexes; outwash deposits also occur within structurally controlled bedrock gorges which formed meltwater drainage channels during deglaciation. Some of these sand and gravel outwash plains are more than 20 km long and up to 5 km wide. Outwash plains are more common in the Napaktulik area than the Winter Lake, Lac de Gras, and Aylmer Lake map areas to the south. As with eskers, their composition is variable, but finely laminated and cross laminated fine sand and silt are common. In many localities, the flanks of sharp crested eskers are surrounded by terraces and outwash plains. Esker development appears to have preceded that of the surrounding kame terraces and outwash plains which exhibit evidence of subaerial deposition. Glaciofluvial deposits are potential resources for large volumes of granular materials.

Glaciolacustrine deposits

Perched deltas, raised beaches, and wave-washed benches identified in a few localities on the flanks of eskers and kames provide evidence for the existence of glacial lakes. Deltas and beach ridges consist of fine to coarse sand, pebbles, cobbles, and boulders. The largest glacial lake was formed in the Napaktulik Lake basin, impounded by a retreating ice front. Abandoned shorelines are well developed in the north-central and eastern parts of Napaktulik Lake, north of Hinigaluk Peninsula. They are generally absent from the northwest, west and southwest regions of the lake, except for a few sites on the southern and western shores of the peninsula.

Craig (1960) reported raised beaches along the southeastern shore of Napaktulik Lake at 425 m a.s.l., about 30 m above the present lake level (394 m a.s.l.). During the present investigation, beaches and wave-washed zones were found up to 440 m a.s.l. on the eastern shores (Kerr et al., 1995a,b). In the southwest Napaktulik Lake map area, along White Sandy River valley, isolated deposits at 360 m a.s.l. forming a 16 m coarsening-upward sequence of rhythmically bedded, normally graded fine sand capped by clay drapes, climbing ripples, and coarse sand and gravel may represent deposits of glacial Lake Coppermine (St-Onge et al., 1981; St-Onge, 1988).

Alluvial deposits

Alluvial deposits are found as isolated occurrences in beds of seasonally flooded streams and rivers, notably along White Sandy River, and as small alluvial fan-deltas such as along the southeast shoreline of Napaktulik Lake. They consist of silt to gravel size sediment up to a few metres thick, are generally stratified, and may undergo annual erosion and deposition. Locally, they can be covered by icings up to 2 m in thickness.

Organic deposits

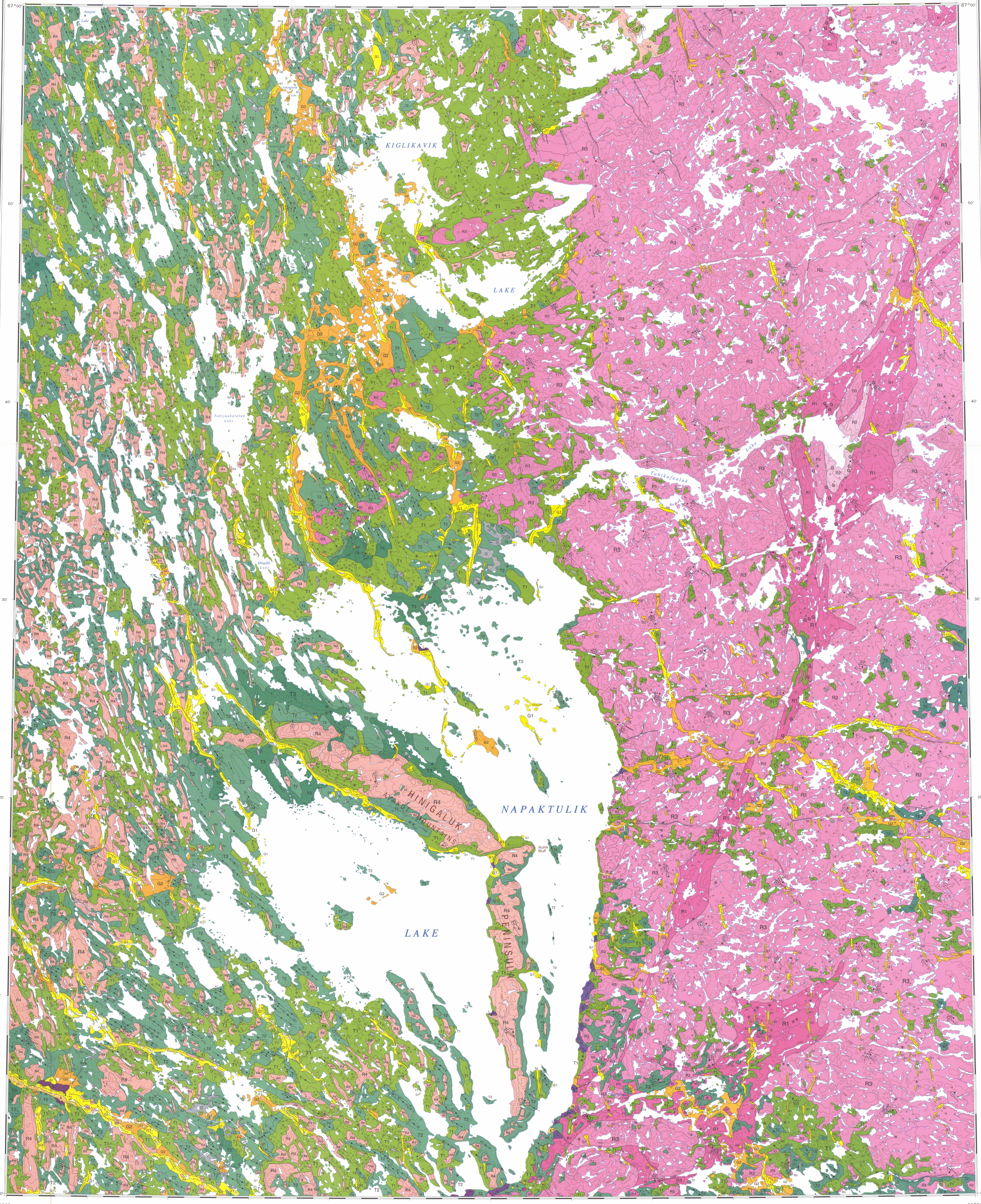
Thin peat deposits formed by the accumulation of saturated, vegetative material are common in low areas along watercourses and on all surficial sediments in topographic depressions with poor drainage. Frozen ground is present as little as 15 cm below the surface.

ICE FLOW INDICATORS

Preservation of striae on outcrops is highly variable throughout the map area. Many rock outcrops are lichen-covered or have rough, weathered surfaces. Glacially scoured and meltwater-washed granitic outcrops, prevalent in the east, have rarely maintained their glacial polish; striae are commonly restricted to surfaces covered by a thin protective veneer of till, or are present as faint traces on individual mineral crystal faces. Striations on volcanic rocks are more prevalent and well defined than other rock types. In the west, and in particular the northwestern areas, striae on some Proterozoic sedimentary rocks are poorly preserved, as the surface of the bedrock has undergone solutional etching producing an irregular pitted surface. The majority of striated outcrops show only one distinct set of striae varying within a few degrees of each other. At a few sites, more than one ice flow direction was observed (northward to southwestward); in most cases however, the cross-cutting relationship was ambiguous.

Large-scale ice flow indicators such as drumlinoid till forms and crag-and-tails are common throughout the map area and coincide with the dominant striation directions. A prominent but discontinuous swarm of crag-and-tails and drumlinoid forms occurs south, west, and northwest of Napaktulik Lake, recording the last major ice movement. Southeast of Napaktulik Lake, isolated drumlinoids and crag-and-tails indicate a northwestward ice flow also parallelling the striation trend. A strong relation also exists between ice flow directions and orientation of glaciofluvial landforms of Figure 2. This suggests that ice directions associated with the eskers persisted after the formation of moulded landforms and were similar to those that created these large-scale ice flow indicators. The largest eskers/outwash complexes have major ridge segments generally trending northwest in the southwest and gradually change towards the north-northwest in the northwest quadrant. East of Napaktulik Lake, those glaciofluvial complexes that are not controlled by west to southwest trending structural bedrock features consist of short segments whose regional trend differs slightly from the last major ice flow direction recorded by striae in this region. Eskers generally trend north-northwest to north whereas striae indicate a northwestward flow. This difference in orientation may reflect the preferential northward direction taken by meltwater during deglaciation (i.e. regional slope to Coronation Gulf).

Figure 3 is a summary diagram of flow direction based on airphoto plots of streamlined landforms and more than 200 striae points, in addition to regional observations made by Craig (1960), Blake (1963), and Bostock (1980). Large-scale ice flow indicators (drumlins and crag-and-tails), together with well defined and abundant striae reflect a



LEGEND

QUATERNARY

HOLOCENE

NONGLACIAL ENVIRONMENT

O	***ORGANIC DEPOSITS:*** *peat and muck up to 2m thick; formed predominantly by the accumulation of vegetative material in bogs; occurs in depressions and along valley bottoms; permafrost is commonly present; contains small palsas, ice wedge polygons, and thermokarst collapse structures. Small unmapped organic deposits occur in most terrain units*
A	***ALLUVIAL DEPOSITS:*** *gravel to silt size sediment deposited by modern streams and rivers; deposits generally are stratified and moderately sorted; 1 to 5 m thick; occurs as floodplains and alluvial fans, in places covered by icings*

PLEISTOCENE (WISCONSIN GLACIATION)

GLACIAL ENVIRONMENT

L	***GLACIOLACUSTRINE DEPOSITS:*** *silt, sand, and gravel; cross-stratified to planar bedded sands; 1 to 16 m thick; deposited into temporary glacier-dammed lakes; rounded pebbles and cobble gravel form raised beaches indicated by symbols*
	GLACIOFLUVIAL DEPOSITS: *sand, gravel and minor silt more than 1 m thick; sorting ranges from good to poor, and stratification from massive or cross-stratified to planar bedded; deposited by water flowing from, or in contact with, glacier ice*
G2	***Outwash:*** *rounded gravel and sand; massive to cross-stratified; probably less than 5 m thick; occurs as braided fans and outwash plains*
G1	***Esker sediments:*** *sand, silt, and gravel; in planar, cross-stratified, and massive beds; 1 to 40 m thick; forms ridges with both sharp-crested and flat-topped segments, mounds, and flanking aprons; deposited at or behind the ice margin; formed subglacially or in subaerially exposed ice-walled channels. Zones of washed bedrock (meltwater scours), isolated kame deposits, and boulder lags shown by symbols*
	TILL DEPOSITS: *unsorted glacial debris (diamicton), consisting of a silty sand matrix containing pebbles, cobbles, and boulders, with minor lenses of sorted sediments; deposited beneath, or along the margin of, glaciers as lodgment till, meltout till, and gravity flow deposits*
T3	***Hummocky till:*** *from 5 to 30 m thick; forms irregular to rolling terrain with relief up to 15 m; some areas have abundant small meltwater channels and lag concentrations of boulders in depressions*
T2	***Till blanket:*** *from 2 to 10 m thick; occurs as till plains mimicking bedrock topography or as drumlinoids. Small rock outcrops in this unit are shown by symbols*
T1	***Till veneer:*** *less than 2 m thick; rock structure is generally visible on airphotos; unit includes patches of bedrock and till blanket*

PRE-QUATERNARY

	BEDROCK: *Archean granitic, gneissic, metasedimentary, and metavolcanic rocks; Proterozoic sedimentary rocks, mafic dykes, and sill; may include patches of till veneer or glaciofluvial deposits; areas of shattered and frost-heaved rock*
R4	*Sedimentary rocks*
R3	*Granitoid rocks*
R2	*Metasedimentary rocks*
R1	*Volcanic rocks*

Geological boundary
Frost heaved and shattered rock
Raised beach
Lag concentration of glacially abraded boulders
Area of meltwater scour
Subglacial or proglacial meltwater channel
Esker (direction of flow known, unknown)
Kames
Drumlinoid till form
Rock crag-and-till tail form
Roche moutonnée or whaleback
Striation (ice flow direction known, unknown; 1 = oldest)
Gossan G
Small rock outcrop
Sample site

Fig. 1: Bedrock geology and clasts lithology map showing contoured percentage of granitoid clast in till. See section on Provenance Investigations for discussion.

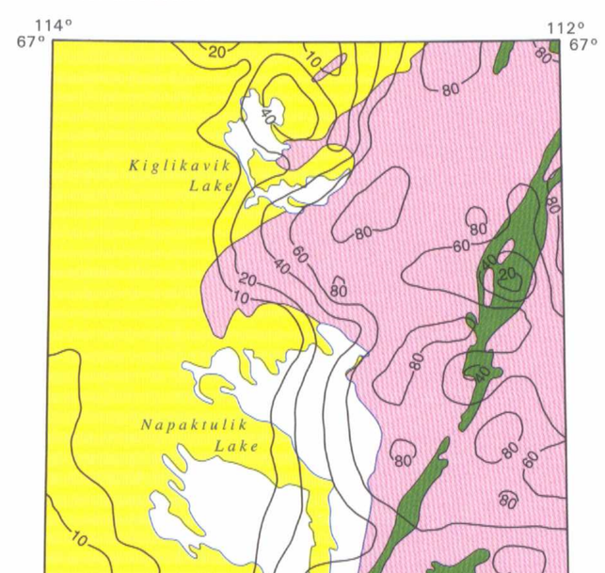


Fig. 2: Subglacial drainage systems determined from eskers, outwash, and meltwater channels

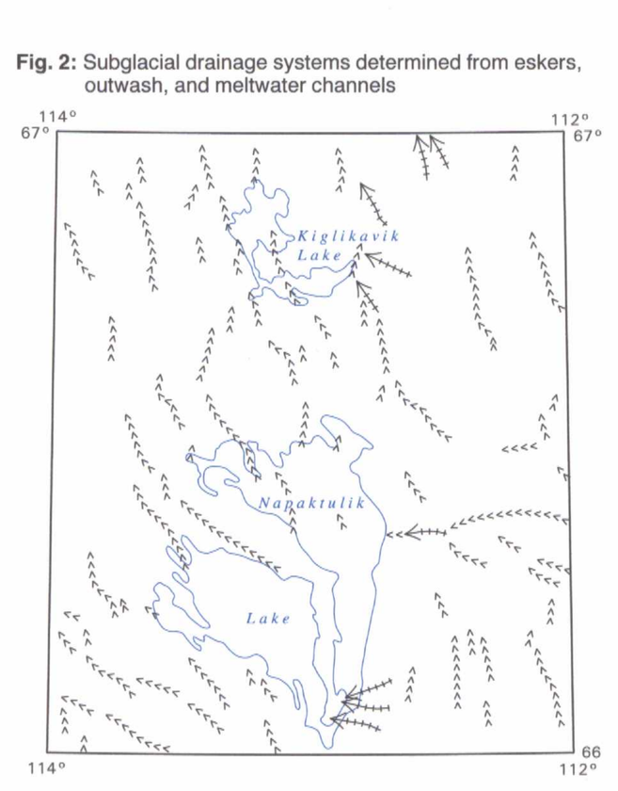


Fig. 3: Summary ice flow diagram based on striae and large-scale ice flow indicators

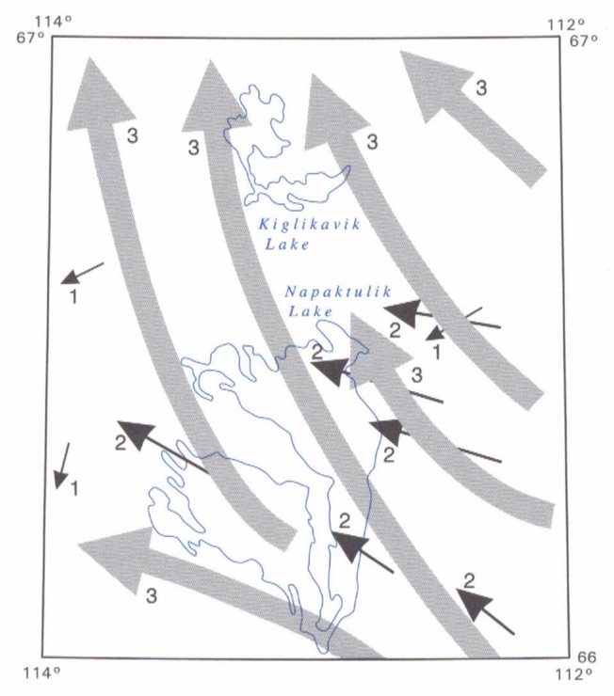


Fig. 4a-4c: Maps illustrating the evolution of glacial Lake Napaktulik during deglaciation. Extent of the lake is extrapolated between isolated beaches at the same or similar elevations

Fig. 4a: 440-438 m

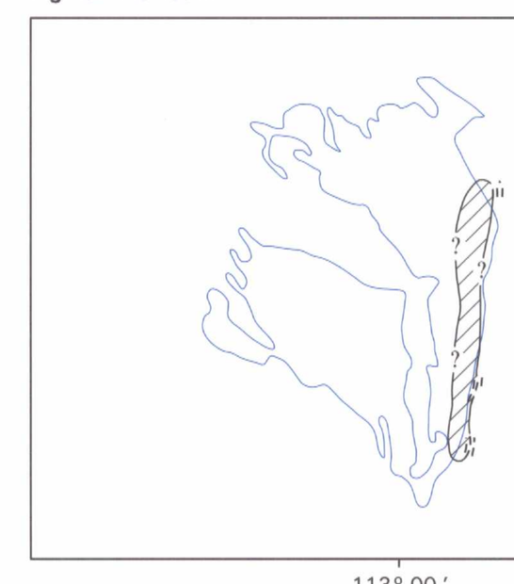


Fig. 4b 426-420 m

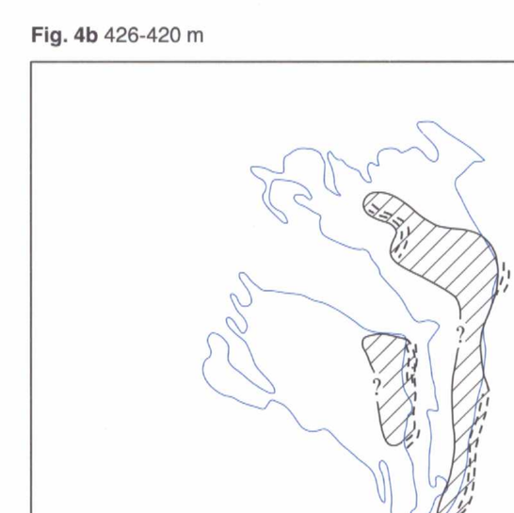


Fig. 4c: 410-400 m

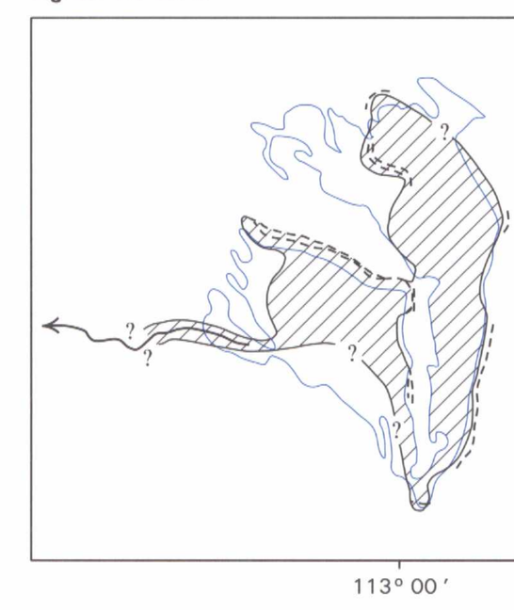
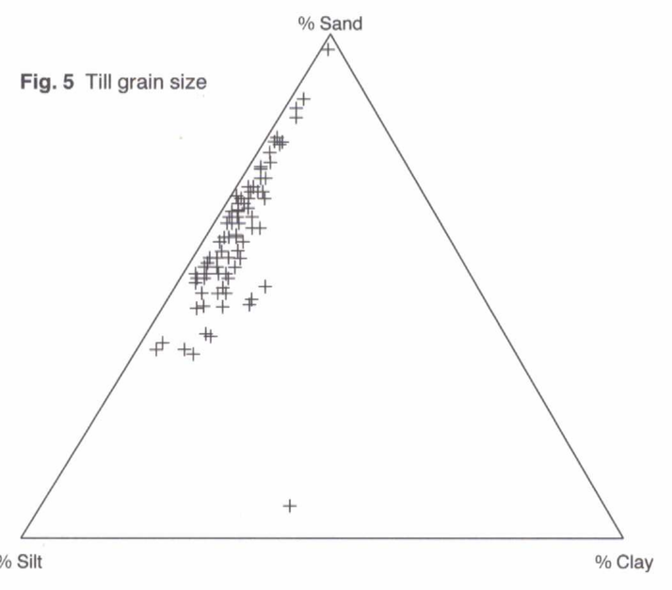


Fig. 5 Till grain size



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

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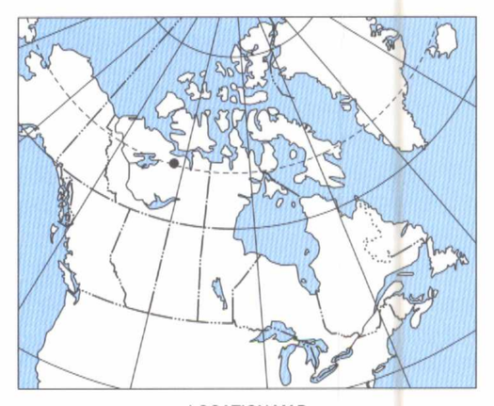


LOCATION MAP

MAP 1889A

SURFICIAL GEOLOGY

NAPAKTULIK LAKE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

Scale 1:125 000 - Échelle 1/125 000

Kilometres 2 0 2 4 6 8 10 Kilomètres

Transverse Mercator Projection
CM 113°00′, Scale Factor 1

Projection transverse de Mercator
MC 113°00′, facteur d'échelle 1

Geology by D.E. Kerr, L.A. Dredge, and B.C. Ward, 1994, with assistance from J. Adams, M. Caddel, and R. Roberts

Compilation by D.E. Kerr

Digital cartography by Martina Proulx and Mario Méthot, Geoscience Information Division

Contribution to the Slave Province NATMAP Project

Logistical support was provided by the Polar Continental Shelf Project

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

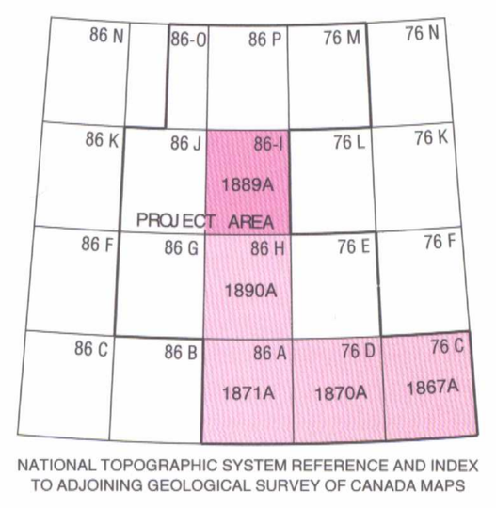
Digital base map data compiled by Geomatics Canada, Natural Resources Canada and modified by the Geoscience Information Division

Copies of the topographical editions covering this map area may be obtained from the Canada Map Office, Natural Resources Canada, Ottawa, Ontario, K1A 0E9

Mean magnetic declination 1997, 28°42′ E, decreasing 23.6′ annually. Readings vary from 27°23′ E in the SE corner to 30°01′ E in the NW corner of the map

Elevations in feet above mean sea level

Published 1997



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

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1889A

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