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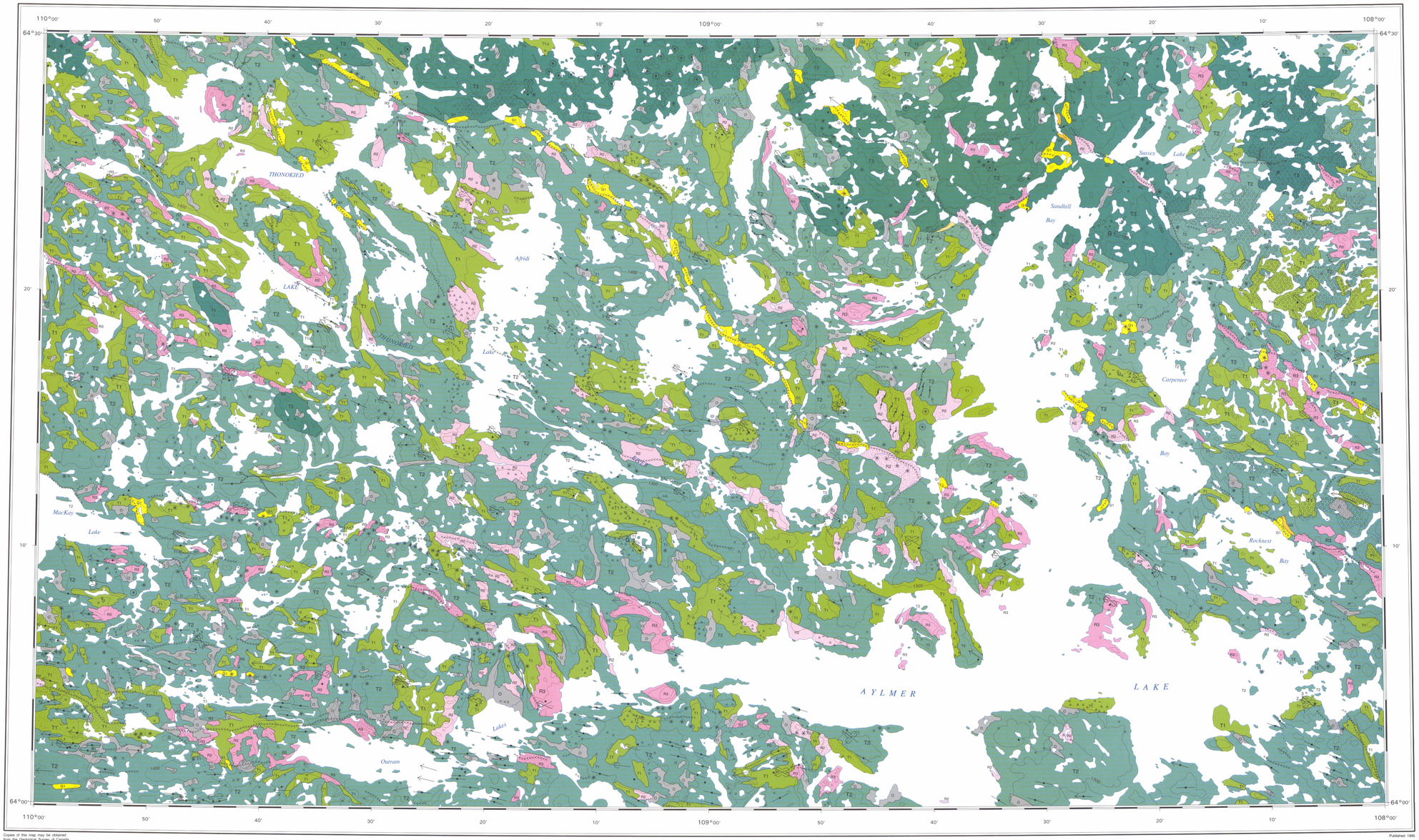
NATMAP
CARTNAT
Canada's National Geoscience Mapping Program
Le Programme national de cartographie géoscientifique du Canada



Copies of this map may be obtained
from the Geological Survey of Canada
601 Booth Street, Ottawa, Ontario K1A 0E8
3303-33rd Street, N.W., Calgary, Alberta T2L 2A7

LEGEND

Coloured legend blocks indicate map units that appear on this map

QUATERNARY

HOLOCENE

NONGLACIAL ENVIRONMENT

O — ***ORGANIC DEPOSITS:*** *peat and muck up to 2 m 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, in places covered by icings*

PLEISTOCENE (WISCONSIN GLACIATION)

GLACIAL ENVIRONMENT

L — ***GLACIOLACUSTRINE DEPOSITS:*** *silt and sand; cross-stratified to planar bedded; 1 to 8 m thick; deposited into temporary glacier-dammed lakes and ponds*

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*

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 drainage channels. Zones of washed rock, small transverse gravel ridges associated with this unit, isolated kame deposits, and circular rim ridges are 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 lodgement 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: *Precambrian granitic, gneissic, metasedimentary and metavolcanic rocks, mafic dykes and minor, younger (Tertiary?) kimberlite; may include patches of till veneer or glaciofluvial deposits; areas of shattered and frost-heaved rock, particularly on metasediments, are designated by symbols*

R3 — *Granitoid rocks*

R2 — *Metasedimentary rocks*

R1 — *Volcanic rocks*

Geological boundary

Ice-wedge polygon

Frost heaved and shattered rock

Age	Material
Lab no	Elevation (m)

Radiocarbon date

Fossil locality (F)

Raised beach

Lag concentration of glacially abraded boulders

Area of meltwater scour

Subglacial or proglacial meltwater channel

Esker (direction of flow known, unknown)

Kames and gravelly transverse ridges

Rim ridges and till plateaus (R)

Moraine

Drumlinoid till form

Rock crag-and-till tail form

Roche moutonnée or whaleback

Striation (ice flow direction known, unknown; 1 = oldest)

Striation, poorly defined (ice flow direction known, unknown)

Gossan G

Small rock outcrop

Sample site

DESCRIPTIVE NOTES

Aylmer Lake map area lies in central District of Mackenzie, on the watershed of major drainage systems flowing northwest (Back River), south (to Great Slave Lake), northwest (Coppermine River), and north (via Contwoyto Lake). Elevations range between 366 m and 500 m. Local relief is low, commonly <10 m in areas of rock and till blanket, although relief >30 m is prevalent in areas of hummocky till, and some eskers are over 45 m high. Rugged rocky areas north of Muskox Lake have about 50 m local relief. Numerous lakes occupy glacially scoured bedrock basins, and smaller water bodies occur in depressions on the till surface. Most drainageways are shallow; streams have not cut into bedrock or the till plain. The area lies beyond treeline. Glacial deposits are covered with low shrubs, alders, and tundra heath vegetation.

The Quaternary geology component of the Slave Province National Geoscience Mapping Programme (NATMAP) was designed to provide a regional framework for geological interpretation, environmental management, and drift prospecting. The project involved helicopter-assisted ground work, including terrain mapping, till sampling, and measuring of ice flow indicators. Field traverses and airphoto interpretation provided information on the nature and distribution of surficial sediments shown on the map. About 170 samples from this map area were collected for textural analysis and trace element geochemistry (Dredge et al., 1995a); 55 additional 10 kg samples were collected for heavy mineral and kimberlite indicator analyses (Dredge et al., 1995b); and pebble samples were collected to assess ice flow styles and glacial transport distances. Maps were constructed using 1:60 000 scale airphotos and recompiled onto a 1:125 000 base. Open File 2798 (Dredge et al., 1995c) and this map are the first regional surficial geology studies of the area.

Bedrock

The area lies within the central Slave Province of the Canadian Shield. Lord and Barnes (1954; Fig. 1) mapped the bedrock and made casual observations on striations and eskers. The rocks consist primarily of Archean volcanics and related fine grained sedimentary rocks, sediments belonging to the Yellowknife Supergroup (McGlynn and Henderson, 1972; Padgham and Atkinson, 1991). Sedimentary rocks are the most abundant type in the area. These rocks have been folded, faulted, and metamorphosed to various degrees, and formed into phyllite, schist, gneiss, and migmatite. The metasediments were later intruded by granite. Sulphide mineralization has occurred along faults near sediment/volcanic contacts. Dyke swarms trending northeast, east, and north-northwest criss-cross the area, and some dykes are 30 m wide. Kimberlite pipes have intruded older rock types. Cretaceous and Early Tertiary microfossils, fish remains in mudstone, and fission track (Fb/Si) dates of 52 Ma delimit the age of some of the pipes (Northern Miner, 1993).

The metasedimentary rocks have been subjected to intensive frost shattering in the postglacial period. Large frost-riven blocks, heaved above the level of the surrounding rock surface, are common features in the Yellowknife Supergroup.

Glacial deposits

Till is the most extensive deposit in the area. Only one stratigraphic unit of till has been recognized and it is attributed to the Wisconsin Glaciation (Dredge et al., 1994a). The till consists of a matrix-supported diamicton, with the matrix ranging from silty sand to sand. The stone content varies from 5 to 40% of the total volume of material, but is generally about 25%. Matrix size varies according to bedrock source and amount of meltwater associated with deposition. Till derived from granitoid rocks has a sandy matrix, while that derived from the Yellowknife Supergroup is siltier. Where glacial meltwater was associated with till deposition the matrix is commonly medium-to coarse-grained sand.

The till sheet has been divided into three subunits based on thickness and surface morphology; veneer, blanket, and hummocky till. Till veneer is generally <2 m thick, contains exposures of bedrock, and conforms to the underlying bedrock morphology. It is generally loose and the surface is characterized by high concentrations of cobbles and boulders of local provenance. Bedrock structure is usually visible on airphotos. Till blanket is generally 2-10 m thick, but thicknesses up to 40 m have been recorded. Till blankets either drape the underlying bedrock, forming gently undulating till plains, or contain low-relief drumlinoid features. Blanket tills are relatively compact and contain fewer boulders than veneers. Hummocky till deposits are >5 m thick and form irregular topography with relief up to 30 m; bedrock forms are totally masked. Hummocky till is associated with deposition by active ice has firm compaction and has a silty sand matrix, whereas hummocky till associated with surface ablation is loose and more bouldery. Till veneers and blankets are pervasive throughout the area. Hummocky till forms a belt about 40 km wide across the central part of the map area; this belt lies between two major esker systems.

Meltwater has variably affected all three till subunits. Ice stagnation features such as gravelly rim and ridge areas, and associated till plateaus, coincide with areas of hummocky till. Lag concentrations of abraded boulders are common in low areas in hummocky terrain, and are present as ablation features on other till surfaces as well.

Glaciofluvial deposits are geographically widespread but limited in extent, and are dominantly in the form of eskers and related kames; proglacial outwash is limited. An extensive trellis network of small eskers feeds into two large eskers that cross the area; these merge into one large trunk esker near Exeter Lake west of the map area. The eskers range from small, sinuous ridges to large, more linear features up to 45 m high that form major topographic elements in the landscape. The ridges vary from sandy and flat- topped, to bouldery and sharp crested; nodes of sand or boulder gravel are spaced between ridge segments. Sediments exposed in rare sections are dominantly immature, subangular sand and gravel into mica flakes, although gravel layers cap some of the sections. Much of the sand is very fine-to fine-grained. Sedimentary structures consist primarily of ripple and ripple drift beds, commonly draped, and planar beds, large scale crossbedding is rare. Foot traversing revealed abrupt changes in surface sediment from fine sand to boulder gravel. Exposures of bare, washed rock up to 1 km wide commonly flank large ridges and connect esker segments.

Eskers underlie till, cut into till, and lie at the surface above both till and outcrop; therefore they span a considerable part of the glacial/deglacial cycle. Associated with the esker systems, either adjacent to, or on, the washed zones, are small kame features. They range from streamlined forms parallel to meltwater flow, through slightly elongate forms perpendicular to flow, to irregular shapes. Their surfaces are strewn with abundant boulders and sandy till, but sections show that lower portions consist mainly of sand.

Thin peat deposits are common in low areas along poorly defined watercourses. Most of the ice-wedge polygons in the map area occur within the organic unit.

Glacial history

The area lies within the central part of the Keewatin sector of the Laurentide Ice Sheet (Dyke and Prest, 1987; Dyke and Dredge, 1989). Aylmer Lake map area lies directly west of the M'Clintock Ice Divide, which developed during the Late Wisconsin maximum (18 000-13 000 BP). From 13 000 BP the ice divide shifted eastwards into District of Keewatin and disappeared there about 7000 years ago. At its maximum, the northern margin of the Keewatin ice sheet lay north of the arctic coast and as far west as Mackenzie Valley. Radiocarbon dates on marine shells beyond the boundaries of this map area suggest that ice still covered the region about 10 000 BP, but that the ice lay east of Aylmer Lake by 9000 BP.

Ice flow indicators

Some aspects of the glacial history and assessment of glacial transport of material can be determined by the relative age and strength of striations. Although many rock outcrops are lichen-covered or have rough, weathered surfaces, small granite pegmatite outcrops, prevalent throughout the map area, have maintained their glacial polish and striations. Striations on other rock types were found on individual mineral crystals and on fresh surfaces exposed by peeling back the turf. Several techniques were used to determine relative ages of striations. At some sites, age relationships could be determined directly by examining sets of crosscutting striations, although in many places, the crosscutting relationship was ambiguous. Numerous outcrops have been bevelled by more than one flow. The ice flow sequence on these can be deduced from the orientations of the facets, and the corresponding presence or absence of striations. Similarly, striations on plucked faces (lee-sides) of roches moutonnées were assumed to postdate the flow that formed and plucked the original feature. The striation data indicate an early southwestern regional ice flow; a westward flow; a shift to northwestward flow; and a final southwest flow in the Muskox Lake area, (Ward et al., 1994). All these striations are thought to represent the same glaciation because the surfaces they were found on are all relatively fresh (i.e., unweathered).

Streamlined bedrock forms are common throughout the map area, and conform in direction to ice flows determined from striations. A prominent swarm of roches moutonnées and drumlins on the volcanic rocks north of Muskox Lake indicate a vigourous, but areally limited southwest ice flow.

One major drumlin field indicating westward ice flow crosses the south part of the map area. A second swath of oriented drift forms of low relief farther north parallels a major striation trend towards the northwest. Rare bi-form drumlins indicate that some earlier forms were reshaped by the northwest flow. A third field containing curved drumlinoid forms arcs from west to northwest in the vicinity of Tarpon Lake.

While eskers are fluvial forms related to hydraulic gradients within the ice, they are indirect indicators of ice flow in that the gradients they record commonly run towards the ice margin, that is, they parallel ice flow. The largest eskers have major ridge segments trending westwards. Near Aylmer Lake they have additional northwest trending segments and may reflect a later ice flow shift towards the northwest (Fig. 3).

Glacial events

1. Striations indicate that an early ice flow towards the southwest crossed the map area (Fig. 5a). Since the striations and the surfaces they are found on are unweathered, they are assumed to postdate the last interglaciation. The ice flow is thus thought to relate to the build-up phase of the last glaciation.
2. Cross-cutting striations, streamlined rock forms, and drumlins indicate a later major flow towards the west (Fig. 5b). This flow is tentatively placed during the main part of the Late Wisconsin Glaciation and may reflect flow from the M'Clintock Ice Divide (Dyke and Prest, 1987), thought to lie directly east of the Aylmer Lake map area. Some of the west-trending eskers may have developed at this time.
3. While westward ice flow persisted in the south, striation sequences and re-oriented drumlins suggest that the rest of the area experienced a progressive shift in flow toward the northwest (Fig. 5c). These shifts may be a response to ice recession and related ice lobing. Major esker segments and their tributaries in the central and northern parts of the area following this northwest trend may have developed during the same late glacial phase.

   The occurrence of till and streamlined forms on top of many eskers suggests that some developed while the ice sheet was active. The angularity, bedforms, and fine grain size of the esker sediments suggest that much material was deposited into a low energy environment. The angularity of the sediment and preservation of mica indicate a lack of abrasion, and suggest either short distance transport of material, or transport in a protective water slurry. Since there is no evidence of glacial lakes in the area, the sediment must have been deposited into subglacial or englacial water-filled cavities. The bare rock zones extending as much as 1 km beyond the flanks of the esker ridges probably resulted from meltwater scour during periods when high water volumes or high hydraulic pressure caused enlargement of tunnels or sheetflow of meltwater beyond the confines of the original tunnels, with subsequent erosion of adjacent till deposits. After these events, the glacier bed recoupled with the rock substrate adjacent to the original tunnel, normal ice flow resumed, and some of the glaciofluvial deposits were streamlined by the overriding ice.
4. Striations, drumlins, and roches moutonnées in the northeast record a late vigourous ice flow (Fig. 5d).. The areal restrictions of these features suggest that they relate to a late ice lobe confined to the area north of Muskox Lake. Curving drumlins suggest that the front of this lobe may have been deflected by ice in the area south of Tarpon Lake.
5. The broad band of hummocky moraine in the central part of the map area, with associated boulder lags, rim ridges, and till plateaus, suggests that part of the ice sheet downwasted. The prevalence of integrated esker systems in this area attests to the abundance of meltwater. Flat-topped esker segments denote the location of open-topped conduits and indicate that streams on the glacier surface may have been feeding into the esker systems at this stage. Near Lac du Sauvage, partly flattened twigs on bedding planes in one esker within hummocky drift date about 8500 BP (TO-4241). They suggest that the hummocky belt was a late ice remnant that persisted after other areas were deglaciated.

REFERENCES

Dredge, L.A., Kjarsgaard, I.M., Ward, B.C., Kerr, D.E., and Stirling, J.A.R.
1995b: Distribution and geochemistry of kimberlite indicator minerals, Aylmer Lake map area (76C), Northwest Territories; Geological Survey of Canada, Open File 3080, 42p.

Dredge, L.A., Ward, B.C., and Kerr, D.E.
1994a: Glacial geology and implications for drift prospecting in the Lac de Gras, Winter Lake, and Aylmer Lake map areas, central Slave Province, Northwest Territories; *in* Current Research, Geological Survey of Canada, Paper 1994-C, p. 33-38.
1994b: Surficial geology, Aylmer Lake, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Open File 2798, scale 1:250 000.
1995a: Trace element geochemistry and gold grain results from till samples, Aylmer Lake area, Northwest Territories; Geological Survey of Canada, Open File 3120, 160 p.

Dyke, A.S. and Dredge, L. A.
1989: Quaternary geology of the northwestern Canadian Shield; *in* Chapter 3 of Quaternary Geology of Canada and Greenland, (ed.) R.J. Fulton; Geological Survey of Canada, Geology of Canada, no. 1, p. 189-214 (also Geological Society of America, The Geology of North America, v. K-1).

Dyke, A.S. and Prest, V.K.
1987: The Late Wisconsinan and Holocene History of the Laurentide Ice Sheet; Géographie physique et Quaternaire, v. 41, p. 237-263.

Lord, C.S. and Barnes, F.Q.
1954: Aylmer Lake, District of Mackenzie; Geological Survey of Canada, Map 1031A, scale 1" to 4 miles.

McGlynn, J. and Henderson, J.
1972: The Slave Province; Geological Association of Canada, Special Paper 11, p. 506-526.

Northern Miner
1993: BHP-DiaMet age date kimberlites; Northern Miner, September 20, p.1-2.

Padgham, W. and Atkinson, D. (ed.)
1991: Mineral deposits of the Slave Province Northwest Territories (field trip 13); Geological Survey of Canada, Open File 2168, 136 p.

Ward, B.C., Dredge, L.A., and Kerr, D.E.
1994: Ice flow indicators, Winter Lake, Lac de Gras, Aylmer Lake, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Open File 2808, scale 1:250 000.

Geology by L.A. Dredge, B.C. Ward, and D.E. Kerr with assistance from M. Gingras, R. Paulen, and B. Pierna

Compilation by L.A. Dredge

Digital cartography by the Geological Survey of Canada

Contribution to the Slave Province Natmap Project

Logistical support was provided by the Polar Continental Shelf Project

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

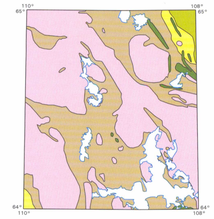
Digital base map at the scale of 1:250 000 from the Surveys, Mapping and Remote Sensing Sector, Natural Resources Canada was assembled by the Geological Survey of Canada

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

Mean magnetic declination 1995, 24°20' E, decreasing 20.9' annually. Readings vary from 22°46' E in the SE corner to 25°51' E in the NW corner of the map

Elevations in feet above mean sea level

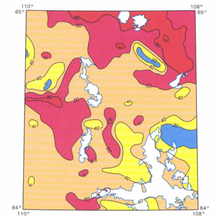
Fig. 1: Bedrock geology



LEGEND

- *Intrusive rocks: granite,diorite, and gneiss*
- *Moderately metamorphosed sediments: schist, quartzite*
- *Slightly metamorphosed sediments: greywacke, slate, phyllite, sandstone*
- *Acid volcanics*
- *Basic volcanics: chiefly basalt*

Fig. 2: Distribution of pebbles from the Yellowknife Supergroup

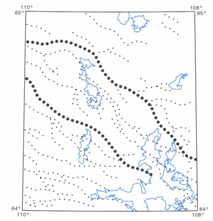


LEGEND

% Yellowknife Supergroup clasts in till

- < 20
- 20 - 40
- 40 - 60
- 60 - 80
- > 80

Fig. 3: Subglacial drainage systems, determined from eskers and meltwater scour zones



LEGEND

- Esker; main ridge
- Esker

Fig. 4: Till grain size

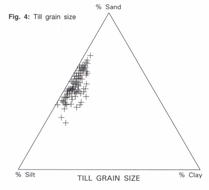


Fig. 5a: Glacial events

Fig. 5b

Fig. 5c

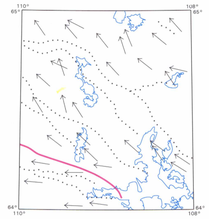
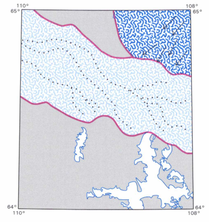


Fig. 5d



LEGEND

- Active ice
- Stagnant ice remnant
- Deglaciated area
- Esker
- Ice lobe margin
- Ice flow

86 H	76 E	76 F
1690A (in press)		
86 A	76 D	76 C
1871A	1870A	1867A North / South
85 P	75 M	75 N

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

LOCATION MAP

GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

MAP 1867A

SURFICIAL GEOLOGY

AYLMER LAKE

(SOUTH)

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

Scale 1:125 000 - Échelle 1/125 000

Kilometres 2 0 2 4 6 8 10 Kilometres

Universal Transverse Mercator Projection | Projection transverse universelle de Mercator

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1995: Surficial geology, Aylmer Lake, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Map 1867A, (South), scale 1:125 000

1867A (S½)