MANITOBA

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

MINERAL RESOURCES DIVISION

REPORT OF FIELD ACTIVITIES 1977

1977

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ERRATA LIST

P. 109 and 115: Figures GS-22-1 and GS-23-1 are switched. This applies also to Figure GS-1, map areas 22 and 23.

P. 164: Caption for Figure GS-33-24 should read: Molson dyke orientations, Kiskitto Lake region. Station number (thickness in cm). Solid line -- β plane; dashed line--azimuth--dip not measurable.

P. 188: In notes to Table GS-39-1: 'lencogranite' should read 'leucogranite'.

1977

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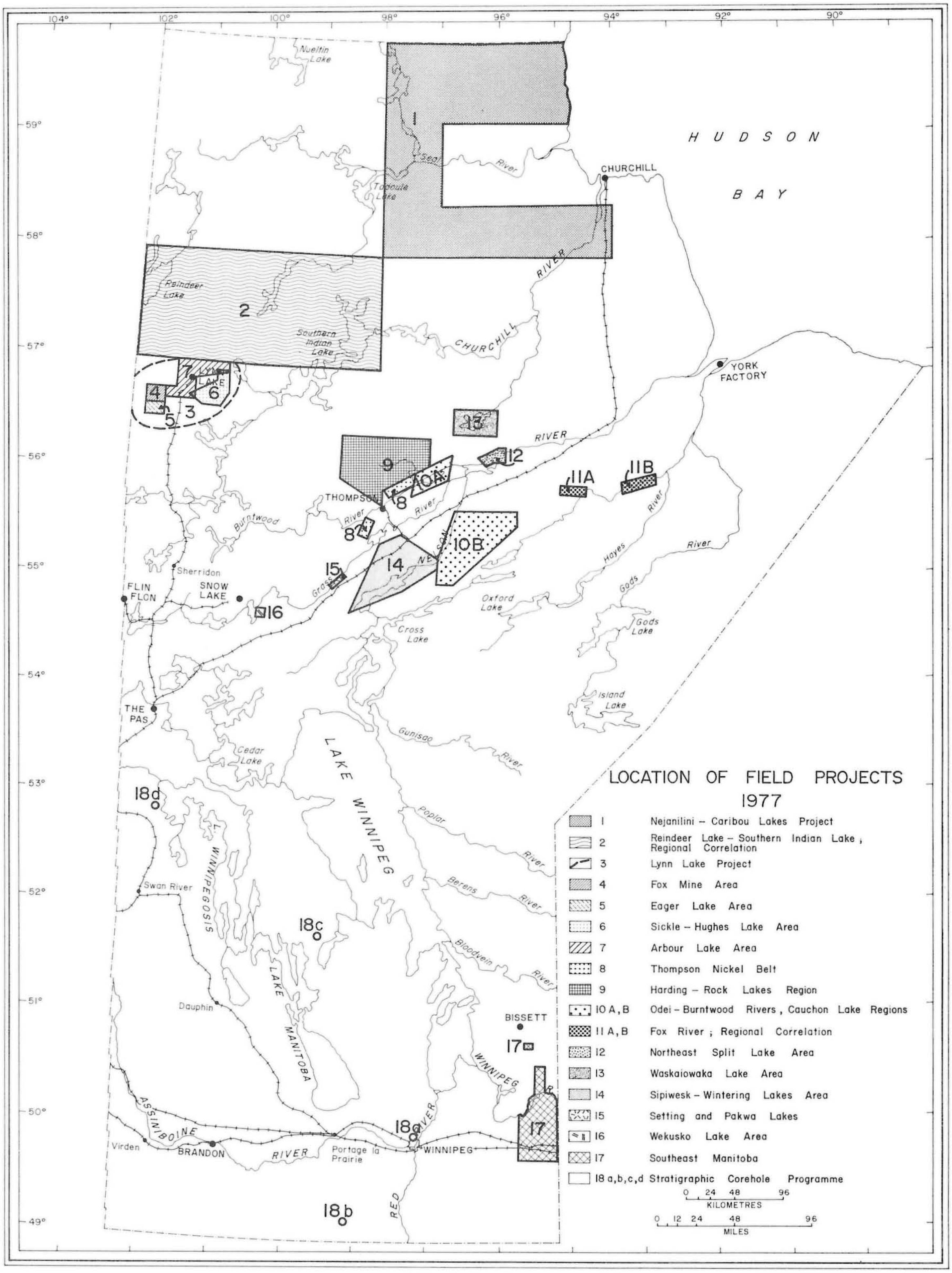

Figure GS 1 Location of Field Projects 1977

INTRODUCTION

The scope of the Geological Survey's activities has been broadened in recent years to provide information in support of:

a) an accelerated regional mapping and correlation programme designed to provide a minimum of 1:100 000 scale coverage for most of the Province by 1979, this to serve as a base for the proposed 1:250 000 compilation series and a new 1:1 000 000 scale geological map of Manitoba; and

b) a comprehensive and soundly based evaluation of the Province's mineral resources.

Such activities complement the ongoing long-term programme of 1:50 000 scale mapping and related investigations in areas where a more definitive delineation and understanding of the geology is required.

In 1977 seventeen field projects ranged from 1:100 000 mapping in the Nejanilini-Caribou Lakes region, through the second and concluding phase of detailed stratigraphic investigations in the Lynn Lake area, to 1:50 000 scale mapping of the Pikwitonei region near Sipiwesk Lake. The last of the exposures to be affected by the Churchill River Diversion were mapped down the Burntwood and Odei River to Split Lake and included coverage of the northeast end of Split Lake. In the adjacent Thompson Belt the initial work focussed on Moak and Ospwagan Lakes and led to important re-examination of earlier Churchill-Superior boundary dogma.

Regional correlation was extended from the Kisseynew metasedimentary gneiss belt through Harding and Rock Lakes towards Waskaiowaka Lake where shoreline exposures were investigated as a preliminary to more comprehensive mapping. Elsewhere in the Province the need to establish a standardized data base for the proposed compilation series and provincial geological map was realized in part through regional correlation operations in the Reindeer Lake-Southern Indian Lake, Pakwa Lake-Setting Lake, and Fox River areas and throughout southeastern Manitoba.

Several new compilations are included as figures in the following reports from which it is readily apparent that substantial advances are being made in delineating the major geological components of the Precambrian shield in Manitoba. In the Churchill Structural Province the major lithologic belts are now better defined and can be correlated with those recognized in Saskatchewan (Figure GS-2-1). Large plutonic bodies of pyroxene-bearing granulite and monzonite occur in both the "Wathaman-Chipewyan" batholith, near Big Sand Lake and the Nejanilini pluton to the north of the Seal River Belt. Of equal importance is the similarity of the greywacke gneiss/,calc-silicate/, arkosic gneiss association and sequence that is found in the Kisseynew, Southern Indian and western Seal River metasedimentary gneiss belts; a feature which appears to imply a shared or similar evolutionary history or pattern of evolution.

In the Thompson region changes are proposed for the location of the "Aphebian-Archean" boundary which is now thought to extend from Birchtree Brook through Pearson Lake to Fourmile Lake. Further to the south, additional evidence has been found to indicate a gradational increase in the grade of a relatively late metamorphic event along the Superior Province greenstone belts into the Pikwitonei granulites. In the Sipiwesk-Wintering Lakes area, the tectonic evolution of the Superior migmatitic granulite terrain appears to have diverged markedly following the emplacement of a mafic dyke swarm. Subsequent northeast-trending possibly Hudsonian deformational and metamorphic-anatectic events were concentrated in the northwestern area adjoining the Thompson belt. To the southeast the older migmatite belt underwent cataclasis and mylonitization without attendant high temperature recrystalization.

In Southeastern Manitoba, 1:50 000 scale coverage of the Precambrian shield was completed from the forty-ninth parallel to the Wanipigow River. The age relationships of the major rocks units have been established and the subdivision of the area south of the Winnipeg River into the Kenora and English River subprovinces has been further substantiated.

The stratigraphic core hole programme continued jointly with the Mineral Evaluation Branch and the Exploration Operations Branch. The work in the Lake St. Martin area is of particular interest in that the stratigraphic outlier of Upper Devonian carbonate breccias present in the "crater" provides a hitherto unavailable key for extrapolating the known facies and paleogeography of the Devonian beyond the limits of the existing outcrop belt.

September 1977

W.D. McRitchie
Director, Geological Services

GS-1 NEJANILINI-CARIBOU LAKES PROJECT

(54L, 54M, 64I and 64P)

by D.C.P. Schledewitz

The area between latitudes 58° and 60° and longitude 93° and the shoreline of Hudson's Bay was mapped during the summer of 1977, with the exception of the region designated as the Seal River Area (Figure GS-1-1). The main part of the geological mapping of the Precambrian rocks, accompanied by on-rock scintillometer readings, was carried out at a scale of 1:125 000 with more detailed mapping at 1:50 000 around Nejanilini Lake, Wolverine River, Caribou Lake and south of Round Land Lake.

These areas were previously mapped by the Geological Survey of Canada at a scale of 1:250 000 (GSC maps 15-1958; 17-1975; 14-1967) and included the Deer River Report (GSC Paper 69-24) with accompanying map at a scale of 1:500 000.

The Nejanilini-Caribou project completes the regional mapping of the area between latitudes 58° and 60° extending from the eastern edge of the Kasmere Project (100°) east to the shoreline of Hudson's Bay (Figure GS-1-2).

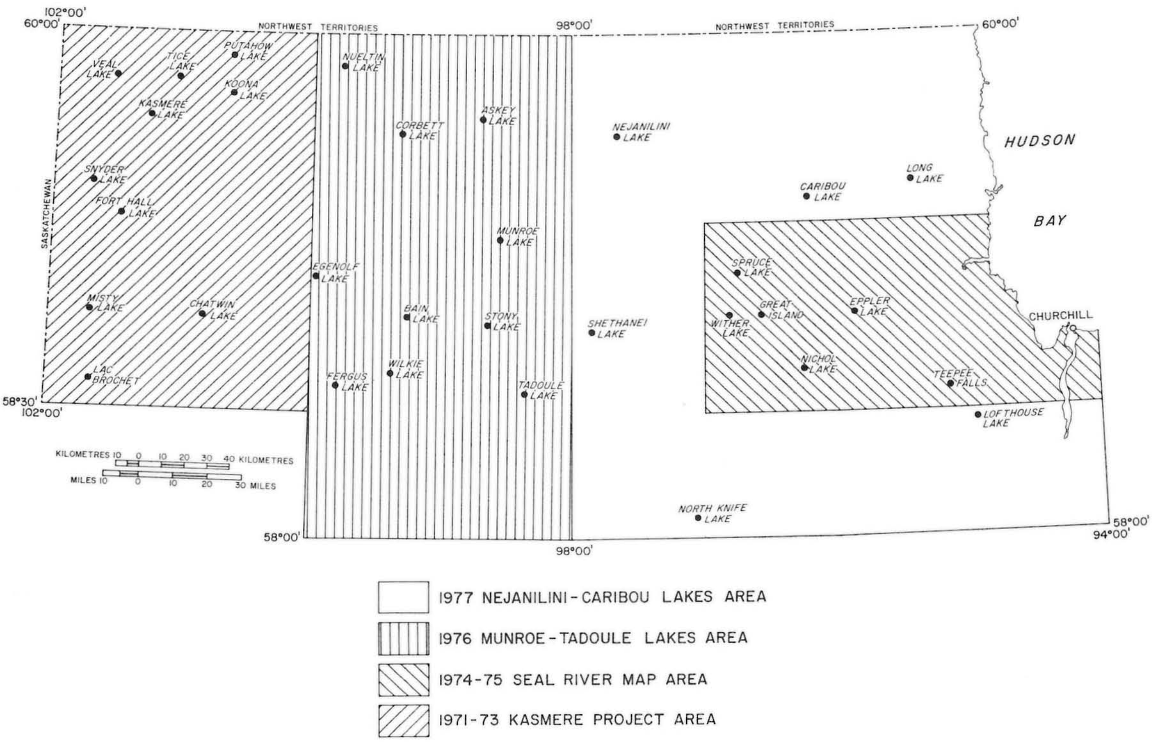

Figure GS-1-1 Location of Regional Mapping Projects for Northern Manitoba (1971-1977)

The Nejanilini-Caribou map-area is covered by extensive glacial drift with an average of 1% outcrop. Some areas such as the region between Nejanilini, Caribou and Gronbeck Lakes may locally contain up to 4% outcrop. Elsewhere there is less than 0.5% outcrop with the extreme south being poorly-drained clay and sand plain barren even of boulder fields.

Examination of sub-angular boulders in large boulder fields can result in the delineation of approximate lithologic contacts, and/or small patches of extremely frost-heaved outcrop. Boulder fields associated with extensive ribbed moraines have generally undergone considerable transportation.

General Geology

The map-area can be divided into two regions on the degree of metamorphism exhibited by the sedimentary rocks and the character of the rocks which they overlie.

The proposed boundary lies to the north of the Seal River and follows an east-trending line which passes through the southern part of Duffin Lake east to Spruce Lake in the Seal River Project area (1977). The line can be extrapolated east to Hudson's Bay; however, there is a slight south-trending embayment in the Eppler Lake Region in the Seal River area (1977).

The northern sub-area or zone primarily contains sedimentary-derived paragneisses and migmatites which contain mineral assemblages characteristic of low-pressure high temperature metamorphism in the upper amphibolite facies. The grade of metamorphism increases eastward. Large masses of hypersthene-bearing basement rocks underlie much of this region.

The southern sub-area contains metasedimentary rocks and local paragneisses which are indicative of lower to middle amphibolite facies of metamorphism. The metamorphic grade appears constant or may decrease slightly to the east, and increases westwards. The rock types which underlie the metasediments are a grey-pink lineated and foliated granodiorite, pink quartz monzonite and aplite.

North Zone

A metasedimentary-derived paragneiss sequence occurs west of Nejanilini Lake. These rocks comprise a sequence of semi-pelitic gneisses which contain cordierite, sillimanite and garnet (unit 7, Table GS-1-1), white to grey massive to faintly bedded quartzite (10) and a grey and pink siliceous calc-silicate. These rocks form a zone up to 11 km wide. However, north-trending faults have offset the sequence in a step-like manner to the north. The major fault displacements occur along Nejanilini Lake. West of Nejanilini Lake the paragneisses overlie a grey foliated quartz monzonite (unit 4) to grey gneissic quartz monzonite (unit 4a). The paragneisses and grey quartz monzonite are intruded by sills, dykes and **lits** of white quartz monzonite (12). However, east and north of Nejanilini Lake the sedimentary-derived paragneisses and migmatites occur as discontinuous bodies in an inhomogeneous granitic terrain, comprising massive to foliated hypersthene-quartz monzonite (unit 2); a hybrid rock (unit 2a) comprising a mixture of the hypersthene-quartz monzonite, a pink quartz monzonite, and a grey quartz monzonite gneiss (unit 3), the latter of which contains sporadic lenticular zones of the hypersthene-quartz monzonite (2).

A subtle change in the colour of the feldspar is detectable in the semi-pelitic gneiss (7) and its mobilizate (12). The normal white to cream coloured feldspars become brown to olive brown in colour. Hypersthene also appears sporadically within the semi-pelitic gneiss forming hypershtene-cordierite ± garnet-biotite assemblages. The hypersthene may form prominent porphyroblasts in the mobilizate. Also present within the hypersthene-bearing granitic rocks (units 2 and 2a) are discontinuous zones of hypersthene-biotite-plagioclase-quartz gneiss (unit 1) and interlayered hypersthene-bearing amphibolite (unit 1). The age of these rocks is uncertain but they have tentatively been placed as the oldest rocks in the region.

East and south of Caribou Lake the complex of hypersthene granulites gives way to a terrain of grey foliated quartz monzonite (4) and grey quartz monzonite gneiss (4a) containing zones of the hypersthene-bearing quartz monzonite (2) and hybrid (2a). The semi-pelitic gneiss (7) is present as small discontinuous remnants 0.5 km to 1 km long or elongate narrow belts.

The younger biotite-bearing to more leucocratic pink porphyritic quartz monzonite to granite (unit 15) occurs along the coastal region of Hudson's Bay where it forms large bodies. This rock type also forms smaller stocks at Round Sand Lake and immediately east of Caribou

Lake along the Caribou River. This rock type is readily distinguishable on airborne radiometric and geophysical maps 3576G and 3594G. The areas of porphyritic quartz monzonite show up as positive anomalies. On-rock scintillometer readings substantiate the high background for this rock type with local zones of higher responses and rare zones of anomalously high values.

South Zone

To the south of the proposed boundary, layers of grey, massive quartzite and impure grey quartz meta-siltstones are interlayered with fine-grained muscovite-biotite schists (locally knotted) to phyllite (unit 11). This sequence overlies a granitic terrain comprising lineated biotite granodiorite to granite (unit 5), massive to foliated medium to coarse-grained pink quartz monzonite (unit 13) and pink aplite (unit 13b).

The metasedimentary rocks (11) are intruded by pink and white pegmatite containing large books of biotite or muscovite. These pegmatites give random radiometric anomalies. One zone occurs along the north shore of Shethanei Lake. The metasedimentary rocks are coarse-grained in areas of abundant pegmatites and also grade into paragneisses with **lit-par-lit** injections. The metasediments are intruded locally by quartz monzonite (13) as along the North Knife River.

The metasedimentary rocks outcrop in a belt along the shore of Shethanei Lake at the west edge of the map-area. They are similar to rocks in the Tadoule Lake area, which locally contain sillimanite-cordierite-muscovite assemblages indicative of low-pressure high temperature conditions of middle amphibolite facies metamorphism. Pegmatite intrusions are also common in this region as abundant sills. The metasedimentary rocks can be traced east of Shethanei Lake as a series of east-trending folds offset by north-trending faults. These metasedimentary rocks appear to be in strike continuity with similar rocks in the Seal River area (1977) south of Wither Lake. At this locality a previously mapped zone of quartzites and interlayered phyllites and schists outline the nose of a westward plunging synform. However, the rocks south of Wither Lake have been previously equated with those of the Great Island Group (Schledewitz, 1977), and the relationships will have to be examined in more detail.

The foregoing is a generalized account of the regional geology of the area. An exception to the simplified two-fold subdivision is a belt of metasedimentary-derived paragneisses (unit 7) which appears to straddle the proposed boundary line. These rocks outcrop around MacLeod Lake along the Wolverine River near the western border of the map-area. Their northern contact flanks they grey foliated quartz monzonite (4) and hypersthene-quartz monzonite (2) and hybrids (2a). The southern contact appears to be in part faulted against pink quartz monzonite (13) and aplite (13b). The paragneisses, which are mainly cordierite-sillimanite-bearing semi-pelitic gneisses, locally contain marble (10a) and psammitic biotite gneiss (unit 8). They strike southeast to the Spruce Lake region. In the Spruce Lake area, the paragneisses and schists are interlayered with quartzites and interdigitate with amphibolites derived from the volcanic rocks at Great Island. This region is intersected by many east-trending low angle shear zones, one of which is marked by a bright orange gossan, 0.5 km wide and several km in length. An apparent decrease in metamorphism along this zone of rocks is most noticeable at the east end of Spruce Lake. However, to the north of Spruce Lake, where a small outlier of semi-pelite flanks the hypersthene-bearing quartz monzonite terrain, the grade of metamorphism appears to be higher with assemblages indicative of upper amphibolite facies of metamorphism.

The Spruce Lake region of the Seal River area is of considerable importance since it appears to be the only locality at which high-grade paragneisses are interdigitated with lower grade schists, and volcanic-derived amphibolites. The metasediments of the Great Island Group are also in close proximity. The area around Spruce Lake also appears to lie near the intersection of an east-trending fault and a northwest-trending fault zone.

Faulting appears to significantly control the distribution of the major lithologies in the Nejanilini-Caribou Lake map-area. East-trending folds are intersected by large fault zones that trend north or northwest to north of west. The north-trending faults produce both major and minor apparent displacements. However, the northwest to east-trending faults produce a major reorientation of the earlier east-trending folds and/or a considerable extension of stratigraphic units which, in some cases, results in complete elimination of parts of the sequence.

LEGEND
(To Figure GS-1-2)

Rocks of uncertain affinity

B	Migmatite
A	Hurwitz Group, Great Island Group metasedimentary rocks

Hudsonian Intrusive Rocks

14	Fluorite-bearing quartz monzonite
13	Quartz monzonite and porphyritic quartz monzonite
12	Gabbro, ultrabasic rocks
11	Porphyritic quartz diorite, granodiorite

Aphebian Metasedimentary Rocks

10	Impure quartzite, interlayered meta-siltstone and muscovite-biotite schist
9	Meta-arkose, arkosic gneiss
8	Calc-silicate rock, albite pyroxene rock, marble
7	Quartzite
6	Psammitic gneiss, meta-greywacke
5	Pelitic, semi-pelitic gneiss, impure quartzite lenses, calc-silicate lenses
4	Volcanic rocks, related intrusive rocks, volcanic-derived sediments

Archean

3	Foliated pink quartz monzonite
2	Foliated grey quartz monzonite and grey quartz monzonite gneisses
1	Hypersthene-bearing quartz monzonite, quartz diorite, hypersthene gneisses

SYMBOLS

 Fault proposed

——— Geologic contact proposed

— — — Drift

 Mineral occurrences — see Table GS-1-2

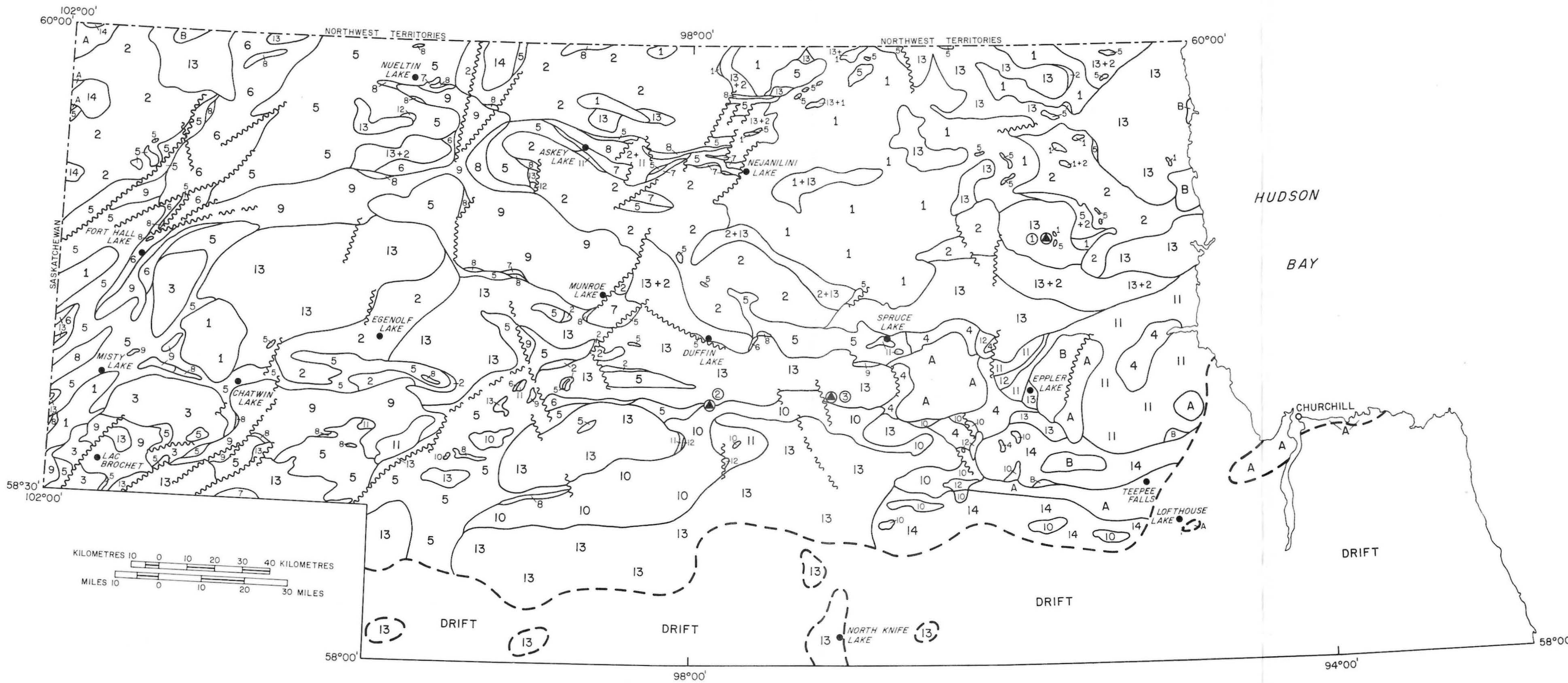

Figure GS-1-2 Simplified Geological compilation for the Seal River Belt (58° to 60°), Manitoba

TABLE GS-1-1
TABLE OF FORMATIONS

Map Unit	Rock type and Occurrence	Description
1	Hypersthene gneiss and amphibolites occurs as discontinuous bodies within areas of units 2 and 2a	Brown foliated medium-grained/hypersthene (3%) — biotite (8%) — feldspar (60%) — quartz (30%). Black, granular medium-grained hypersthene (5%) — diopside (8%) — hornblende (40%) — plagioclase (45%) — quartz (5%). Background: 2000 — 4000 CPM
2	Hypersthene quartz monzonite occurs as discontinuous bodies of variable size from lit and dykes in unit 1 to large bodies 100 km^2	Olive green to honey brown — massive to foliated — medium to pegmatitic — hypersthene (5%) — hornblende (0-3%) — diopside (0-5%) — biotite (5%) — plagioclase (35%) — potassium feldspar (20%) — quartz (25%). Background: 1500 - 3000 CPM
2a	hybrid quartz monzonite forms the main mass of crystalline basement	Honey brown, weathers deeply — contains from 8 to 40% pink quartz monzonite and 95 to 50% hypersthene quartz monzonite. Background: 3000 - 5000 CPM
3	Grey gneiss forms irregular-shaped zones at peripheries of areas of hypersthene quartz monzonite (2). Best exposure is along Nejanilini Lake	Well foliated, grey with more deeply weathering lenses of hypersthene quartz monzonite (2). The main mass of the rock is well foliated and medium grained — biotite (8%) which forms lenticular to wispy anastomosing layers — feldspar (65%) quartz (27%). Background: 4000 - 5000 CPM
4	Grey quartz monzonite to granodiorite appears to form stocks within areas of grey foliated quartz monzonite gneiss and as large areas around Caribou Lake and east and northeast of Caribou Lake	Grey, to white and pink — massive to weakly foliated — medium to coarse-grained — biotite (5-8%) — hornblende (0-3%) — plagioclase (40%) — potassium feldspar (30%) quartz (20%). Background: 1500 - 2500
4a	Grey quartz monzonite gneiss forms large areas west of Nejanilini lake. This rock type forms large areas of flat outcrops	Grey, well foliated gneiss with pink granitic lit — medium grained — biotite (8-10%) — feldspar (65%) — quartz (25%). Background: 1500 - 2500
5	Lineated biotite granodiorite occurs underlying metasediments south of Shethanei Lake and south of Seal River	Well foliated and lineated — buff coloured to pink — biotite (10%) — hornblende (0-5%). Both these minerals commonly form mineral trains which describe pencil-like rodding. Background: 1400 - 2100 CPM
6	Meta-gabbro occurs as small stock-like body east of Caribou Lake within an area of granite gneiss	Massive — black and white — hornblende (40%) as circular aggregates in brilliant white plagioclase (55%) — quartz (5%). Background: 1500 — 2500 CPM
7	Semi-pelitic gneiss occurs as part of a layered sequence on the west side of Nejanilini Lake, elsewhere it forms only discontinuous bodies ranging from 1 km^2 to 100 km such as at Commonwealth Lake. Hypersthene is a rare constituent in the semi-pelite where it occurs as discontinuous zones in the hypersthene quartz monzonite(2)	White and grey layers; grey layers — cordierite as grey lenses (5%) — garnet as spherical to highly elongated grains (0-5%) — sillimanite as silky flattened lenses (5%) — biotite (15%) — feldspar (40-50%) — quartz (20-30%). The white layers are comprised of plagioclase and quartz with accessory biotite and $\pm$ cordierite. Background: 2500 - 4500 CPM
7a	Impure quartzite this rock type forms a synformal structure 18 km east of Commonwealth Lake. The west end of the structure is faulted by a northerly-trending fault.	Honey brown colour — well foliated — biotite (5%) — sillimanite (5-8%) — feldspar (10%) — quartz (75%). The rock is granoblastic; however, a weak to moderate cataclastic foliation defined by alignment of thin smeared-out sheets of sillimanite. Background: 2000 - 2500 CPM
7b	Grey biotite gneiss this rock type occurs in the region to the east and northeast of Caribou Lake	Grey and white — well foliated, gneissic, biotite feldspathic layers alternating with cream coloured coarse-grained quartzo-feldspathic layers. In the grey biotite — garnet (0-3%) — biotite (10-15%) — feldspar (60%) — quartz (30%). Background: 2500 CPM
8	Psammitic gneiss this rock type is notable for its consistent appearance in the areas where calc-silicate rocks or marble outcrop	Dark grey dense medium-grained, foliated — amphibole (0-3%) — biotite (disseminated) (8-10%) — plagioclase (70%) — quartz (15-20%). The rock also contains dense cream coloured granitic lit which comprise mainly plagioclase (10-15%) quartz and accessory amphibole or tourmaline. Background: 2000 CPM
9	Quartzite this rock type occurs in the Nejanilini Lake area	White to grey masive to thick-bedded. Bedding defined by biotite laminations. Milky white quartz veins are abundant in the white massive quartz. Background: 1500 - 2500 CPM
10	Calc-silicate rock occurs at Nejanilini Lake and northeast of Nejanilini Lake	Well layered sequence of alternating dense fine-grained pale pink, pale green and black layers. The pale pink layers can be siliceous with up to 20% quartz. The pale green layers are mainly diopside. Background: 2000 - 2500 CPM

10a	Marble forms a single occurrence east of Duffin Lakes	Honey coloured medium- to coarse-grained granoblastic. Contains 3% acicular or columnar grey crystals 1 mm to 3 mm in length — possibly tremolite. Background: 2000
11	Interlayed quartzite, metasiltstone and biotite-muscovite-quartz schist this rock type occurs along Shethanei Lake and south of the Seal River. Locally the rock is recrystallized to a paragneiss	Quartzite — grey medium-grained — disseminated biotite (5%) — thickly bedded — muscovite (3%) — feldspar (10%) — quartz (80%)) meta-siltstone — grey very fine-grained dense — thinly bedded biotite-muscovite schist
12	White quartz monzonite to granodiorite occurs as stocks and granitic lit within areas of the semi-pelitic gneiss (7)	White — massive to weakly foliated, medium to pegmatitic grain size. biotite (0-3%) — cordierite (grey blue) — garnet (0-1%) — tourmaline (0-5%). Background: 4000 CPM
13	Foliated pink quartz monzonite to granite this rock type occurs as small stocks in the northern half of the region but forms very large area in the southern half of the region	Pink medium- to coarse-grained locally porphyritic massive to well foliated biotite (3-5%) — microline as medium- to coarse-grains (40-45%) — plagioclase as medium grains (15-20%). Background: 4000 - 9000 CPM
13a	Hybrid quartz monzonite contains 5-40% brown hypersthene-bearing quartz monzonite (2). This rock type occurs randomly within unit 2a	Weathers white to rusty brown — pink on fresh surface to a pink and brown variegated pattern. Individual feldspars vary internally from a pink to brown colour. Background: 4000 - 9000 CPM
13b	Pink aplite this rock type outcrops along and north of the Seal River east of Shethanei Lake. The origin of this rock type is uncertain. It may represent a highlygranitized meta-arkose or a aplitic phase of the quartz monzonite (13). Inclusion blocks or remnants of a grey biotite granite gneiss occur sporadically	Translucent pink — fine- to medium-grained, lineated to weakly foliated. The lineation or foliation is defined by disseminated green to black amphibole or biotite plus magnetite. These minerals are sporadic in occurrence, therefore, the foliation is not always developed. Magnetite (0-1%) — hematite (1-2%) — m uch of the pink colour is due to hematite staining. The rock is actually a pale creamy pink where not stained byhematite feldspar (75%) — quartz (25%). Background: 2500 - 3500 CPM
13c	Biotite granite gneiss occurs mainly east of Caribou where it lies between areas of quartz monzonite (13 and 15) and the area of porphyritic diorite and granodiorite of the Seal River area	Pink and white — medium- to coarse-grained, appears to be a mixing phase of the pink quartz monzonite and the grey quartz monzonite gneiss (4a) and possibly the porphyritic diortite. Background: 3500 - 8500 CPM
14	Porphyritic quartz monzonite forms large bodies at Round Sand Lake and east and northeast of Caribou lake. At Round Sand Lake the porphyritic quartz monzonite is locally contaminated by the hypersthene-bearing quartz monzonite (2) locally producing a hybrid of the porphyritic quartz monzonite	Pink - coarsely porphyritic with local pegmatitic zones — phenocrysts from 1/2 cm to 2 cms in length — biotite (2-8%) coarse grained — microcline (45%) — plagioclase (25%) — quartz (20%). Background: 6000 - 15,000 CPM
15	Pegmatite occurs in the Shethanei Lake area, south of Shethanei Lake and to the east along and south of the Seal River. In these areas the pegmatites form mappable bodies occurring as thick sills and irregular-shaped bodies	Large books of muscovite and biotite. Background: 4500 CPM
A	Amphibolite occur within the grey quartz monzonite gneiss (4a) and also within the metasedimentary sequence at Nejanilini Lake. Also within an area of grey gneiss (3) south of Nejanilini Lake	Layered variety and more massive salt and pepper variety. Layered variety comprises diopside (10%) — hornblende (70%) — plagioclase (20%). White plagioclase-quartz granitic lit are also present. The salt-and-pepper refers to the texture and colour of the second type. it is medium- to coarse-grained. Amphiboles are equant habit — hornblende (60%) — plagioclase (40%)
B	Granodioritic biotite migmatite occurs in the northeast corner of the map-area along the shoreline of Hudsons Bay. These bodies occur mainly within an area of porphyritic quartz monzonite	Black and white layers. Alternating biotite-rich layers and feldspathic layers. This layering is intruded by pink quartz monzonite dykes and pegmatites. Biotite (10-15%) occurs with quartz and feldspar in layers 1 mm to several cms thick — hornblende (0-3%) — occurs in the biotite layers. Cream coloured layers are feldspar (75-80%) and quartz. Background: 1500 - 4000 CPM
C	Pebble-bearing quartzite occurs in the southeast corner of the area immediately southeast of Lofthouse Lake. This rock is very comparable to the rocks that outcrop in the area of Churchill	Grey — medium- to coarse-grained matrix containing rock fragments (5%) — potasium feldspar (10%) — quartz (80%) — hematite, steel grey and red (2%) — muscovite very fine-grained (3%). Concentrations of pebbles of buff quartz monzonite, pink granite, bull quartz, quartzite, siltstone in the grey matrix form lenses within the grey quartzite containing isolated pebbles. Background: 1500 - 2000 CPM

Mineralization

During the course of mapping, scintillometer readings using the TV-1 scintillometer and BGS-1 scintillometer were taken at most stations. The readings were taken on the T1 spectral band which registers the full spectrum of radiation. In areas of responses several times greater than background, readings were taken on the T2 spectral band which registers uranium and thorium. Background values for most of the rock types are listed in Table GS-1-1.

Only three areas displayed significant levels of radioactivity. These areas are indicated in Table GS-1-2.

TABLE GS-1-2

Occurrence	Mineralization suspected	Scintillometer Reading in CPM (Counts per Minute)	Rock Type Geologic Setting and radioactivity background	Location Long. and Lat.
1	Ur	T_1 — 50,000 to 90,000 T_2 — 2,900	Porphyritic granite to quartz monzonite (unit 15) — 9,000 to 14,000 CPM. Anomalous readings were in a pegmatitic phase of the quartz monzonite. The radioactivity occurs within two distinct fractures trending 023° and 192° spaced 3 to 4 metres apart	East of Caribou Lake 95° 15' 59° 21' 40"
2	Ur	T_1 — 55,000 - 60,000 T_2 — 850 - 1,500	Gossan zone containing pegmatite sills which have intruded meta-sedimentary sequence of quartzite, quartz meta-siltstone and muscovite-biotite schist	North shore of Shethanei Lake 97° 53' 58° 50'
3	Ur	T_1 — 40,000 T_2 — 700	Pegmatite contains gneissic inclusions in an area of aplite. CPM 4,000	South of Seal River and east of Shethanei Lake 97° 09' 58° 51' 30"

TABLE GS-1-2 Radioactivity measurements, Caribou Lake, Shethanei Lake, Seal River

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GS-2 REINDEER LAKE — SOUTHERN INDIAN LAKE
(Regional correlation programme)

(64G, 64F)

by W.D. McRitchie

Numerous field checks were made in the area between Reindeer Lake and Southern Indian Lake as part of the ongoing regional compilation and correlation programme (McRitchie, 1976). Information and samples were collected from lakes and rivers where landings could be made, using a De Haviland Beaver aircraft. The data was augmented by detailed shoreline traverses on the major lakes, and by recent (1968-69) 1:50 000 mapping throughout the eastern half of the Southern Indian Lake area (64G). Airborne magnetic maps were used to extrapolate and correlate between the major units. The resultant 1:250 000 preliminary compilation maps (1977M1 and M2) for 64F and 64G represent an advance over the previously available reconnaissance coverage (Gadd, 1948; McRitchie, 1976) in that the lithologies encountered have been traced and correlated on a regional basis from Saskatchewan to Southern Indian Lake. The major geologic trends are now better delineated and two new lithotectonic belts have been defined.

Both NTS areas are well suited to the short-term, (4-week) semi-reconnaissance spot sampling approach for the following reasons:

(a) the major lithologies are of limited number and widely differing composition;
(b) the major lithostratigraphic units are of regional extent;
(c) the magnetic signatures of the major units are sufficiently diagnostic that extrapolation of ground data using airborne magnetic maps can be conducted with a high degree of confidence;
(d) numerous lakes afford excellent access and reasonable exposure;
(e) the adjoining areas to the south and east are mapped at 1:50 000, thereby providing detailed relationships from which to extrapolate from;
(f) a major portion of both sheets is covered by a continuous blanket of superficial deposits, thereby substantially reducing the area from which data could be recovered, and the time needed to effect coverage.

General Geology

Three distinct lithotectonic belts can be recognized in the region (Figures GS-2-1, 2):
Wathaman (Chipewyan) batholith.
Reindeer Lake-Southern Indian Lake metasedimentary gneiss belt.
Lynn Lake greenstone belt.

WATHAMAN (CHIPEWYAN) BATHOLITH

The entire northern one-third of both map sheets is occupied by granitoid rocks of a major batholithic domain that can be traced west and correlated directly with the Wathaman "batholithic complex" in Saskatchewan (Lewry, 1976). In Manitoba, the pluton is widely exposed on Reindeer Lake but the outcrop frequency drops off considerably over most of the batholith. Continuity may be inferred from:

a) a limited fluctuation in the regionally prominent and relatively high airborne magnetic signature; and
b) a limited variation in composition from biotite and hornblende-bearing quartz monzonite on Reindeer Lake through hornblende monzonite near Kustra Lake, and hornblende/biotite granite on Big Sand Lake to quartz monzonite on Southern Indian Lake.

The texture is characteristically coarse-grained and porphyritic (2-4 cm) with alignment of feldspar blasts apparent only near the margins of the pluton. Late pink and white alaskitic quartz monzonite dykes occur throughout the pluton but are more prominent near the border zones which also tend to be more heterogeneous and contaminated with partially assimilated inclusions of the metasedimentary country rock. Within the batholith a large, distinctive regionally Z-folded body of ortho and clinopyroxene-bearing monzonite extends from Attridge Lake, north of the Katimiwi River, through the south end of Big Sand Lake to

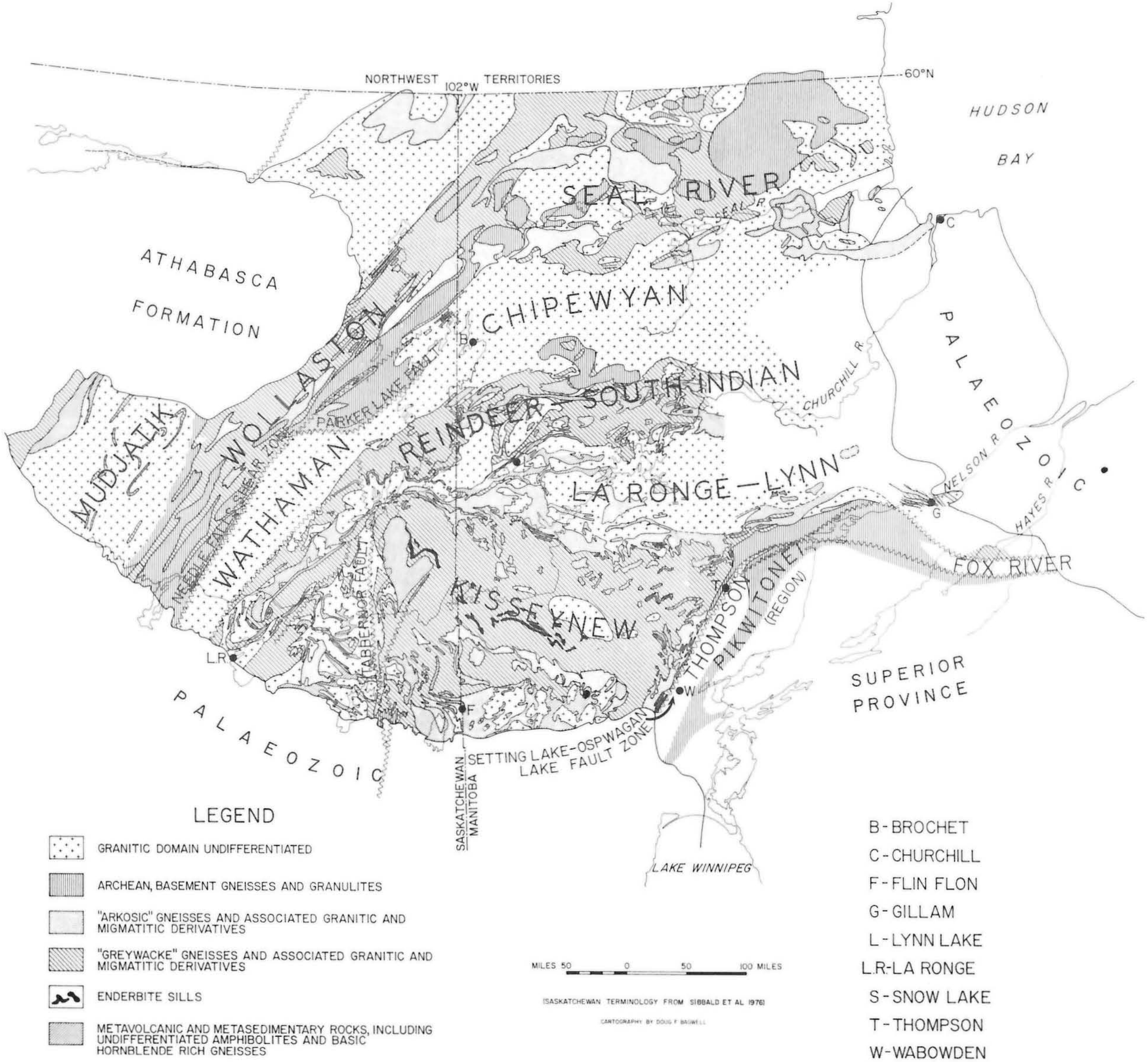

Figure GS-2-1 The Reindeer Lake-Southern Indian Lake Metasedimentary gneiss belt in relation to other major tectonic and lithostratigraphic units of the Churchill Structural Province in Northwest Manitoba and Saskatchewan

MacKerracher and Denison Lakes. The rock is characterized by euhedral and commonly unsieved brown feldspar, a strongly pleochroic orthopyroxene, clinopyroxene, hornblende and a generally fresh texture ranging from ophitic through inequigranular to coarsely porphyritic. Though generally monzonitic in composition (An^{35}) a unique potassium feldspar-free gabbroic phase (An^{65}) is prominent at the south end of Attridge Lake. The pyroxene monzonite is similar in texture and regionally homogeneity to the dominant rock type of the batholith and may represent a silica deficient-more ferromagnesian phase of the complex. Gradational relationships from pyroxene monzonite to porphyritic hornblende monzonite are well exposed on the lake north of Le Clair Lake.

Inclusions within the batholith are generally of dioritic composition and are limited to a few tens of metres in length. However, those north of Brochet, north of and on Jordan Lake, and on Big Sand Lake, are many kilometres in length and breadth and contain associated grey metasedimentary gneisses both as bodies and/or xenoliths. The latter two occurrences exhibit granulitic textures, greasy-green feldspars and enderbitic compositions, which may have resulted from contact metamorphism by the pyroxene monzonite complex.

REINDEER LAKE-SOUTHERN INDIAN LAKE METASEDIMENTARY GNEISS BELT

A 70 km wide belt of metasedimentary gneisses and migmatites lies to the south of the Wathaman Batholith. Two major lithologic groups identified in the region can be correlated directly with the arkosic Sickle "type" and greywacke Wasekwan "type" rocks mapped on Southern Indian Lake (Cranstone, 1972; Frohlinger, 1972; Thomas, 1972). Both groups show considerable variation in the range and degree of migmatitic derivatives; however, the contrasting magnetic signatures and mineralogies persist as diagnostic characteristics throughout the area and permit continuous delineation of the groups for 220 kms along the length of the belt from Paskwachi Bay to Southern Indian Lake.

The arkosic and greywacke gneisses exhibit a preferential distribution into three regionally persistent fold belts. From north to south these are referred to as the Eyrie, Le Clair and Enatik Lake fold belts (Figure GS-2-3).

The Eyrie Lake belt contains high grade garnet-cordierite and sillimanite-bearing greywacke derived gneisses and migmatites with variably abundant white leucocratic quartz monzonite and granodioritic mobilizate. The belt ranges up to 20 kms in width and is best exposed on Eyrie Lake where sporadic garnet anthophyllite and hornblende-rich lenses occur interlayered with tightly folded north dipping diatexitic and metatexitic metagreywackes. Graphite is prominent throughout, a feature which persists to the south into the other greywacke-bearing regions.

The *Le Clair Lake belt* of arkosic gneisses is marked by a prominent narrow 5 km wide "high magnetic-high relief" signature which persists from the Hughes River to south of MacKerracher Lake. To the east and west the magnetic ridge is broken up into a series of *en echelon* north-east trending keels 20-30 km in length and up to 15 kms in width. Similar yet more isolated keels of highly magnetic arkosic gneiss which occur in the Enatik greywacke belt to the south are interpreted as interference structures resulting from the imposition of the NE cross folds on the earlier E trending axes.

The composition of the pink and green weathering arkosic gneisses in the Le Clair belt varies widely yet all are characterized by the presence of hornblende, potassium feldspar, quartz, minor epidote and generally a significant amount of magnetite. Layering is well preserved on South Indian Lake where conglomerate layers are also reported within the arkosic group (Cranstone, 1972). In the Nutter Lake area the gneisses are thinly layered (20-30 cm) massive and more foliated beds. The contact with the adjacent greywacke units is generally sharp, conformable and the site of a calc-silicate-bearing unit with sporadic pyrite and pyrrhotite concentrations and local gossaning. To the west of the gneisses include rafted diatexitic and metatexitic derivatives of the arkosic group. Thinly layered (2-5 cm) units are prominent on Le Clair Lake, where the adjacent biotite and garnet-bearing greywackes exhibit layering on a similar scale. The thinly layered metatexite persists to the Hughes River. Westwards, metre thick white quartzite layers become prominent in rafted complexes with commonly dominant quartz monzonite.

The somewhat different facies of the Arkosic Group encountered on Paskwachi Bay (McRitchie, 1976; Wielezynski, 1976) are believed to represent relicts preserved in the next synclinal keel to the south of the main contact of the Le Clair belt.

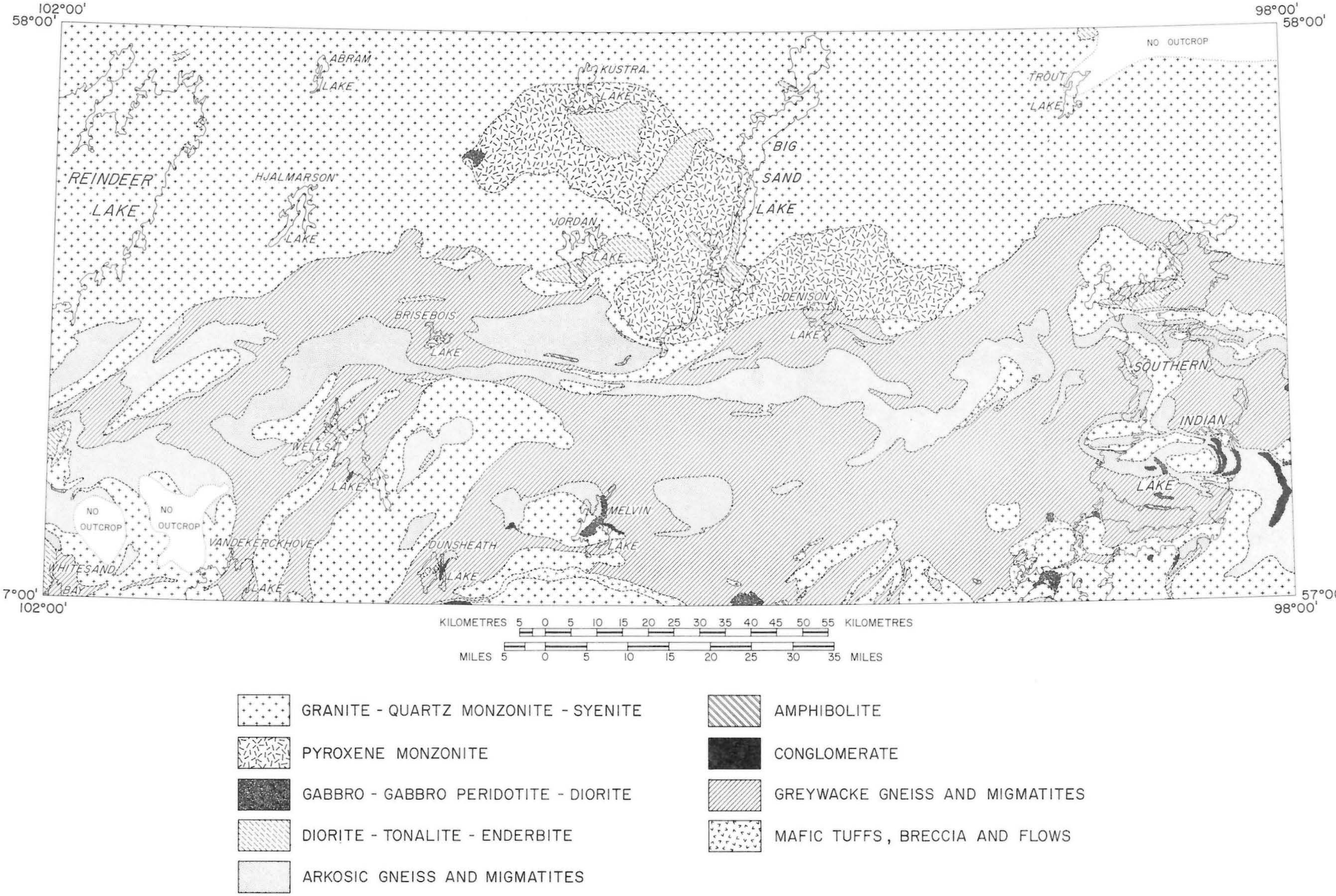

Figure GS-2-2 Outline geology of the Reindeer Lake-Southern Indian Lake region

The Enatik belt represents the broadest and diverse (40 km) section of the Reindeer Lake-Southern Indian Lake belt. The region is characterized by a relatively flat magnetic background signature (2200-2500 gammas) with isolated ellipsoidal and generally northeast trending magnetic highs (up to 3700 gammas). Greywacke derived gneisses and migmatites are widely exposed throughout the region and comprise the dominant paragneiss. They are generally well layered (20-100 cm); however, primary top criteria were not observed. Calc-silicates are developed sporadically and the greywacke is noticeably poor in garnet yet rich in graphite. A 100 metre thick conglomerate horizon was recorded on Dunsheath Lake at the contact with the arkosic gneisses which appear in a small structural outlier. The conglomerate is matrix-supported and contains clasts (2-20 cm) of rhyolite and dacite, and more rarely granite and metasediment. Carbonate veins are prominent, and the typical mineralology comprises hornblende, epidote, plagioclase and potassium feldspar, and quartz. The character and stratigraphic position of the conglomerate appears very similar to those encountered on Melvin and "Dino" Lakes (McRitchie, 1976) at the contact of an arkosic structural outlier 20 kms to the northeast.

Elsewhere in the belt arkosic gneisses were encountered in each of the elliptical aeromagnetic highs as major units or rafts in hornblende-bearing quartz monzonite, wherever exposure was available. Extrapolation to areas of no exposure could, therefore, be made with a fair degree of confidence. Magnetic highs less than 5 kms in size may be due to isolated keels of somewhat lower stratigraphic levels as evidenced by "transitional" calc-silicate units on Mulcahy Lake.

Intrusive Rocks

Major portions of the Enatik belt are occupied by large elliptical stocks of pink porphyritic quartz monzonite similar in many respects to some phases of the Wathaman (Chipewyan) batholith. In the Wells Lake region they are northeast trending and appear to control the distribution of the paragneisses.

Granite phases also occur throughout much of the area mapped as paragneisses. Typically those cutting and enveloping the greywacke gneisses are white and contain biotite and garnet ± graphite. Those associated with the arkosic gneisses are cream or pink coloured, equigranular and magnetite and hornblende-bearing. Compositions in both cases range from tonalite through granodiorite to quartz monzonite.

The boundary between the Enatik Lake belt and *Lynn Lake belt* is defined by the last/first appearance of metavolcanic rocks. South of Dunsheath and Melvin Lakes this is marked by the occurrence of a thin yet regionally persistent mafic tuff horizon (Syme, 1977). A single top determination in the greywackes to the north indicates tops away from the tuff horizon (Syme, pers. comm.) into the greywackes. An equally persistent conglomerate lies below and to the south of the tuffs between them and the main Lynn Lake greenstone occurrences. However, the more mafic clast composition and top indications stated above suggest that the conglomerate cannot be correlated with those found at the base of the arkosic gneisses in the structural outliers on Dunsheath, Melvin and "Dino" Lakes.

To the east the southern boundary of the Enatik Lake belt is less well defined, but may be inferred close to or just north of the MacBen Lake gabbro and the pillow basalts of "Pukatawagan Bay" on South Indian Lake (Frohlinger, 1972).

Structure

The major structural elements and lithologic belts strike east with northerly dips that range from moderate to steep. A sequence of early isoclinal, shallow, east and west plunging folds is observed in small-scale structures and can be inferred from the distribution of the major units. Most of the layering, bedding and early **lit-par-lit** granitic injections appear to be parallel to the axial planes of the early folds.

The main trend is prominently reoriented into a northeast direction, the axes of which are most pronounced in zones extending from Reindeer Lake to Wells Lake, and from McPherson Lake to Numakoos Lake. Elsewhere in the region the existence of the major Z cross folds can be inferred from local structural data and from reorientation of the airborne magnetic trends. The single most apparent major structure comprises the Z-folded distribution of the "Katimiwi pyroxene monzonite" along a northeast axis situated between Jordan and Big Sand Lakes. The imposition of the northeast plunging and trending folds on the early trending shallow plunging keels and ridges has resulted in the widespread development of discrete *en echelon*, northeast trending, canoe-shaped structures.

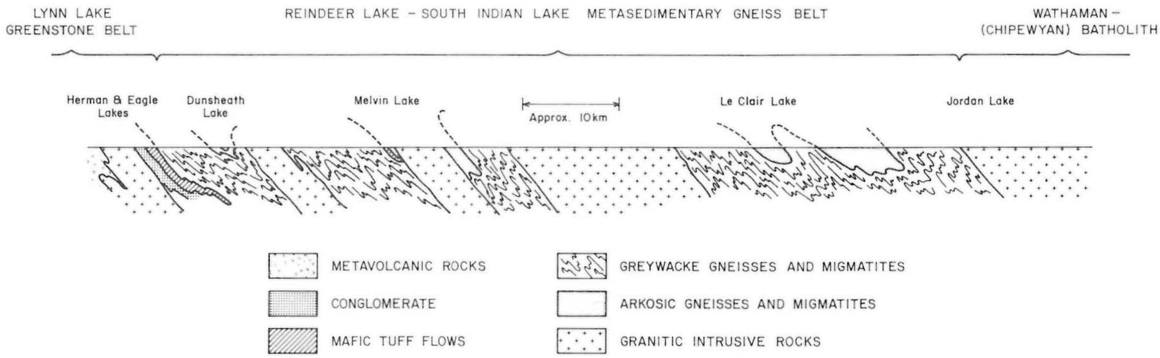

Figure GS-2-3 Sectional Cartoon across the Reindeer Lake-Southern Indian Lake metasedimentary gneiss belt showing the setting between the Lynn Lake greenstone belt and the Wathawan (Chipewyan) batholith

A single major east trending lineament with associated cataclasis and mylonitization strikes along Le Clair Lake and may be traced on ERTS images through Loon Narrows on Southern Indian Lake to Thorsteinson Lake. This is the only indication of major faulting observed in the region.

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GS-3 LYNN LAKE PROJECT

by H.V. Zwanzig

The main programme of geologic mapping for the Lynn Lake Project was completed by Gilbert, Syme and Zwanzig in the 1977 field season. The coverage extends from Laurie Lake (64C-12) northeast past Hughes Lake (64C-16) and south to Sickle Lake (64C-10). The entire Wasekwan Group of metavolcanic and metasedimentary rocks was examined only near the greenstones. A larger area was mapped by Keay where slender structural outliers of the Wasekwan rocks occur in the Sickle rocks at Eager Lake.

The major features of the plutonic rocks are retained from previous work. Local work was done on the Snake Lake Gabbro by Zwanzig and on two bodies of granitic rock by McGill. One of the plutons pre-dates the Sickle Group; the other intrudes the Sickle Group.

The new mapping supports the earlier finding that there are extensive lateral variations in the nature of the volcanic and sedimentary rocks along and across the greenstone belt. The stratigraphic divisions which were established in the Lynn Lake area (64C-14) can be only broadly correlated with the sequences at Sickle Lake and southest to Fox Mine. The rocks in the southern localities have been tentatively assigned to the lower and middle parts of the Wasekwan Group. Near Fox Mine there may be some of the oldest rocks in the region.

There is structural continuity along the southern belt of volcanic rocks from Cockeram Lake to Wilmot Lake in the common limb between a major anticline-syncline pair. This allows a tentative correlation of the rocks at Fox Mine with the lower part of the Wasekwan Group. The smaller belts of volcanic rocks near Sickle Lake are iterpreted as isoclinal folds, truncated by granitic rocks.

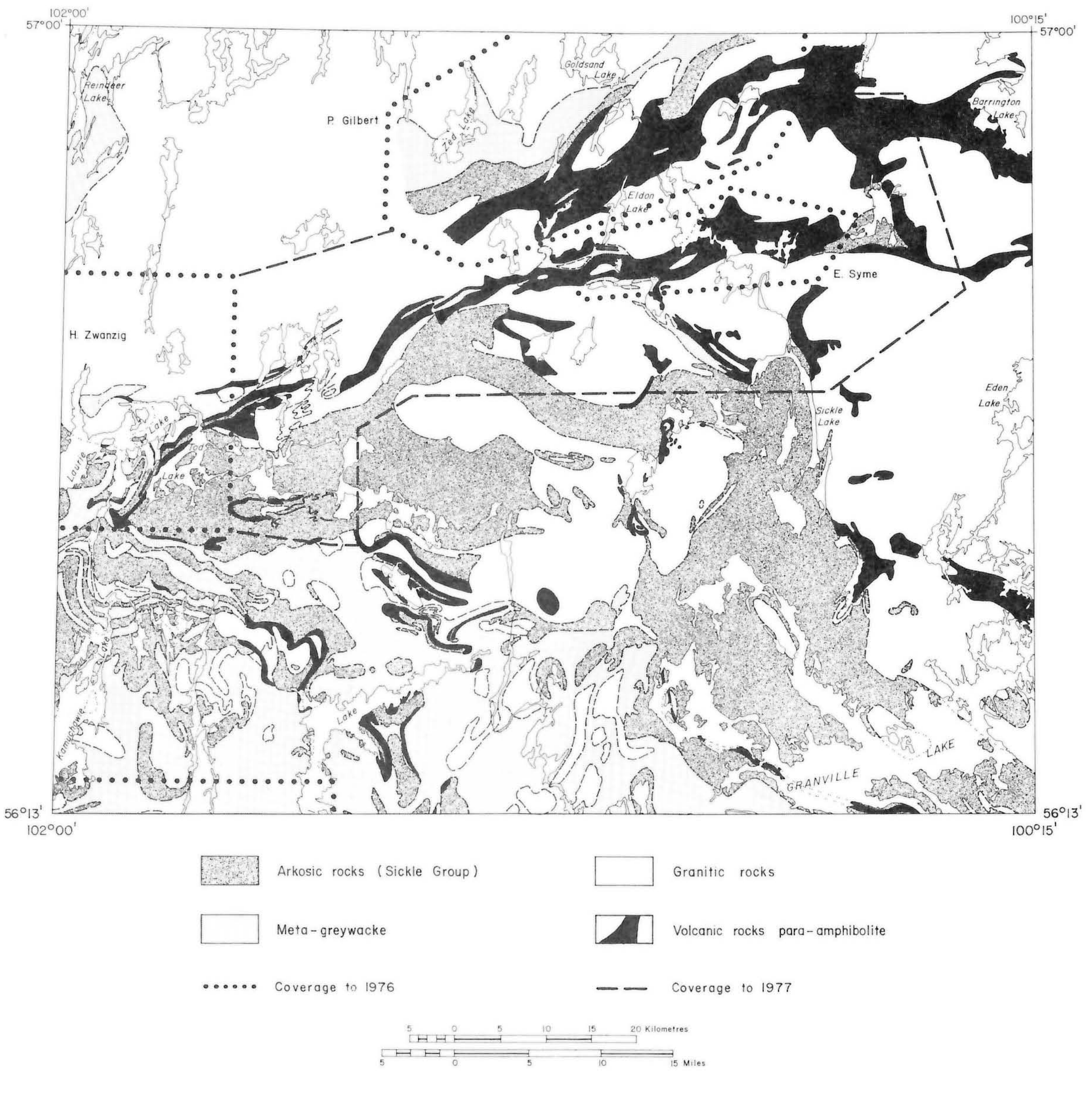

Figure GS-3-1 Lynn Lake Project: Outline and General Geology

GS-4 GEOLOGY OF THE FOX MINE AREA

(Parts of 64C-11 and 64C-12)

by H.V. Zwanzig

Introduction

Mapping was conducted from Hatchet Lake, east of Wilmot Lake and from Dunphy Lakes, south to Pyta Lake. Data was compiled at 1:20 000 in the field. Extensive use was made of Questor (1977) magnetic and INPUT maps to trace units in the drift-covered terrains. The maps of Stanton (1949), Oliver (1952) and Milligan (1960) were used to outline plutons in the north, and folds in the Sickle Group in the south.

I am very grateful for the pleasant and helpful co-operation of the Sherritt-Gordon staff, especially of Mr. P.E. Olson. He and Mr. G. Lustig of the University of Manitoba supplied much helpful information.

Summary

At Fox Mine the volcanic strata of the Wasekwan Group become thinner towards the west and a turbidite unit appears at the base of the group. The basal contact of the overlying Sickle Group changes from unconformable to disconformable.

The volcanic rocks and the underlying sediments are tentatively correlated with the lower part of the Wasekwan Group, Division A (Gilbert, 1976). However, a laterally persistent stratigraphic succession does not extend across the Fox Mine area. Instead, there is a series of sedimentary and volcanic facies-changes from Hatchet Lake, east of Wilmot Lake.

At Hatchet Lake the sedimentary rocks constitute a turbidite basin-facies of greywacke (Burntwood River Supergroup), and a more proximal, less pelitic, more mafic turbidite facies belonging to the Wasekwan Group. The two facies are in fault contact. The overlying volcanic rocks are aphyric pillow basalts that extend in a fault-sliver along the south shore of Dunphy Lakes.

At the site of Fox Mine a structureless sedimentary facies appears in thin units of volcanic sediments intercalated with flows, breccias and tuffs. South, and east of the mine, there are two main types of volcanic rocks: mafic porphyritic breccia with interlayered flows, and dacite or felsic-andesite flows with associated breccias and sediments.

Six kilometres east of the mine is the last thick turbidite deposit. It is a 2 km thick lense containing thick-bedded volcanic wacke, siltstones and resedimented volcanic conglomerates. The body was probably the head of a small turbidite apron. Near Wilmot Lake there remains only a thin unit of sediments associated with intermediate volcanic rocks. Most of the succession consists of mafic porphyritic breccia and flows.

Structure

Numerous, truncated units suggest that the central part of the Fox Mine area is a patchwork of fault-blocks. The tight folds within the blocks cannot be traced across the major faults. Lack of outcrop and lack of top indicators permit only a tentative structural interpretation of this complex terrain.

Pillow tops indicate an anticlinal structure south of Hatchet Lake (Figure GS-4-1). Graded beds and differentiated flows at "O.Z." Lake indicate another anticline there. It is cut off on the east by intrusive rocks and it is assumed to be separated from the pillow basalts on the west by a north-trending fault.

The thin sliver of Sickle rocks north of the mine is believed to be truncated against a fault on its southern contact. This fault may have several splay features, one of which extends through Hatchet Lake and joins the fault along Tod Lake (Zwanzig, 1976).

A synclinal axis, lying in mafic porphyritic breccia (unit 4) may pass through the northern end of Snake Lake but reliable top indicators are lacking. The only well documented fold is a large syncline along Highway 396, west, and north of Wilmot Lake. It serves as a basis for a stratigraphic interpretation of the area: its northern limb extends northeast into the south-facing panel of volcanics of Division A (Gilbert, 1976). A tentative correlation between these rocks and the main unit (4) of porphyritic volcanics would assign the entire succession of Wasekwan rocks to Division A.

Metamorphism

All rocks in the Fox Mine area are in the amphibolite facies and there is an increase in metamorphic grade from northeast to southwest.

Staurolite occurs north of Wilmot Lake but at Snake Lake and in the mine (Lustig, pers. comm.) staurolite occurs with sillimanite. At Hatchet Lake and south of the area at Eager Lake (Keay and Zwanzig, GS-5 this report) sillimanite occurs alone. These changes are part of the regional gradient at the north flank of the Kisseynew sedimentary gneisses.

Stratigraphy

The Burntwood River Supergroup of muscovite, biotite and sillimanite-bearing meta-greywackes are exposed locally at Hatchet Lake where they form the oldest rocks. They may be equivalent to the oldest part of the Wasekwan Group. Burntwood River meta-greywacke is distinguished from Wasekwan meta-greywacke by its higher content of pelite or the presence of muscovite and absence of hornblende.

No stratigraphic succession within the Wasekwan Group has been established to extend throughout the area. If the mafic porphyritic breccias and flows are correlated from McWhirter Lake to Wilmot Lake they overlie both greywacke and intermediate volcanic rocks. North of the mine thin units of similar porphyritic basalts overlie and are intercalated with pillow basalt.

The porphyritic basalt occurs in three belts:

1) northeast of McWhirter Lake;
2) south of Dunphy Lakes; and
3) along Wilmot Lake.

These belts can be correlated on lithologic similarities. These include composition, volcanic structures, types of phenocrysts and vesicularity. However, the unit (4) of porphyritic basalt, as well as the other units, are best regarded as a lithofacies.

The Sickle Group overlies various lithologies of the Wasekwan Group and makes a sharp angular contact with units north of Pyta Lake. There are probable faults along the contact but an angular unconformity is indicated. This relationship contrasts with the conformity or disconformity found at Tod Lake (Zwanzig, 1976).

The units within the Sickle Group are described by Keay and Zwanzig (GS-5 this report).

Lithology

In the Fox Mine area the lower part of the Wasekwan Group (Division A) is subdivided into four broad lithofacies:

1) volcanogenic greywacke, conglomerate and shaly siltstone;
2) aphyric pillowed and massive basalt;
3) intermediate flows, felsic to mafic breccia and tuff, and associated sedimentary rocks; and
4) mafic porphyritic flows and minor ultramafic rocks.

Metasedimentary Rocks

The metasedimentary rocks are made up of volcanic debris deposited as turbidites. They seem to occur near the base of the section exposed at Fox Mine and reach a maximum thickness of 2 km.

North of Hatchet Lake fine and medium-grained greywackes predominate. At "O.Z." Lake greywackes rich in hornblende are interlayered with volcanic rocks, apparently at the top of the sedimentary succession.

The best preserved wackes are exposed along Highway 396 where drab, grey-green volcanic wacke, buff and green hornblendic siltstone and local beds of matrix-supported conglomerate are interbedded to a thickness of 2 km. Bedding is often thick and massive. Gritty beds generally show coarse-tail grading and provide excellent top indicators facing southeast all along the road.

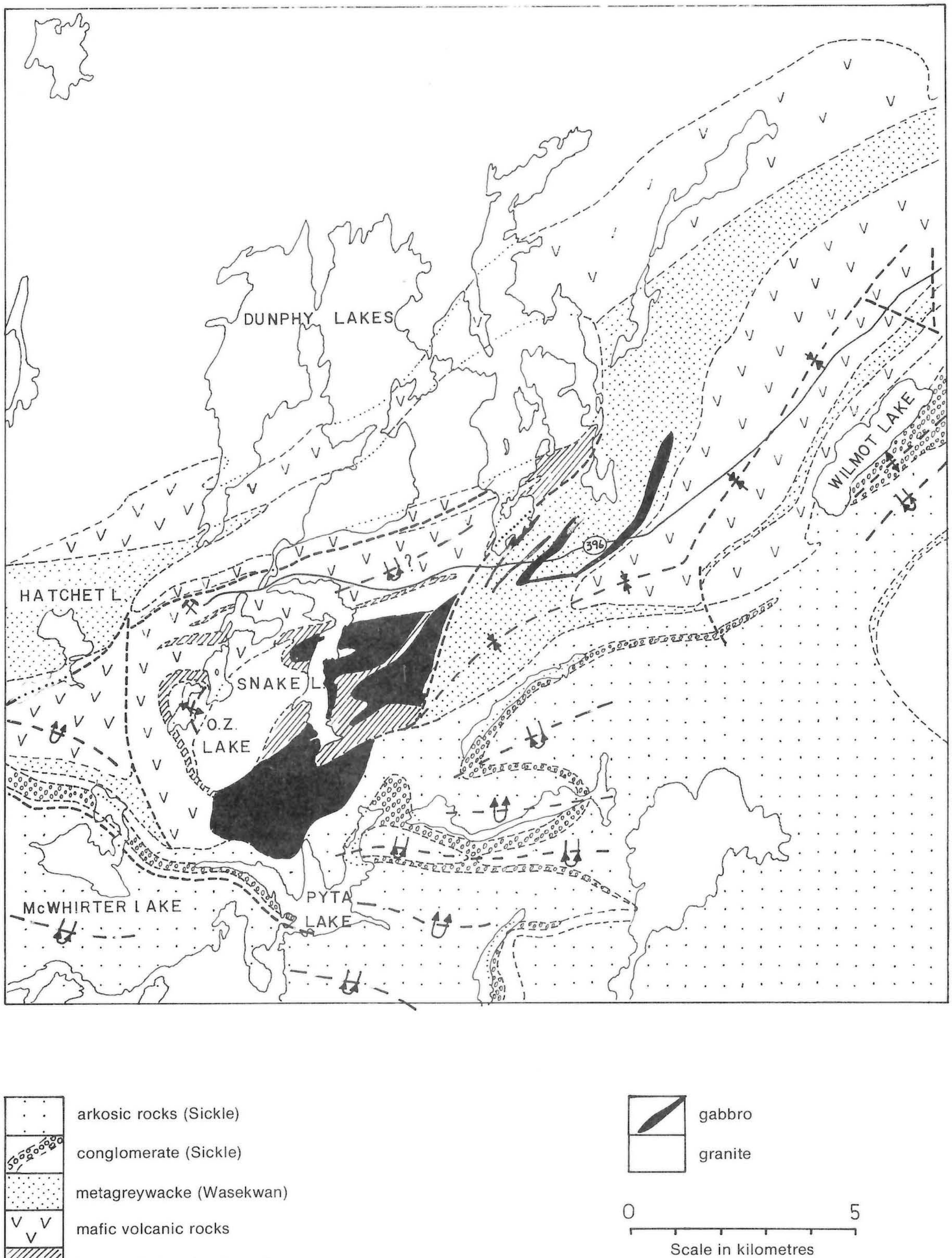

Figure GS-4-1 Geology of the Fox Mine Area

Bouma divisions start with (A) and commonly reach only the ripple laminated (C) division. Conglomerate beds are isolated turbidite units, 2 to 10 m thick. Clasts are mainly of volcanic origin. They are up to 10 cm long and one rip-up is over 1 m long. Massive and laminated siltstone commonly occurs as interbeds between greywacke in the upper half of the deposit. The top of the section is very rich in hornblende.

These proximal turbidites suggest that the Fox Mine area may have been the margin of a volcanic chain.

Pillow Basalt

A fine-grained meta-basalt consists of pillowed and massive, aphyric flows and local pillow breccia. These rocks were over 1 km thick south of Hatchet Lake, but south of Dunphy Lakes where pillows are highly stretched, they reach only 300 m. The basal contact is not exposed but cherty material between some pillows and a thin member of cherty sediment near the base of the unit are similar to some of the underlying sediments so that a natural contact is suggested. Pillow basalt is locally overlain by a thin mafic to ultramafic breccia or by Sickle meta-sandstone.

North of Fox Mine there are several 10 m flows of porphyritic basalt and south of the mine pillow flows and pillow breccias are intercalated with various mafic to felsic breccias. There are zones in which these rocks are altered to coarse-grained cordierite-anthophyllite schist.

Intermediate and Felsic Volcanic Rocks

Large bodies of grey and buff volcanic rocks surround parts of Snake Lake and lie southeast of Dunphy East Lake. Thinner deposits are west of Wilmot Lake and south of Fox Mine. The predominant rock type is a fine-grained massive flow which is very rich in plagioclase. It contains needles of amphibole partly replaced by biotite and generally has a strong linear or planar metamorphic fabric. The larger flows contain 1.5 mm phenocrysts of plagioclase and, locally, rounded quartz eyes.

Breccias which are associated with these flows are more heterolithic; they contain intermediate or felsic fragments in an intermediate to mafic matrix. Air-fill breccias and tuffs can be identified at the south tip of Dunphy East Lake and they may be common elsewhere. The (lower?) margins of the bodies at Snake Lake contain a tuff with scattered siliceous lapillae, about 5 cm in diameter.

At the northern half of Snake Lake the dacitic rocks are altered to a spectacular cordierite-anthophyllite schist. Large euhedral garnet, staurolite and small knots with sillimanite (?) or iron sulphides or magnetite occur locally. South of Snake Lake there is a layer of coarse-grained biotite schist with a considerable pyrrhotite content. It extends into a more mafic rock with sphalerite and galena.

Gossan zones, thin felsic layers and sediments occur along the stratigraphic extension of the intermediate to felsic bodies at Dunphy Lakes.

The thin unit of intermediate volcanic rocks southwest of "O.Z." Lake contains fine-grained grey dacite with zones of amygdales filled with quartz. The rock is ribbed with mafic material at the top of the unit.

The major proportion of felsic and intermediate rocks and all the thick flows are restricted to the fault block which contains Snake Lake and Fox Mine: there was probably a vent nearby. The most intensive alteration is restricted to this area and mineral showings are most common.

Porphyritic Basalt

The most common rock in the Fox Mine area is a mafic porphyritic breccia with intercalated mafic flows. The rock has a number of distinctive characteristics. It contains hornblende phenocrysts which have apparently replaced euhedral grains of pyroxene, commonly 5 mm in diameter. These crystals form cumulate layers locally. Breccias predominate over massive flows but they are commonly flow breccias. These are often amygdaloidal, locally with large gas cavities. A common but highly distinctive breccia contains irregular medium green fragments with amygdales and light alteration-rims in a mafic to ultramafic matrix. The matrix contains abundant hornblende (after pyroxene) phenocrysts or it contains green or brown fibrous amphibole. Similar rocks at Laurie Lake have over 10% MgO (Zwanzig, unpublished data).

There are some important differences in detailed lithology from one area to another. The belt northeast of McWhirter Lake contains the most ultramafic rocks. Near Pyta Lake there are differentiated flows with amygdaloidal tops and bottoms and a cumulate layer rich in hornblende (after pyroxene) at the base. The upper part is lighter coloured and may be andesite or basalt. Fragmentation of these flows has produced heterolithic breccias.

South of Dunphy Lake aphyric and porphyritic flows are interlayered in the north. Porphyritic flows are common in the south of the same outcrop belt, and breccias in the centre. Phenocrysts of feldspar occur locally and there are fewer hornblende phenocrysts than near McWhirter Lake.

North and west of Wilmot Lake the unit is over 2 km thick, and almost the entire succession consists of breccia. Flow breccia predominates at the base and layered breccia with 1 or 2 mm grains of feldspar, in addition to hornblende, occurs higher in the section. Some breccias may be laharic and these have a few interbeds of greywacke.

Blocks with intermediate compositions, as well as tuffs and interlayered flows, lie above the layered breccias.

Amphibolite

A belt of mafic volcanic amphibolite and mafic volcaniclastic rocks separates the southern pluton at Dunphy Lakes from the main batholith in the north. The amphibolite is sheared, often layered with veins and other felsic material.

Gabbro

The Snake Lake gabbro is a weakly foliated hypabyssal intrusion. It is generally uniformly medium-grained gabbro in the north but diabase and very fine-grained phases are common in the south. However, the gabbro is remarkably fresh, even where it intrudes the most highly altered intermediate volcanics. The rock was probably intruded after the local hydrothermal alteration.

Several thick sills north and northeast of the gabbro show a variation of lithologies ranging from diorite to hornblendite (after pyroxenite?).

Felsic Intrusions

The granitoid rocks are almost exclusively quartz diorite. Their cross-cutting contacts and some fine-grained and porphyritic textures suggest that they were intruded at a high level in the crust.

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GS-5 GEOLOGY OF THE EAGER LAKE AREA

(Parts of 64C-5, 64C-11, 64C-12)

by J.P. Keay and H.V. Zwanzig

Introduction

Mapping was conducted by J.P. Keay in a 130 km^2 area encompassing Eager and Murray Lakes and extending east of McGavock Lake. Data was collected at a scale of 1:20 000 with attention directed to the stratigraphy and structure.

Upper amphibolite facies metamorphism and migmatization have obscured primary sedimentary structures south of Eager Lake, therefore, much of the stratigraphic succession is based on mapping of slightly lower grade rocks at Tod Lake (Zwanzig, 1976) and at Pyta Lake by Zwanzig and Keay.

The area has been previously mapped by M.S. Stanton (1948).

Summary

Metasedimentary rocks and gneisses of the Sickle Group underlie most of the Eager Lake area. Greywackes of the Burntwood River Supergroup outcrop north and south of Murray Lake, and a thin amphibolite unit occurring south of Eager Lake has been equated with the Wasekwan Group. Folded granitic bodies outcropping along the east border of the map-area intrude the base of the succession.

The thin amphibolite unit has been interpreted to occupy the core of a very tightly appressed anticline which has been refolded about gently eastward plunging axes.

Structure

The Wasekwan Group amphibolite occupies the core of an attenuated, isoclinal fold. The isocline has been refolded into a large mushroom-shaped structure opening to the south. On the south shore of Eager Lake, the isocline is recumbent and the Sickle gneisses around the lake occupy the underlimb of the fold. Parasitic folding has produced repetitions in the overturned units. Minor folds and lineations plunge east at a very low angle.

Metamorphism

All rocks are in the upper amphibolite facies but there is an increase in metamorphic grade towards the south which is marked by the appearance of sillimanite faserkiesel in muscovite-bearing rocks rich in potash. The isograd trends east-west along the Laurie River and across Eager Lake. Pegmatitic veins appear in the affected rocks, generally a few hundred metres north of the first sillimanite. Granitic mobilizate constitutes as much as 50% of the rocks south of Murray Lake.

General Geology

A large east-west trending fold, south of Murray Lake, contains greywacke of the Burntwood River Supergroup in the core (Zwanzig and Wielezynski, 1975). The limbs of this fold contain a thin unit of amphibolite overlain by the Sickle Group. The amphibolite can be traced west to Laurie Lake and then northeast into pillow basalts of the Wasekwan Group (Zwanzig and Wielezynski, 1975; Zwanzig, 1976).

A narrow belt of meta-greywacke lies north of Murray Lake. It is flanked on one or both sides of the amphibolite unit that forms a completely folded layer within the large area underlain by Sickle Group gneisses. In many places, the amphibolite is separated from the pink-weathering gneisses of the Sickle Group by a thin unit of hornblende-bearing meta-greywacke and meta-conglomerate. The amphibolite is comprised of a complex succession of rocks including recrystallized felsic tuffs and ultramafic rocks identical to those of the Wasekwan Group at Laurie Lake (Zwanzig, 1976). Consequently, the succession: greywacke-amphibolite-conglomerate-pink gneiss at Eager Lake may be equated with rocks which are typical of the Burntwood River-Wasekwan and Sickle Groups. Moroever, the folded, narrow belts of greywacke and amphibolite are the cores of highly attenuated, early anticlines refolded within the Sickle gneisses.

The stratigraphic subdivision of the Sickle Group is based on information from scattered exposures near Pyta Lake, and on the mapping of Stanton (1948), to augment data from the better exposed but more highly metamorphosed terrain south of Eager Lake. There are three major Sickle units. Meta-greywacke with lenses of greywacke conglomerate is lowermost. It is overlain by micaceous sandstone or biotite-sillimanite gneiss containing two isolated lenses of arkosic conglomerate. The uppermost unit is a calcareous sandstone or hornblende-bearing gneiss which has an extensive conglomerate near the base.

The composite stratigraphic succession is given in Figure GS-5-1.

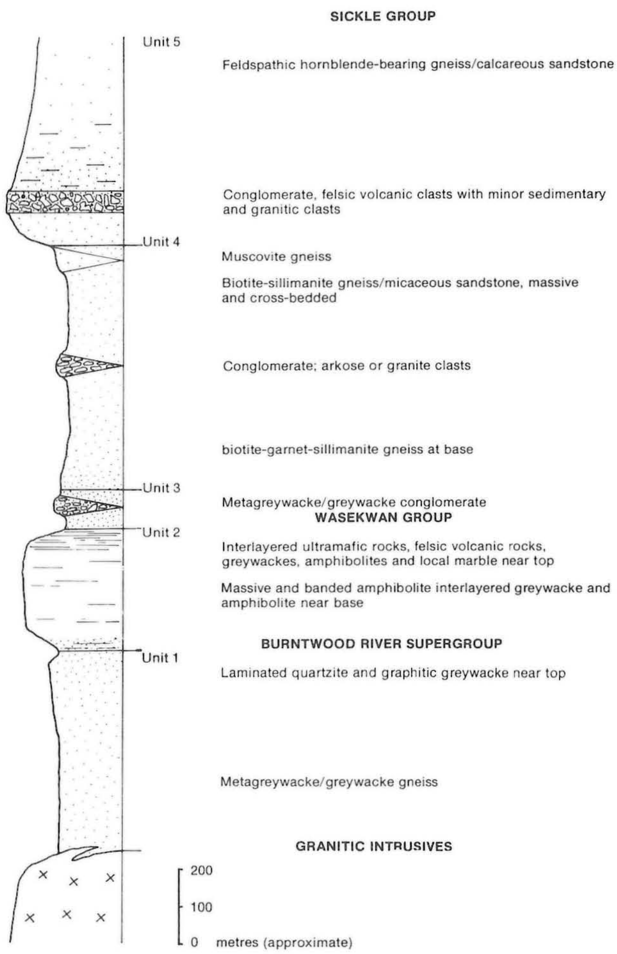

Figure GS-5-1 Stratigraphy, Eager Lake

Stratigraphy

Unit 1: Meta-greywacke (Burntwood River Supergroup)

In general, the rock is a grey to buff weathering, fine-grained biotite gneiss. Garnet, graphite and lensoid sillimanite-garnet-muscovite faserkiesel are present in minor amounts. It is locally migmatitic with white, coarse-grained granitic mobilizate constituting up to 50% of the rock.

A finely laminated quartzite horizon and disseminated sulphides define the top of the unit.

Unit 2: Amphibolite (Wasekwan Group)

Overlying the Burntwood greywackes is a 50-metre unit of massive to banded, locally garnetiferous amphibolite. The amphibolite is interlayered with biotite-hornblende greywacke at the base and felsic volcanic rocks, greywackes, ultramafic rocks, and local marble at the top. Individual layers rarely exceed 50 cm in thickness.

Unit 3: Meta-greywacke, Greywacke Conglomerate (Sickle Group)

A biotite-hornblende meta-greywacke with lenses of conglomerate constitutes the basal 100 metres of the Sickle Group south of Eager Lake. The conglomerate is an average of 20 metres thick, often with a sharp lower contact and a gradational upper boundary due to an upward increase in matrix. Greywacke pebbles and cobbles predominate over quartz and granite clasts. The greywacke matrix is rich in hornblende and biotite. Magnetite is a minor constituent.

At Pyta Lake the greywacke contains garnetiferous beds and hornblende is absent.

Unit 4: Biotite-Sillimanite Gneiss, Micaceous Sandstone, Conglomerate (Sickle Group)

The basal meta-greywacke or conglomerate is overlain by a pink-grey weathering, faserkiesel-bearing gneiss. North of Eager Lake the equivalent rock is a pale red or yellow, massive and cross-bedded sandstone. Pebble beds are present north of Pyta Lake.

The base of the unit is exposed in numerous places south of Eager Lake. It is a biotite-rich zone with magnetite and red garnet as minor constituents.

A thin discontinuous zone of muscovite-rich feldspathic gneiss exposed northwest of Eager Lake may indicate the top of the unit.

Lenses of orthoconglomerate are exposed at two locations within the unit. In gneissic rocks along the Laurie River, west of Eager Lake, the conglomerate is comprised almost entirely of cobble-sized arkosic clasts. At Pyta Lake, in the micaceous sandstone, a similar deposit consists of abundant, rounded cobbles of granodiorite and rhyolite and well developed weathering rinds.

Unit 5: Feldspathic Hornblende-bearing Gneiss, Calcareous Sandstone, Volcanic Conglomerate

This distinctive gneiss represents the uppermost unit of the Sickle Group. The most common variety of the rock is characterized by 5 to 20 cm, green-weathering hornblende-epidote-rich layers alternating with 1 to 10 cm buff to pink weathering quartzofeldspathic layers. A poorly layered to massive, grey weathering variety outcrops north and west of Eager Lake. In this rock hornblende and epidote are present as indistinct layers and clasts. Fine-grained biotite is a common constituent and magnetite is normally present. On Pyta Lake the unit includes very fine-grained parallel and ripple-laminated beds with magnetite placers.

A conglomerate occurs near the base of the hornblende-bearing gneiss or sandstone. It consists of angular to rounded felsic volcanic clasts with fewer mafic volcanic, quartz, granitic and black, cherty, iron-rich clasts. The matrix is comprised of fine- to coarse-grained quartz, feldspar, hornblende and magnetite. Zones of epidote alteration are common.

The conglomerate extends from Tod Lake to Pyta Lake decreasing in thickness from 300 metres to 50 metres with clast size ranging from pebbles to boulders. A much finer-grained 1 to 10 metre thick layer extends along the Laurie River from Tod Lake to Eager Lake and can be traced east and west of Eager Lake.

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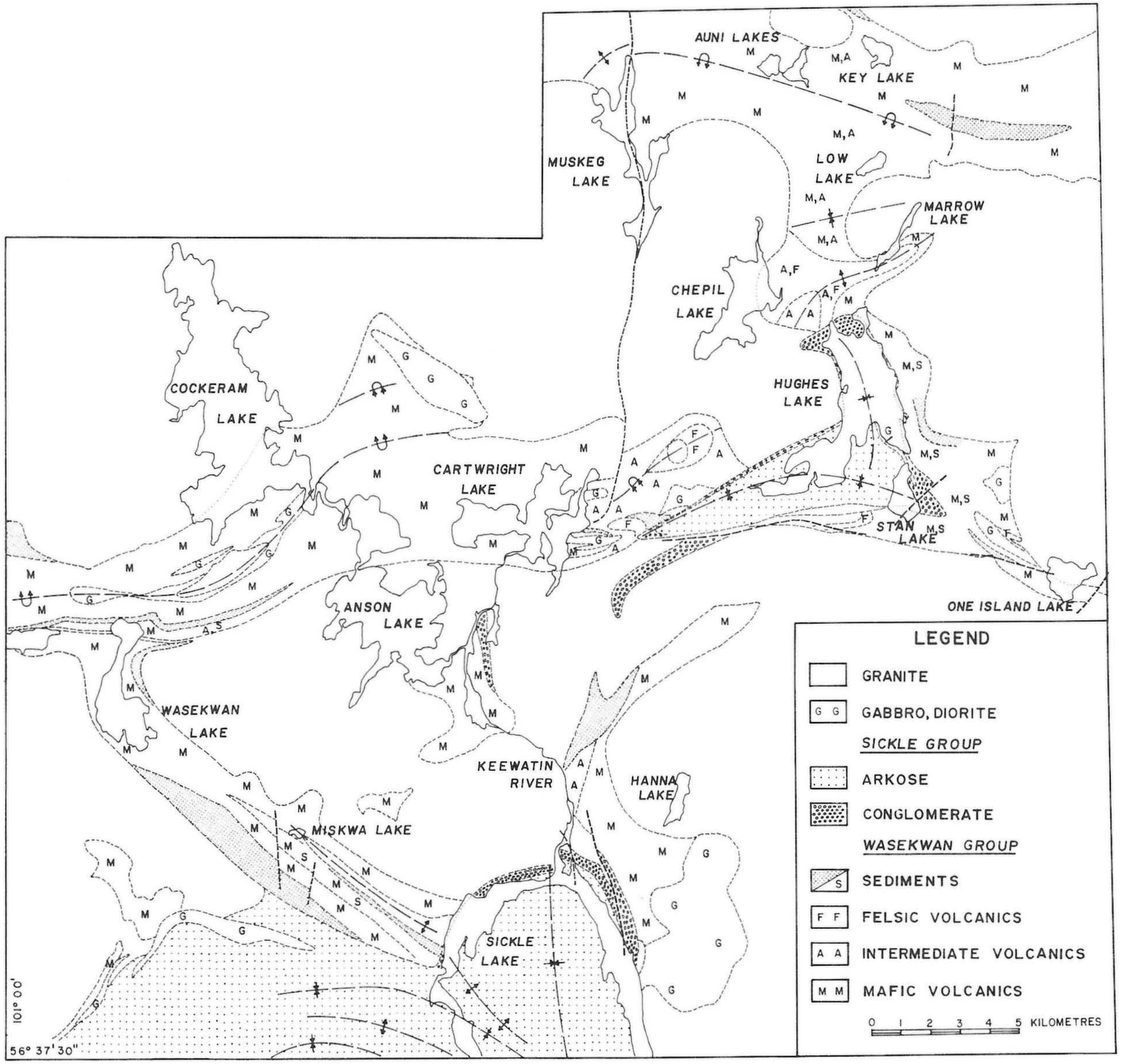

Figure GS-6-1 Generalized geological map of the Wasekwan Lake-Sickle Lake-Hughes Lake Area

GS-6 SICKLE LAKE-HUGHES LAKE AREA

(Parts of 64C-10, 15 and 16)

by Eric C. Syme

Introduction

Mapping at a scale of 1:20 000 was carried out in the Sickle Lake area (64C-10N) and Hughes Lake area (64C-15E and 64C-16W), extending coverage of the southern Lynn Lake greenstone belt to 40 km east of Lynn Lake. Attention was directed to the Wasekwan and Sickle Groups whereas details of the plutonic rocks are mainly retained after Milligan (1960).

Previous mapping (Gilbert and Syme, 1976; Syme and Gilbert, 1976) has outlined a sevenfold subdivision of the Wasekwan Group in the vicinity of Lynn Lake town. This stratigraphy can be extended only with difficulty to the Hughes Lake and Sickle Lake areas. The southeast-trending greenstone belt extending from Wasekwan Lake to Sickle Lake (herein referred to as the Miskwa Lake belt) is separated from the east-trending Cockeram Lake belt by a zone of shearing which can be traced along the southern margin of the metavolcanic terrain from the Hughes River to Franklin Lake. The band of greenstones extending from Sickle Lake to south of Hughes Lake (herein referred to as the Keewatin River belt) is cut off by granodiorite in the north and is not in structural continuity with the Hughes Lake belt. Lithologic units within the Miskwa Lake belt and Keewatin River belt generally bear little similarity to the units in the main southern belt and the stratigraphic subdivision in these areas must be considered preliminary.

MISKWA LAKE BELT

Structure

Bateman (1945) interpreted the Miskwa Lake portion of the McVeigh Lake area as a southwest-facing monoclinal structure, the southern limb of a major westward-plunging anticline whose axis passes through Franklin, Foster, and Wasekwan Lakes. He did not find any direct evidence of facing direction in the rock units.

The present mapping suggests that an anticlinal axis passes lengthwise through the centre of the belt, with the fold possibly cored by an elongate tonalite pluton. The porphyritic mafic flows and flow breccia forming the northern margin of the belt face northeast, whereas on the southwest side of the tonalite pluton one doubtful determination in mafic tuff indicates the beds face southwest. There is no lithologic similarity between limbs of the fold.

Wasekwan rock units and bedding attitudes at Sickle Lake are essentially at right angles to bedding attitudes in the Sickle Group conglomerate exposed on the shore of the lake. Such a relationship implies either a profound unconformity between the two groups or a fault contact. There is little evidence to suggest the presence of a major fault.

Stratigraphy

Stratigraphic subdivision of the Miskwa Lake belt is based on two tentative correlations:

1) The thick (600 m) siltstone unit southwest of Miskwa Lake is correlated with unit 4 greywacke and siltstone in the Lynn Lake area.
2) The porphyritic mafic flow-flow breccia unit forming the northern margin of the belt is correlated with unit 2 porphyritic mafic flow-flow breccia south of Eldon Lake.

Table GS-6-1 compares composite stratigraphic sections for the Miskwa Lake belt and Keewatin River belt.

The northeast-facing sequence of porphyritic mafic flows and flow breccia comprises a 730 m thick unit extending from the north end of Wasekwan Lake to the shore of Sickle Lake. A 10-50 m thick unit of thinly interlayered siltstone, mafic siltstone, and mafic flows exposed between Miskwa Lake and Sickle Lake splits the porphyritic mafic unit into upper and lower members. The lower member is comprised mainly of massive porphyritic flows: feldspar-phyric and feldspar + amphibole (after pyroxene) - phyric types. The upper member is comprised mainly of flow breccia, which locally grades abruptly to massive non-fragmental flow material. Fragments in the flow breccia are lensoid in shape, 4-40 cm long, porphyritic, and often vesicular or amygdaloidal. The matrix is darker in colour than the fragments, porphyritic, with few or no amygdales. Amphibole (after pyroxene) + feldspar-phyric and feldspar-phyric flow types are interlayered on a scale of several metres. A few differentiated flows, with cumulate, amphibole pseudomorph-rich basal zones, massive central zones, and flow-brecciated tops are present. In the Wiley Lakes area porphyritic flows are interlayered with aphyric flows.

TABLE GS-6-1

Stratigraphic sub-division of units in the Sickle Lake area

UNIT	MISKWA LAKE	MAXIMUM THICKNESS (m)	MAXIMUM THICKNESS (m)	KEEWATIN RIVER
4	Siliceous sediments, siltstone, arkose. Quartz diorite sills.	300?	760?	Greywacke, siltstone, pebble conglomerate. Minor mafic tuff.
	Siltstone (thin bedded to laminated), semi-pelitic laminae. *Minor* mafic tuff, massive mafic flows, massive felsic flows, crystal tuff.	600		
3	Mafic tuff, massive mafic flows; diorite, quartz diorite, granodiorite dykes and sills.	520	760	Feldspar-phyric intermediate flows, crystal tuff; minor mafic flows, mafic tuff.
			100	Siltstone, massive.
	Siltstone and mafic tuff, thinly layered to laminated. Minor mafic flows, sills. Minor siliceous siltstone, felsic volcanics.	370	50	Feldspar-phyric felsic volcanic.
			50	Laminated mafic tuff, massive mafic flows.
	Pyrite-bearing quartzite/chert, siltstone; massive basalt sills.	100		
			200	Interlayered feldspar-phyric intermediate flows, mafic flows.
			200	Siltstone, massive.
			600	Aphyric and feldspar-phyric intermediate and mafic flows.
			430	Mafic feldspar crystal tuff, pyroclastic breccia. Minor intermediate and mafic flows.
			0-1200	Mafic flows, feldspar-phyric intermediate-mafic flows; minor greywacke, siltstone.
2	Porphyritic mafic flow breccia, flows. Minor siltstone, mafic tuff.	430		
	Siltstone, mafic tuff, porphyritic mafic flows.	50		
	Laminated mafic tuff.	15		
	Porphyritic mafic flows, minor flow breccia. Porphyritic mafic dykes, sills.	150		

The northeast-facing porphyritic mafic unit is separated from the southeast-facing panel of rocks by an elongate tonalite-quartz diorite pluton. The body is 350-650 m wide and extends 5.5 km from Miskwa Lake to Sickle Lake. The plutonic rocks are usually strongly foliated and are locally gneissic.

Immediately southwest of the tonalite pluton are 100 m of siliceous sediments (quartzite?), siltstone and greywacke, intruded by aphyric basalt sills. Locally, pyrite-bearing white quartzite or chert occurs as 1-5 m thick units between massive mafic units, while in some localities the pyrite-bearing quartzitic rocks are clearly layered, and interlayered with micaceous siltstone.

A distinctive unit characterized by finely interlayered, laminated buff siltstone and dark green mafic material overlies the siliceous sediments. The siltstone-mafic tuff assemblage is locally interlayered with massive mafic flows and intruded by basaltic sills. It grades laterally (to the southwest) to an interlayered mafic flow, felsic volcanic, siltstone assemblage.

The main mafic unit in the southwest-facing fold limb is quite unlike the porphyritic mafic unit across the fold axis. The lower part of the 520 m thick unit comprises a mixed mafic metavolcanic-intrusive complex, in which aphyric massive mafic flows are heavily injected by dykes, sills, veins and irregular bodies of diorite and buff quartz diorite and tonalite. This passes abruptly to an upper 200 m finely layered grey-green and dark green mafic tuff. The layered tuff locally grades to massive material, and is interlayered with massive mafic flows.

Conformably overlying the mafic tuff are 600 m of thin bedded (2-15 cm) to laminated siltstone. The siltstone weather shades of buff and grey, and include micaceous, siliceous, semi-pelitic, and amphibolite-bearing beds. Apparently interlayered in the sedimentary sequence are minor felsic crystal tuff, massive felsic flow/intrusive material, rare massive mafic flows or sills, and quartz diorite sills. Finely interlayered siltstone and mafic material occurs near the top (SW) of the unit.

The top of the exposed volcano-sedimentary section at Miskwa Lake is represented by a few exposures of quartz-feldspar-rich siltstone, hornblende arkose, and light grey, siliceous gneiss.

KEEWATIN RIVER BELT

Structure

The Keewatin River belt forms an arcuate structure 12 km long, truncated at both ends by diorite and granodiorite. It is not in structural continuity with any part of the main Lynn Lake metavolcanic belt. No facing directions were determined, but it is assumed that the lithologies top westwards, towards the Sickle Group with which the metavolcanic rocks are in contact for 2 km. Unit within the belt have been wrapped around a large tonalite pluton centered south of Hughes Lake.

Stratigraphy

Two assumptions are required to fit the lithologic units (Table GS-6-1) into the established stratigraphy:

1) The thick greywacke-siltstone unit in the northwest part of the belt is correlated with unit 4 greywacke and siltstone.
2) The units comprise a west-facing, monoclinal structure.

Repetition of units by folding was not recognized within the belt.

The lower part of the Keewatin River belt comprises a sequence of massive mafic and intermediate flows, mafic crystal tuff and pyroclastic breccia, and massive siltstone. Units thicken to the southeast. Mafic flows weather dark green, and are fine-grained, aphyric to weakly feldspar-phyric. Intermediate flows weather brownish buff to greenish buff, with 0-15% .5-2 mm feldspar phenocrysts. A wedge-shaped unit of thickly interlayered mafic feldspar crystal tuff and oligomictic fragmental material is at least 430 m thick south of Hanna Lake, thinning northwest to less than 100 m east of the Keewatin River. The crystal tuff has layering from 2 mm to 1 m thick defined by varying proportions of feldspar crystals and a local delicate alternation of buff feldspathic material and more mafic, crystal-bearing layers. The fragmental material is most abundant in the thicker portion of the unit. Light grey weathering fragments are lensoid in section, 1 x 2 mm to 2 x 17 cm, fine-grained, phyric, with some small quartz amygdales. Matrix for the breccia is fine-grained, and weathers dark green. A crude stratification is defined by the size and abundance of fragments.

East of the Keewatin River three thin units separate the dominantly mafic lower portion of the sequence from an upper intermediate metavolcanic unit. The thin units are (1) delicately layered (1 mm - 2 cm) green-black weathering mafic tuff, locally interlayered with siliceous siltstone and massive mafic flows or sills, (2) feldspar-phyric, massive and fragmental felsic volcanic material, and (3) massive, featureless, buff weathering siltstone. The upper intermediate metavolcanic unit is wedge-shaped, 760 m thick at the Keewatin River and pinching out to the northeast. It comprises monotonous, brownish buff weathering, massive intermediate flows with 2-10% mm feldspar phenocrysts, and poorly layered crystal tuff of similar composition. Flows and tuffs are thickly interlayered and are often indistinguishable.

A unit of greywacke, siltstone, minor pebble conglomerate and mafic tuff comprising the northwest portion of the Keewatin River belt is tentatively correlated with unit 4 metasediments south of Lynn Lake. The greywackes weather light grey to buff, with extremely variable size and abundance of clastic feldspar and quartz. Layering (up to 50 cm thick) is defined by the grain size of the detrital components and interlayers of siltstone. Near the contact with the (presumably) underlying porphyritic intermediate metavolcanic rocks the greywackes locally contain up to 40% feldspar crystal detritus. Light buff weathering siltstone is often finely laminated, locally interlayered with layered mafic material or greywacke.

Although layering in the greywacke-siltstone unit is conformable with layering in the underlying crystal tuffs, the abrupt truncation of the intermediate volcanic unit may indicate an unconformable (erosional) relationship between the two units.

HUGHES LAKE AREA

Structure

Sickle Group conglomerate and arkose occupies a structural basin centered on Hughes Lake. Pillowed mafic flows east of Stan Lake face southwest, towards the Sickle Group, and along the east shore of Hughes Lake bedding attitudes in the two groups are conformable. Near the fold closures at the north end of Hughes Lake, and east of Cartwright Lake, Wasekwan lithologic units and bedding locally trend at a high angle to bedding in adjacent Sickle arkose.

North of Hughes Lake the Hughes Lake metavolcanic belt joins the northern Lynn Lake metavolcanic belt through a series of east-west trending folds. An easterly-trending anticlinal axis south of Auni Lakes is required to accomodate north-facing mafic flows and pyroclastic breccia exposed between Auni Lakes and Key Lake, and south-facing mafic tuff exposed at Muskeg Lake. Bedding attitudes and distribution of rock units suggest that there is a syncline-anticline pair between Low Lake and the north end of Hughes Lake.

A major east-west trending shear zone along the southern margin of the greenstone belt south of Hughes Lake can be traced as far west as Franklin Lake. South of Hughes Lake the shear zone is characterized by the development of a strong foliation, abundant sub-parallel rusty-weathering carbonate stringers, and tight folding of foliation and stringers. Granitic rocks within the shear zone contain a strong cataclastic foliation. Translational movement along the shear zone appears to be negligible, although a Wasekwan siltstone unit and Sickle conglomerate appear to be cut off where they intersect the fault.

Stratigraphy

West of One Island Lake the following stratigraphy can be outlined:

A Lower mafic volcanic unit (at least 800 m): massive and pillowed mafic flows, mafic flow breccia and pyroclastic breccia, minor interlayered siltstone, pebble conglomerate, felsic flows.

B Felsic volcanic unit (approximately 270 m): amygdaloidal felsic flows capped by heterolithic felsic breccia.

C Gabbro sill-massive basalt complex (270 m).

D Upper mafic volcanic unit (200 m): massive mafic flows, capped by layered pyroclastic breccia, mafic tuff.

E Sedimentary unit (200 m): basal polymictic pebble conglomerate, layered and laminated amphibole-bearing siltstone, minor greywacke.

The sediment and felsic flow units pinch out to the northwest, so that east of Stan Lake the Lower and Upper mafic volcanic units merge to form one thick mafic section. East and southeast of Hughes Lake the Sickle Group rests disconformably on this section, which comprises 500-2000 m of mafic flows and breccias, interlayered with a significant proportion of massive siltstone, polymictic pebble conglomerate, mafic tuff, and heterolithic volcaniclastic material. The heterolithic cobble breccias form thick (up to at least 30 m) lenses rather than blanket deposits, and probably represent inter-flow volcanic mudflows (lahars).

North of Hughes Lake three broad lithologic subdivisions can be made:

(1) Intermediate volcaniclastics and flows. Exposed in the core of a fold (anticline?) east of Chepil Lake, this unit comprises crudely stratified, matrix supported breccias with minor interlayed amygdaloidal flows. The breccias contain sub-rounded to angular cobbles of several intermediate volcanic lithologies. The assemblage is interpreted as vent-facies laharic breccia, associated extrusive material, and possible some air-fall pyroclastic breccia.

(2) Interlayered intermediate and felsic flows. Between Chepil Lake and Marrow Lake aphyric and quartz-feldspar-phyric rhyolite flows are interlayered with aphyric and porphyritic intermediate flows and flow breccia. The massive, thick (20-30 m) rhyolites weather light buff to light greenish white and are often amugdaloidal.

(3) Intermediate to mafic flows, tuff, and pyroclastics; possibly equivalent to subdivisions A and D west of One Island Lake. This thick unit is folded about a southeast-trending anticlinal axis lying south of Auni Lakes. Between Auni Lakes and Key Lake aphyric, feldspar-phyric, and amphibole (after pyroxene)-phyric massive and pillowed mafic flows are locally interlayered with mafic feldspar crystal tuff and laminated mafic tuff. A 300 m thick unit of pyroclastic breccia south of Key Lake contains rounded vesicular andesitic bombs in a matrix of sub-angular, dense to finely vesicular andesite lapilli. North of Low Lake the flows are intermediate to mafic in composition, with the exception of one quartz-feldspar-phyric dacite stratum. The intermediate flows are almost all feldspar-phyric, often amygdaloidal, and locally grade to flow breccia. Layered feldspar crystal tuffs are exposed on the south limb of the anticline, south of Auni Lakes.

SICKLE GROUP

At Sickle Group and Hughes Lake the Sickle Group unconformably overlies tonalite, quartz diorite, and gabbro plutons, and Wasekwan metavolcanic and metasedimentary rocks. The base of the Sickle Group is marked by up to 540 m of polymictic pebble and cobble conglomerate, containing sub-rounded clasts of porphyritic felsic hypabyssal rocks, equigranular granodiorite and tonalite, mafic and felsic metavolcanics, a variety of metasediments, chert, iron formation, and epidosite. Relative abundance of the several clast lithologies is variable and does not reflect the composition of the underlying basement material. Massive sandstone lenses up to several metres thick occur within the conglomerate section.

Overlying the conglomerate is a thick sequence of arkosic sandstone, at least 3350 m at Sickle Lake. The sandstones weather light buff to light pink, and range from coarse silts to grit. Fine-grained (0.5 mm) sandstones are usually massive or thickly bedded, feldspar-rich, with a few isolated pebbles and sporadic fine planar or curviplanar dark grey laminae. Interlayered coarse sandstone (0.5-2 mm) are poorly sorted and contain up to 10% pebbles. Gritty, pebble-filled scours and thin conglomeratic lenses occur locally. Cross-bedding occurs rarely throughout the section but is common only at a level approximately 400 m above the top of the conglomerate.

METAMORPHISM

Wasekwan group rocks contain upper greenchist to lower amphibolite grade assemblages characterized by ubiquitous green-black amphibole, biotite, and extremely rare garnet. Sickle Group arkose at Hughes Lake and the northern part of Sickle Lake contains feldspars, quartz, and micas, indicating (at most) lower amphibolite grade.

East of Hughes Lake are widespread zones in which all the Wasekwan lithologies contain abundant acicular amphibolite blasts, locally masking primary textures and composition. Epidote segregations (epidote + amphibole + quartz) are widely developed in intermediate and mafic flows in the Hughes Lake area and in the Keewatin River belt; they are present but not as abundant in the Miskwa Lake belt.

Retrograde chlorite-biotite assemblages are developed within the carbonate-injected shear zone south of Hughes Lake.

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GS-7 LYNN LAKE AREA

(Arbour Lake Project)

(Parts of 64C-11, 14 and 15)

by H. Paul Gilbert

Introduction

Mapping was conducted at a scale of 1/2 mile = 1 inch in the northern parts of the Cockeram Lake (64C-15), and McGavock Lake areas (64C-11). This represented an extension to previous field work which was concentrated in the Lynn Lake area (Gilbert, 1976). Some work was also undertaken in the latter area. The mapping focussed primarily on the volcano-sedimentary sequence; contacts with the larger intrusions on the preliminary maps (1977L-3, 4 and 5) are based partly on earlier publications (Milligan, 1960; Emslie & Moore, 1961). Some attention was directed to the granitoid intrusion at Berge Lake and Pool Lake; an investigation of these intrustions is in progress by B. McGill, who was also responsible for some mapping in the northern part of the McGavock Lake area.

The main results of the field work are as follows:

1. The stratigraphy established in the Lynn Lake area (see Gilbert, 1976) is extended northeastwards to the northeast part of the Cockeram Lake area; information derived from the Questor INPUT surveys (1976 & 1977) and cancelled assessment files has been incorporated in the mapping (Preliminary Map 1977L-5).
2. Lower Wasekwan mafic volcanic rocks in the southern part of the Lynn Lake area are laterally continuous southwestwards with a sequence comprised largely of mafic to intermediate flows and breccias, with a central subdivision of fine-grained sediments and subordinate conglomerate.
3. The Sickle Group rests unconformably on Wasekwan strata in the vicinity of Gemmell Lake, with the basal conglomerate overstepping a contact between mafic volcanics and a pre-Sickle quartz diorite, and truncating two subdivisions of the lower Wasekwan.
4. A unit of fine-grained semipelitic rocks occurs between upper Wasekwan mafic volcanics and the Sickle conglomerate north of Motriuk Lake (Figure GS-7-1). The age of these rocks in uncertain, but they are provisionally classified as Sickle. Similar sediments and staurolite schist overlie Sickle conglomerate at Gemmell Lake. These metasediments are atypical for the Sickle Group, which is generally more arkosic.
5. Tight folding is locally characteristic in the vicinity of the Sickle/Wasekwan contact — e.g. structural enclaves of Wasekwan rocks within the Sickle (and probably vice-versa) in the Gemmell Lake area.

Cockeram Lake Area (64C-15) — northern part

The stratigraphy previously defined in the Lynn Lake area (Gilbert, 1976 and Table GS-7-1) may be extended northeastwards to Hughes River, utilizing iron formations and associated aeromagnetic anomalies revealed by the Questor INPUT surveys flown in 1976 and 1977 (Figure GS-7-2 and GS-7-4). Two east-northeast trending magnetiferous zones occur in the area south and east of Dot Lake. A thin (1 metre) iron formation (black-magnetiferous, and white-chert) outcrops within the northern zone; fragments of magnetiferous chert occur in a volcanic breccia at one outcrop within the southern zone. The northern iron formation may be correlated with a magnetiferous zone just north of Arbour Lake. The zone, which occurs between felsic volcanics and siliceous siltstone to the south, and mafic flows to the north, is characterized by interlayered amphibolite, chert and magnetite, associated with massive pyrite and pyrrhotite. Iron formations in the area between Arbour lake and Hughes River (located by Allan, 1948, replotted on Preliminary Map 1977L-5) are correlated with those extending between Dot and Arbour Lakes; in both areas the magnetiferous rocks occur within a mafic volcanic sequence, with up to 300 m of fine-grained sediments and conglomerate in discontinuous formations to the south. The mafic volcanics correlate with division C and the sediments with division B in the stratigraphic section at Lynn Lake (Table GS-7-1). The iron formations may be traced further east (with sporadic outcrops and associated magnetic anomalies) from Hughes River to the area northeast of Auni Lakes. The sediments (division B)

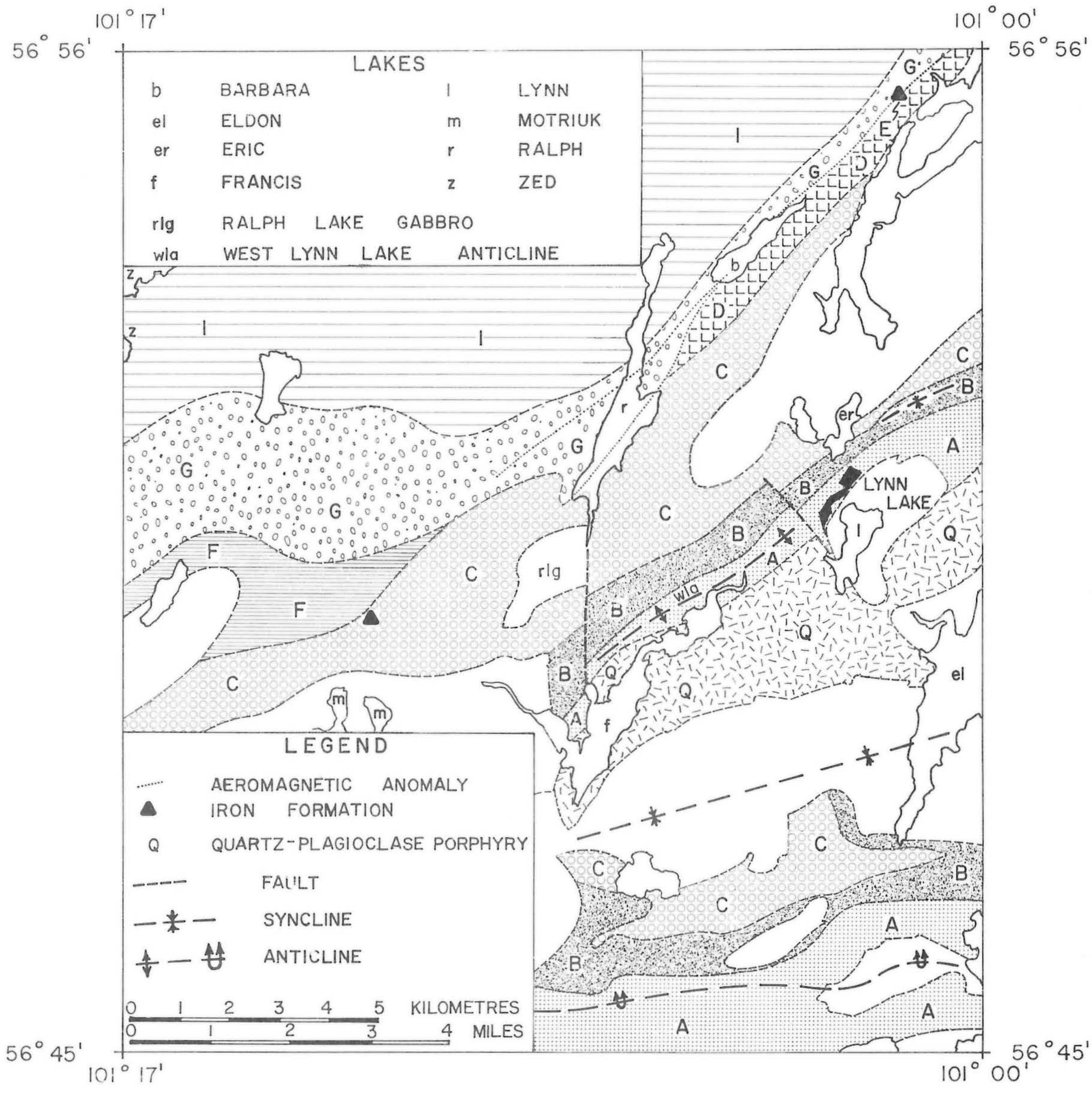

Figure GS-7-1 Geology of the Lynn Lake Area (64C-14); stratigraphic divisions (A to I) are described in Table GS-7-1; intrusive rocks are not patterned

cannot be reliably mapped east of Hughes River since outcrop is poor; however, sporadic occurrences of magnetiferous, fine-grained sediments occur south of Bob Lake (Allan, 1948) and northeast of Pill Lake (cancelled assessment data). A metasedimentary suite of magnetite-rich argillaceous and quartzitic rocks occupies a stratigraphic position equivalent to division B in the area southeast of Key Lake approximately 16 km east of Arbour Lake (Stanton, 1948). South of Arbour Lake, remnants of division B strata may be recognized within the plutonic rocks.

Stratigraphic Summary

The stratigraphic sequence in the northern Cockeram Lake area is correlated with divisions A to D in the Lynn Lake area (Table GS-7-1). Features which distinguish the northern Cockeram Lake area from the section at Lynn Lake are as follows:

Division A — intermediate to mafic volcanic flows are predominant and the division displays less lithologic diversity. East of Minton Lake coarse volcanic breccias are absent and felsic volcanics rare. At least 200 m of intermediate to mafic tuffs occur at Muskey Lake; these rocks are laterally equivalent to mafic volcanic flows and breccias in the vicinity of Auni Lakes (see Syme, this report).

Division B — the division between Arbour Lake and Hughes River consists of alternating fine-grained sediments and conglomerate in a rhythmic turbidite-like sequence. North of Lynn Lake the sediments are predominately fine-grained, with conglomerate increasing southwestwards.

Division C — iron formations are locally well developed in the lower part of the division. These occur in two main zones, which together comprise at least four discrete units. The magnetiferous rocks occur either within the mafic volcanic sequence, at the interface between fine-grained sediments and mafic volcanics, or in association with felsic volcanic rocks. Mafic tuff interlayers within mafic volcanics, or in association with felsic volcanic rocks. Mafic tuff interlayers within the flows are well developed south of Dot Lake and west of Arbour Lake.

Structure

Structure is interpreted largely from top indicators in tuffs and fine-grained sediments; graded-bedding and rare rip-ups and turbiditic sequences are utilized for facing directions.

A northward-facing direction is indicated by graded tuffs and flow-contact in the volcanic division (C) extending from Dot Lake to the area north of Arbour Lake; however, an east-northeast-trending synclinal axis is recognized in sediments (division B) south of these volcanics (Figure GS-7-2). Local reversals indicate the sediments (B) are deformed in several tight folds, and the division is considered to separate the major volcanic divisions (A and C) in a northwestward-facing sequence. The discontinuity of the sedimentary division (e.g. south of Dot Lake) is interpreted as a primary feature, but may also represent structural closures. The structural model is also applicable to the sequence between Arbour Lake and Hughes River; a synclinal axis has also been mapped in the sediments (B) in that area. A northeast trending anticline between Muskeg and Bob Lakes is indicated by a southeast-facing top directions in the tuffs (A) at Muskeg Lake, and north-facing pillowed basalt in the vicinity of Bob Lake; a facies change is thus represented across the fold structure.

In order to correlate the stratigraphy north of Arbour Lake with the section south of the lake it is necessary to postulate a fold axis or a major dislocation across Arbour Lake in the area occupied by granitic rocks. A fold axis, which might correlate with the West Lynn Lake anticline in the area southwest of Lynn Lake (see Gilbert, 1976) may be interpreted from the aeromagnetic patterns south of Minton Lake (Figure GS-7-4).

Several faults intersecting the primary layering at high angles are interpreted from magnetic anomalies on the Questor INPUT maps; a north-northwest trending fault is indicated northwest of Bob Lake (Figure GS-7-4). A north-trending fault through Muskeg Lake is also indicated, with approximately 200 m right lateral displacement of the magnetic "high" associated with iron formation just north of the lake (Figure GS-7-4). (A right lateral displacement of 120 m is estimated on this fault in the Tulune Lake area by INCO — cancelled assessment data.)

Age	Division (stratigraphic sequence from A to H)	Lithologies	Thickness** (maximum, in metres)	Thickness (maximum, in metres)	Lithologies	Sub-division
uncertain	I	fine-grained semi-pelitic sediment and paragneiss; subordinate mafic volcanic unit at southern margin	5000*	260 (assuming synclinal structure at Gemmel Lake)	fine-grained semi-pelitic and minor psammitic sediments; coarse grained staurolite schist	
SICKLE	H			4270* /	arkosic wacke, feldspathic greywacke	
SICKLE	G //	conglomerate — mainly volcanogenic; sedimentary and granitoid clasts locally abundant	2650*	730*	conglomerate, minor fine-grained sediments	
uncertain	F	local development only: fine-grained semi-pelitic sediments, minor quartz-plagioclase porphyry with	900*			
uncertain	F	local development only: mafic volcanic interlayer	120 (approx.)			
uncertain	E	local development only: iron formation	80			
WASEKWAN	D	mafic tuff, basalt; minor pyroclastics and sediments	425			
WASEKWAN	C	mafic to intermediate flows and breccia; minor felsic extrusives, mafic tuff, and fine-grained sediments; contains iron formation northeast of Lynn Lake	2500			
WASEKWAN	B	fine-grained sediments, conglomerate; minor quartz-plagioclase porphyry, basalt, tuff	760			
	A	mafic to felsic flows and fragmental rocks; minor quartz-plagioclase porphyry and fine-grained sediments	1400	1370 (approx.)	mafic to intermediate flows and breccia; subordinate felsic volcanics and sediments	UPPER (VOLCANIC)
				430	fine-grained sediments, conglomerate, and minor felsic and mafic volcanics (includes coarse grained garnet schist at Boiley Lake)	MIDDLE (SEDIMENTARY)
				3	iron formation	
				300 (approx.)	mafic flows and breccia	LOWER VOLCANIC
	age uncertain (probably approximately contemporaneous with B)	quartz-plagioclase porphyry (with associated sediments and volcanic rocks in the upper part)	2400			

* thickness uncertain, probable structural repetition

** thicknesses based on sequence between Eldon Lake and Zed Lake

/ width of unit based on mapping of Milligan (1960); thickness of arkosic Sickle sediments south of Black Trout Lake estimated to be 3300 m (Syme, GS6, this report)

// note (a) classification of the conglomerate (G) as Sickle in the area north of the volcanic rocks at Lynn Lake is not a final interpretation; the stratigraphic and structural relationships between divisions G, I and the Wasekwan sequence (A to D) in the Lynn Lake area are not yet resolved (see Gilbert, 1976). (b) conglomerate (approx. 200 m) east of Wilmot Lake may be part of division H rather than G.

TABLE GS-7-1 Stratigraphy of the Wasekwan-Sickle Groups in the area between Wilmot Lake and Lynn Lake

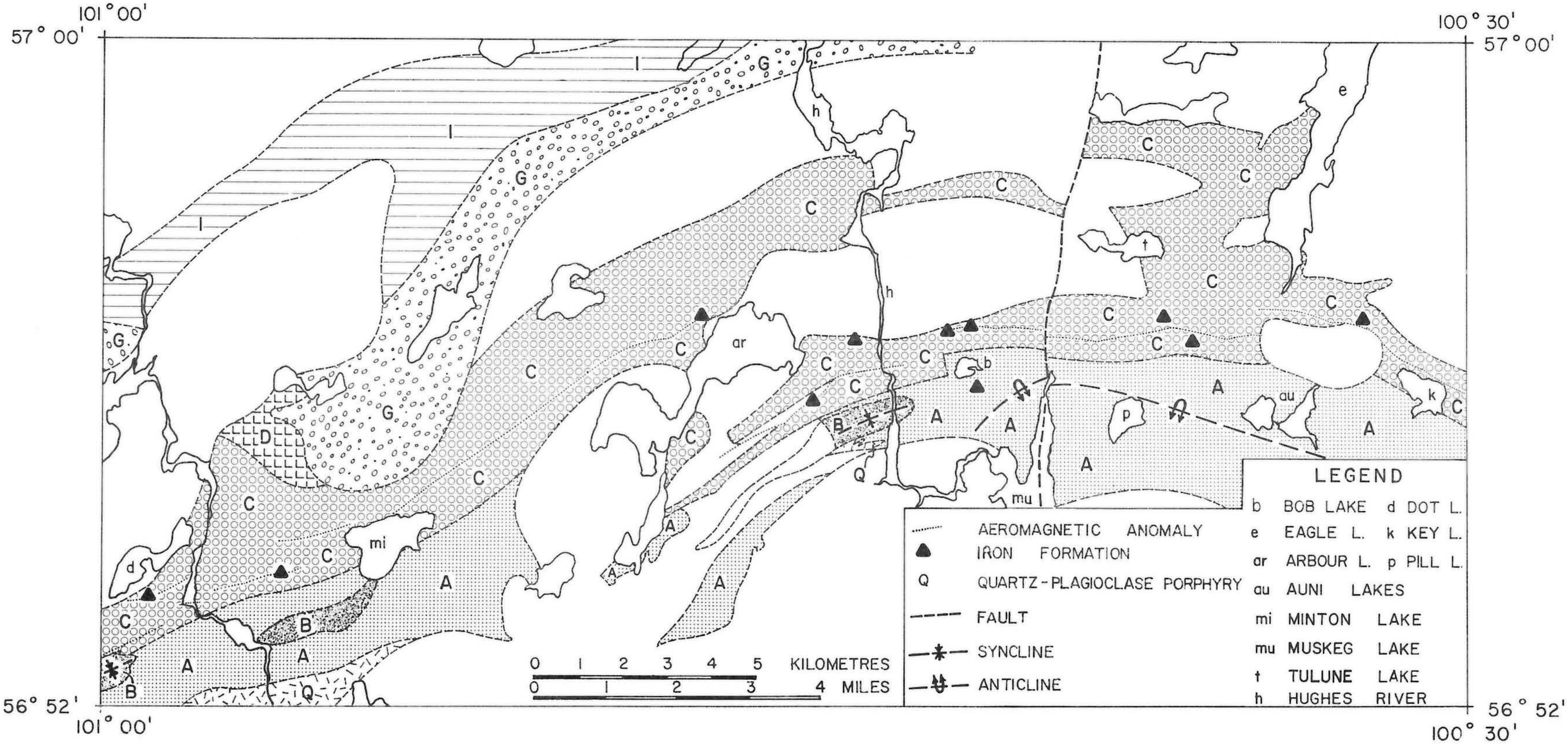

Figure GS-7-2 Geology of the Cockeram Lake Area (64C-15); stratigraphic divisions (A to I) are described in Table GS-7; intrusive rocks are not patterned

Lynn Lake Area (64C-14)

Additional information in this area (Preliminary Map 1977L-4 and Figure GS-7-1) is as follows:

1. A synclinal axis is mapped within sediments (division B, Table GS-7-1) east of Eric Lake.
2. Interlayered volcanic flows, tuffs and sediments immediately north of the west end of Frances Lake are re-interpreted as part of the largely sedimentary division (B); north of these rocks the volcanic division (C) is extended to the area immediately south of the Ralph Lake gabbro.
3. Fine-grained semipelitic sediments (division F, Table GS-7-1) occur between Wasekwan volcanics (C) and Sickle conglomerate (G) in the area north and northwest of Motriuk Lake. Fine-grained amphibolite (extrusive?) is interlayered with the sediments. A minor conglomerate lens within the sediments (F) may be an outlier of division G; the structure in the vicinity of the Wasekwan/Sickle contact is apparently complex with tight folding/or faulting indicated by the aeromagnetic pattern (Questor INPUT survey, 1976) which is correlated with the iron formation (division E) extending through Ralph and Barbara Lakes (Preliminary Map 1977L-4 and Figure GS-7-1).

Quartz-plagioclase porphyry intrusions are abundant in the sediments (F) north of Motriuk Lake. A magnetic anomaly at the contact with the volcanics (C) is associated with massive pyrite/pyrrhotite mineralization in a cherty aphanitic rock* overlain by mafic flows and breccia; and a porphyritic andesite flow with clots of magnetite up to 5 cm x 2 cm. Pillows in the flow, and the contact with an overlying bed of dislocated iron formation indicate the sequence faces south; however, the volcanic division (C) is considered to be essentially north-facing. Several felsic volcanic units are interlayered with mafic volcanic rocks south of the pillowed flow.

The age of the semipelitic sediments (F) is uncertain, but the division is assigned to the Sickle Group since the contact with the Sickle conglomerate (G) is apparently gradational (interlayered). The contact between the sediments (F) and volcanics (C) is not exposed. Division F is lithologically similar to the thick sequence of sediments (I) extending from Zed Lake to south of Goldsand Lake, which may be of Wasekwan age (see Gilbert, 1976). Division F is also similar to semipelitic rocks (I) in the vicinity of Gemmell Lake, which overlie the Sickle conglomerate (G). Lastly, divisions F and E may be of equivalent age, since a lateral transition from iron formation (E) to fine-grained sediments (F) may be interpreted in the area southwest of Ralph Lake (Figure GS-7-1).

McGavock Lake Area (64C-11) — northern part

Wasekwan Group:

(a) *Gemmell Lake-Wilmot Lake Area*

The lower volcanic division (A) is comprised largely of mafic flows and tuffs in the southern part of the Lynn Lake area (see Gilbert, 1976). These rocks are laterally continuous with a volcano-sedimentary sequence extending from the vicinity of Gemmell Lake to the area north and west of Wilmot Lake (Preliminary Map 1977L-3 and Figure GS-7-3). Three subdivisions are recognized within division (A) in the Gemmell-Wilmot Lake area (see Table GS-7-1). Division (A) is bounded to the south by younger granitoid rocks (chiefly hornblende quartz diorite and tonalite) extending from Franklin Lake to Pool Lake (Preliminary Map 1977L-3). The sequence between Gemmell and Wilmot Lakes is considered to face north on the basis of the possible synclinal structure at Gemmell Lake (see description of Sickle Group) and pillow-tops reported by Oliver (1952) east of Gemmell Lake.

Limited exposure of the lower volcanic subdivision between Wilmot and Gemmell Lakes consists of mafic flows and volcanic breccia; the uppermost lithology is a patchy, gneissic amphibolite with aggregates of graphite and possible clinopyroxene. The middle sedimentary subdivision north and northeast of Wilmot Lake consists of greywacke, siltstone and subordinate volcanogenic conglomerate; argillite, chert, amphibolite and felsic volcanics are minor components of this sequence. The upper volcanic subdivision is comprised largely of mafic to intermediate flows and volcanic breccia, with numerous minor sedimentary interlayers and intermediate to felsic volcanic units. The latter are generally massive, probably extrusive, but fragmental structures are locally displayed, and minor felsic porphyry intrusions

* Assay results of the massive sulphide (per cent): Cu .04, Ni .03, Zn .24, Pb .02; Au .01 oz./ton.

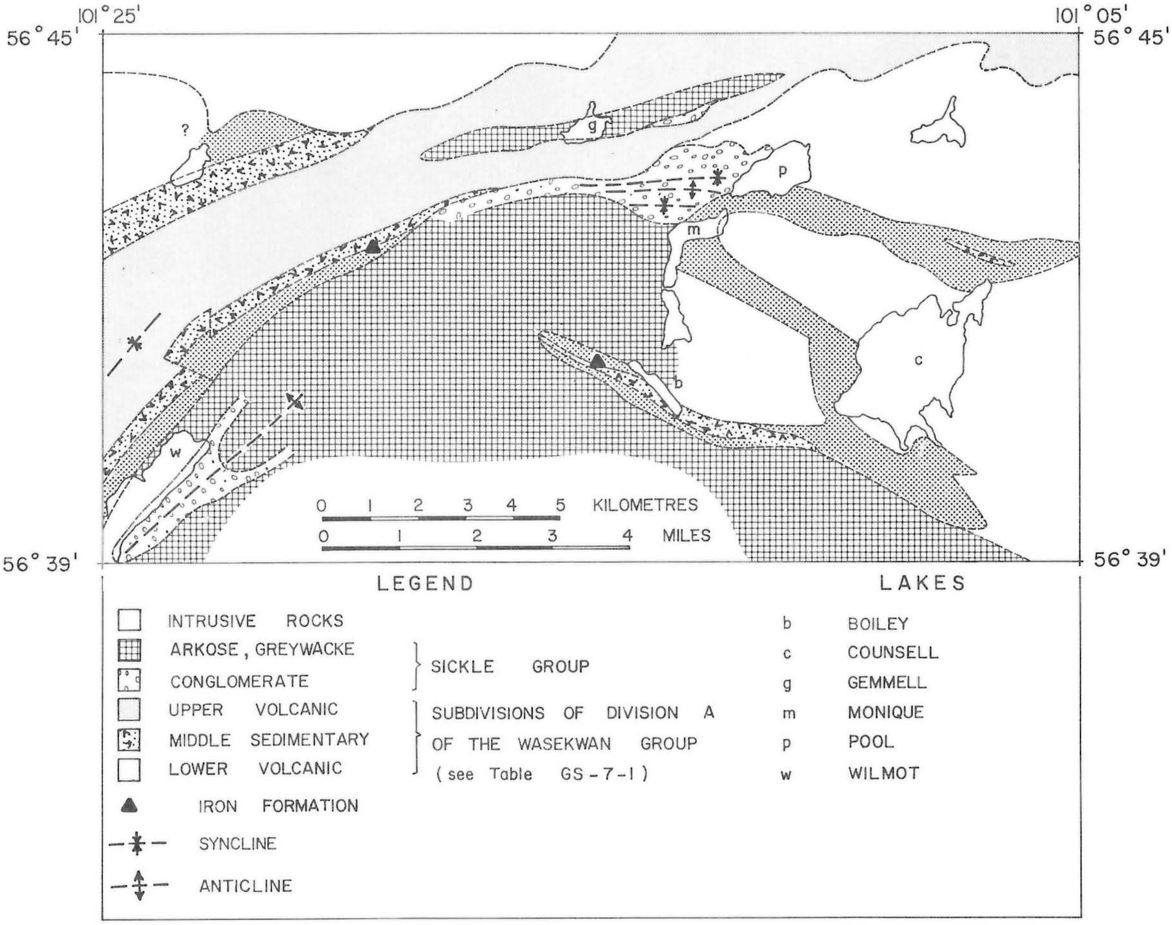

Figure GS-7-3 Geology of the Gemmell, Wilmot, Counsel Lake Area; intrusive rocks are not patterned

occur in some units. Several lensoid gabbros intrude the upper volcanic subdivision in the vicinity of Gemmell Lake (the largest is approximately 3.5 km long and 350 m thick). The age of the intrusions is uncertain; similar gabbros intrude Sickle sediments of division (1); the gabbros are slightly foliated and display chilled margins.

(b) *Pool Lake Area*

Volcanic rocks extending east-southeast from Pool Lake to the area north of Counsell Lake consist largely of mafic flows, with subordinate mafic tuffs and volcanic breccia. Felsic volcanic rocks, commonly with quartz phenocrysts, occur as minor interlayers, and comprise a unit approximately 160 m thick at the northern margin of the mafic rocks. Fine-grained sediments occur within the mafic volcanics north of Counsell Lake.

(c) *Boiley Lake Area*

A volcano-sedimentary belt passing through Boiley Lake extends at least 2 km east-southeast of the lake; these rocks are apparently conformable with a sequence of mafic volcanic flows, gabbro, and subordinate mafic tuff south of Counsell Lake (Preliminary map 1977L-3). A unit of fine-grained sediments and garnetiferous, locally magnetiferous schist and subordinate quartz porphyry occurs in the vicinity of Boiley Lake, flanked to the north and

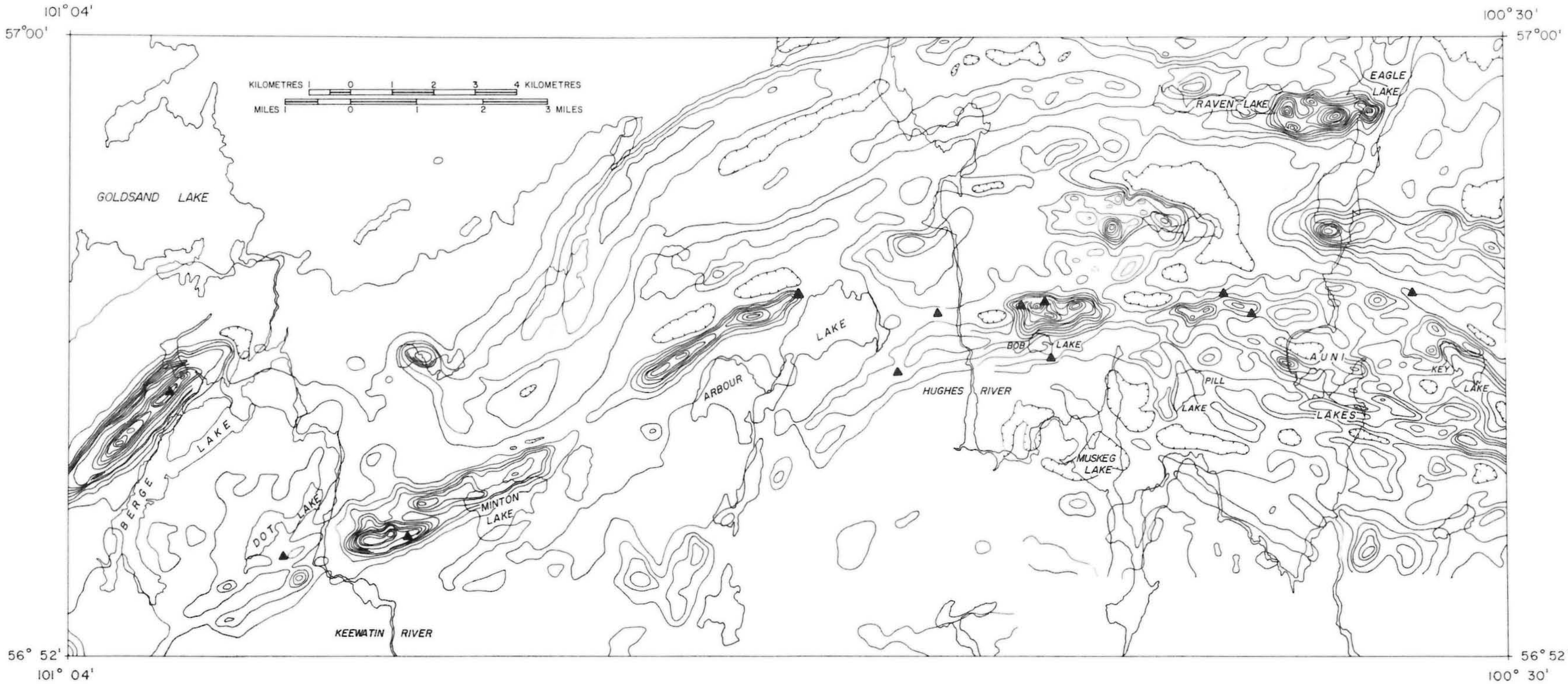

Figure GS-7-4 Aeromagnetic map of the Berge Lake, Eagle Lake Area, after Questor INPUT surveys 1976, 1977; (isogons drawn at 100 gamma intervals)

south by mafic volcanic rocks. Iron formation extends along the northern margin of the sediments and schist. The latter may be equivalent to the middle sedimentary subdivision (Table GS-7-1) which implies a synclinal structure extending east-southeast through Boiley Lake. The sediments and schists at Boiley Lake may be equivalent to similar garnetiferous rocks reported by Oliver (1952) in the area southeast of Story Lake.

Sickle Group

The contact between lower Wasekwan volcanics and granitoid rocks is overstepped by the Sickle conglomerate (G) between Pool and Gemmell Lakes; the conglomerate extends westwards from this area, with consequent truncation of the Wasekwan lower volcanic and middle sedimentary subdivisions. The wedge-shaped area of Sickle conglomerate (G) north of Monique Lake is gradational southwards to arkosic sediments (H); similar rocks occur as lensoid intercalations within the conglomerate. The fine-grained sediments display cross-bedding and grading, which indicate a tight fold pattern north of Monique Lake (Preliminary Map 1977L-3). A ribbon shaped inlier of Wasekwan mafic volcanic flows and breccia is preserved in the core of the anticline approximately 1 km south of Gemmell Lake. The contact between the northern margin of the inlier (A) and the conglomerate (G) is characterized by a bed of siltstone immediately overlain by conglomerate containing pebbles of quartz and subordinate quartz-plagioclase porphyry.

A lensoid body of semipelitic sediments and staurolite schist (division I), trending westerly through Gemmell Lake, occurs within an area of the upper volcanic subdivision of division (A). Graded-bedding in the sediments faces north 1 km east of Gemmell Lake, where these rocks are in gradational contact with cobble-conglomerate to the south. The conglomerate is characterized by a fine silty matrix containing the following clasts: mafic and felsic volcanic, quartz-plagioclase porphyry, greywacke, iron formation, tonalite and quartz. The semipelitic and conglomerate unit is interpreted as synclinal outlier of the Sickle Group. A fold is indicated by the distribution of conglomerate east of Wilmot Lake. A southeast-facing sequence south of this structure is based on the occurrence of arkosic sediments south of the conglomerate, which are correlated with similar rocks overlying the Sickle conglomerate at Pyta Lake (Keay and Zwanzig, GS-5, this report). The fold structure is interpreted as anticlinal on this basis; it follows that the conglomerate southeast of Wilmot Lake is underlain by pebbly, pink arkosic wacke (division H, Table GS-7-1) which occupies the core of the fold structure (Preliminary Map 1977L-3). West of Pool Lake, however, conglomerate (division G) is the basal Sickle unit; these rocks may be older than the conglomerate southeast of Wilmot Lake; the latter may be equivalent to conglomerate at Pyta Lake which is underlain by a basal sandstone with minor conglomerate (Keay and Zwanzig, GS-5, this report).

This correlation is supported by the presence of hornblende in the conglomerate (and overlying fine-grained sediments) southeast of Wilmot Lake, since this is also distinctive for the younger Sickle conglomerate (and arkosic wacke) at Pyta Lake; the lower Sickle units at Pyta Lake and west of Pool Lake are generally devoid of hornblende.

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GS-8 THOMPSON NICKEL BELT PROJECT

(Parts of 63P-13NE, 63P-14NW, 63P-12SW and 63O-9NE)

by R.F.J. Scoates, J.J. Macek and J.K. Russell

Geological examination of rocks on Moak and Ospwagan Lakes (Figure GS-8-1) was undertaken in 1977 as part of the Thompson Nickel Belt project. Mapping on Moak Lake continued the mapping begun last year on the Mystery Lake-Apussigamasi Lake area (Scoates, 1976; Weber and Scoates, 1976; and Weber, 1976). The examination of rocks on Ospwagan Lake complements the work of Stephenson (1974) and permits the collection of further information from this area prior to completion of the Churchill River diversion project and consequent inundation of excellent shoreline exposures.

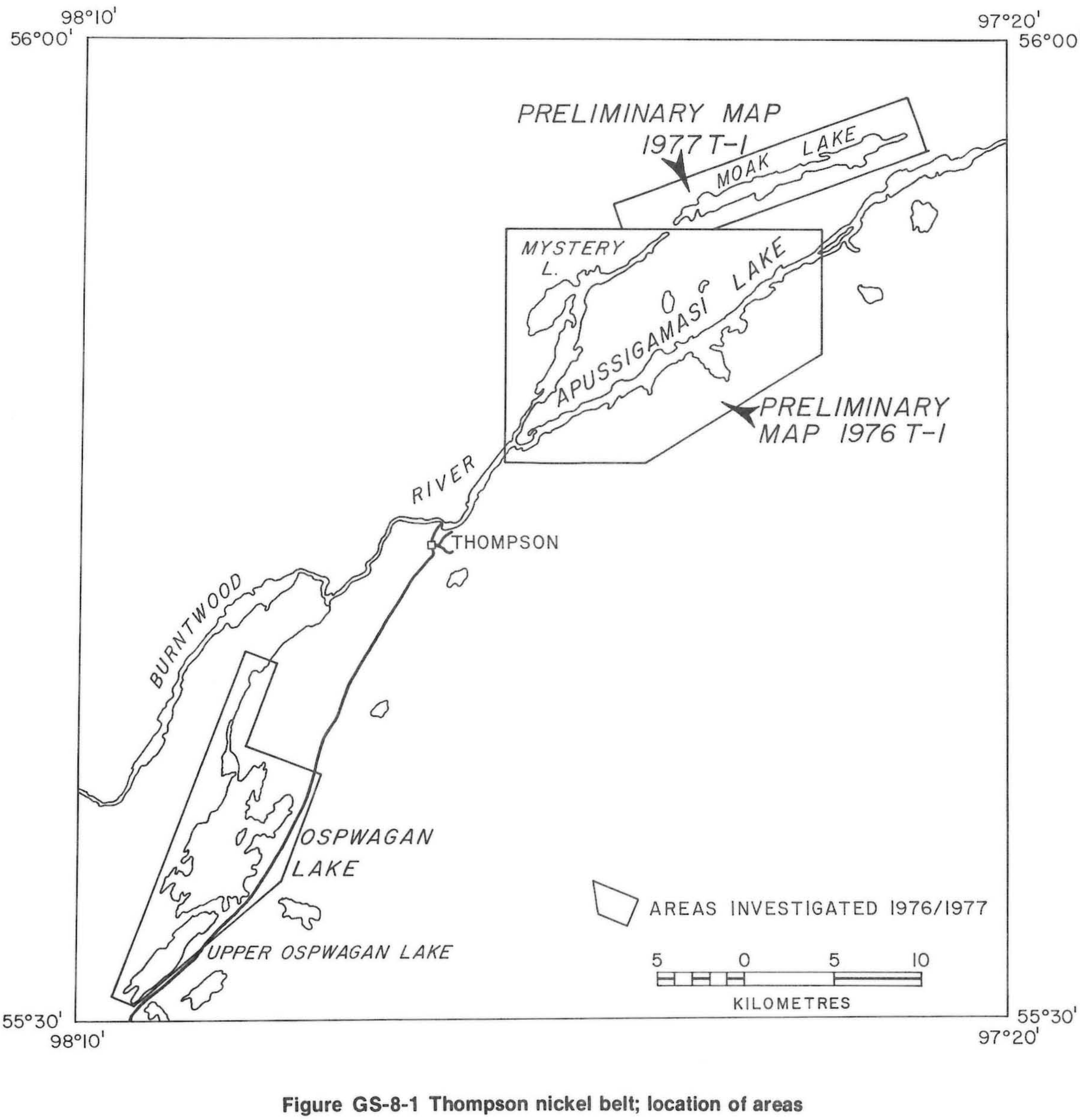

Figure GS-8-1 Thompson nickel belt; location of areas

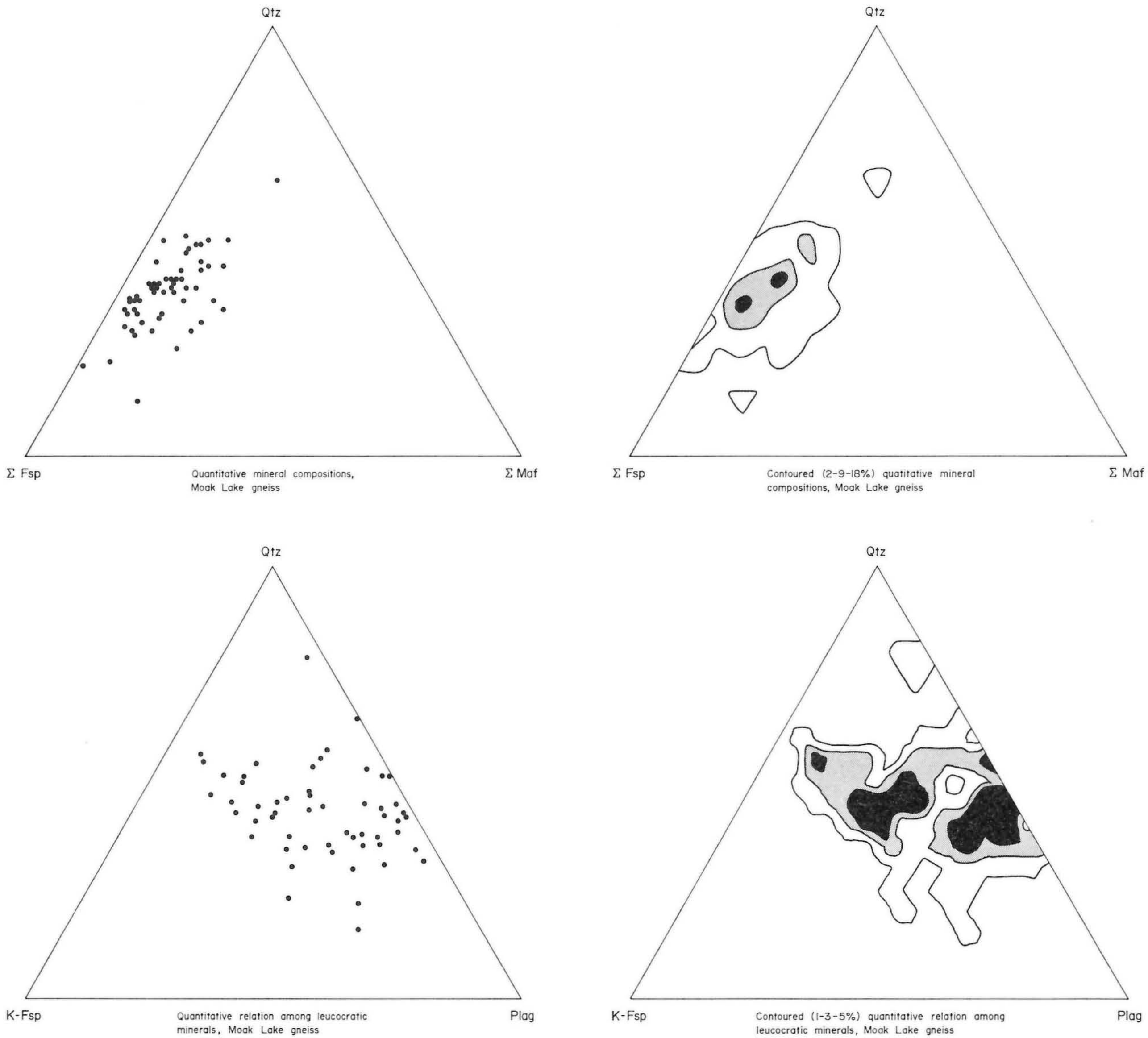

Figure GS-8-2 Modal variations, Moak Lake gneiss Moak Lake

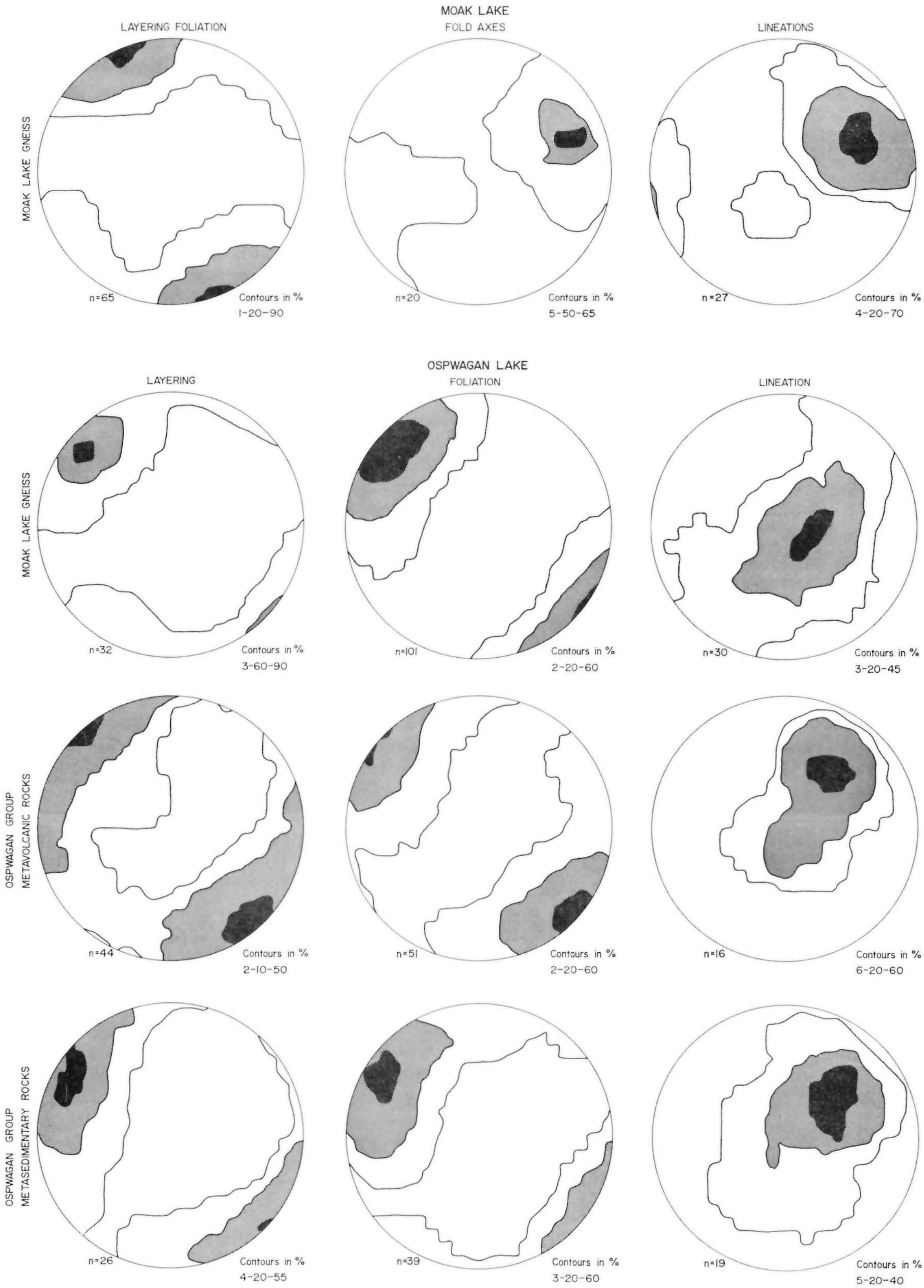

Figure GS-8-3 Stereograms of structural elements, Moak Lake gneiss and Ospwagan Group Moak Lake and Ospwagan Lake

Terminology

Bell (1971) defined the Wabowden subprovince to encompass what has been named the Moak-Setting Lakes belt, Manitoba nickel belt or Thompson nickel belt. The term Thompson nickel belt is the one generally used and accepted and will be used in this report. The Thompson nickel belt includes rocks that have been assigned to the Pikwitonei province, the Wabowden subprovince, and the Churchill province (Bell, 1971; and Coats, et. al., 1972). The name Wabowden subprovince (Bell, op. cit.) refers to a suite of migmatitic gneisses and associated metasedimentary, metavolcanic and ultramafic rocks that occupy the area bounded to the southeast by granulite facies rocks of the Pikwitonei region (Weber, 1976) and to the northwest by paragneisses of the undivided Churchill province. The use and significance of the terms Pikwitonei province and Wabowden subprovince is presently being questioned (Weber, 1976 and Weber and Scoates, in prep.) because of the apparent transitional nature of the contact between these two terrains. The migmatitic gneisses which underlie approximately 80 per cent of the Wabowden subprovince are well exposed along the Moak Lake shoreline. As most of the variations of this gneissic suite are found on Moak Lake, the informal name *Moak Lake gneiss* is suggested for this important suite of rocks.

The Moak Lake gneiss is host to a suite of metasedimentary-metavolcanic and ultramafic rocks which are of lower metamorphic grade than the enclosing migmatitic gneiss. The informal name *Thompson belt sediments* has been applied to the metasedimentary sequence by Coats, et. al., (1972). However, the metasedimentary, metavolcanic and ultramafic sequences comprise a related rock series in the Ospwagan Lake and Mystery-Moak Lakes area. The exposures of the metasedimentary, metavolcanic rocks on Ospwagan Lake are the best exposures of this suite in the entire belt and the informal name *Ospwagan group* is suggested in referring collectively to this suite of rocks. This is in accord with Bell (1966) who tentatively included these rocks as part of one group. Cranstone and Turek (1976) suggest that it is likely that the metasedimentary-metavolcanic sequence is younger than the enclosing migmatitic gneiss.

Moak Lake

The Moak Lake shoreline consists of migmatitic and cataclastic gneisses (Scoates and Macek, 1977) similar to those exposed on the east and northeast shore of Mystery Lake (Weber and Scoates, 1976). Outcrops of Ospwagan group metavolcanic and metasedimentary rocks occur along the Moak Lake road. Metasedimentary, metavolcanic, ultramafic and gneissic rocks are found in the waste pile of the Moak Lake Mine. The relationship between the Ospwagan group and the enclosing Moak Lake gneisses cannot be determined in this area.

Moak Lake Gneiss

The most common component of the mixture of rock comprising the migmatitic gneiss, is a poorly layered, medium-grained, grey to pink weathering, quartz-feldspar-biotite ± hornblende gneiss. This gneissic component contains amphibolite inclusions and pegmatite-aplite layers, lenses and dykes. The amphibolite inclusions are dark grey to black weathering, medium- to fine-grained, and occur as boudins, lenses and discontinuous layers in the gneiss. Some of the large inclusions (> 1 m wide) display a delicate, deformed lamination defined by alternating, 2 - 3 mm wide, amphibole-rich and plagioclase-rich layers. Epidote and garnet have been observed in some amphibolite inclusions and the inclusions are more abundant on the north shore than the south shore of the lake. Interlayered quartz-rich and hornblende-biotite-rich rocks occur adjacent to some amphibolite masses. Individual layers range from 5 to 10 cm wide and the rocks are intensely deformed. The contacts between quartz-rich rocks and the quartz-feldspar-biotite gneiss are generally sharp.

Pink pegmatite and aplite occur as layers, discontinuous lenses, and boudins in the gneiss. Pegmatite dykes cross-cutting the layering and foliation of the gneiss have been observed in several outcrops. These dykes display a fabric which indicates that they have also been affected by cataclasis.

Stromatic, surreitic, folded and opthalmitic structures (Mehnert, 1968) are common in the migmatites.

Cataclastic varieties of quartz-feldspar-biotite ± hornblende gneiss occur in two areas along the south shore of Moak Lake (Scoates and Macek, op. cit.). Amphibolite inclusions are rare and small in size in the cataclastic gneiss. Strongly folded mylonite zones, ranging from 5 cm to 1 m wide and consisting of oval clasts in a jet black aphanitic matrix are common.

Fifty-four samples of Moak Lake gneiss have been stained to provide modal variations of the main constituent minerals. The relationship between quartz, feldspar and mafic minerals can be seen in Figure GS-8-2. The relationship between quartz, plagioclase and potash feldspar is also shown in Figure GS-8-2.

Ospwagan Group

The mafic metavolcanic flows exposed on the Moak Lake road are strongly recrystallized to plagioclase amphibolite. Massive flows are more abundant than pillowed lava and the rocks weather dark grey-black to black and are greenish-black on fresh surface. Finely disseminated sulphides (pyrite, chalcopyrite) give rise to rusty weathered surfaces in some flows. Many flow contacts are marked by chlorite-, quartz-, and carbonate-filled shears. Massive flows are coarser grained near their base and thin (25 cm) flow top breccias occur at the top of some of the massive flows. Features interpreted as incomplete or partial selvages on some outcrops indicate pillow breccia.

The metasedimentary rocks exposed along the Moak Lake road consist of fine-grained, finely interlayered quartz-rich siltstone, ferruginous shale and phyllite, iron formation, chert and minor greywacke. Individual layers range from 2 to 5 cm thick and the rocks have been intensely folded. Quartz-rich siltstone, chert and phyllite are the most abundant units. Strong, local magnetic anomalies are due to iron formation.

Siltstone and phyllite layers range from moderately to highly iron-stained depending on their sulphide content. Rocks with approximately 5 per cent pyrite have a dark-yellow to brownish-red weathered surface which tends to obscure the character of the rock. The siltstones display a wide range in composition and may be transitional between chert and phyllite. Quartz-rich siltstones are dark grey to blue-grey, and individual layers contain 2 to 5 mm laminae. Phyllites form greenish-grey, fine-grained muscovite-rich layers.

Finely laminated, cryptocrystalline chert layers range from 2 to 5 cm thick. The chert weathers dark grey, has little iron staining and is light grey to grey-brown on fresh surface. Visible sulphide is rare.

An isolated outcrop of medium to fine-grained dark grey-brown weathering greywacke occurs adjacent to one of the metasedimentary outcrop areas. The greywacke is well-bedded and characterized by abundant 2 to 4 mm garnets.

Structure

The metamorphic layering and foliation of the Moak Lake gneiss are parallel and have an average strike of 070° and an average dip of 90° (Figure GS-8-3). The broad spread of contours about the maximum reflects the intense folding of the suite (Figure GS-8-3). Mineral lineations and microcrenulations cluster about an aximuth of 065° and a plunge of 37° (Figure GS-8-3). Fold axes have a similar orientation and cluster about an azimuth 070° and a plunge of 25° (Figure GS-8-3). No structural data is available for comparison from the metasedimentary-metavolcanic suite.

A major fault extending through the middle of Moak Lake, is indicated by an increase in deformation towards the middle of the Lake and by a discordance in geology between the north and south shores of the lake. A number of minor faults, at oblique angles to the inferred fault, and displaying dextral displacement, have been noted along the north shore of the lake.

Ospwagan Lake

Ospwagan Lake is particularly important for understanding the geology of the Thompson Nickel Belt as it has many of the best exposures of the Ospwagan group metasedimentary and metavolcanic rocks along its shoreline. These rocks which display lower grades of metamorphism than the enclosing Moak Lake gneiss are particularly important as they are host to large ultramafic masses, some of which are ore-bearing. For this reason, detailed examination of the rocks in this area concentrated on the metasedimentary and metavolcanic suites, their mutual relationship, and their collective relationship with the enclosing Moak Lake gneiss. Descriptions of the major lithologic units can be found in Stephenson (op. cit.).

The mafic metavolcanic rocks on Ospwagan Lake comprise massive and pillowed basalt and picritic basalt. Quench textures, similar to those found on Mystery Lake (Weber and Scoates, op. cit.) were observed in one locality. Two suites of metasedimentary rocks were observed, a suite of medium- to fine-grained quartz-bearing clastic rocks including sandstone, quartzite, greywacke and arkose, and a suite of fine-grained, finely laminated rocks including siltstone, chert, shale, dolomite and iron formation.

The average strike and dip of layering and foliation of the Moak Lake gneiss is different by approximately 10° from that of the metasedimentary and metavolcanic rocks of the Ospwagan group (Figure GS-8-3 and Table GS-8-1). The average strike and dip of layering and foliation of the metavolcanic rocks is slightly different from that of the metasedimentary suite (Figure GS-8-3 and Table GS-8-1) however the number of measurements is not great enough to permit a thorough evaluation of this apparent non-parallism of layering and foliation among these rocks suites. The Moak Lake gneiss possesses linear structures that are substantially different in attitude to the linear structures of the Ospwagan group rocks (Figure GS-8-3 and Table GS-8-1).

TABLE GS-8-1

Structural Elements

a. Moak Lake

	Layering/Foliation	Fold Axes	Lineation
Moak Lake gneiss	070/90	070/25	065/37

b. Ospwagan Lake

	Layering	Foliation	Lineation
Moak Lake gneiss	040/75	040/80	105/73
Metavolcanic rocks	228/81	223/82	037/43
Metasedimentary rocks	030/75	032/75	046/52

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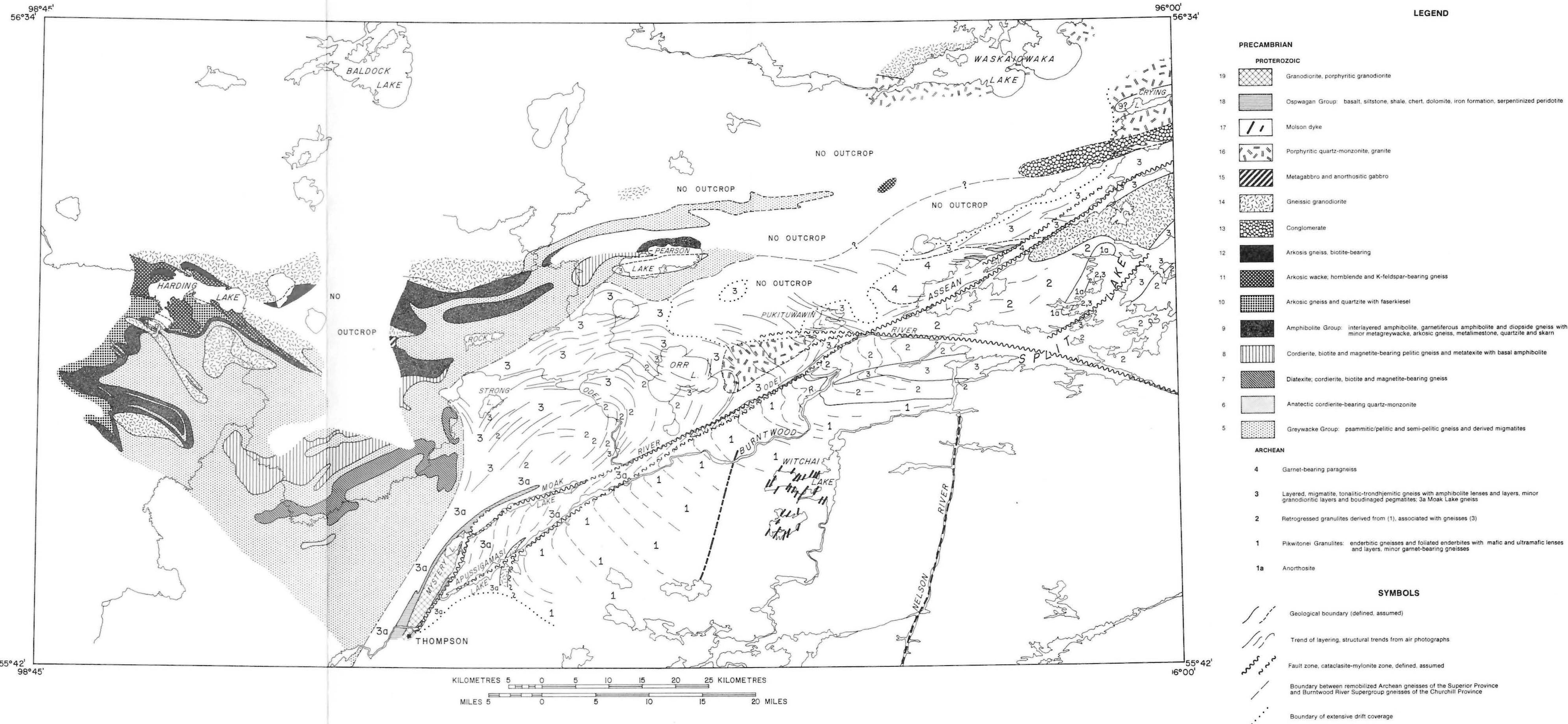

Figure GS-9-1 Generalized geology of the Odei River Region and the location of the contact between the greywacke-derived gneisses of the Burntwood River Supergroup and the remobilized gneisses of the Superior Province. Geology compiled from contributions by R.F.J. Scoates, W. Weber, M.T. Corkery and W.D. McRitchie

GS-9 HARDING-ROCK LAKES REGION

(64A-3W; 64B-1, 630-16 NE half, 63P-13 NW half)

by W.D. McRitchie

Introduction

In 1976 a regional reconnaissance of the Mynarski-Waskaiowaka region demonstrated the potential of using the airborne magnetic maps to define, correlate and distinguish between the greywacke and arkosic gneisses in this part of the Churchill Province. The approach was adopted and applied again in 1977 to the Harding and Rock Lakes region (Figure GS-9-1); however, ground checks were intensified so that two-thirds of the available outcrops were spot sampled using an Alouette 2 helicopter. Extensive drift deposits blanket most of the region and outcrop frequency ranges from 10% south of Harding Lake to 0% north and east of Pearson Lake. The sporadic and well spaced distribution of the outcrops in the eastern area incurred more than usual reliance upon the airborne magnetic maps for extrapolating the geological boundaries. Consequently, the airborne magnetic interpretation was used entirely to extrapolate the "Churchill-Superior Boundary" east of Pearson Lake to south of Crying Lake.

General Geology

One of the more significant results of the programme arose from the delineation of the southeastern boundary of the greywacke-derived gneisses and migmatites of the Burntwood River Supergroup. The contact between the greywacke gneisses, and the interlayered amphibolites and quartzofeldspathic gneisses of possible Kenoran age ("group seven" of the Thompson belt) was traced northeastwards from Birchtree Brook to the Odei River near Rock Lake, and thence east and northeast to Pearson Lake (Figure GS-9-1). The contact is commonly the site of a topographic depression and at least local cataclasis may be inferred from increases in the degree of foliation and flattening in outcrops adjacent to the contact. An inlier of amphibolites and quartzofeldspathic gneisses on Pearson Lake, which outcrops north of a thin belt of greywacke paragneiss, is interpreted as an upfolded or upfaulted "peepthrough".

Strong and Orr Lakes region

South of the contact the gneisses comprise interlayered amphibolites and quartzofeldspathic gneisses with local and very subordinate mafic dykes and 1-8 metre ultramafic pods. White alaskitic mobilizate is locally dominant but characteristically appears as aplitic dykes and stringers parallel to the axial planes of tight folds which are a ubiquitous feature of these rocks. Skialithic granodioritic gneisses with rounded rafts of amphibolite are rare and restricted in occurrence. The quartzofeldspathic gneisses are commonly layered (10-200 cm), coarse-grained, equigranular and in some respects resemble Sickle Group arkosic gneisses. Previously McRitchie (1976) subscribed to a Sickle affinity for these gneisses but subsequently has revised this opinion in favour of correlation with "Thompson group seven" gneisses of possible Archean age. Amphibole is the dominant ferromagnesian mineral with local, minor diopside and trace magnetite. Some gneisses were described as dirty quartzites in the field and are interlayered with thin para-amphibolites themselves displaying an internal compositional layering. Lineations are characteristically absent, a feature which contrasts with the commonly well lineated and foliated amphibolites of the Churchill Province Transitional and Sickle groups.

Coarse-grained, vaguely layered, homogeneous, equigranular granodioritic and tonalitic gneisses, with thin pink potassic stringers, occur sporadically throughout the area. Locally they occur interlayered with medium-grained quartzofeldspathic paragneisses and appear to have resulted from anatexis or partial anatexis of the latter. Typically the amphibolites and quartzofeldspathic gneisses exhibit amphibolite facies mineral assemblages; however, west of Blank and Orr Lakes, and sporadically elsewhere, two-pyroxene assemblages in both mafic and leucocratic host rocks indicate pyroxene granulite facies recrystallization.

Trend lines (Figure GS-9-1) illustrate the existence of broad regional folds in the otherwise near vertical layering, and the persistence of a 90° trend in the Pukituwawin and Hunting Lakes regions. This layering is transected by the later 70° trending faults and mylonite zones that strike through Assean Lake down the Odei River to Moak Lake.

Harding-Rock Lakes region

North of the boundary with the interlayered amphibolites and quartzofeldspathic gneisses the dominant lithologies comprise the Burntwood River Supergroup greywacke gneisses and migmatites, the Transitional Amphibolite Group and the Sickle Arkosic Group, together with locally dominant intrusive gneissic granodiorite and quartz monzonite. The greywacke gneisses are well exposed in a series of high ridges along the powerline northwest of Birchtree Brook. Excellent 2-40 cm interlayering of psammitic, semipelitic and pelitic turbidite units is well preserved in garnet-cordierite and sillimanite-bearing rocks that exhibit evidence of partial anatexis (Figure GS-9-2). Pods, lenses and stringers of garnetiferous leucosome are preferentially concentrated along the axial planes of repeated small-scale asymmetric Z-folds. Elsewhere in the region the greywacke gneisses display variations in the proportion of mobilizate and psammite, semipelite and pelite. South of Rock Lake psammitic formations several tens of metres thicks are interlayered with stringer diatexites containing biotite-rich selvedges and screens enveloped in locally dominant white pegmatitic mobilizate. Graphite appears abundant in the palaeosome and neosome of the greywacke migmatites throughout the Rock and Pearson Lakes region. The upward progression from the greywacke group through the transitional amphibolite group into the arkosic group was documented and discussed at length in a previous report (McRitchie, 1976). The main marker horizons were traced eastwards from Harding Lake, the most significant findings being:

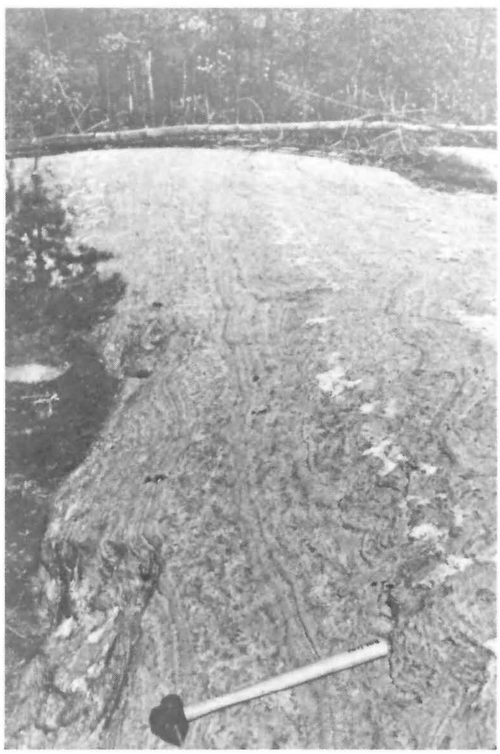

Figure GS-9-2 Interlayered psammitic, semi-pelitic and pelitic garnet-cordierite-sillimanite and potassium feldspar-bearing "metagreywacke"gneisses of the Burntwood River Supergroup 20 km northwest of Thompson. Note granitic segregations concentrated into hinge zones of repeated small scale folds

a) a gradual S-folded offset of all units to the north from Harding to Pearson Lakes;
b) a thickening of the interlayered amphibolite and diopside granulite unit with the appearance of thin meta-limestone and interlayered calc-silicate units and quartzite northwest of Rock Lake;
c) the delineation of a separate cordierite-magnetite-garnet and sillimanite-bearing pelitic formation (see also Patterson 1963) which may represent a facies variant of the faserkiesel-bearing arkosic gneiss in the Sickle Group (a transitional interlayered relationship was observed on the north shore of Pearson Lake between a strongly foliated derivative of the cordierite-magnetite pelite, and thin arkosic gneisses, and amphibolite lenses immediately adjacent to the biotite and garnet-bearing greywacke group);
d) the delineation of diatexitic and anatectic cordierite-bearing quartz monzonite structural "outliers" that may have been derived from the cordierite and magnetite-bearing pelite;
e) the delineation of major granodiorite intrusions that appear to occupy the NW trending hinge and axial zones of the repeated major S-folds in the region.

Structural comments

The boundary between the greywacke gneisses and the interlayered amphibolites and quartzofeldspathic gneisses may well represent the interface of the Aphebian and Archean rocks in this part of Manitoba. It is certainly a closer approximation to this section of the Churchill-Superior boundary than was previously available. Since the contact is never exposed the nature of the relationship must remain the subject of speculation until drill hole information is available to cover this gap in our data. The occurrence of a possible structural inlier on Pearson Lake and conglomerate outlier on Fourmile Lake (Corkery, 1976) may indicate an original direct superposition of the Aphebian sediments over the Archean craton. However, evidence of extensive deformation is observed in adjacent outcrops and a sole thrust, together with subsequent folding, might well obscure any earlier relationships. Generally the layering in the greywacke and arkosic sequences dips at moderate to steep angles to the north and northeast; however, as the boundary is approached all dips become near vertical and strikes conform with those of the boundary. Throughout the Strong Lake-Orr Lake region dips are vertical or near vertical and appear to be parallel to the axial planes of an early period of isoclinal folding.

Narrow east-west trending zones of cataclasis and mylonitization were recorded on Pearson Lake and, together with the main Assean Lake-Odei River-Moak Lake lineament, probably represent the latest tectonism in the region.

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GS-10 ODEI — BURNTWOOD RIVERS REGION

(Parts of 64A-2, 3; 64P-14)

by W. Weber

Shoreline exposures on the Odei and Burntwood Rivers between Moak and Apussigamasi Lakes and Split Lake were mapped in the early part of the summer to update geological information prior to flooding by the Churchill River Diversion. A helicopter was used to visit the few isolated inland exposures near the river.

The major findings are:

- the Odei River lineament is a fault zone comprising cataclastic rocks and mylonites which is, for most of its extent, bounded on both sides by the Moak Lake gneisses. The fault does not, therefore, separate the Churchill and Superior structural provinces as was proposed by Beil (1971), but lies within the extension of the Thompson nickel belt (Scoates and Macek, this report). The lineament is part of an extensive fault zone which extends from Mystery Lake to Assean Lake;
- a belt of metasedimentary rocks mapped by Dawson (1952) and Patterson (1963), along the south shore of the Odei River, was found to comprise mylonitic rocks derived from Moak Lake gneisses; clear evidence for a sedimentary origin is lacking.

Lithology

Pikwitonei Granulites* (1a, b, c, d):

Pikwitonei granulites are exposed along the Burntwood River (Figure GS-10-1) and at a few lakes to the south. They are similar to the granulites at the eastern end of Apussigamasi Lake (Weber and Scoates, 1976). In many outcrops they are either partly retrogressed — pink and cataclastic, or they are greenish mylonites. Foliated schollen-enderbites and enderbitic gneisses (1c) appear more abundant than the mafic granulites (1a), but the outcrops are scattered and may not accurately represent the relative abundance of the four main sub-units on the preliminary maps.

Retrogressed Granulites (2a, 2b):

Retrogressed granulites are exposed along the Burntwood River above its intersection with the Odei River. The majority (2a) have apparently been derived from schollen-enderbites (1a). They are similar to clotted granodiorites at Split Lake (Corkery, this volume). Layered gneisses similar to unit 3a are associated with retrogressed granulites and appear to have been derived from them. Light grey trondhjemites and tonalites (2b) may be derived from enderbites or they might be younger than the granulite facies metamorphism.

Moak Lake Ggneisses (3a, b):

Moak Lake gneisses, as defined by Scoates *et. al.* (this report), are exposed along the Odei River. They are similar to the amphibolite facies gneisses at Apussigamasi Lake (Weber and Scoates, op. cit. unit 2). The gneisses are generally strongly layered due to intensive shearing and cataclasis with the resultant flattening of contrasting mafic/siliceous layers and lenses (similar to unit 2h, Weber and Scoates, op. cit.). Syn- and post-crystalline cataclasis increases towards the northeasterly striking Odei River lineament. The outcrops south of the river contain discontinuous mylonitic zones and form a fault-line scarp. The belt of metasedimentary rocks, mapped by Dawson (1952) and Patterson (1963) coincides with the mylonitic rock. Haugh's (1969, p. 44) suggestion that this belt might be a continuation of the Assean Lake fault zone is, therefore, correct. The topographic low containing the Odei River and extending southwest through Moak Lake may coincide with a less resistant shear zone or fault gouge. The Odei River cataclastic rocks are part of a fault zone which extends to the

* "Pikwitonei granulites" is a term used for rocks having granulite facies mineral assemblages which occur in the Pikwitonei region. "Pikwitonei region" is used as a term of reference in preference to "Pikwitonei Province" (Bell, 1971), because the justification for defining the Pikwitonei region as a structural province has been questioned on several accounts (Weber, 1976b).

southwest through Moak and Mystery Lakes (Scoates, *et. al.*, op. cit.; Figure GS-9-1) and northeasterly through the western end of Split Lake.

Outcrops along the lower part of the Burntwood River suggest that some of the Moak Lake gneisses may be derived from schollen-enderbites through shearing, possibly axial planar to a series of tight folds, and recrystallization under amphibolite facies conditions. Intrusions of pegmatites, aplites and granodiorite **lits**, with associated metasomatism, lead to a further modification of these gneisses.

Garnet-Biotite Flaser Gneiss with fine-grained, greenish-black amphibolite lenses (4):

Near the mouth of Split Lake an outcrop of garnet-biotite flaser gneiss containing fine-grained, greenish-black amphibolite lenses is possibly equivalent to Haugh's (op. cit.) unit C1 (grey biotite gneiss, pelitic schist) which is exposed along the east shore of Assean Lake. These gneisses are possibly part of the Burntwood River Supergroup of the Churchill Province, but are more siliceous and "gritty" than the typical greywacke-shale association.

Mafic dykes (5):

Straight-walled mafic dykes 2 cm to over 10 m wide occur in units 1 and 2. The dykes have chilled margins but the mineralogy is secondary although primary textures are preserved. The dykes near the Odei fault zone are locally sheared and cataclastic, in particular along their margins. The dykes strike north-northeasterly to north-westerly in unit 2. The different strike in unit 2 may be the result of regional folding after the intrusion of the dykes. The direction of the dykes suggests that they are part of the Molson swarm; however, typical Molson dykes are not significantly altered (Scoates and Macek, in prep.).

Felsic Mylonites (6):

Mylonites along the Burntwood River trend in a northeasterly direction parallel to the Odei River fault zone. The strike length cannot be estimated because of lack of outcrop along the mylonite zones. A younger east trending cataclastic event, exposed in the west trending portions of the Burntwood River may have displaced some the mylonite zones. Others may be discontinuous (en echelon?). Mylonites along the east flowing Odei River near the mouth of Split Lake are part of the Split Lake-Aikens River fault zone.

Structural Geology

On many geological maps the Odei River fault zone defines the boundary between the Superior and Churchill structural provinces (c.f. Bell, op. cit.). However, for most of its extent this fault lies within the Moak Lake gneisses and is flanked by similar lithologies and fold styles on both sides. This fault therefore does not define the contact between different structural provinces, but lies largely within the northeast extension of the Thompson nickel belt. However, at the junction of the Odei and Burntwood Rivers the Odei River fault zone truncates the subparallel Apussigamasi-Partridge Crop shear zone (Figure GS-9-1). From here to Split Lake the Odei fault defines the contact between the Moak Lake gneisses and the retrogressed Pikwitonei granulites.

Intersecting small scale cataclastic structures observed on outcrops in the lower part of the Odei River, near Split Lake-Aikens River fault, indicate that an east trending cataclastic event (possibly related to the Split Lake-Aikens River fault zone) is younger than the northeast trending Odei River direction. Although the minor structures show right lateral displacement along the younger cataclastic zones, this cannot be proven by outcrop mapping due to lack of exposures where the two faults intersect. The virtual continuity of the Odei River lineament into the Assean Lake lineament does not suggest significant lateral displacement.

CAUCHON LAKE REGION

(Parts of 53M-5, 12; 63P-1, 2, 7, 8, 9, 10, 15)

A mapping program in the Cauchon Lake region, directed towards the completion of a 1:250 000 geological atlas sheet, consisted of a regional helicopter survey covering the area between Dafoe-High Hill-Utik-Bear-Cotton Lakes and the Nelson River, and a shoreline survey of Bear Lake. Advantage was also taken of the extremely low water level along the Nelson River system to survey the Nelson River between latitudes 55° 15′ and 56°, and to obtain additional data in the Cauchon-Prud'homme Lakes area, where typical Superior Province rocks are in contact with Pikwitonei granulites.

The main results of the survey are:

1. Discontinuous layers of Superior-type greenstones (silicate-oxide iron formation, amphibolites, garnet-bearing paragneisses, calc-silicate rocks) are common in the southern part of the Pikwitonei granulites, but rare further south.
2. Although complicated by later faults along the boundary between the Superior greenstone terrain and the Pikwitonei granulites (c.f. Weber, 1976b), it appears that there is a metamorphic gradation and not a break, between the granulites and the lower grade greenstone belt terrain. All the rocks, with the exception of the Molson dykes but including the greenstones, have been affected by the granulite facies metamorphism which is a relatively late event. This was observed in the Cauchon Lake area and along the northern contact of the High Hill greenstone belt. The granulite facies metamorphism is associated with a deformation period which produced west-southwest trending folds and associated planar structures. This tectonic-metamorphic event (M_2, S_2) is preceded by a period of migmatization under amphibolite conditions (M_1) leading to garnet-bearing assemblages in rocks of suitable composition and a **lit par lit**-type metamorphic layering (M_1). Local cordierite is associated with garnet. The early metamorphic layering (S_1) may strike at a large angle to the west-southwest direction (S_2) but axial traces relating to folding during the earlier metamorphic (M_1) are rare. A third event (S_3) produced retrogression, cataclasis and local mylonitization along the southwest trending shear zones, approximately parallel to S_2. These S_3 zones coincide with pronounced topographic lineaments. The first and second events are conceivably not part of a Pre-Kenoran orogeny, because Superior-type greenstones were affected. The third event might be Hudsonian.
3. The anorthosites in the Cauchon Lake area (Weber, 1976a) could be extended further to the west. It appears that the anorthosites represent part of a differentiated sill-like body with a mafic to ultramafic base along the southern contact of the main anorthosite belt at Cauchon Lake. However, this base has been extensively intruded by later tonalites (now enderbites) and remnants of the earlier intrusion are only preserved as xenoliths. Igneous differentiation within the anorthosites is very rare and the present interlayering of mafic and anorthositic rocks in the main layered anorthosite complex at Cauchon Lake is interpreted as a result of intensive deformation during the F_2 event.
4. Anorthosites occur north of Superior-type greenstones at Bearhead Lake, but the relationships between the anorthosites and greenstones are not exposed.

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GS-11 DAFOE RIVER-FOX RIVER REGIONAL CORRELATION — PART A

(Part of 53M-14, 53M-15)

by R.F.J. Scoates and W. Weber

A program of traversing the major rivers of the Fox River area was initiated in order that Superior province gneisses south of the Fox River belt (Scoates, 1975a, 1975b and 1977) and Churchill province gneisses north of the belt (see McRitchie, Part B) could be examined (Figure GS-11-1). Areas where exposures of Fox River belt rocks might be encountered were included in the program so that units which have been observed only in drill core could be examined. This would also permit a better definition of the boundary between the Fox River belt and the enclosing gneissic rocks. Since this is the Churchill-Superior boundary zone, the nature of the rocks associated with the zone is of importance in understanding the nature of this fundamental Precambrian structure. This program was prematurely suspended due to difficulty with air support.

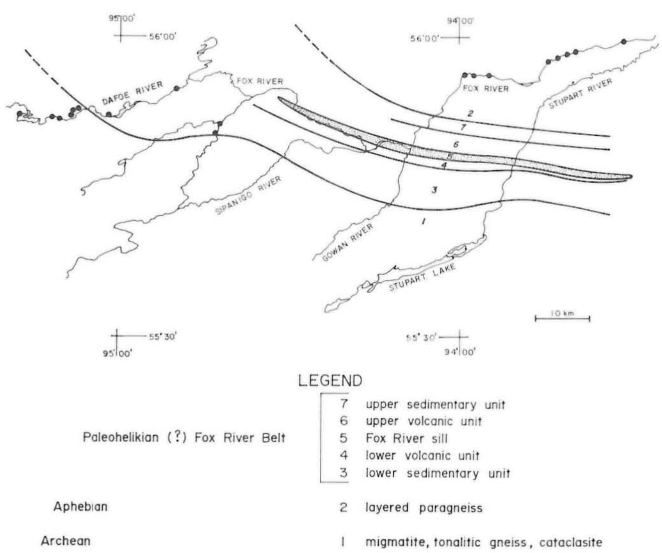

Figure GS-11-1 Fox River regional correlation, station locations

Grey to slightly honey coloured, layered tonalitic gneisses are sporadically exposed along the Dafoe River. These gneisses which stratigraphically and/or structurally underlie rocks of the Fox River belt are similar to retrogressed granulites of the Cauchon Lake region (Weber, 1976). Just below the contact with Fox River belt rocks the gneisses are strongly cataclastic and augen gneiss is developed. Dark grey, slightly porphyritic, plagioclase-rich gneiss-anorthositic gneiss, exposed in one outcrop area, is comparable to anorthositic gneiss found along the Nelson River, south of the Kelsey generating station.

The only known exposure of Fox River belt, lower sedimentary unit siltstones occurs in the Dafoe River, approximately 5 km downstream from the last gneiss outcrop area. Similar rocks have been observed in core from drill holes 40 km to the east (Scoates, 1975a, 1975b). The siltstones exposed on the Dafoe River are dominantly grey-buff weathering, fine-grained and delicately laminated. Dark grey, fine-grained shales and creamy-buff dolomite are interlayered with the siltstones. A foliated, dark green, medium-grained altered gabbro occurs within the sedimentary sequence. This suite of siltstones may represent the lowest stratigraphic level of Fox River belt rocks yet examined. They posses a well-developed schistosity and display rare, incipiently developed, small-scale kinks. Correlation of sedimentary units from the Dafoe River outcrop area with sedimentary units exposed in core from drill holes 40 km to the east may be possible.

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GS-11 FOX RIVER REGIONAL CORRELATION — PART B

RAINBOW FALLS-"AFTERNOON RAPIDS" (FOX RIVER)

by W.D. McRitchie

Introduction

Two sections of the Fox River were traversed to investigate the character of the metasediments lying downriver and to the south of the Fox River belt (Figure GS-11-2). Outcrops are concentrated in two-5 km long corridors at Rainbow Falls (A) and in the rapids 19 km downstream (B) (hereinafter referred to informally as "Afternoon Rapids"). Eight kilometres further downstream (C) a thick foliated, homogenous, equigranular amphibolite and strongly foliated granitoid gneiss with rare lenticular inclusions of amphibolite, are exposed in the last small outcroppings exposed on the river. Traverses were conducted on the south bank of the Rainbow Falls section and the north bank of "Afternoon Rapids". A helicopter was used to collect additional data from well exposed midstream islands.

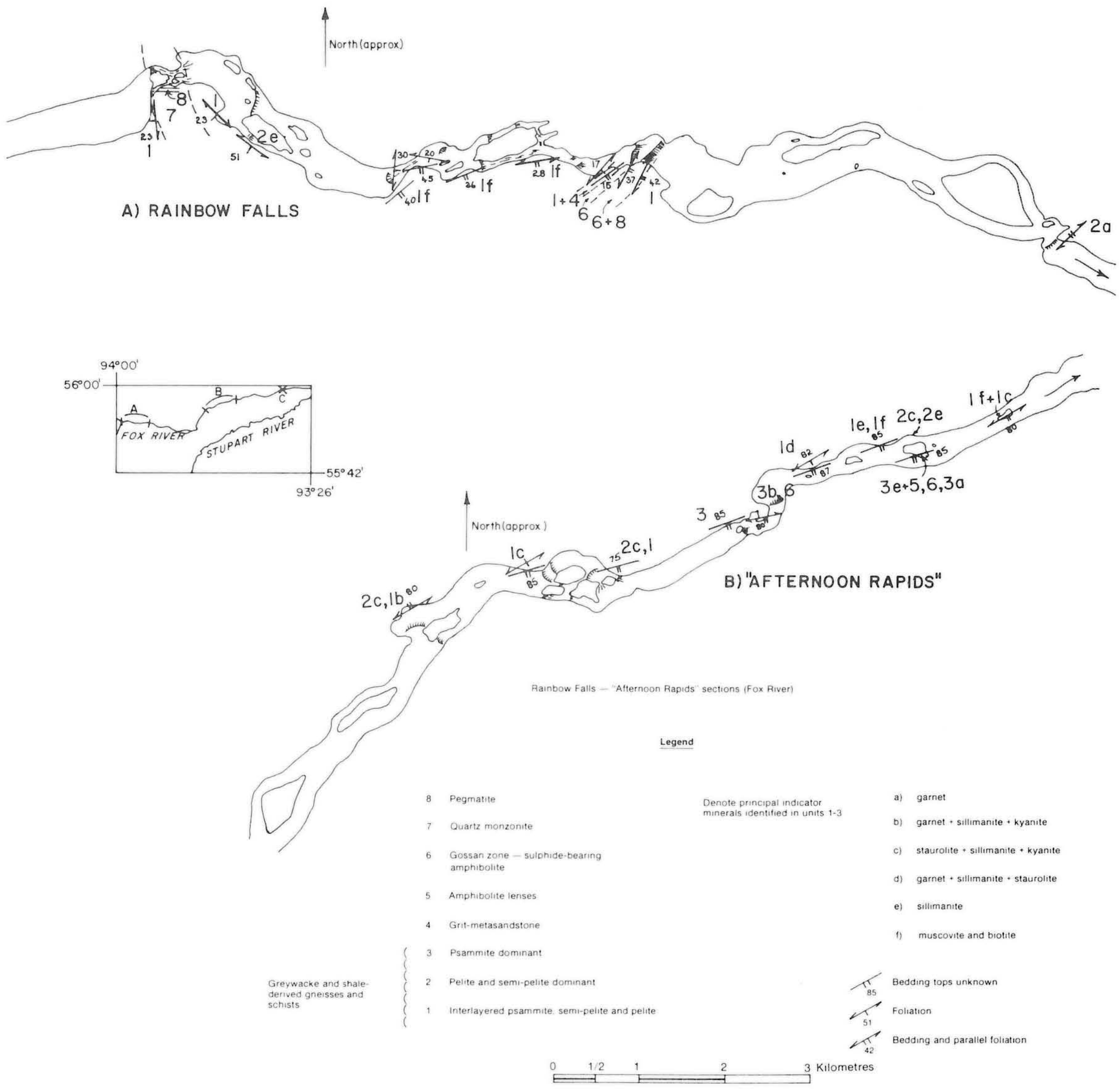

Figure GS-11-2 Geology of the Rainbow Falls — "Afternoon Rapids" sections (Fox River)

General Geology

The most prominent and abundant rock types comprise well layered and bedded grey, and grey-brown weathering psammitic, semipelitic and pelitic plagioclase-quartz and biotite-bearing metasediments representative of an original greywacke-shale association. Individual layers range in thickness from 10 cm to 2 metres, and the proportion of psammite to pelite varies from outcrop to outcrop. Calc-silicate pods and lenses (5 - 20 cm thick) are common and thin amphibolite layers and lenses are present locally. The pelites and semi-pelites are highly micaceous and contain varying proportions of staurolite, sillimanite, garnet and kyanite whereas the more siliceous psammitic layers generally contain lesser amounts of garnet and local muscovite-sillimanite-bearing faserkiesel. Staurolite crystals up to 2 cm long occur in seams of pelite near the downstream end of the "Afternoon Rapids" section. At the same locality, the psammitic layers exhibit delicate, thin laminations and a compositional layering emphasized by the varying proportions of metamorphic indicator minerals.

Pink weathering feldspathic-wacke layers are interlayered with muscovite and biotite schists near the top of the Rainbow Falls section. Further downstream a 1 metre thick grit-metasandstone, with 3-4 mm quartz grains in a 1 mm matrix, occurs near the structural top of the section above thinly laminated pelitic and semi-pelitic schist and 1 - 2 metre thick psammitic metagreywacke. Immediately to the south and lying above the grit a 10 metre thick gossan zone of interlayered (4 - 10 cm) pyritiferous amphibolite and siliceous semi-pelite is exposed over a strike length of 150 metres.

Quartz veins, stringers, pods and lenses are present throughout both sections and are preferentially concentrated in the more schistose horizons.

Intrusive rocks are rare, limited to a single major sill at Rainbow Falls and rare 20 - 110 cm sills in the metasedimentary rocks. The main intrusive body is well jointed and comprises a medium to fine-grained pink, equigranular, homogeneous alaskitic quartz monzonite. Associated pegmatite dykes contain graphic microcline, plagioclase, centrally concentrated quartz, large plates of muscovite, and lesser amounts of biotite partially altered to chlorite. The quartz monzonite is bleached near its contact with the pegmatite dykes.

Structure

The layering in the metasediments is generally planar but repeatedly folded zones occur through both sections. A large swing in the layering is apparent in the Rainbow Falls Section which also exhibits the greatest divergence in foliation/layering attitudes. At "Afternoon Rapids" the strike of the layering and foliation is constant and is parallel to the river channel.

Regional Considerations

In terms of regional correlation the metasediments encountered in the Rainbow Falls-"Afternoon Rapids" section of the Fox River resemble the greywacke and shale-derived gneisses of the Burntwood River Supergroup (and at Kettle Rapids and Long Spruce) in their compositional range, lithologic association and in their layering characteristics. Though less metamorphosed they are similar in metamorphic grade to greywacke and shale-derived gneisses on the north and south flanks of the Kisseynew gneiss belt. They differ, however, from typical Burntwood River Supergroup-derived gneisses in that they are more micaceous. The metamorphic grade of the Rainbow Falls metasediments is higher than that exhibited in the volcanics and sediments to the south of the Fox River belt, and the sedimentary facies differ markedly.

GS-12 NORTHEAST SPLIT LAKE AREA

(Parts of NTS sheets 64A-1, 64A-8, 54D-4 and 54D-5)

by M.T. Corkery

Introduction

Geologic mapping was conducted in the northeast portion of Split Lake (parts of NTS map sheets 65A-1, 64A-8, 54D-4 and 54D-5) to complete the geological record of shoreline exposures on the lower Nelson River (Corkery, 1977N-5).

A simplified geological map of the area is shown on the northeastern portion of Figure GS-9-1.

Ample shoreline outcrop was exposed this year on Split Lake due to the extremely low water level on the Nelson River System. A helicopter was used to facilitate inland mapping where bedrock exposures are minimal due to thick glacial drift.

Previous mapping by Dawson (1939), Gill (1950), and Mulligan (1956) has been extensively revised.

GENERAL GEOLOGY

Domains with two distinctly different structural and metamorphic patterns were observed within the map area and are designated S_1 and S_2. The S_1 domains contain weakly deformed gneisses and older intrusives. The S_2 domains display similar rock types but have undergone extensive migmatization and deformation.

S_1 Domains

Within the S_1 domain the major rock types are: amphibolite, hornblende gneiss, anorthosite and clotted granodiorite.

Amphiboles and hornblende gneisses are most common, and contain varying proportions of hornblende, diopside, plagioclase, quartz and garnet. These are usually fine- to medium-grained and the percentage of coarser grained mobilizate rarely exceeds 25% and is usually less than 10%.

Variations in the ratio of hornblende to diopside and in the abundance of garnet define a relatively continuous layering on a scale of 20 cm to 50 cm within the amphibolite. Within the hornblende gneisses the larger scale layering is obscured by a 2 cm to 10 cm layering, defined by mobilizate layers and injected **lits**.

The S_1 domains are only mildly deformed. Minor undulations in the layering were observed on the outcrops. However, on a regional scale gradational changes in the strike indicate a dome structure for the anorthosite, and its country rocks. A very weak and inconsistent foliation is defined by the alignment of hornblende parallel to the layering. Small scale folding is observed only within the transition to the S_2 domains.

Mineral assemblages indicate amphibolite and possibly local granulite facies metamorphism. A later period of retrograde metamorphism led to local retrogression of pyroxene and hornblende to green amphibole, biotite and chlorite, and alteration of garnet along rims and fractures to chlorite.

S_2 Domains

The rock types characteristic of the S_1 domains are recognized as rafts and inclusions within the S_2 domains and show varying degrees of assimilation and alteration as well as a higher percentage of granite to granodiorite injection. Most of Mehnert's (1968) migmatite structures have been observed.

The layering within the S_2 areas ranges from **lit par lit** gneisses, with 1 cm to 10 cm layering, to vague nebulitic structures. A well developed regional foliation, which generally trends 060° to 070°, is parallel to the layering except in the noses of the common minor folds. A lack of lateral lithologic continuity has prevented the delination of any large scale folding. Large rafts of amphibolite and northosite, up to several hundred metres long are observed in these areas, with their long axis or layering parallel to the later S_2 trends.

A period of retrograde metamorphism is indicated by the extensive development of pale green amphibole (actinolite), biotite, chlorite and epidote. The degree to which this retrogression progressed varies from outcrop to outcrop and has resulted in a series of hornblende-rich to biotite-rich gneisses.

The entire map area has been intruded by two late phases of medium grained pink and grey granites, which occur as irregular dykes throughout the area, as well as a large granite body centered on Fox Lake.

Several cataclastic and mylonitic zones were observed parallel to the S_2 tectonic fabric within the S_2 domains. These are parallel to the Assean Lake fault zone and may be contemporaneous with the younger fault zones observed in the region (Haugh, 1965, Corkery, 1976).

DESCRIPTION OF ROCK UNITS:

Unit 1 — Amphibolites:

This unit comprises an assemblage of medium-grained, dark green-grey to grey-buff amphibolites, which vary from massive to weakly foliated. The amphibolites have been subdivided into three subunits:

(a) Mafic hornblende-pyroxene amphibolite
(b) Plagioclase-quartz amphibolite
(c) Plagioclase amphibolite

Hornblende and/or pyroxene are the dominant constituents of subunit 1a with plagioclase and a few per cent of quartz forming the groundmass. Varying amounts of garnet are commonly found as well as minor magnetite and pyrite.

This unit often displays a compositional layering (20 cm to 50 cm thick) defined by a variation in the proportions of hornblende, pyroxene, plagioclase and quartz; and/or the presence, proportion or absence of garnet.

Subunit 1b is a more leucocratic buff to light grey amphibolite in which the total mafic content rarely exceeds 40 per cent and consists of tabular hornblende, which may exhibit a crude foliation, and a small percentage of pale green amphibole which may be altered pyroxene. The matrix consists of plagioclase and quartz.

Large scale layering is not observed in this unit, but a 2 cm to 10 cm compositional layering, defined by the ratio of dark to light minerals is observed. This unit may contain up to 10% mobilizate which has segregated into 1 cm to 2 cm coarse-grained **lits**.

Subunit 1c is slightly coarser-grained than the previous units, grey to green-grey in colour and contains plagioclase and amphibole. It displays layering similar to 1b but has virtually no mobilizate and appears to be associated with the anorthosite unit 3.

Unit 2 — Hornblende Gneiss:

Unit 2 is similar to subunits 1a and 1b but has been defined on the basis of having up to 25 per cent subparallel injected **lit**. Compositional layering, on a scale of 1 to 10 cm, similar to the amphibolite is enhanced by injected granitic layers which are generally medium to coarse-grained, equigranular and white to pale pink. The amphibolite layers in these gneisses are mineralogically and texturally identical to the amphibolites with a dominance of the mafic hornblende-pyroxene amphibolite.

Unit 3 — Anorthosite:

This is a distinctive homogeneous unit, the main body of which forms a north to northeast trending lens-shaped body in the western portion of the map area. It is a buff weathering, light grey-green unit which is composed of medium to coarse-grained plagioclase with restricted zones of minor amphibole or garnet. A very vague foliation defined by less than 2 percent radiating acicular dark green amphiboles is locally developed.

Unit 4 — Clotted Granodiorite:

Intrusive bodies of vaguely foliated clotted granodiorite, unit 4a, are restricted to the eastern portion of the map area. The most definitive features of the rocks in this unit are: a) the abundance of hornblende or ultramafic inclusions; and b) clots of mafic minerals which range from 0.2 to 1 cm in size, set in a matrix of feldspar and quartz.

The mafic clots, which may form from 25 to 50 per cent of the rock, comprise fine-grained aggregates of amphibole and chlorite with sporadic cores of pyroxene and hornblende. An even distribution of mafic to ultramafic inclusions, which may comprise up to 15 per cent of the unit, display a wide variety of composition and fabric.

Within the S_2 domain a highly recrystallized and strongly foliated granodiorite body, unit 4b, is parallel to the S_2 structural fabric. Chlorite, green amphibole and minor biotite, occurring as lensoid clots, define a discontinuous lamination. Highly altered and elongated remnants of the mafic rafts and 5 to 10 per cent discontinuous 5 mm to 2 cm thick layers of plagioclase and quartz mobilizate are generally parallel to the regional structure.

Unit 5 — Biotite Gneiss, Amphibolite-Biotite Gneiss:

This unit includes a broad group of fine to medium-grained, grey to green-grey, mostly well layered, highly migmatized gneisses common to the S_2 domains.

The mafic layers, which may comprise from 10 per cent to more than 50 per cent of the outcrop, range in thickness from thin discontinuous laminae up to 10 cm thick laterally continuous hornblende-plagioclase layers. The thicker mafic layers and groups of layers tend to pinch and swell and may form discontinuous boudinaged lenses.

Where biotite is found, a foliation is observed which is parallel to the layering, except in areas in which minor folds are developed in which case the foliation cuts the layering and is parallel to the axial planes of the minor folds.

Interlayered with the well layered gneiss are schollen zones containing irregular rafts of amphibolite, hornblende gneiss and some anorthosite, which display varying degrees of assimilation, within a coarse-grained to pegmatitic leucocratic granite.

Within this unit either hornblende or biotite can comprise the major mafic mineral, but pyroxene and garnet are no longer stable and amphibole, chlorite and epidote are common, indicating extensive retrogressive metamorphism to greenschist facies.

Unit 6 — Gabbroic Dykes:

Numerous fine to medium-grained dark grey to black, gabbroic dykes occur throughout the area. They generally contain hornblende and plagioclase with a typical salt and pepper texture and range in width from a few centimetres up to 70 metres in width. Within the S_1 domains the margins are chilled and relatively straight. Post-inclusion movement within the S_2 domains resulted in sheared and undulating contacts. A foliation is developed along the margins and alteration of hornblende to fine-grained, green amphiboles is common.

Two phases of dykes are exposed in some outcrops where younger dykes crosscut and display chilled margins against the earlier dykes. The relative age of a particular dyke can only be determined where the crosscutting features exist.

Unit 7 — Granitic Intrusions:

Granite and pegmatite occur as irregular dykes and veins in most outcrops throughout the area and the margin of a large granitic intrusion, centered on Fox Lake (Corkery, 1976) is exposed along the shore north of the town of Split Lake.

Pale pink granite containing feldspar and quartz with up to 5 per cent biotite is generally fine to medium-grained but irregular coarse-grained pegmatitic patches are common within the granitic veins. A second grey to buff, fine-grained granite with a locally developed vague foliation is observed as a later phase along the margin of the granite.

Pegmatite dykes which are massive, coarse-grained and pink are the youngest unit in the area.

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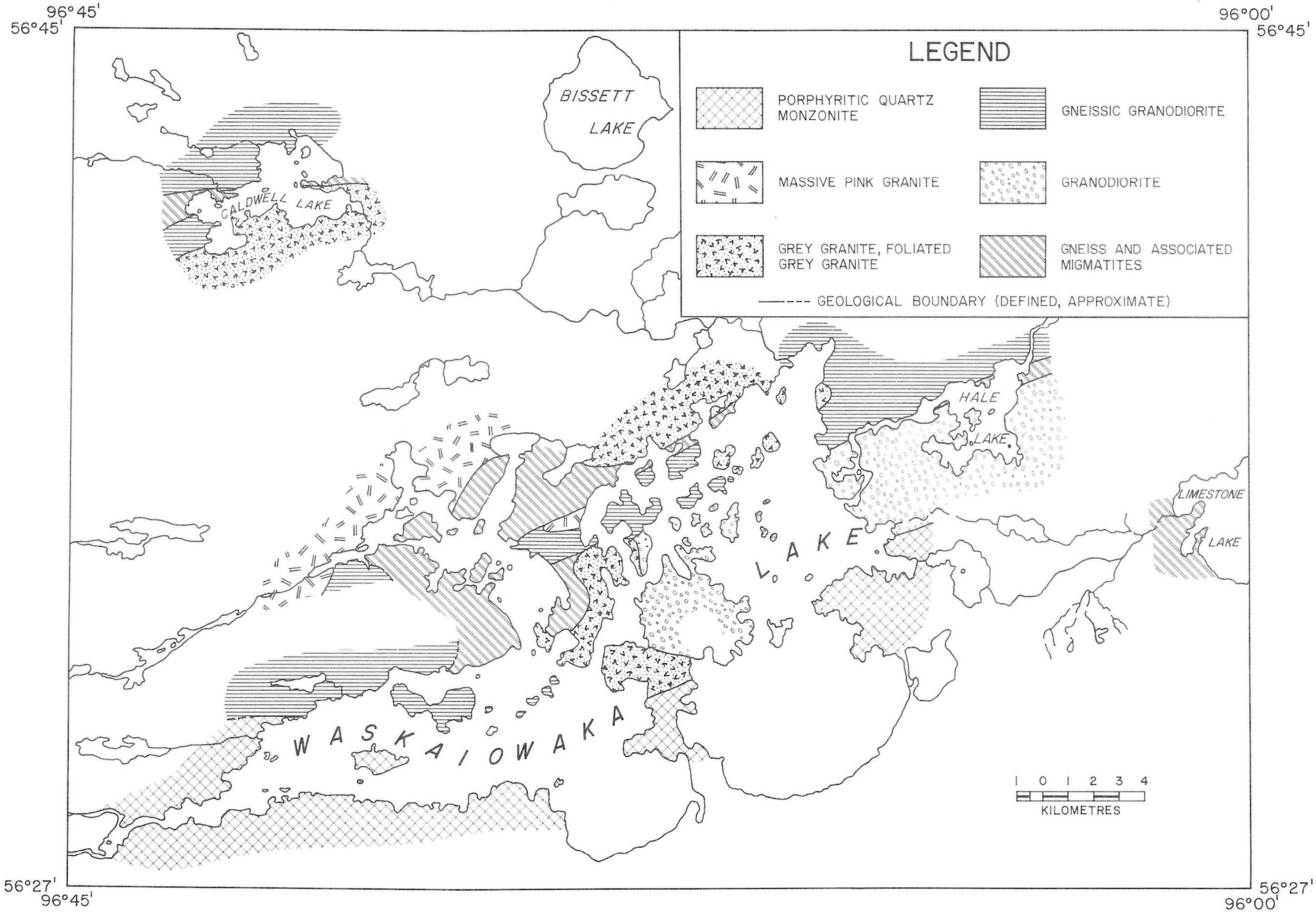

Figure GS-13-1 General Geology of the Waskaiowaka Lake area

GS-13 WASKAIOWAKA LAKE AREA

(Parts of 64A-7, 8, 9, 10)

by M.T. Corkery

Introduction

Geological field mapping was conducted on a reconnaissance scale in the Waskaiowaka Lake area during late July and August, 1977. The objectives were to obtain a preliminary overview in preparation for further work in the Baldock and Waskaiowaka Lakes area, and to ascertain whether the gneisses show affinities to the arkosic or greywacke derived metasedimentary groups (Figure GS-13-1) of the Churchill structural province. Due to the reconnaissance scale of mapping and the high degree of migmatization which persists throughout most of the area, the relicts of the gneisses could only rarely be equated with either of the Churchill metasedimentary groups.

Shoreline outcrops were mapped on Waskaiowaka Lake, Caldwell Lake and Limestone Lake.

A simplified geological map is shown in Figure GS-13-1. A preliminary 1:50 000 scale map is also available (Corkery, 1977).

GENERAL GEOLOGY

The rocks in the Waskaiowaka Lake area have been subdivided into three main groups:

Gneisses and derived migmatites
Granodiorite and Gneissic Granodiorites
Late granites and Quartz Monzonite

The oldest gneisses are highly migmatitic and contain felsic granitoid segregations which are interpreted as both mobilizate and injection. Extensive deformation has accompanied the migmatization and amphibolite facies mineral assemblages are dominant.

Granite and porphyritic quartz monzonite form late intrusive bodies which outcrop over widespread portions of the map-area.

DESCRIPTION OF ROCK UNITS

Unit 1 — Gneisses and derived Migmatites

This unit comprises a broad assemblage of gneisses in varying stages of migmatization. Three subunits are defined on the basis of their mineral assemblages; a fourth consists of diatexite.

Unit 1a is composed of light grey to dark grey, fine- to medium-grained, often well layered biotite gneisses and associated metatexites which contain a massive medium-grained, white to buff felsic mobilizate which ranges from 25 to 75 per cent of the rock. The unit is generally well foliated and is composed of plagioclase, quartz, and biotite with accessory local garnet and magnetite. In zones where granite veins and dykes are prevalent pink feldspar is also common.

Unit 1b is texturally similar to unit 1a but is pink-buff, often with a green cast, and is composed primarily of feldspar, quartz, dark green amphibole and biotite and common accessory magnetite.

Grey to dark grey, medium-grained hornblende gneiss (unit 1c) contains hornblende, plagioclase, minor quartz, and in some zones garnet. This unit is generally well layered on a scale of 1 cm to 10 cm and is commonly associated with the granodiorite (unit 2a). Three well layered outcrops in the area were found to contain layers or boudinaged layers of calc-silicate which are mainly composed of epidote and garnet.

Diatexite, unit 1d, contains highly mobilized and assimilated schlieric and/or nebulitic relicts of the gneisses, the original identify of which cannot be defined.

Unit 2 — Granodiorite, Gneissic Granodiorite

An intrusive body of massive to vaguely foliated granodiorite, unit 2a, is observed in the eastern portion of the map area. The most distinctive feature of this unit is the occurence of mafic clots, varying in size from 0.5 mm to 2 cm and comprising 20 to 40 per cent of the rock. Commonly the clots consist of medium-grained hornblende and biotite, within an equigranular matrix of feldspar and pale blue translucent quartz.

Local hornblende-rich mafic inclusions, averaging 10 to 20 cm in the large dimension, may comprise up to 5 per cent of the rock.

A more extensive foliated to gneissic granodiorite, unit 2b, outcrops throughout the northern half of the area. Numerous inclusion layers of amphibolite and amphibolite-biotite gneiss and medium-grained mafic-rich and mafic-poor layers parallel the foliation to produce a gneissic layering.

Hornblende, biotite and local chlorite comprise the dominant mafics with a matrix of plagioclase and quartz. Where granitic dykes have intruded a blastic growth of alkali-fledspar is commonly observed within the granodiorite, particularly near the contacts.

Unit 3 — Granite, Quartz Monzonite

Two distinct phases of granitic intrusion are recognized in the area, the relative ages of which were not determined. A large quartz monzonite body occupies the entire south side of the lake.

Unit 3a comprises a grey to pale pink, fine- to medium-grained granite, which is characterized by a random to slightly oriented distribution of biotite within the quartz-feldspar matrix.

Extensive bodies of coarser-grained massive pink granite, unit 3b, containing a mosaic of pink feldspar, white feldspar, quartz and minor chlorite, and magnetite are common throughout the northwestern portion of the area.

Unit 3c is a distinctive and relatively homogeneous unit of porphyritic quartz monzonite. This unit characteristically weathers pink to green-pink. Pink weathering tabular phenocrysts of feldspar, varying in size from 5 mm to 3 cm are surrounded by a medium-grained groundmass consisting of plagioclase, quartz, green hornblende and biotite. A foliation in the quartz monzonite body is defined by a preferred orientation of the feldspar phenocrysts.

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GS-14 SIPIWESK LAKE — WINTERING LAKE AREA

(63P-3, 4E1/2, 5, 63J-16N1/2)

by J.J.M.W. Hubregtse

Introduction

A 2-year mapping programme was initiated in the area bounded by Thompson and Wabowden in the northwest, and Cross Lake in the southeast. Areas mapped this summer include Bulger Lake, eastern Sipiwesk Lake (east of 97°45'), western Sipiwesk Lake (west of 98°10') and Wintering Lake (Hubregtse *et. al.*, 1977a, b, c and d). The main objective of this programme is to identify the origin of the granulites, underlying much of the map-area and their relationship with the greenstone belt-gneiss terrains of the Superior Province to the east and the southeast, and the Thompson Nickel belt and the Churchill Province to the northwest.

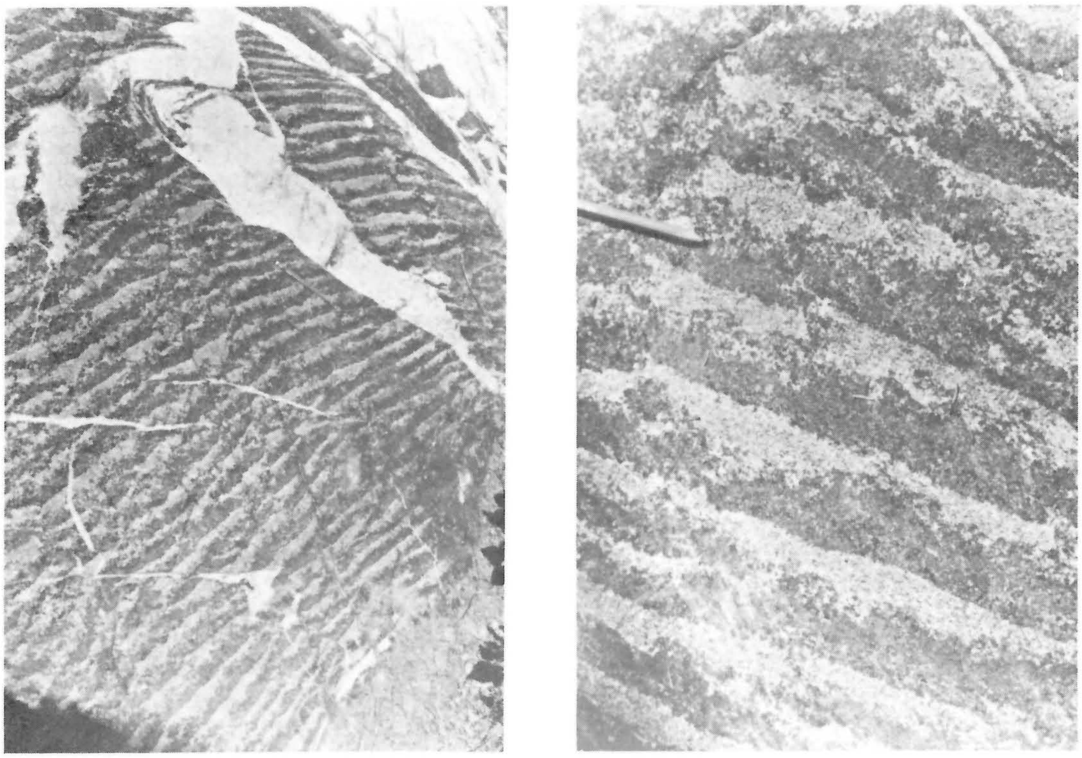

Figure GS-14-1: A: Rhythmic igneous layering in metagabbro of pre-M1 migmatite complex, Wintering Lake; pencil (17.5 cm) in centre for scale; B: Detail of A; width of area illustrated is 30 cm.

Bell (1971), on the basis of previous work in the area under investigation and the adjacent greenstone belt-gneiss terrain to the east (Rousell, 1965; Elbers, *et. al.*, 1973; Weber, 1974) proposed that the granulites formed the basement upon which the Archean greenstones were deposited. He referred to the granulite facies gneiss terrain as the Pikwitonei Province. Rousell (1965), on the other hand, considered the granulite facies metamorphism to be of Aphebian age, on the basis of K-Ar biotite ages. Another alternative which must be considered is that the granulites are Archean. In order to resolve this problem, we have embarked upon a Rb-Sr dating programme (whole rock method) to determine the original ages of the oldest units of the

Sipiwesk Lake-Wintering Lake area, and to test the validity of an early-Archean basement for the Superior Province. Results of preliminary work in the Cauchon Lake area (Weber, 1976) did not support Bell's (1971) justification for a separate, older structural province. Consequently, the high-grade gneiss terrain will be referred to as the Pikwitonei region (Weber, 1976) since Bell's (1971) interpretation of the granulite facies gneisses is at least contentious.

Geological history

The earliest geological events appear to have been more or less uniform throughout the entire map-area (see Table GS-14-1). The geological evolution of the northwest and southeast sub-areas diverged radically after the emplacement of a mafic dyke swarm and the development of structures that are almost exclusively confined to the northwestern area. Correlation between the northwest portion (Wintering Lake and western Sipiwesk Lake) and the southeast portion of the map-area (Bulger Lake and eastern Sipiwesk Lake) is tentative, since the central area, including Landing Lake and central Sipiwesk Lake, has not yet been investigated.

The early evolution of the Sipiwesk-Wintering Lakes area is similar to that of the northern Pikwitonei region near Ilford (Corkery & Hubregtse, 1975; Hubregtse, 1975). The oldest units are gabbro and minor picrite, which exhibit a "skaergaard type" rhythmic primary igneous layering in areas of weak deformation. A first order and a second order compositional layering are recognized. The first order layering was caused by gravity-settling of the original crystals within each layer, producing pseudo-graded bedding (Figure GS-14-1). The second layering reflects a repetition of gradually changing magma compositions from picrite to gabbro. These primary structures are best preserved on Wintering Lake. Remnants of the sequence occur throughout the map-area, but are rather rare in the Bulger Lake and southeastern Sipiwesk Lake area.

Intrusion of tonalite, and minor quartz diorite and diorite, resulted in the formation of migmatites. Felspar-phyric mafic dykes (Bulger Lake dyke swarm) were emplaced prior to the onset of the first phases of deformation and metamorphism (D_1 and M_1), which gave rise to the formation of a well-defined metamorphic layering. The dykes occur sporadically throughout the map-area but are very abundant in the Bulger Lake region. Conditions during the oldest metamorphic event (M_1) were most likely those of the (hornblende) granulite facies.

The second phase of metamorphism (M_2) is marked by the derivation of plagioclase-quartz (orthopyroxene/hornblende) mobilizate from the older meta-tonalites/enderbites and meta-gabbros. These mobilizates of tonalitic/enderbitic composition are the most significant members of an intrusive suite that was emplaced after M_1-D_1 but prior to D_2. The suite ranges in composition from minor monzodiorite and fine-grained tonalite, to quartz monzonite and pegmatite, and includes a few mafic dykes with "salt-and-pepper" texture and characteristic clotty aggregates of mafic minerals (clotty dykes). The metamorphic conditions of M_2 varied regionally but were most commonly those of the (hornblende) granulite facies. Kyanite nodules, ranging from 1 cm to approximately 30 cm in width, were encountered in syn-M_2 plagioclase-quartz mobilizate on southeastern Wintering Lake and southeastern Sipiwesk Lake. Only four occurrences of kyanite were noted in the map-area. The presence of kyanite rather than sillimanite points to a relatively high pressure/temperature ratio during the M_2 event. The D_2 deformation gave rise to the formation of the platy quartz texture that is characteristic for the high-grade rocks of the Pikwitonei region.

Garnet growth was a late M_2 and mainly post D_2 event. In mafic rocks garnets were formed as a result of a retrograde reaction between plagioclase and pyroxene during the waning stages of granulite facies metamorphism.

The southeast and northwest sub-areas evolved separately following the M_2 event. The southeast portion was only affected by cataclastic deformation, faulting, local mylonitization and the emplacement of two diabase dyke swarms, whereas regional metamorphism and strong deformation took place in the northwest area.

Wintering Lake-western Sipiwesk Lake area

The M_3-D_3 event in the Wintering Lake-western Sipiwesk Lake area was heralded by local, probably syn-tectonic "wet" anatexis of the older "dry" migmatites, along well defined linear northeast trending zones of movement. A mafic dyke swarm (Wintering Lake dyke swarm), pegmatites and fine-grained tonalite dykes were emplaced in the newly created zones of

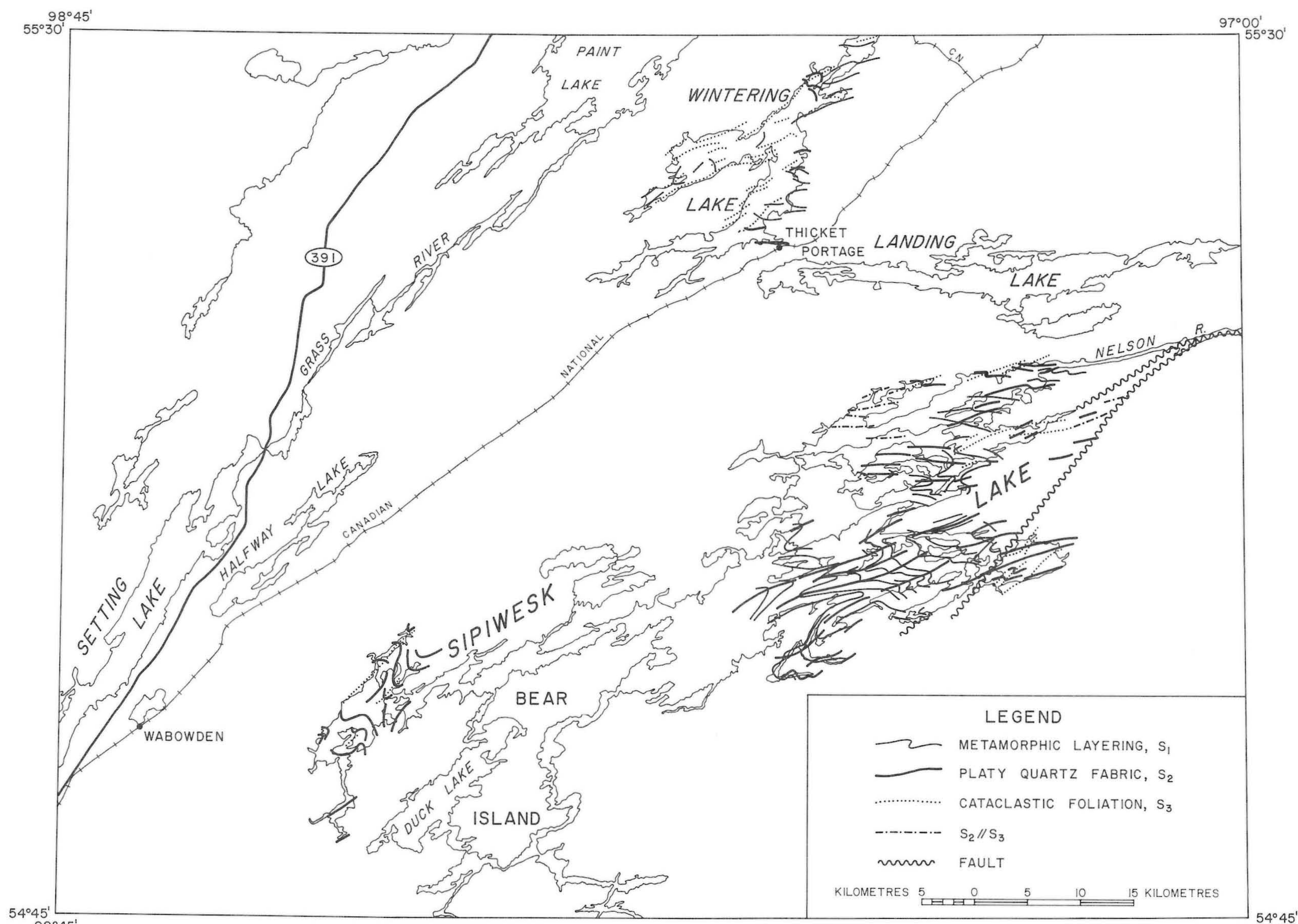

Figure GS-14-2 Structural map of the Sipiwesk Lake-Wintering Lake area

TABLE GS-14-1

ORDER OF EVENTS

Wintering Lake — western Sipiwesk Lake Area	Bulger Lake — eastern Sipiwesk Lake Area
	— "breccia dykes"
	— northwest trending diabase dyke swarm (McKenzie dykes)
	— D_5: northeast trending faults and mylonites
	— "diabase — breccia" dykes
— granite and pegmatite	— northeast trending diabase dyke swarm (Molson dykes)
— greenish-grey dykes of intermediate composition	— greenish-grey dykes of intermediate composition
— D_4: renewed shearing within S_3 — tectonite zones	— D_4: north-northwest trending mylonites
— D_3: profound shearing and (blasto-) mylonitization; formation of well-layered gneisses (S_3 — tectonites)	— D_3: cataclastic deformation, attenuation of augen gneiss, east-northeast trending mylonites
— M_3: amphibolite facies (granulite facies ?)	
— formation of M_3 — migmatite	
— pegmatite and tonalite	
— aphyric mafic dykes swarn (Wintering Lake dykes)	— aphyric mafic dykes
— local anatexis of older migmatite gneisses	

— growth of late — M_2, post-D_2 garnet

D_2: formation of platy quartz fabric (S_2)

M_2: (hornblende) granulite facies to amphibolite facies

— formation of M_2 — migmatites

— minor monzodiorite, fine-grained tonalite, quartz monzonite and pegmatite

— mafic dykes (clotty dykes)

— derivation of quartz-plagioclase (-orthopyroxene/hornblende) mobilizate from M_1 — migmatite gneiss

D_1: formation of metamorphic banding (S_1)

M_1: (hornblende) granulite facies (?)

— feldsparphyric mafic dykes (Bulger Lake dykes)

— formation of M_1 — migmatites

— tonalite, minor quartz-diorite and diorite enderbite ?)

— gabbro, picrite and leucogabbro with igneous layering (S_0)

structural weakness (S_3-tectonite zones). The Wintering Lake dykes are most useful indicators of D_3-activity. Undeformed, but metamorphosed meta-gabbroic Wintering Lake dykes can be traced into the S_3-tectonite zones in which the dykes were transformed into amphibolite bands. Extended movement of D_3 and subsequent cataclasis were concentrated in the S_3-tectonite zones producing well layered, often delicately banded migmatite gneiss in which the pre-M_2 and younger lithological elements are strongly attenuated and concordantly arranged. The transition from S_3-tectonite zones to older migmatite gneisses is generally abrupt and takes place within a few centimetres. The M_3-recrystallization is characterized by mineral assemblages typical of the middle and upper amphibolite facies.

The M_3-migmatites are characterized by mafic xenoliths enriched in biotite, and biotite-rich schlieren. The biotite enrichment is attributed to reaction between the syn-M_3 pegmatites and the more mafic country rocks during anatexis. The pegmatites became peraluminous as a result of the alkali depletion and characteristically contain muscovite and local garnet instead of biotite.

The last major event in the Wintering Lake area was the emplacement of a post-tectonic northeast trending granite body parallel to, or within the D_3-shear belts.

Bulger Lake-eastern Sipiwesk Lake

The D_3 deformation was mainly cataclastic and resulted in local attenuation of F_1 and F_2-structures with strain-slip along S_1 and S_2-planes local development of augen gneiss and minor folding. Locally it is accompanied by minor mobilization and reorientation of the platy quartz fabric. The cataclastic zones tend to grade into mylonites. Only a few mafic metamorphosed post-M_2 dykes occur in this portion of the map-area and their relationship with D_3 could not be established, nor is it certain whether these dykes can be correlated with the Wintering Lake dykes.

North-northwest trending mylonites (D_4) are most significant in the vicinity of Bulger Lake. They pre-date the emplacement of a widespread northeast trending unmetamorphosed diabase dyke swarm (Molson dyke swarm). The larger dykes, notably those just west of Bulger Lake, exhibit primary igneous layering, such as "pseudo-cross-bedding" and "pseudo-graded bedding". This dyke swarm is intimately associated with "diabase-breccia" dykes which consist of rounded to sub-rounded country rock fragments set in an aphanitic, locally glassy diabasic matrix. Younger northeast trending fault movements (D_5) often coincide with the northeast trending diabase and "diabase-breccia" dykes. Fault breccias associated with D5 are well developed in eastern Sipiwesk Lake. D_5-related mylonites, however, prevail in the Bulger Lake and McCormick Lake area.

Northwest trending diabases (McKenzie dyke swarm) truncate the abundant northeast trending dykes. A set of "breccia dykes" emplaced along pre-existing north-northwest and east-northeast joints form the youngest unit in this portion of the map-area. These "breccia dykes" consist of reddish fragments of country rock surrounded by a buff-green sporadically carbonaceous matrix.

Structure

The regional distribution of structural elements is shown in Figure GS-14-2.

The S_1-layering was mapped on eastern Sipiwesk Lake and along the east shoe and in the southwestern arm of Wintering Lake. The overall trend of S_1 is west-northwest in southeastern Sipiwesk Lake and changes to approximately east-west in northeastern Sipiwesk Lake and Wintering Lake. The S_1-structures are not preserved in domains of strong D_3-activity, such as Bulger Lake and western and northern Sipiwesk Lake.

The metamorphic layering S_1 is best preserved in southeast Sipiwesk Lake where it is folded by F_2 on a regional scale. The L_2 lineation (intersection and mineral orientation) is well developed in outcrop. The average direction of the F_2-fold axes trend 65° and plunges 58° east-northeasterly. The associated S_2-foliation is generally sub-vertical.

The S_1-S_2 relationship is less clear on a regional scale in the Wintering Lake area, although the S_2 quartz-plagioclase fabric is locally well developed in the rocks underlying the east shore. The S_2-fabric is the oldest structural element visible in western Sipiwesk Lake. The S_2-foliation trends northeast, west of southern Duck Lake, but is folded along northeast trending F_3-axes in the north portion of western Sipiwesk Lake.

D_3-activity is primarily characterized by the formation of mylonites, blastomylonites, shear zones and drag folds (S_3-tectonite zones). Regional F_3-folding is only of a minor nature and is mainly confined to western Sipiwesk Lake. S_3-tectonite zones are narrow and discrete in western Sipiwesk Lake. On Wintering Lake they form larger mappable units. D_3-trends were often deflected as S_3-shear planes formed preferentially along pre-existing foliations, particularly in the eastern Sipiwesk Lake-Bulger Lake area, where D_3 was a cataclastic event.

The remnants of "dry" pre-M_3 migmatite gneiss were hardly effected by younger shearing movement (D_4) in the northwest portion of the map-area, as shearing stress was preferably released along the linear belts of "wet" S_3-tectonite. North-northwest trending mylonites(D_4) and northeast trending mylonites and faults (D_5) transect the southeastern part of the map-area. A set of mylonites and faults (D_5) which converges towards the bend in the Nelson River east of Landing Lake, is most likely related to the major lineament that can be traced in east-northeast direction over a distance of 70 km directly south of Cauchon Lake (Weber, 1976).

Superior Province-Pikwitonei Region-Churchill Province Relationship

In a high-grade gneiss terrain, such as this, lithological units are irregularly distributed and discontinuous and the processes of migmatization and anatexis have a converging effect upon rocks of different age and origin. Consequently, as an alternative to conventional lithologic correlation, emphasis has been placed on the recognition and correlation of structural elements, an approach which has proved successful within the map-area over distances of 50 km. A similar correlation between the Pikwitonei region and the Cross Lake greenstone belt in the south, should establish the relative ages of deformational events within the supracrustal belt and the high-grade gneiss terrain. The findings of this detailed mapping programme will be augmented and hopefully supported by the geochronological work.

The early metamorphic and tectonic events appears to have been uniform throughout the map-area. After the formation of the late-M_2-garnet geological events were significantly more intense in the northwest portion of the map-area. It seems logical, therefore, to assume that the northeast trending D_3-structures (parallel to the Thompson nickel belt) belong to the Hudsonian orogeny. D_3 and M_3 are separated in time from the older granulite facies events by the Wintering Lake dykes. The age of this dyke swarm (Rb-Sr method) is currently under investigation. If our assumptions are correct, then the Hudsonian activity was not only confined to the northwest portion of the map-area but was also manifest as a chiefly cataclastic event in the Bulger Lake-southeastern Sipiwesk Lake area.

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GS-15 APHEBIAN METASEDIMENTARY ROCKS ON SETTING AND PAKWA LAKES

(63J-15 and 63O-2E)

by A.H. Bailes

Introduction

A brief examination of Aphebian metasedimentary rocks on Setting and Pakwa Lakes was undertaken to compare them to paragneisses of the Kisseynew Sedimentary Gneiss Belt and to sediments of the Thompson Group*. At the same time, the major rock units, mapped by Rance (1966), Cranstone (1969) and Bell (in press), were field checked so that they can be properly correlated on 1:250 000 geological compilation maps of 63J and 63O, which are in preparation by the Geological Services Branch.

Fieldwork involved examination of selected shoreline exposures on Setting and Pakwa Lakes, from June 1st to June 8th. I wish to thank Falconbridge Mines Limited for the use of their facilities in Wabowden during this field work.

Previous Geology

The Setting-Pakwa Lakes area includes the contact between the Churchill and Superior Geological Provinces. The east shore of Setting Lake comprises Archean layered migmatite gneisses (Cranstone and Turek, 1976), similar to those referred to by Scoates (this publication) as Moak Lake Gneisses. The remainder of Setting Lake, and the area to its northwest, consists of Aphebian paragneisses (Cranstone and Turek, 1976). A major fault, separating the Aphebian paragneisses and the Archean Moak Lake Gneiss, follows the east shore of Setting lake (Rance, 1966; Cranstone, 1969; Bell, in press). A large zone of cataclasis runs down the centre of Setting Lake. It outcrops along the east shore of the chain of large islands in the centre of Setting Lake (Cranstone, 1969).

Description of Aphebian Metasedimentary Rocks

Aphebian metasedimentary rocks, observed on northern Setting Lake and on northern Pakwa Lake, comprise a widespread sequence of conglomeratic and weakly conglomeratic meta-subgreywacke, with upper almandine amphibolite facies mineral assemblages, and a few small exposures of fine-grained meta-siltstone and meta-subgreywacke, with upper greenschist facies mineral assemblages. The former rocks are similar to the "arkosic" suite of paragneisses of the Kisseynew Sedimentary Gneiss Belt and the latter rocks, which outcrop only on a few tiny islands in the central Setting Lake are similar to sediments of the Thompson Group (Scoates, pers. comm.).

A brief description of the Aphebian metasedimentary rocks follows.

Conglomeratic and Weakly Conglomeratic Meta-Subgreywacke

The conglomeratic and weakly conglomeratic meta-subgreywackes are light grey to buff, magnetite-bearing, felsic quartzofeldspathic paragneisses. They are commonly thickly bedded and consist of alternating conglomeratic and non-conglomeratic beds (Figure GS-15-1). They are locally cross-bedded and contain numerous bright green calc-silicate beds. Clasts in the conglomerates are generally pebble-sized. The predominant pebble lithology is quartz and/or quartzite**. Quartzofeldspathic pebbles are the next most abundant clast type. Other pebble types are rare.

The conglomeratic and weakly conglomeratic meta-subgreywacke is strongly recrystallized and is characterized by upper almandine-amphibolite facies mineral assemblages. It has a strong biotite foliation and generally contains garnet porphyroblasts and/or metamorphic aggregates of fibrolitic sillimanite plus quartz (faserkiesel). On Pakwa Lake it is migmatitic and contains a pink granitic mobilizate. On the east shore of the chain of large islands in north-central Setting Lake, the unit is strongly crushed in a zone of cataclasis.

* The Thompson Group is defined by Scoates (this publication).

** All the quartz and quartzite pebbles are now meta-quartzites, due to strong metamorphic recrystallization and local cataclasis. Thus, no distinction could be made between primary vein quartz and quartzite pebbles.

Figure GS-15-1 Conglomeratic meta-subgreywacke:

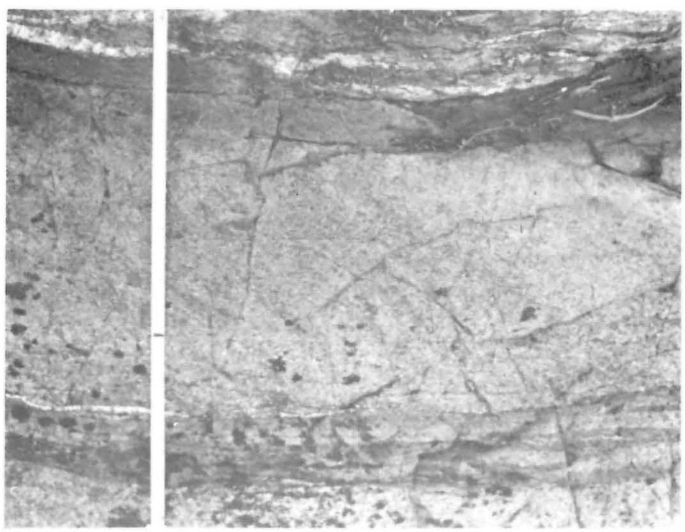

Figure GS-15-2 Metagreywacke with graded bedding

Meta-siltstone and Meta-subgreywacke

The meta-siltstone and meta-subgreywacke are light to medium grey and felsic to intermediate in composition. They are repetitively bedded, and graded bedding is common (Figure GS-15-2). Clasts at the base of thick beds of graded meta-subgreywacke are up to grit size. In these beds, the dominant clast lithology is quartz and/or quartzite*.
The grade of metamorphism of the meta-siltstone and meta-subgreywacke is probably upper greenschist facies. Biotite is the only metamorphic mineral megascopically visible.

The meta-siltstone and meta-subgreywacke exhibits cataclastic textures adjacent to and within the zone of cataclasis along Setting Lake.

Interpretation of Aphebian Metasedimentary Rocks

The conglomerate and weakly conglomeratic meta-subgreywacke is similar to, and probably correlates with, the "arkosic" group paragneisses of the Kisseynew Sedimentary Gneiss Belt. Both have the following features in common:

1) similar composition;
2) similar bedding characteristics, including local cross-bedding;
3) numerous thin calc-silicate layers;
4) accessory magnetite and, consequent, high aeromagnetic signatures;
5) large distinctive metamorphic aggregates of fibrolitic sillimanite plus quartz (faserkiesel);
6) light grey to buff colour; and
7) a pink granitic mobilizate in migmatitic varieties.

However:

1) the paragneisses are more strongly conglomeratic on Setting and Pakwa Lakes than they are elsewhere in the Kisseynew Sedimentary Gneiss Belt, including the Missi and Sickle Group of the Flin Flon and Lynn Lake Greenstone Belts; and
2) the dominant pebble-type in the conglomeratic paragneisses on Setting and Pakwa Lakes is quartz and/or quartzite, whereas in conglomeratic paragneisses adjacent to the Flin Flon and Lynn Lake Greenstone Belts, the pebbles are a heterogeneous mixture of immature clasts of the underlying volcanic and sedimentary strata.

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GS-16 "MISSI GROUP" ROCKS, WEKUSKO LAKE AREA

(63J-13)

by R.J. Shanks and A.H. Bailes

Introduction

Maps by Stockwell (1937), Frarey (1948) and Armstrong (1939) show a large area of sandstones east of Wekusko Lake. The sandstones, and contained conglomeratic layers, are similar, according to Frarey (1948), to Missi Group rocks, exposed 130 km to the west, near Flin Flon. An examination of the Missi-like rocks, east of Wekusko lake, was undertaken in 1977:

1) to compare these rocks to the Missi Group strata of the Flin Flon area;
2) to provide a representative stratigraphic section of these rocks;
3) to determine their environment of deposition; and
4) to provide information on an overlying suite of volcanic rocks.

Fieldwork, in 1977, involved examination of the most representative and best exposed sections of the Missi-like strata. Detailed examination was concentrated on outcrops chosen most suitable for meeting the project objectives (outlined above). Systematic mapping was undertaken only where the existing mapping was found to be inadequate.

Collection of sedimentological data from the "Missi Group" strata in the Wekusko Lake area was severely limited by heavy organic growth of lichen and moss on outcrop surfaces and by strong metamorphic recrystallization of strata. The zonation of metamorphic isograds on northern Wekusko Lake (Froese and Gasparrini, 1975) indicated a decreasing grade of metamorphism to the south, and suggested that rocks southeast of Crowduck Bay should be upper greenschist facies or lower. However, the metamorphic grade increases across a fault, which follows the southeast shore of Crowduck Bay, to almandine-amphibolite facies.

Comparison to Missi Group Rocks at Flin Flon

The "Missi Group" rocks at Wekusko Lake are 130 km from the type Missi strata at Flin Flon. The latter rocks have been interpreted by Mukherjee (1971) to be a piedmont alluvial fan. The Wekusko Lake "Missi" strata have the following features in common with the Flin Flon Missi strata:

1) both comprise a thick massive sequence of sandstone, mainly subgreywacke in composition;
2) siltstones and mudstones are absent;
3) the sediments are poorly sorted and immature;
4) large- and small-scale cross-stratification are common;
5) graded bedding is rare;
6) tabular units of conglomerate are present;
7) conglomerate units, in both, are immature and polymitic, and are composed mainly of clasts of the underlying volcanic strata; and
8) both unconformably overlie thick sequences of Amisk Group volcanic strata. (An unconformity under the "Missi" strata at Wekusko Lake is inferred from the large amount of volcanic detritus in the conglomerate units and by one fragment of spheroidally weathered basalt. The latter is a common fragment type in basal Missi Group conglomerates, at Flin Flon, and is derived from regolith or underlying Amisk volcanic strata.)

It is suggested that there are enough similarities between these two groups of strata to warrant those on Wekusko Lake being referred to as part of the Missi Group.

Stratigraphy

The main features of Missi Group sedimentary rocks, in the Wekusko Lake area, are summarized in Table GS-16-1. Most of the data in Table GS-16-1 is from three sections (Figure GS-16-1) where Missi strata were examined in detail.

The oldest rocks of the Missi Group (see Section A), comprise a pebble conglomerate (unit 1a), overlain by a massive sequence of sandstones (unit 2a), overlain, in turn, by a second pebble conglomerate (unit 1b). The first pebble conglomerate (unit 1a), which is thought to be

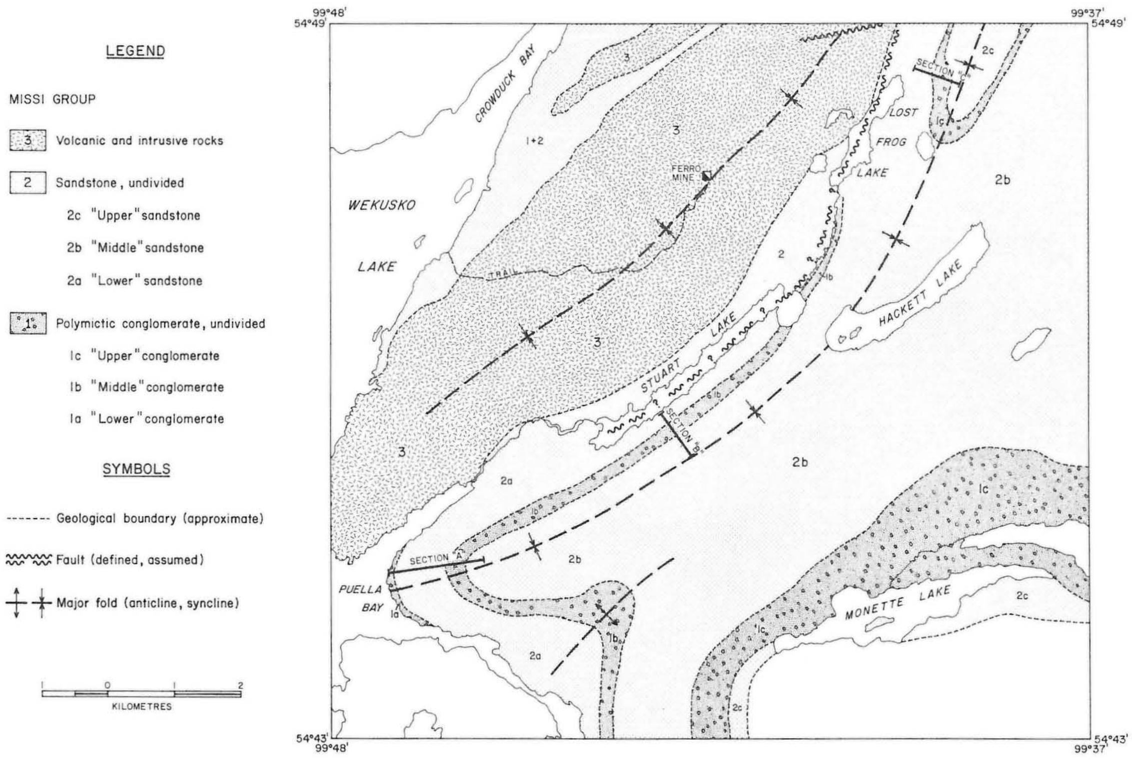

Figure GS-16-1 General Geology of Missi Group Strata, Wekusko Lake Area

TABLE GS-16-1

Main features of the Missi Group Sedimentary Rocks

	Unit No.	Thickness (in metres)	Rock Type	Common Clast Type	Mineralogy	Character of Bedding	Primary Structures and Textures	Comments
	2c	300	Medium- to coarse-grained sandstone		Sandstone strongly recrystallzied and composed of a mixture of quartz, feldspar and biotite		Minor cross-bedding	Quartzite pebbles present locally
Section C[1]	1c	240	Polymictic conglomerate	In order of abundance: intermediate, felsic, and mafic volcanic pebbles; quartzite pebbles, cobbles, and boulders; quartz and feldspar porphyry pebbles, cobbles, and boulders; sandstone pebbles and cobbles, granite pebbles and cobbles; epidote-rich pebbles; biotite-rich gneissic pebbles; gabbroic pebbles; gabbroic pebbles; iron formation pebbles and cobbles		Conglomerate beds are lenzoid; conglomerate beds are separated by very coarse-grained sandstone beds	Minor graded bedding	Conglomerate contains boulders up to 60 cm in size
	2b	1300	Fine- to medium-grained sandstone		Sandstone strongly recrystallized and composed of a mixture of quartz, feldspar, biotite and, rare, garnet porphyroblasts		Abundant cross-bedding	Sandstone beds locally contain quartzite pebbles
Section B[1]	1b	160	Polymictic conglomerate	In order of abundance: intermediate, felsic, and mafic volcanic pebbles; quartzite pebbles and cobbles; quartz porphyry pebbles; sandstone pebbles		Conglomerate beds are lenzoid and alternate with thick, very coarse-grained sandstone beds sandstone beds	Minor graded bedding	
	2a	700	Medium- to coarse-grained sandstone		Sandstone strongly recrystallized and composed of a mixture of quartz, feldspar, and biotite		Cross-bedding common; minor graded bedding	Sandstone locally contains pebble conglomerate bands
Section A[1]	1a	65	Polymictic conglomerate	In order of abundance: intermediate, felsic, and mafic volcanic pebbles; quartzite pebbles; cobbles, and boulders; granite pebbles		Bedding is defined by alternating beds of conglomerate and coarse-grained sandstone		Large well-rounded quartzite boulders, up to 70 cm in diameter, noted locally; one pebble of a spheroidally weathered mafic volcanic rock observed

[1] For section location see Figure 1

very close to the base of the Missi Group, is only exposed along the east shore of Puella Bay. The second conglomerate (unit 1b) is a laterally extensive unit.

The middle part of the Missi Group sedimentary rocks have been examined south of Stuart Lake (see Section B). In this area a thick section of sandstones (unit 2b) overlies the second conglomerate layer (unit 1b). Southeast of Lostfrog Lake (see Section C) the sandstones of unit 2b are overlain by a third conglomerate layer (unit 1c). Unit 1c is a thick and laterally extensive layer of conglomeratic rocks. It is overlain by a sequence of homogeneous massive sandstones (unit 2c).

North of Stuart Lake and south of Crowduck Bay a thick sequence of volcanic rocks and related intrusions (all included in unit 3 in Figure GS-16-1) overlie sedimentary rocks of the Missi Group. The stratigraphic position of the Missi Group sedimentary rocks in this area, relative to those previously discussed, is not known because of a fault interpreted to run down Lostfrog and Stuart Lakes (Figure GS-16-1). Thus, it is not known whether the volcanic rocks comprise part of the Missi Group. These rocks are described, more fully, later in this report.

Environment of Deposition

The depositional environment of the Missi Group sediments, east of Wekusko Lake, has not been established. A local source of detritus is suggested by the high percentage of volcanic rocks fragments, which could have been derived from the underlying Amisk volcanic strata, in conglomerate layers. A turbid medium of deposition is indicated by poor sorting and the matrix supported character of the conglomerate layers.

The Missi sediments east of Wekusko Lake are very similar to the Missi sediments at Flin Flon, where Mukherjee (1971) interpreted the Missi Group sediments as a piedmont alluvial fan deposit.

Overlying Volcanic Rocks

North of Stuart Lake and south of Crowduck Bay, Missi sediments are overlain by a thick 1600 metre section of volcanic strata. The volcanics are dominantly mafic to intermediate in composition, with several layers of felsic volcanic strata. This suite of rocks was examined along the east shore of Wekusko Lake, along the trail into the Ferro Mine, and in a few selected localities northwest of Stuart and Lostfrog Lakes. Some of the more important features observed in these rocks are:

1) top determinative structures verifying that volcanic rocks overlie the Missi sedimentary rocks;
2) pillow structures were not observed in mafic volcanic rocks, with the exception of exposures on the east shore of Wekusko Lake. This observation was also made by Stockwell (1937);
3) all volcanic rocks in this suite contain abundant disseminated magnetite, reflected in their very high aeromagnetic signature; and
4) several of the felsic volcanic horizons are extremely fragmental, have a strong flow layering and contain shard-like fragments. They may be welded tuffs.

The lack of pillow structures and the presence of possible welded tuffs in the volcanic sequence suggest it may be a subaerial deposit. The high magnetite content of volcanic strata indicates they may be alkaline in composition. A representative suite of samples has been collected for geochemical analysis.

Future Investigations

This project will form the basis of a M.Sc. thesis study to be done by R. Shanks at the University of Manitoba. Work planned as part of the M.Sc. study includes analysis of data and samples, collected in 1977, and further fieldwork in 1978.

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GS-17 SOUTHEASTERN MANITOBA

(Parts of 52E, 52L and 62I)

by D.A. Janes and J. Malyon

Field mapping of Precambrian outcrop in southeast Manitoba from the U.S. border to the Winnipeg River has been completed to 1:50 000 scale. During the 1977 field season, the remaining gaps were covered by two field parties under D. Janes and J. Malyon using canoe, fixing wing and helicopter access to complete pace and compass traverse.

In addition, a short mapping project was carried out west of Tooth Lake to fill a gap in previous mapping.

One week of helicopter traverses were undertaken north of the Winnipeg River between Anson and Round Lakes. The object was to gain further information on the composition of the sedimentary-volcanic band separating the two centres of the "Great Falls" quartz diorite. It was found that volcanic and sedimentary enclaves form a part of this zone and can be related to the Bird River greenstone belt in the south, and the Maskwa River volcanics in the north. The area is largely underlain by quartz diorite to diorite of the Great Falls batholith and the zone probably represents an enclave-rich roof zone between two intrusive cupolas.

General Geology of S.E. Manitoba

A simplified compilation map of the Precambrian outcrop of Manitoba south of the Winnipeg River is included with this report (Figures GS-17-1,2).

The rocks of this region are of Archean age and form part of the Superior Province of the Canadian Shield. In the area mapped, the rocks can be divided into five groups of one or more units.

1. Old Volcanic-Sedimentary Complexes
(Units 1, 2, 3, 4 and tentatively 6)

Three distinct outcrop areas of these rocks occur within the map boundaries:

(a) Powawassan River-Indian Bay (Lamb, 1975).
(b) West Hawk Lake (Lamb, 1975).
(c) Bird River-Winnipeg River (Trueman, 1975).

The first two listed above are extensions of the Kenora sub-province in Ontario and occur as small bodies and fragmentary lenses within intrusive felsic rocks.

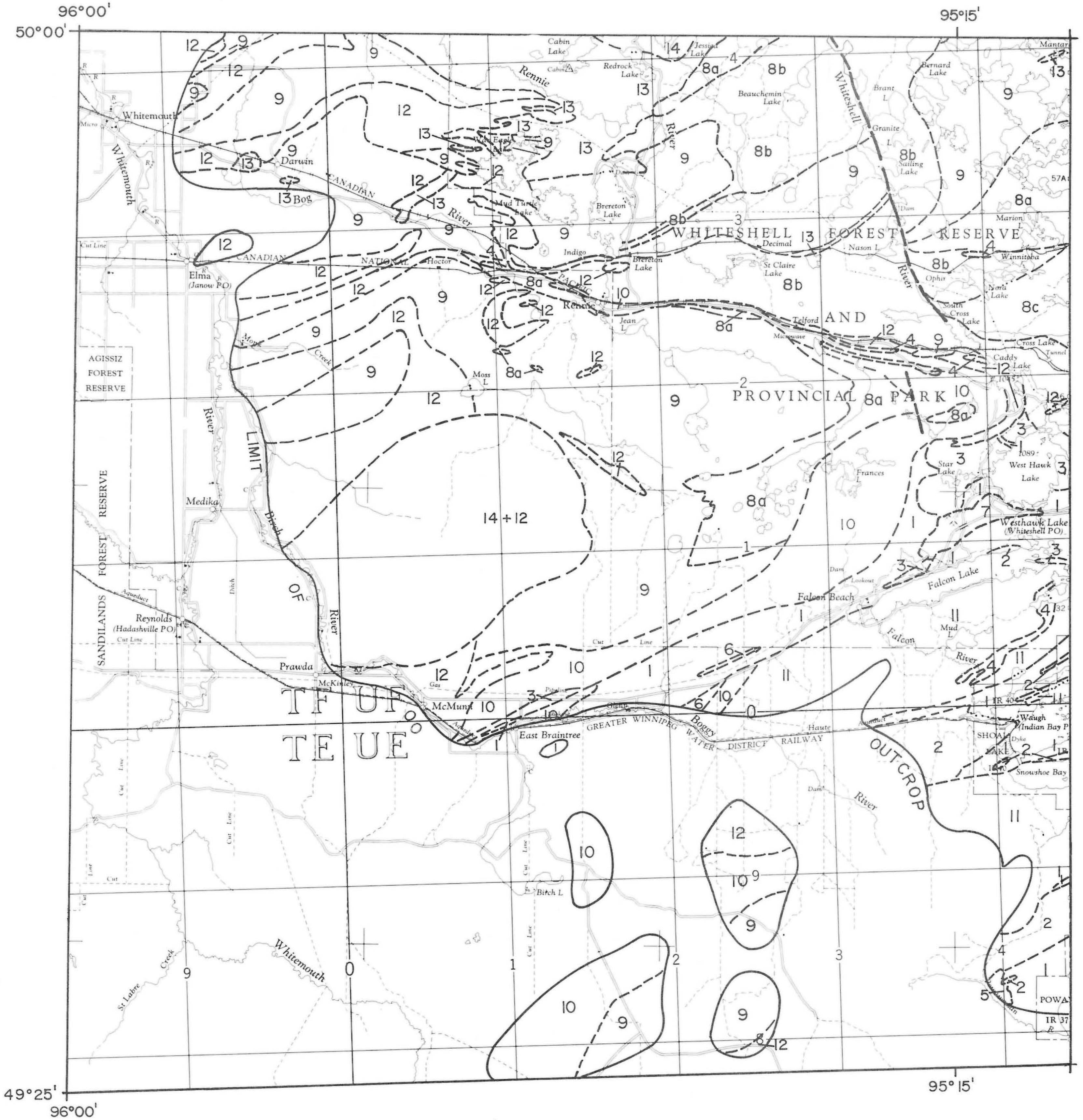
The Bird River-Winnipeg River rocks have been assigned to the Winnipeg River plutonic division of the English River sub-province (Beakhouse, 1977).

2. Gneissic Complex
(Unit 8)

This unit has been termed the Early Gneissic Suite (Beakhouse, 1977). In fact, the predominant lithology of these rocks within the map-area is quartz dioritic to granodioritic. The rocks are gneissic to schlieric and contain minor but significant content of old enclaves of sedimentary and volcanic gneiss, presumably derived from Group 1 rocks, though this is not clear in all cases. Several small bodies of orthogneiss (usually deformed diorites to trondhjemite), were mapped as were several small enclaves (1 to 30 acres) of layered, clearly sedimentary gneisses.

3. Syn-tectonic to post-tectonic Intrusives
(Units 9, 10, 11)

These rocks range in composition from quartz diorite to monzogranite but most are granodioritic. They underlie at least 50% of the area mapped and have the form of composite batholiths. Their emplacement appears to be diapiric and controls the present outcrop pattern.



LEGEND

Precambrian Intrusive Rocks

15	Pegmatite sills, dykes, stocks.
14	Red, coarse grained granite.
13	Brown porphyritic granodiorite
12	Pink to buff quartz monzonite and granodiorite contains less than 10% schollen or nebulitic inclusions.
11	Pink granodiorite (West Hawk belt).
10	Frances Lake porphyroblastic granodiorite (probably metasomatic).
9	Granodiorite and quartz diorite.

Gneissic Complex

8(a)	a) nebulite to schollen textured gneissic granodiorite.
8(b)	b) schollen to nebulite textured quartz diorite gneiss
8(c)	c) grey equigranular quartz diorite.
8(d)	d) layered grey paragneiss

Intrusive Rocks of Uncertain Age

7	Falcon Lake stock.
6	Coarse amphibolite, derived from clinopyroxene rich rocks.
5	Hornblende gabbro.

Early Metamorphic Rocks

4	Amphibolite, probably derived from metavolcanic and metasediments.
3	Metasedimentary rocks.
2	Felsic metavolcanic rocks.
1	Mafic metavolcanic rocks.

0 1 2 3 4 5 10 Kilometres

0 1 2 3 4 5 10 Miles

Figure GS-17-1 Geology of the Wesk Hawk Lake-Winnipeg River Region, southern area

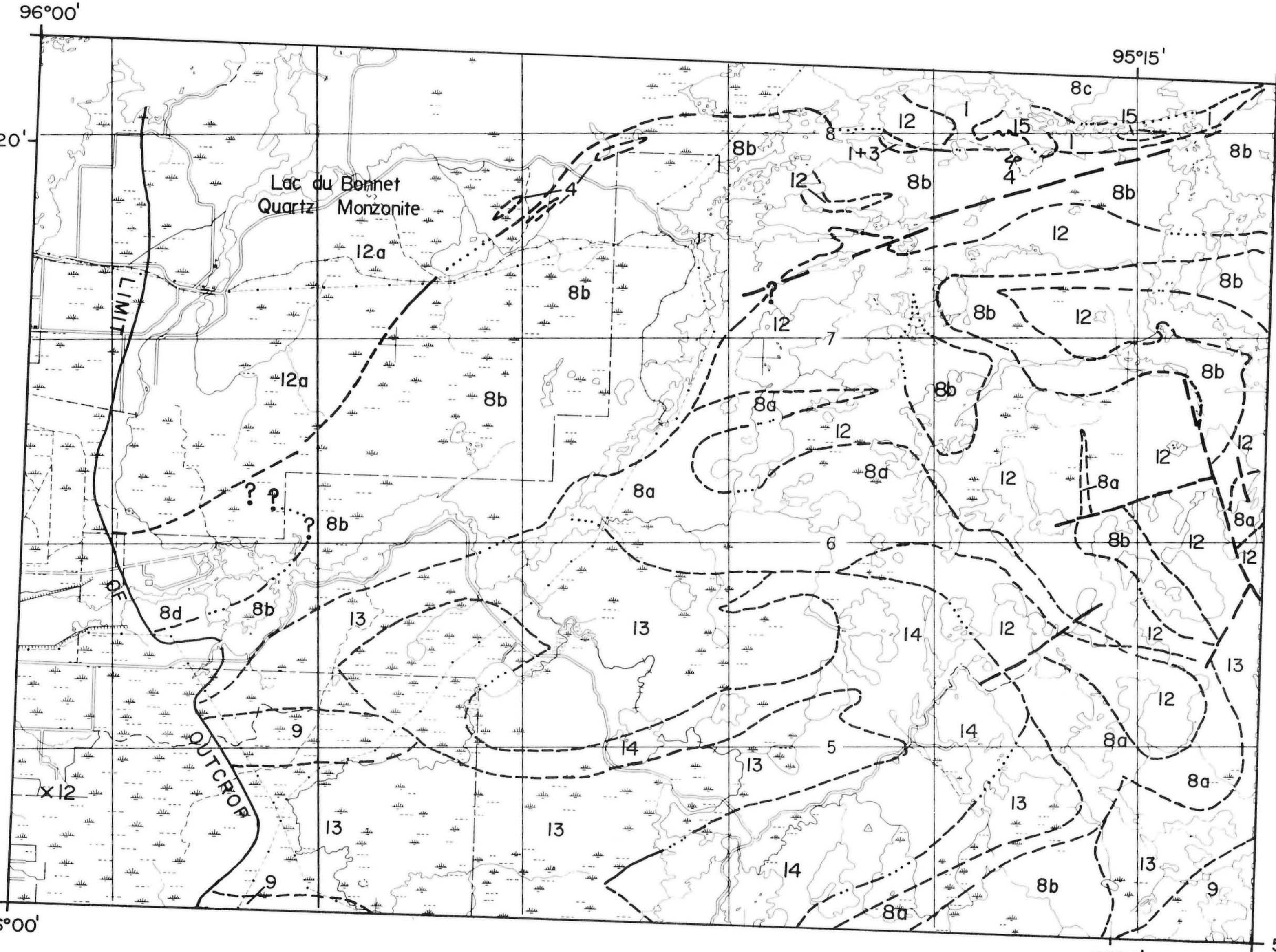


Figure GS-17-2 Geology of the Wesk Hawk-Winnipeg River Region, northern area (Legend as for Figure GS-17-1)

4. Metasomatic Intrusives
(Unit 13)

This unit covers a wide range of composition, from quartz diorite to syenogranite, related by the common factor of potassium feldspar blastesis and a dark red-brown colour. The rocks occur within a zone from the Ontario border to the edge of Paleozoic outcrop roughly parallel to the Winnipeg River. The rocks are characterized by the development of coarse porphyroblastic microcline, commonly twinned and aligned parallel to the unit boundaries. The potassium blastesis has been superimposed on rocks ranging from quartz diorite to granodiorite, with the development of feldspar blasts in a finer-grained groundmass. A spectacular coarsely-grained syenogranite may be an intrusive phase related to the metasomatism, since it occurs both within the belt and to the south within the Kenora block on the Birch River. The unit intrusive into the Syn-tectonic and Gneissic groups and appears to have intruded their contact. It is associated with topographic and airphoto lineaments and forms the southern limit of the beryl occurrences of the Greer Lake Winnipeg area.

5. Intrusive Monzogranites, Epigranites and Related Rare Element Pegmatites
(Units 12, 15 and Lac du Bonnet Monzogranite)

These rocks are clearly post-tectonic and the sills to stocks of pink, fine-grained biotite monzogranite are tentively correlated to the Lac du Bonnet quartz monzonite (McRitchie, 1971). They occur between the West Hawk volcanics and the Winnipeg River. Rocks of this group cut all other rocks other than the small plugs of highly differentiated epigranite and associated rare element pegmatites which occur within this zone and in the Winnipeg River volcanics. The beryl pegmatites are assigned to this group.

Economic Geology

The relationship of the beryl containing pegmatites to Unit 8b (Gneissic Complex) has been verified. A zone of minor beryl pegmatites extends from east of Greer Lake to the Winnipeg River south of Pointe du Bois. The larger pegmatite dykes are found in association with a distinctive gneissic monzogranite and a pink granite aplite, commonly having banding of thin garnet-rich and garnet-poor bands. While these relationships are geologically interesting, beryl occurrences found to date have been subeconomic.

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GS-18 STRATIGRAPHIC CORE HOLE PROGRAMME

by H.R. McCabe

The 1977 stratigraphic core hole programme was undertaken jointly with the Mineral Evaluation Branch (B.B Bannatyne) and the Exploration Operations Branch (D.S. Evans). The industrial minerals and exploration data derived from the drilling are discussed elsewhere in this report. Four separate projects were involved (Figure GS-1).

(a) Stonewall area: quarry site evaluation.
(b) Miami Area: shale evaluation.
(c) Lake St. Martin Area: mineral distribution and structure of the crypto-explosion crater.
(d) Red Deer River Area: geochemical anomaly evaluation and reef structure.

This year all drilling was carried out utilizing the J.K.S. 300 wire line drill with a maximum rated depth capacity of 300 metres, rather than the small "Winkie" drill used previously. Use of the "300" drill permitted drilling of much deeper holes, in more difficult rock formations, and through thicker overburden. Drilling was done "in-house", using existing laboratory staff. Results were satisfactory with respect to drilling costs, but total footage of 699 m was not as high as hoped for. However, rates of 20 to 30 m per day were attained under favourable drilling conditions. Performance can undoubtedly be improved as operating experience is acquired. Overall, the drill proved highly satisfactory for this type of stratigraphic core hole programme, where road access is possible.

Stonewall Area:

Five holes were drilled in the general Stonewall area to test potential quarry sites, where hammer seismic studies had indicated overburden thicknesses of less than 3 metres. Results showed that all locations have an overburden thickness greater than anticipated, and that data from seismic surveys will have to be checked carefully. It is hoped that a detailed comparison of core hole data with the seismic records may permit more accurate estimates of overburden thickness.

Miami Area:

Three holes were drilled in the Miami area to obtain samples from portions of the Cretaceous section (especially lower Boyne) that are not exposed or are only poorly exposed in outcrop. These samples were required to evaluate the possible use of the shales for ceramic purposes (B. Bannatyne, MEA-13 this report). Satisfactory core recovery proved to be very difficult in these partly bentonitic beds, and modified drilling techniques would be required in any future core hole programme in this area.

Lake St. Martin Area:

Four holes, totalling approximately 330 metres were drilled north and west of the town of Gypsumville. These holes provide significant new data concerning the Lake St. Martin crypto-explosion crater since compilation of Geological paper GP3/70 (McCabe, H.R. and Bannatyne, B.B., 1970). Inasmuch as no further publication is anticipated on this area at the present time, a more extensive than normal discussion of the drill results is presented herewith. The reader is referred to Paper GP3/70 for background data and detailed geologic map.

Hole M-13-71, drilled near the northern end of the gypsum quarry was located at a point close to the centre of the crater annulus midway between the central uplift and the crater rim where a maximum thickness of crater fill was anticipated. Results show a sharp thinning of Mesozoic (Amaranth) section relative to the main quarry area. Placement of the thick (21.6 m) sequence of dolomite breccia in the lower Amaranth (Table GS-18-1) is possibly open to two different interpretations. The writer has suggested that these are late breccias, derived from the "crater rim" and deposited more or less contemporaneously with the Amaranth (Jurassic?) beds. The "crater rim" in this case would be merely the much later topographic (exhumed) expression of a deeply eroded structure. Alternatively, these breccia beds could have formed

TABLE GS-18-1

Summary of Core Hole Data

Hole No.	Location and Elevation (est.)	Formation/Member		Interval metres	Summary Lithology
M-1-77	NE 16-8-13-2E	(overburden)		0 — 4.5	Clay, boulder till
	(+ 800')	Stony Mountain	— Gunton	4.5 — 6.4	Dolomite, buff, mottled
			— Penitentiary	6.4 — 12.5	Argillcaeous dolomite
			— Gunn	12.5 — 22.0 T.D.	Argillaceous limestone, shale
M-2-77	NE 8-11-13-1E	(overburden)		0 — 6.4	Clay and till
	(+ 810')	Stony Mountain	— Williams	6.4 — 10.8	Red shale, sandy dolomite
			— Gunton	10.8 — 21.6	Dolomite, buff, mottled
			— Penitentiary	21.6 — 23.0 T.D.	Argillaceous dolomite
M-3-77	SE 1-27-12-1E (+ 795')	(overburden)		0 — 11.4 T.D.	Clay, boulder till
M-4-77	SW 4-14-12-1E (+ 790')	(overburden)		0 — 12.8 T.D.	Clay, boulder till
M-5-77	NW 15-8-12-2E	(overburden)		0 — 4.9	Clay
	(+ 795')	Stony Mountain	— Gunn	4.9 — 23.2	Argillaceous limestone, calcareous shale
M-8-77	SW 5-24-4-7W	Riding Mountain	— Odanah	0 — 13.7	Shale, siliceous
	(+ 1,425')			13.7 — 32.6	Shale, bentonitic
		Vermilion River	— Millwood	32.6 — 38.4	Shale, bentonite
			— Boyne	38.4 — 74.4 T.D.	Calcareous and non-calcareous shale
M-10-77	NE 14-32-3-6W	Overburden		0 — 5.2	Till
	(+ 1,245')	Vermilion River	— Boyne	5.2 — 30.5(?)	Calcareous and non-calcareous shale
				30.5(?) — 55.5 T.D.	Shale, carbonaceous
M-12-77	SW 1-14-4-6W (+ 975')	Favel		0 — 45.1	Limestone, calcareous speckled shale, oil shale
M-13-77	NE 5-2-33-9W	Amaranth(?)		0 — 18.0	Gypsum
	(+ 835')			18.0 — 20.7	Limestone, argillaceous
				20.7 — 32.3	Dolomite breccia
				32.3 — 35.7	"Red Beds" (sandy breccia)
		St. Martin Series		35.7 — 37.8	Polymict breccia
				37.8 — 55.5	"Trachyandesite" and breccia
				55.5 — 82.9	Carbonate breccia (mostly limestone — Devonian?)
				82.9 — 103.9	Microbreccia, granitic
				103.9 — 127.7 T.D.	Highly shocked and altered granitic rock (basement?)
M-15-77	SW 2-29-32-9W	(overburden)		0 — 9.6	Clay, till
	(+ 820')	St. Martin Series		9.6 — 137.6 T.D.	Carbonate breccia
M-16-77	9-8-32-9W	(overburden)		0 — 25.6	Silt, boulder till
	(+ 810')	St. Martin Series		25.6 — 51.0 T.D.	Carbonate/shale breccia
M-17-77	SW 10-8-32-9W	(overburden)		0 — 16.8	Silt, boulder till
	+ 810')	Red River	— Fort Garry	16.8 — 26.7 T.D.	Dolomite
M-18-77	C 3-17-45-25W	Dawson Bay	— (Member B)	0 — 4.3	Limestone, basal dolomite
			— Second Red Beds	4.3 — 14.3	Shale, red to grey
		Winnipegosis	— transition beds	14.3 — 24.4	Limestone, vuggy, minor dolomite
			— upper (reef)	24.4 — 97.5	Dolomite, massive, vuggy
			— lower (platform)	97.5 — 109.4	Dolomite, nodular
		Ashern		109.4 — 111.2 T.D.	Shale, red and grey

much earlier, shortly after crater formation, in which case they would represent the earliest normal sedimentary fill in the crater. If the latter interpretation is correct, the underlying St. Martin Series represents an essentially complete sequence of contemporaneous crater fill, virtually unaffected by any appreciable post-crater erosion. If the breccia is of Amaranth age, however, the underlying crater fill has been subjected to an unknown but probably extensive amount of pre-Amaranth erosion. A detailed study of the nature of the breccia fragments and also the nature of the sand grains in the "Red Beds" section (32.3 m - 35.7 m) will be undertaken to resolve this question.

The beds occurring in hole M-13-77 below the Amaranth(?) beds undoubtedly correlate with the St. Martin Series, and consist of an upper unit of "trachyandesite" or melt rock similar to that found elsewhere within the crater, but all highly altered and/or weathered, and with an abundance of included rock fragments. Below this is a sequence of carbonate breccias showing a wide range of lithologic types. Most fragments are calcareous, with a Devonian aspect, but in general cannot be correlated with any known Devonian lithologies. These beds are, in turn, underlain by a 21 metre section consisting dominantly of granitic micro-breccia containing scattered small carbonate rock fragments.

The basal 23.8 metres of hole M-13-7 consists of extremely altered and "shocked" granitic or basement rock with several thin intervals of micro-breccia and trachyandesite. The continuity of granitic lithology suggests that these rocks comprise the crater floor, although they could possibly comprise merely a zone of coarse granite breccia. Although the presence of true shock features will have to await petrographic studies, visual examination suggests a degree of shock considerably greater than that observed in the central uplift; the degree of alteration (or weathering?) also seems higher. If these granitic rocks do in fact represent basement, then the crater fill (= depth) is much shallower than anticipated, and it is difficult to reconcile the 104 metre basement depth in hole M-13-77 with the 137 metres of carbonate in hole M-15-77 or the 318 metres noted previously in the Bralorne Gypsumville 8-20-32-28W test hole.

The western portion of the crater rim has previously been defined to within about ± 1.5 kilometres by two earlier holes, LSM-6 and LSM-7, but the amount of structural uplift on this flank of the crater was uncertain. In an attempt to locate the crest of the rim, three holes were drilled, with hole M-17-77 finally intersecting what appears to be the uppermost part of the rim. The diameter of the crater thus appears to be approximately 1 kilometre greater than previously estimated; the present best estimate is 24 kilometres. The first two holes, M-15-77 and M-17-77 both intersected carbonate breccia beds of the St. Martin Series. These breccias represent material slumped into the crater from the uplifted rim at the time of crater formation, and suggest a position immediately within the rim.

Hole M-17-77 intersected 10 metres of dolomite beds at a depth of 16.8 metres. Although no diagnostic marker beds were intersected, the relatively uniform dense dolomite is believed to comprise part of the Fort Garry member — the uppermost member of the Ordovician Red River Formation. The dolomite beds show relatively little brecciation, and bedding lamination, where discernible, is surprisingly close to horizontal. The "normal" lithology and apparent structural and stratigraphic continuity with hole LSM-7 strongly indicate that these beds are part of a normal stratigraphic sequence on the uplifted crater rim. Also strongly indicative of a position on the crater rim was the presence of an artesian flow that was intersected at the top of the dolomite beds. Artesian flow requires that the beds be directly connected to, or comprise part of, a regional aquifer, a condition that can occur only outside of the crater. No artesian flows are known or would be expected from the crater fill. Local farmers report the existence of an arcuate belt of artesian wells on this flank of the crater, extending to the town of St. Martin. This artesian trend is believed to coincide with the crater rim.

Structural data for hole M-17-77 indicate that the crater is asymmetric, with only about 103 metres of uplift on the western rim compared to 228 metres on the eastern rim. As a result, Precambrian rocks which occur in outcrop on the eastern rim of the crater, occur at a depth of approximately 150 metres on the western rim (based on extrapolation of hole M-17-77). A superimposed regional dip to the southwest accounts for approximately 50 metres of this difference.

Although data are still sparse, the new core holes suggest that the lithology of the crater fill also is asymmetric, with carbonate breccia forming a higher proportion of the crater fill towards the west, and trachyandesite and granite breccia apparently more common towards the eastern rim of the crater. This possibly is the result of the different stratigraphic sequences exposed around the crater rim because of the differing amounts of structural uplift.

The nature of the "carbonate breccia" in hole M-15-77 possibly offers some evidence as to mode of crater formation. The "breccia" apparently consists of a series of large slump or fault blocks. Each block shows some degree of internal brecciation, ranging from slight to intense, but this involves only in-situ brecciation with no mixing of lithologies. Although positive age correlation will have to await micro-fossil studies, tentative correlations based solely on lithology suggest that the uppermost breccia beds, consisting of interbedded limestone and dolomite, are of Devonian age, possibly correlative with the upper member of the Dawson Bay Formation. The section appears to repeat the same lithologic sequence three times. The middle portion of the carbonate breccia consists of dense dolomite having a distinctly Silurian aspect, and the lower portion of the breccia has a distinctly Ordovician aspect, including some argillaceous beds almost certainly correlative with the Stony Mountain Formation. Thus, despite large-scale faulting and/or slumping, the breccias have maintained an approximte stratigraphic succession, from Devonian to Silurian to Ordovician, although the succession is highly fragmentary and abbreviated. The 128 metres of carbonate breccia in hole M-15-77 is believed to span a stratigraphic section estimated at 500 metres or more, which section probably was exposed in the crater rim at the time of formation.

Limited faunal data on earlier drill holes, obtained since publication of Paper GP3/70, (T.T. Uyeno, pers. comm.) have confirmed the presence of Devonian Elm Point and Souris River beds as components of the carbonate breccias. To date, the youngest strata occurring in the carbonate breccias of the St. Martin series are of Upper Devonian Souris River age, but the possibility of finding still younger strata cannot be ruled out. In any case, these carbonate breccias offer the only possible key to paleo-geographic events on the northeastern flank of the Williston basin, for the interval mid-Silurian to Jurassic.

Although the new data described above add considerably to the bank of geological data available for the crater structure, a great deal more data will be required before the crater configuration and stratigraphy can be defined accurately, let alone a definitive origin ascribed to this feature.

Red Deer River Area:

This joint project with the Exploration Operations Branch (D.S. Evans) involved the drilling of one core hole to the base of the Devonian section, to test for possible base metal mineralization. A previous biochemical survey by Exploration Operations Branch, along a winter road on the north bank of the Red Deer River, showed three principal trace element anomalies. Two of these were drilled last year (Holes D-47-76-2 and D-47-76-14). Both locations proved to be structurally low inter-reef locations, with Devonian strata overlain by 25 metres of glacial overburden and Jurassic(?) shales and sandstone. However, the third anomaly, drilled this year, occurs at a prominent structural-topographic dome roughly 120 metres by 180 metres in diameter. The dome reflects the presence of an underlying Winnipegosis reef, with the outcropping lower Dawson Bay beds draped over the reef. Because the location of the drill hole is on the crest of the dome (reef), the core provides the first known complete core of the central portion of a Winnipegosis reef, (i.e. located precisely with respect to reef configuration).

Preliminary core examination indicates a slightly higher than usual concentration of pyrite in the Winnipegosis Formation, especially in the uppermost beds, but no sulphide mineralization other than pyrite was noted.

Below a thin 14 metre cover of lower Dawson Bay beds, hole M-18-77 encountered, as expected, a moderately strong (± 5 litres per minute) flow of brackish water from uppermost Winnipegosis beds. The final flow rate, on removal of drill rods at completion of the hole, was several times the initial flow rate, but despite the strong water flow, the hole was plugged and cemented with no difficulty. The total Winnipegosis thickness proved to be approximately 95 metres, one of the thickest reported to date in Manitoba. The upper 10 metres of the formation consist mainly of an extremely coarsely recrystallized vuggy limestone. The calcareous beds are referred to as the transition beds, and have been noted at the top of the Winnipegosis sequence in most core holes. Below the calcareous beds is a 73 metre section of massive dolomite showing variable fine to coarse vuggy porosity and patchy relict coral-algal-biofragmental texture. These "reef" beds pass sharply downward to a thin 12 metre platform facies of nodular-bedded, fine-grained somewhat argillaceous dolomite believed to be Elm Point equivalent.

A boat traverse was made down the Red Deer River from Red Deer Lake to Highway 10 to check for additional outcrops. Only three other outcrops were noted (SW2-13-45-26, NE9-7-45-25, and N14-8-45-25), all of which appears to consist of lower Dawson Bay beds forming structural/topographic domes roughly comparable to that described at hole M-18-77, although the structural configuration of the third noted outcrop is poorly defined. Several large salt flat complexes were also checked for outcrop. Non was noted, but angular rubble of limestone similar to lower Dawson Bay beds was observed on the river bank in the vicinity of 14-11-45-26, and patches of abundant angular vuggy dolomite of Winnipegosis-type were noted within the salt flats. In all likelihood, the large salt spring complex, approximately 1.6 by 2.0 kilometres, centred in 5-11-45-26 represents a Winnipegosis reef complex capped by a thin cover of lower Dawson Bay beds.

References

McCabe, H.R. & Bannatyne, B.B
1970: Lake St. Martin Crypto-explosion crater and geology of the surrounding area; *Man. Mines Br.*, Geol. Paper 3/70.

GS-19 LIST OF PRELIMINARY MAPS

1977F-1	Whitemouth, East Half (52E-13E) by D.A. Janes and J. Malyon	re-issue	1: 50 000
1977F-2	Pinawa (52L-4) by D.A. Janes and J. Malyon	re-issue	1: 50 000
1977H-1	Harding Lake (64B-1, 630-16NE) by W.D. McRitchie		1: 50 000
1977H-2	Rock Lake (64A-4, 64A-3W) by W.D McRitchie		1: 50 000
1977H-3	Hunter Lake (63P-13NW) by W.D. McRitchie		1: 50 000
1977H-4	Waskaiowaka Lake (parts of 64A-7,8,9,10) by M.T. Corkery		1: 50 000
1977L-1	Fox Mine (parts of 64C-12, 64C-11) by H.V. Zwanzig		1: 50 000
1977L-2	Eager Lake (parts of 64C-12, 64C-11, 64C-5) by J. Keay		1: 50 000
1977L-3	McGavock Lake (part of 64C-11) by P. Gilbert, H.V. Zwanzig & B. McGill		1: 50 000
1977L-4	Lynn Lake area (part of 64C-14) by P. Gilbert		1: 50 000
1977L-5	Cockeram Lake area (part of 64C-15) by R. Syme and P. Gilbert		1: 50 000
1977L-6	Sickle Lake, North Half (64C-10N) by R. Syme		1: 50 000
1977L-7	Barrington Lake, West Half (64C-16W) by R. Syme		1: 50 000
1977M-1	Brochet, Regional Compilation (64F) by W.D. McRitchie and J. Peters		1:250 000
1977M-2	Big Sand Lake, Regional Compilation (64G) by W.D McRitchie		1:250 000
1977N-1	Bulger Lake (63P-3) by J.J.M.W. Hubregtse, R.T. Kusmirski, and R. Charbonneau		1: 50 000
1977N-2	Sipiwesk Lake, East Half (63P-4E) by J.J.M.W. Hubregtse, R.T. Kusmirski and R. Charbonneau		1: 50 000
1977N-3	Wintering Lake (63P-5) by J.J.M.W. Hubregtse, N.G. Culshaw and R. Charbonneau		1: 50 000
1977N-4	Duck Lake, North Half (63J-16N) J.J.M.W.Hubregtse and N.G. Culshaw		1: 50 000

1977N-5	Split Lake, Northeast (parts of 64A-1,8, 54D-4,5) by M.T. Corkery	1: 50 000
1977S-1	Nejanilini Lake (64P) by D.C.P. Schledewitz and H.D.M.Cameron	1:200 000
1977S-2	Shethanei Lake (64I) by D.C.P. Schledewitz	1:200 000
1977S-3	Caribou River (54M) by D.C.P. Schledewitz	1:200 000
1977S-4	Churchill (54L) D.C.P. Schledewitz	1:200 000
1977T-1	Moak Lake (parts of 63P-13NE, 63P-14NW) by R.F.J. Scoates and J. Macek	1: 20 000
1977U-1	Burntwood-Odei Rivers, West Half (63P-14N), (64A-3SE) by W. Weber	1: 50 000
1977U-2	Burntwood-Odei Rivers, East Half (64/A-2W) by W. Weber	1: 50 000

The following maps have been revised and updated.

1969A	Ultramafic Rocks of Manitoba by R.F.J. Scoates
Index Map 7A	Preliminary Geological Maps; Man. Min. Res. Div., Geological Survey

THE MINERAL EVALUATION AND ADMINISTRATION BRANCH

INTRODUCTION

Except for gold evaluation (MEA-1) all field programs by personnel in the Mineral Evaluation and Administration Branch were carried out under cost-shared Federal/Provincial agreements.

The four-year Non-Renewable Resource Evaluation Program entered its third year on April 1, 1977. Field investigations for the massive sulphide project (MEA-2) took place in greenstone belts of the Superior Province and in the Flin Flon area. The Sherridon — Batty Lake — Limestone Lake area was investigated for its potential for massive and disseminated base metal mineralization (MEA-3). Environments for nickel mineralization were studied in the Island Lake area and other selected locations in the Superior and Churchill Provinces (MEA-4), and in the Lynn Lake greenstone belt (MEA-5).

Evaluation of uranium environments (MEA-6) became part of the Canada-Manitoba Exploration and Development Agreement on April 1, 1977; field work was carried out in northern and southeastern Manitoba. Other projects under this agreement undertaken by personnel in the Mineral Evaluation and Administration Branch are concerned with industrial minerals and especially sand and gravel resources near urban centres. Field investigations were carried out in the Brandon region (MEA-7) and the Winnipeg region (MEA-8) supplementing work carried out for the Department by Underwood McLellan and Associates Ltd. Studies of Quaternary geology with emphasis on sand and gravel resources were carried out in the Cranberry Portage — Flin Flon region (MEA-9), The Pas region (MEA-10) and eastern Manitoba (MEA-11).

The peat project (MEA-12) continued investigation of sphagnum bogs in southeastern Manitoba. Drilling for industrial minerals (MEA-13) took place at various localities in southern Manitoba to obtain information on dolomite, limestone, shale and gypsum resources.

September, 1977

F.J. Elbers
Director, Mineral Evaluation
and Administration Branch

MEA-1 GOLD EVALUATION PROGRAM

by J.W. Stewart

1. West Hawk Lake — Falcon Lake Area

This area forms the western extension of the Wabigoon greenstone belt of Kenora; felsic volcanic rocks in the Lake of the Woods region do not extend into Manitoba.

Gold mineralization in the district is strongly focussed on the Falcon Lake stock, a composite mafic-felsic body measuring 3.6 x 2.4 km at surface. The Sunbeam-Kirkland deposit, an inclined pipe-like zone of intense silicification and sericitic alteration occurs within the felsic core of the stock. The pipe was explored to a depth of 145 m with development of 110 000 tons of potential ore grading 0.256 oz. Au/ton, but there has been no production.

This pipe seems to provide a classic example of "porphyry"-type gold mineralization. Pyrite is abundant in the silicified zone and is accompanied by accessory sphalerite and galena; pyrrhotite, arsenopyrite, tennantite and molybdenite have also been recorded. A similar mineralized pipe occurs on the Moonbeam claims, 275 m to the NW. Southeast of the Kirkland — Sunbeam pipe, planar shear zones in the felsic core of the pluton have been mineralized, and show a paragenesis and gold values similar to those of the pipe.

Numerous minor gold showings are found in the country greenstones, mostly within 1 km of the periphery of the stock. Those within massive volcanic rock take the form of quartz veins in shears, whereas several occurrences within volcanic conglomerate on the NW flank of the pluton appear to be associated with cherty, sulphide iron formation.

The only gold occurrence in the volcanic rocks to be explored underground was on the Penniac Reef claims, located in volcanic conglomerate on the contact of the pluton; strong pervasive silicification is present.

2. Rice Lake Gold District

One and a half million ounces of gold have been produced from this district, 80% of it from the San Antonio gold mine which operated from 1932 to 1968. Stephenson (1971) has dealt comprehensively with the geology and genesis of the numerous gold deposits.

Although felsic volcanic rocks, including fragmental varieties, are abundant in this belt, gold mineralization shows a distinct predilection for mafic host rock, and all of the seven former producers and most of the major prospects are wholly, or in a few instances, partly, within mafic rock ——— especially diabase. Gold mineralization accompanies quartz veins developed in shears and fractures. Generally there is quite strong wall rock alteration, particularly in mafic hosts, with formation of abundant chlorite and carbonate. Pyrite is the dominant sulphide, subsidiary chalcopyrite is of general occurrence, and arsenopyrite and sphalerite are found in most of the major deposits.

The sites of the former producing mines (San Antonio, Jeep, Central Manitoba, Ogama-Rockland, Oro Grande-Solo, Diana and Gunnar) and various minor deposits were visited and the geological settings and spoil heaps examined.

The essentials of Stephenson's (op. cit.) genetic model for the gold deposits are endorsed. This model entails the extraction of gold (and other elements enriched in the mineralization) from country rocks by late-tectonic hydrothermal solutions. Controls of mineralization envisaged by Stephenson are: (a) structural: comparatively competent rock types such as diabase and dacite more readily supported continuous fractures, and thus favoured strong vein structures, (b) chemical: the gold content of veins tends to be higher in host rocks rich in ferromagnesian minerals; the more mafic the rock, the more intense the reaction with the mineralizing fluid.

There is little to suggest the involvement of exhalite horizons in the regional gold mineralization. A possible exception may occur at the Central Manitoba Property, where the veins are closely associated with a chert horizon.

3. Flin Flon — Snow Lake Belt (Refer to Figure MEA-1-1)

To the north and east of Flin Flon many gold showings are indicated on the 1 inch = 1 mile

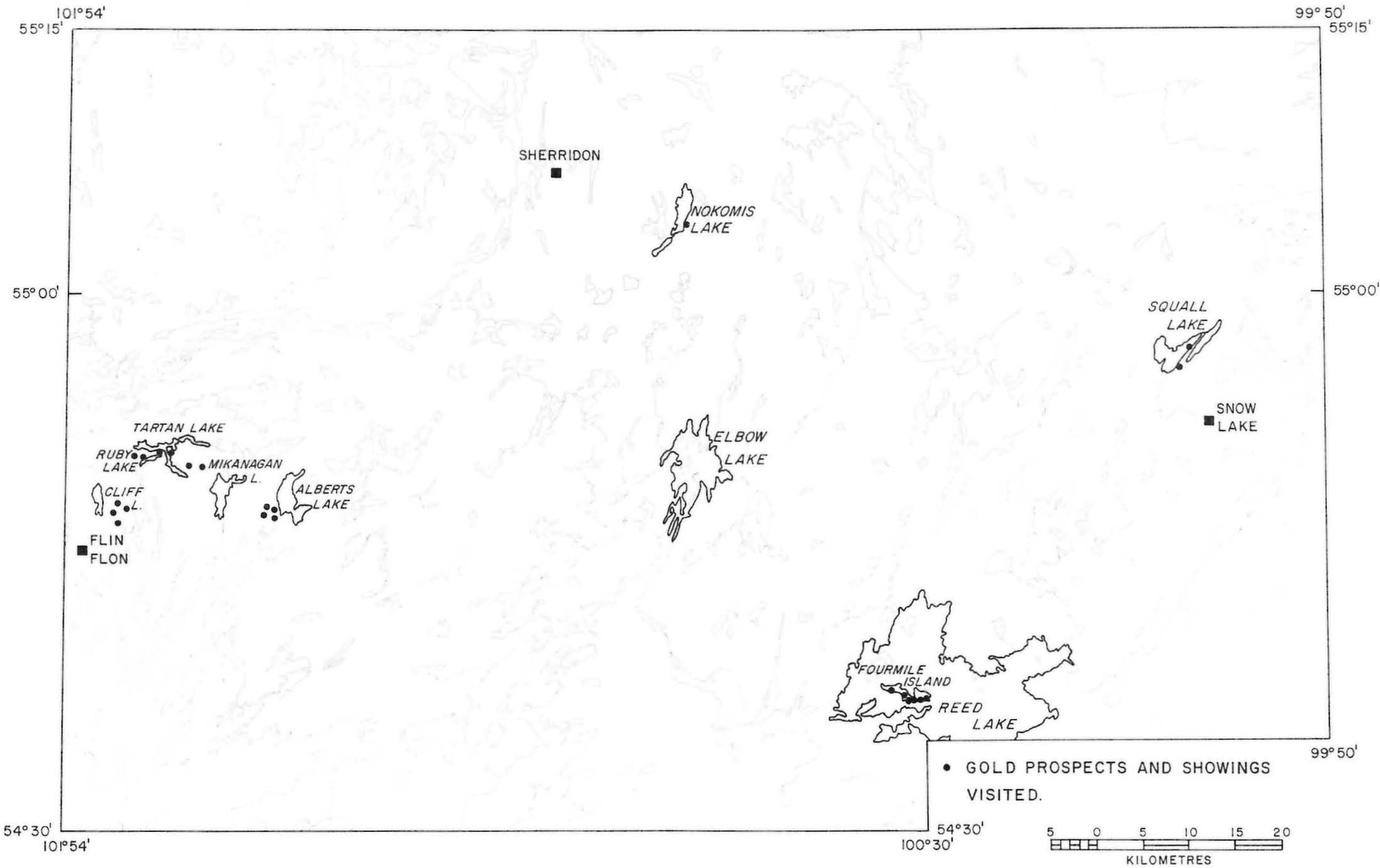

Figure MEA-1-1 Location of gold evaluation activities, Flin Flon — Snow Lake belt

geological maps of Tanton (1941) and Bateman and Harrison (1945). These showings are located in the Cliff Lake quartz porphyry stock 3 km NE of the city, in mafic volcanic rocks around Ruby Lake, in a body of gabbro stretching from Tartan Lake to Mikanagan Lake, and in gabbro at the SW corner of Alberts Lake.

Gold showings in the Cliff Lake porphyry correlate strongly with enclaves of mafic country rock, and with zones within the porphyry showing contamination by such material. Mineralization, confirmed by the presence of prospecting pits, occurs as isolated areas a few metres across, characterized by a light rusty weathering and/or veinlets of white quartz. The rustiness is caused by weakly disseminated pyrite, accompanied in places by minor chalcopyrite; the quartz ranges from indefinite silicification and stockworks of tiny veinlets to discontinuous veins up to 25 cm thick. Irregular masses of massive, fine-grained chlorite accompany some of the veins, which sporadically contain schorl and a little carbonate. At some of the showings the porphyry has been shattered, with production of a mosaic of angular fragments about 10 cm across. The fragments are lightly coated with silica and chlorite, and a little sulphide is present.

It is suggested that deuteric fluids of the stock, or perhaps extraneous hydrothermal fluids, leached various major elements, and gold, from mafic enclaves (and wall rock?), eventually depositing quartz, chlorite, schorl, sulphide and gold in open spaces in the porphyry.

Of nine showings located (with difficulty) in the Ruby Lake — Tartan Lake — Mikanagan Lake and Alberts Lake areas, all but one share closely similar characteristics. The exception is a strongly folded pyritic layer, possibly as much as 10 m thick, located at the extremity of a sliver of volcanic rocks which extends NW for 3.2 km from the west shore of Mikanagan Lake into the gabbro body.

Each of the remaining eight showings, whether in gabbro or mafic volcanic rock, consists of vein quartz in a shear zone. The sheared wall rock is impregnated with carbonate and, locally, with sulphide — mainly pyrite. The vein is of massive white quartz with a little schorl on planes parallel to the walls, concentrations of coarse crystals of brown carbonate, and knots of pyrite with minor associated chalcopyrite, occur sporadically. Two of the occurrences are adjacent to dikes of quartz porphyry; the dike rock does not appear to be affected by the mineralization.

A quartz porphyry body on Fourmile Island at the south end of Reed Lake is similar to the Cliff Lake porphyry near Flin Flon, containing evidence of greenstone digestion, analogous weakly mineralized shatter zones and weak silicic stockworks. Veins of massive quartz in faults or shears in the porphyry presumably provided some encouraging gold values; two veins have been explored with shafts and pits. The veins show extreme variations in thickness, and in outcrop appear as a series of boudin-like bodies up to 2 m thick and measuring up to 9 m along strike, separated by narrow necks, or pinching out for intervals of several metres. Wall rock alteration appears to be somewhat variable, involving silicification, chloritization and the development of disseminated carbonate. Sulphide is scarce (unless perhaps, in vein material already removed) and only pyrite was seen.

Gold mineralization is present in amphibolitic gneiss in a metasedimentary gneissic sequence on the east shore of Squall Lake, approximately 7 km north of Snow Lake township; the amphibolitic rock is thought to represent a gabbroic sill. Gold, iron sulphides and arsenopyrite are reported to occur with quartz and some associated chlorite in shear zones concordant with the foliation. Mineralization of similar character is developed in amphibolitic gneiss of uncertain origin on the east shore of Nokomis Lake, 14.5 km ESE of Sherridon. The mineralization of the two occurrences is certainly not post-tectonic, to judge by the diffuse margins and absence of overt wall rock alteration. Whether the mineralizing process accompanied development of the foliation, or represents gold quartz veins of an original mafic sill or stratum, sheared out and remobilized, is an open question.

The contrast of these two occurrences with auriferous quartz veins in the diabase and gabbro intrusions of the Rice Lake and Flin Flon districts is evident. Deposits of the latter type commonly are discovered by investigation of more or less prominent quartz veins, generally of steep attitude. Gold mineralization of the gneissic rocks, on the other hand, is much more diffuse, and adopts the attitude of the host rock foliation (at Nokomis Lake there is a 30° dip to the east). As grades of around 0.2 oz. Au/ton appear to be quite usual for mineralization in the gneissic occurrences, deposits of this type might advantageously be sought.

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MEA-2 EVALUATION OF MASSIVE SULPHIDE ENVIRONMENTS

by G.H. Gale, D.A. Baldwin, L. Solkoski, G. Ostry and M. Fedikow

Introduction

Field studies in 1977 were conducted mainly in greenstone belts of the Superior Province and parts of the Flin Flon belt (Fig. MEA-2-1)

The objectives of the project for 1977 were to:

(a) investigate the environments of deposition of volcanic and sedimentary rocks in selected greenstone belts;
(b) examine known mineral deposits and establish their stratigraphic positions, types and forms; and
(c) provide a data base for use in evaluating the massive sulphide potential of the Superior Province.

This is a preliminary report of our investigations. A more detailed account to be presented in the next NREP annual report will incorporate the results of geochemical studies and further compilations of data from field studies and assessment data files.

Methodology

Areas for investigation were selected prior to the field season on the basis of available geological maps, assessment work records and access. No attempt was made to remap an area; the aim was simply to establish the geological environment(s) present within individual map units by studying several cross-sections through each greenstone belt.

Sulphide occurrences and areas from which sulphide mineralization was reported in assessment work were examined to determine (a) the type and form of the mineralization, (b) associated lithologies, (c) nature of alteration, and (d) relative stratigraphic position within the greenstone belts.

Environments

Volcanic and sedimentary terrains were classified into the following environment types.

Type I Flows and pyroclastic rocks
Type II Volcaniclastic rocks (Synvolcanic)
Type III Volcanogenic sediments (Synvolcanic)
Type IV Clastic sediments (Intervolcanic)

An example of the "environment" maps is presented in a simplified form in Figure MEA-2-2. Areas for which detailed geological maps are available, e.g. in the Greenstones Project area (Campbell et al, 1971), are amenable to the establishment of depositional environments, whereas other areas within the Superior Province, and most areas in the Flin Flon greenstone belt, require considerable re-investigation prior to outlining environment types.

Mineralization

Massive sulphide lenses, sulphide iron formation, chert horizons and zones of hydrothermal alteration are common. The greenstone belts with the highest frequency of occurrences of these phenomena are those enclosing Island Lake, Knife Lake and Knee Lake. A number of sulphide occurrences noted on geological maps, especially in the Island Lake area, are mobilizates formed during intrusive activity which took place distinctly later than the volcanism.

Previously unrecorded alteration zones and stringer sulphide mineralization were observed in the Knife Lake, Knee Lake, Bigstone and Island Lake greenstone belts. These zones of alteration are characterized by the development of veins and lenses of Mg-chlorite and/or sericite which can generally be observed in outcrop for several hundred metres, both along and across strike. Sulphide mineralization is generally present as veins and

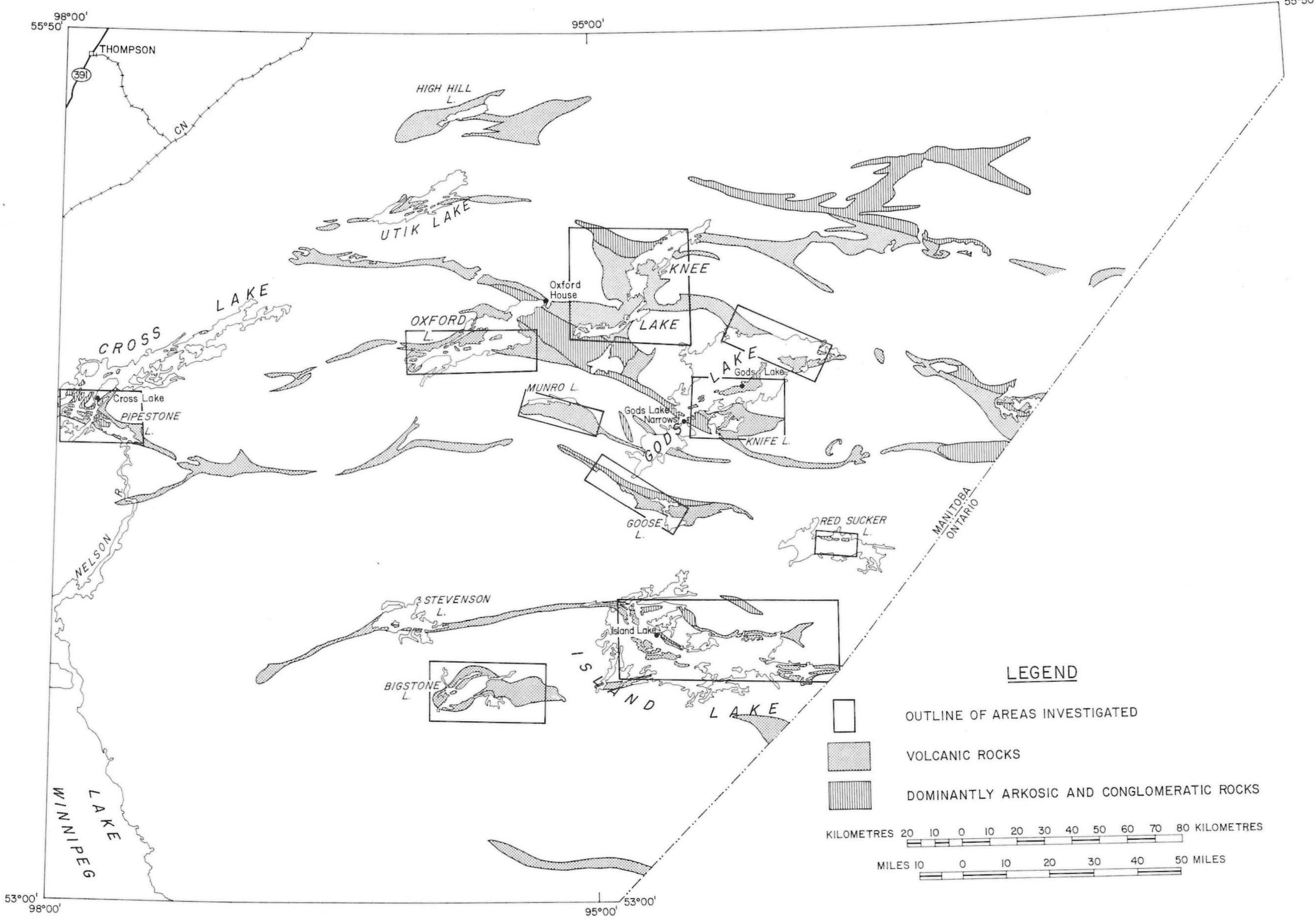

Figure MEA-2-1 Location of areas investigated in the Superior Province

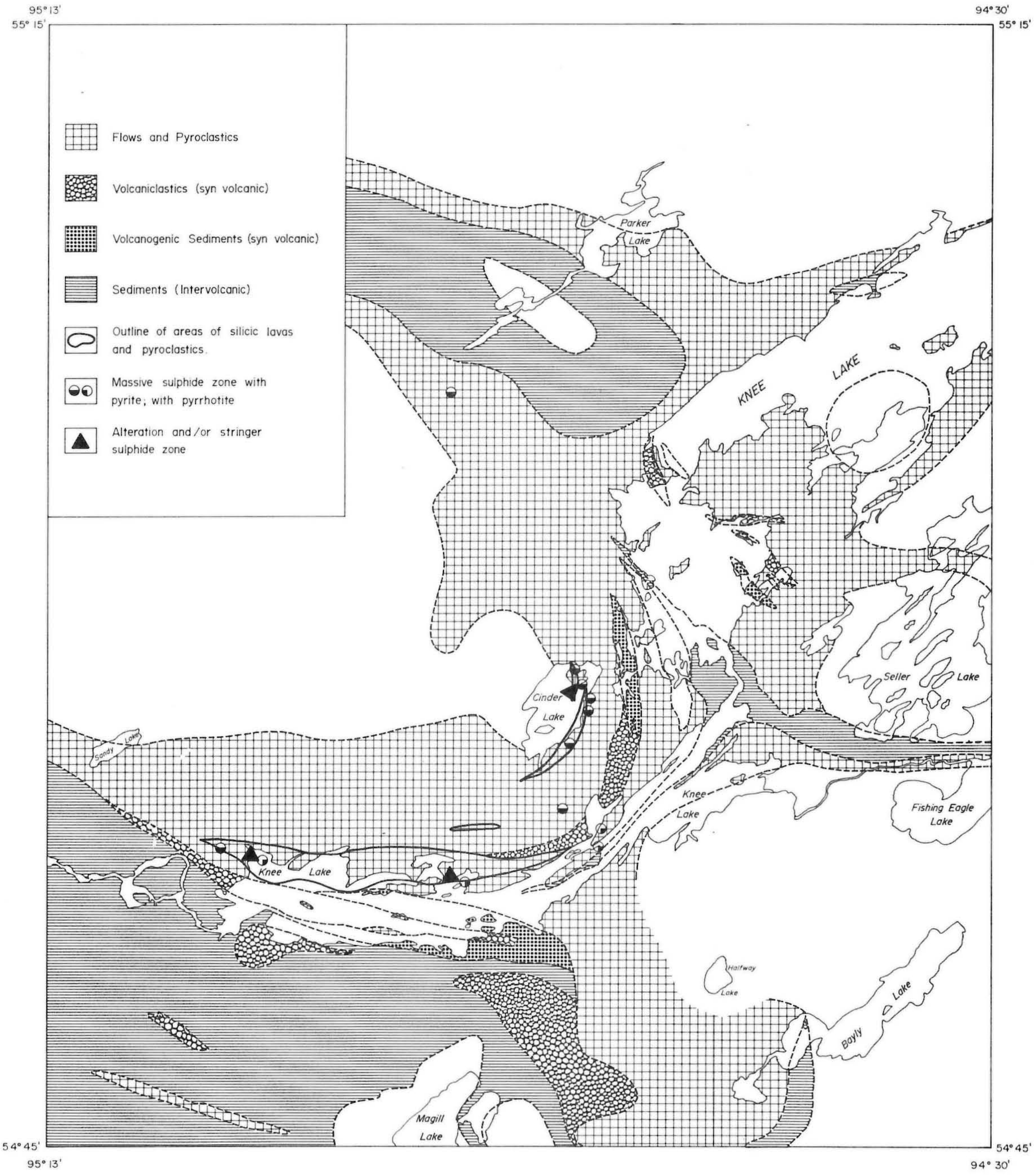

Figure MEA-2-2 Preliminary "environment" types for part of the Knee Lake greenstone belt

disseminations; pyrite and/or pyrrhotite are the most common sulphide minerals. Trace amounts of chalcopyrite and sphalerite were observed in three alteration zones only: (1) at Cinder Lake, (2) in the western part of Knee Lake, and (3) in the eastern part of the Island Lake greenstone belt. In the Knee Lake, Bigstone and Knife Lake areas, some of the alteration zones were observed to be stratigraphically overlain by occurrences of massive pyrite and/or pyrrhotite. A zone of alteration and mineralization on Hyers Island is considered to be related to a mineralized tonalite.

Massive sulphide type mineralization in the Superior Province greenstone belts is generally closely associated with silicic volcanism, e.g. Bigstone Lake, Munroe Lake, Knife Lake and Knee Lake. Five cycles of volcanic rocks have been recognized in the Knee Lake area (Hubregtse, 1976). Massive sulphide type mineralization is associated with silicic rocks in at least three of these cycles. Only one episode of silicic volcanism with associated massive sulphide type mineralization has been identified in the Knife Lake, Munroe Lake and Bigstone Lake greenstone belts. Silicic volcanic rocks are present in several places within the Island Lake greenstone belt; however, a direct relationship between mineralization and silicic volcanism has not yet been established there.

Flin Flon Region

Reconnaissance studies in the Morgan Lake area (10 km SW of the Chisel Lake Mine) indicate that the host rock lithologies and stratigraphic position of massive sulphide type mineralization are similar to those established for the Chisel Lake area (Gale, 1977; Gale and Koo, 1977).

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MEA-3 BASE METAL MINERALIZATION IN GNEISSIC TERRAINS

By D.A. Baldwin

Introduction

During the 1977 field season two and one-half weeks were devoted to investigating environments of mineralization in the Sherridon — Batty Lake — Limestone Point Lake area (N.T.S. 63N/2 and the east-half of 63N/1). This area was chosen for study because (1) there are known massive Cu-Zn sulphide deposits in the area, including the Sherridon East and West ore bodies which were mined prior to 1951; (2) there are many reported occurrences of anthophyllite-garnet rock, in some instances associated with sulphide mineralization; (3) there are indications that some of the examples of sulphide mineralization with associated anthophyllite-garnet rock occur at the same stratigraphic horizon.

The objectives of the study are:

(1) to determine the stratigraphic position of the sulphide deposits and occurrences, and
(2) to investigate the genesis of massive sulphide type mineralization in this gneissic terrain, outside the more familiar greenstone setting.

Methodology

Using available published geological maps (Bateman and Harrison, 1946; Robertson, 1953; Froese and Goetz, 1976), locations of sulphide deposits and occurrences were plotted on a geologic base (1" = 1 mile), and a few days were spent looking at the various lithologies and becoming familiar with the stratigraphy. Deposits and occurrences were selected for investigation according to ease of access, amount of exposure, reported sulphide mineralization and the association of sulphide mineralization with anthophyllite-garnet rock.

Results

(1) Batty Lake — Limestone Point Lake Area

Outcrops in this area are generally scarce and the quality of exposure is poor at best.

The sulphide occurrences chosen for investigation were either not found, badly overgrown or so poorly exposed that collection of meaningful data was very difficult. Nevertheless, it was determined that the rocks mapped as Sherridon Group by Robertson (1953) in the Batty Lake — Limestone Point Lake area bear no similarity to the Sherridon Group of Bateman and Harrison (1943) and Froese and Goetz (1976).

The rocks are migmatitic, feldspathic meta-greywacke to arkosic wacke with 10% to 15% mafic minerals (hornblende + biotite); in contrast, rocks of the Sherridon Group at the type locality (near Sherridon) are quartzitic gneisses (quartzite and quartz-rich meta-arkose), which are not migmatitic, very siliceous and poor in mafic minerals. Calcareous metasedimentary rocks and marbles found as discrete rock units and as layers within the quartzitic gneisses at Sherridon are absent in the Batty Lake — Limestone Point Lake area.

Limestones reported at the base of the amphibolite which separates the Sherridon Group and the Nokomis Group (Robertson, 1953) were, where observed, found to be calc-silicate layers within the amphibolite.

(2) Sherridon Area

The lithologies which comprise the Sherridon Group are quartzitic gneisses, amphibolite, calcareous metasediments, marbles and semi-pelitic gneisses. Quartzitic gneisses underlie much of the area west of the Molly Lake Fault and almost all of the area east of the fault (Fig. MEA-3-1).

Froese and Goetz (1976) define three horizons along which sulphides occur in varying concentration. During the present work, these three horizons were confirmed but it was noted that west of the Molly Lake Fault, each horizon lies at a contact between quartzitic gneiss and amphibolite. Further, it was noted that on horizons corresponding to the Sherritt Gordon

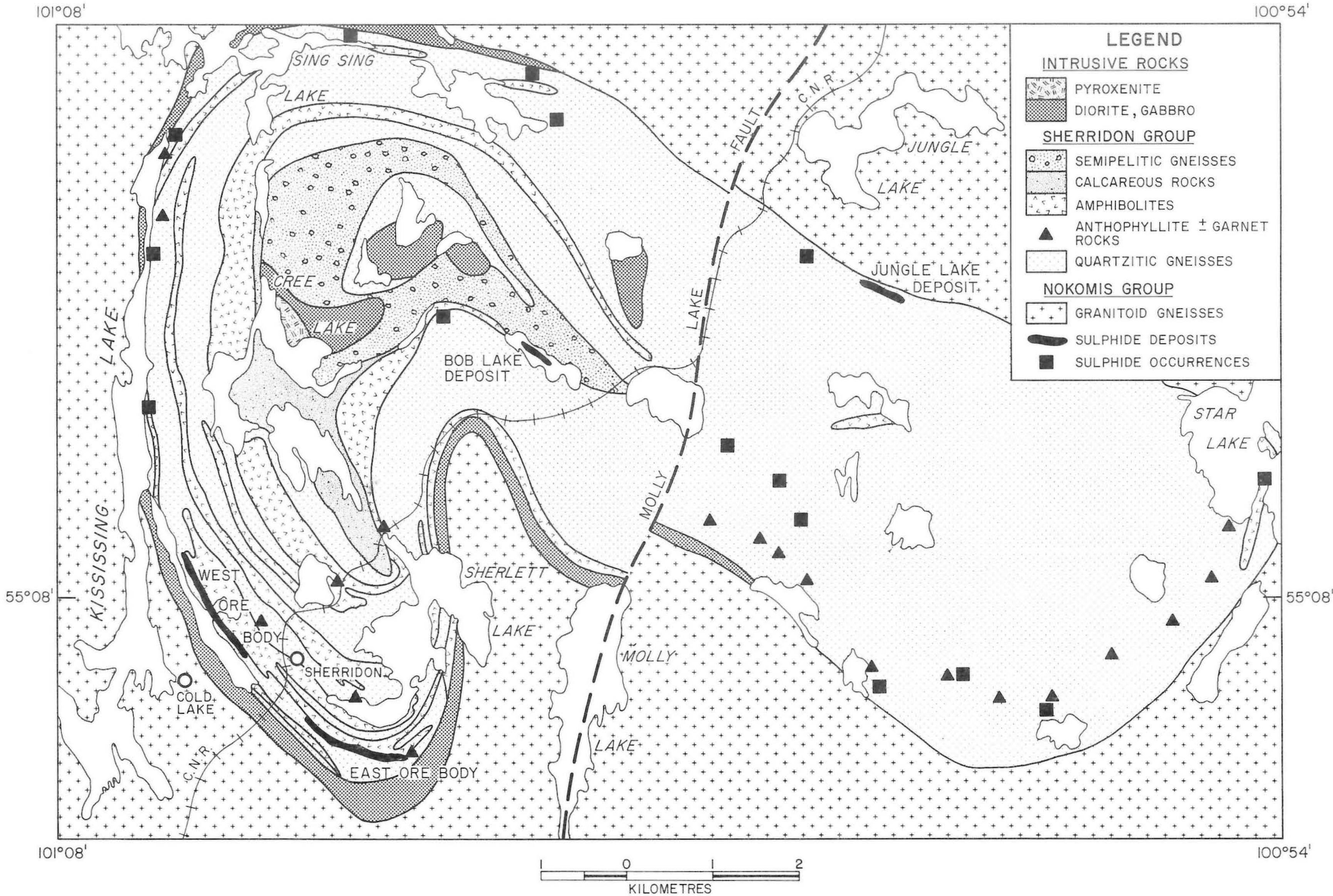

Figure MEA-3-1 Geological sketch map of the Sherridon area, Manitoba (modified after Froese and Goetz, 1976) orebodies and the Bob Lake Deposit, there are sporadic occurrences of anthophyllite-garnet rock which in some instances is associated with Cu-Zn mineralization.

None of the occurrences east of the Molly Lake Fault were visited because of inaccessibility. From the map (Fig. MEA-3-1) the following general observations can be made: (1) the Jungle Lake Deposit and the occurrence immediately to the NW appear to lie on the same horizon, (Froese and Goetz (1976) suggest that the Jungle Lake Deposit and the Sherritt Gordon orebodies occur at the same horizon); (2) three sulphide occurrences appear to be situated on the same horizon as the Bob Lake deposit; (3) occurrences of anthophyllite-garnet rocks near the south and southeast margin of the Sherridon Structure appear to be regularly distributed along a stratigraphic horizon; three sulphide occurrences appear to fall on this horizon; (4) of nine sulphide localities, only three are associated with anthophyllite-garnet rock; (5) occurrences of anthophyllite-garnet rock west of the Molly Lake Fault are much more sporadic than east of the fault.

Summary

Sulphide mineralization in the Sherridon area is stratigraphically controlled.

Both geology and mineralization show significant contrast across the Molly Lake Fault — in particular:

(1) to the west, there is considerable range in lithology; and to the east, a monotonous sequence of quartzitic gneisses;
(2) to the west, there are sporadic occurrences of anthophyllite-garnet rock; to the east, such occurrences are rather regularly spaced;
(3) to the west, sulphide mineralization occurs at contacts of quartzitic gneiss and amphibolite; to the east, mineralization occurs at equivalent stratigraphic positions; although the amphibolite is absent.

It is suggested that future studies of metallogeny in the area give consideration to a hypothetical model wherein the sporadic association of anthophyllite-garnet rock with Cu-Zn massive sulphide deposits (west of the Molly Lake Fault) represent centres of hydrothermal activity, and the closely spaced, apparently coeval bodies of anthophyllite-garnet rock (east of the Molly Lake Fault) represent a distal chloritic mud derived from such centres.

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MEA-4 EVALUATION OF NICKEL ENVIRONMENTS

by P. Theyer

Introduction

The field season was spent studying ultramafic bodies in the Superior and Churchill Provinces of Manitoba. The assessment of ultramafic bodies included observations on the nature of contacts and textures, on the type, amount and distribution of sulphide mineralization.

These observations will be complemented by petrographical and geochemical studies and will eventually be used to evaluate the Ni-Cu mineralization potential of relatively well studied ultramafic bodies, as a basis for estimating the nickel potential of their host environments.

The ultramafic occurrences examined were those at the following localities (Fig. MEA-4-1): (1) Bird River Sill; (2) Rice Island; (3) Chisel Lake; (4) Boundary Intrusions, Flin Flon; (5) Island Lake area (several occurrences); (6) Goose Lake; (7) Stevenson Lake; (8) Knight Lake; (9) Oxford Lake; (10) Carrot River; (11) Thompson; (12) Mynarski Lake; (13) Pyta, Tod and Laurie Lakes region; (14) Russell Lake. Only areas in which immediately interpretable field observations were made will be dealt with in this report. They include ultramafic occurrences in the Island Lake area, two ultramafic bodies on Goose Lake, a mafic to ultramafic sill on the Carrot River, an ultramafic body on Mynarski Lake and stratabound ultramafic lenses on Tod, Laurie and Russell Lakes.

Island Lake Area

The Island Lake greenstone belt is composed of two major stratigraphic sequences. The Hayes River Group consists of an apparently conformable stratigraphic succession of volcanic rocks interbanded with and overlain by sediments. Stratigraphically overlying these rocks, separated by an unconformity, is the Island Lake Series which consists exclusively of sediments (Wright, 1928, Quinn, 1960, Godard, 1963).

Ultramafic bodies were mapped in the Island Lake area (Fig. MEA-4-2) by Quinn (1960) and Godard (1963), and further ultramafic occurrences were found by Ames (1975) as part of a B.Sc. study; the latter ultramafic bodies are not included in Figure MEA-4-2 since petrographic work is needed to confirm their supposedly ultramafic composition.

Two ultramafic bodies on Island Lake contain proven Ni-Cu mineralization. The first outcrops on a small reef located approximately 1.8 km north of Loonfoot Island, displaying talcose light green to dark grey serpentinite cut extensively by carbonate veins (up to 5 cm thick), and containing up to 10% disseminated sulphide. The main minerals observed, besides magnetite, were (in order of decreasing amount): pyrite, pyrrhotite, chalcopyrite and rare exsolutions of pentlandite, derived from the pyrrhotite. Quinn (1960) refers to a sample from this island containing 0.72% nickel and 0.02% cobalt. The mineral rights in this area are currently held by COMINCO.

The second ultramafic exposure of economic interest is located in the north-western part of Island Lake, on Linklater Island and on several nearby islands to the southeast and west (Fig. MEA-4-3). INCO Metals Ltd. have defined a zone of low grade Ni-Cu mineralization supposed to measure approximately 60 m (width) by 3 km (length) by 600 m (depth), (Quinn, 1960). The company presently holds the mineral rights in this area.

Exposures of ultramafic to mafic rocks on Island #1, Island #4 and Island #5 (Figure MEA-4-3) show quench textures varying in size from macroscopically visible needles exposed on an escarpment on the shore of Island #1 (Plate MEA-4-1) to minute hornblende needles only visible with a hand-lens, on Island #5. These textures could be interpreted to indicate that at least part of the rock was exposed to an environment of rapid cooling.

These ultramafic rocks display an undisturbed, essentially concordant, chilled contact with a clastic sedimentary sequence which consists of quartz pebble conglomerates and quartzites. These sediments contain cross-beds, flow channels and incipient graded bedding with undeterminable tops and are tentatively interpreted as the basal unit of the Island Lake Series. The areal distribution of the conglomerate is at variance with the published map (Godard, 1963) which shows volcanic rocks on these islands.

Part of the ultramafic unit displays an undisturbed contact (on Island #12) with the Hayes River Group andesite. On Island #1, the ultramafic unit has a faulted contact with

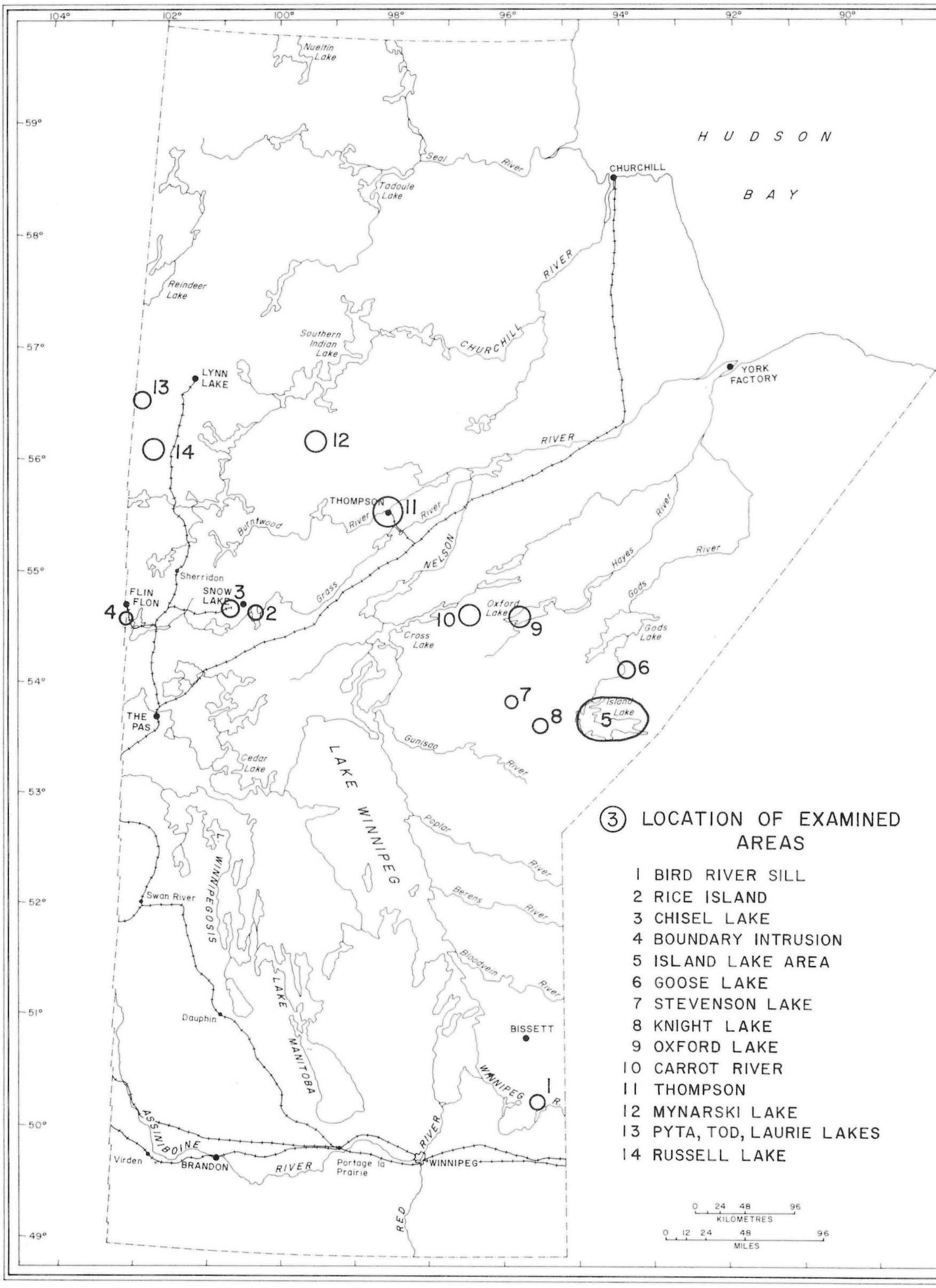

Figure MEA-4-1 Location of nickel evaluation activities

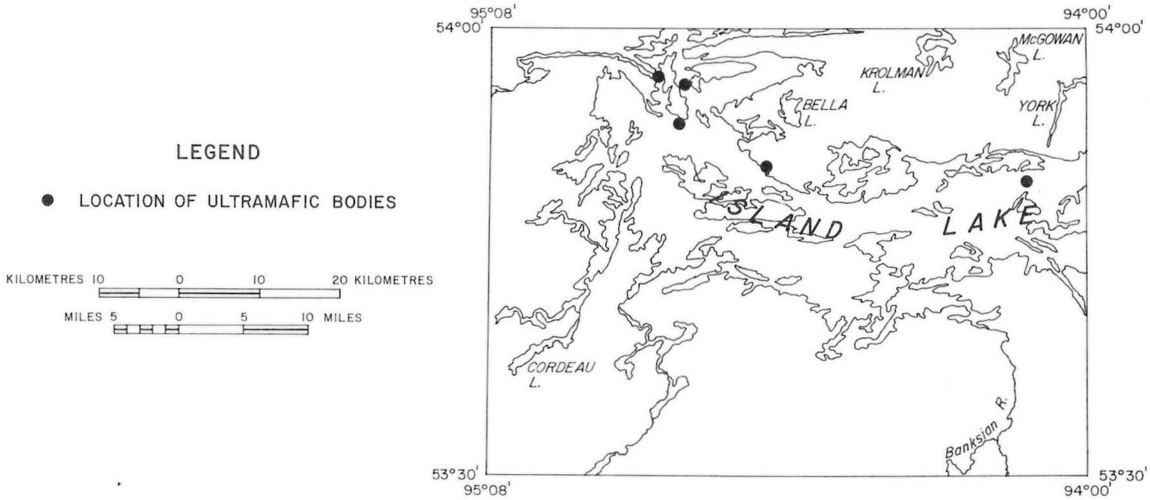

Figure MEA-4-2 Location of ultramafic bodies in the Island Lake area (after Godard, 1963)

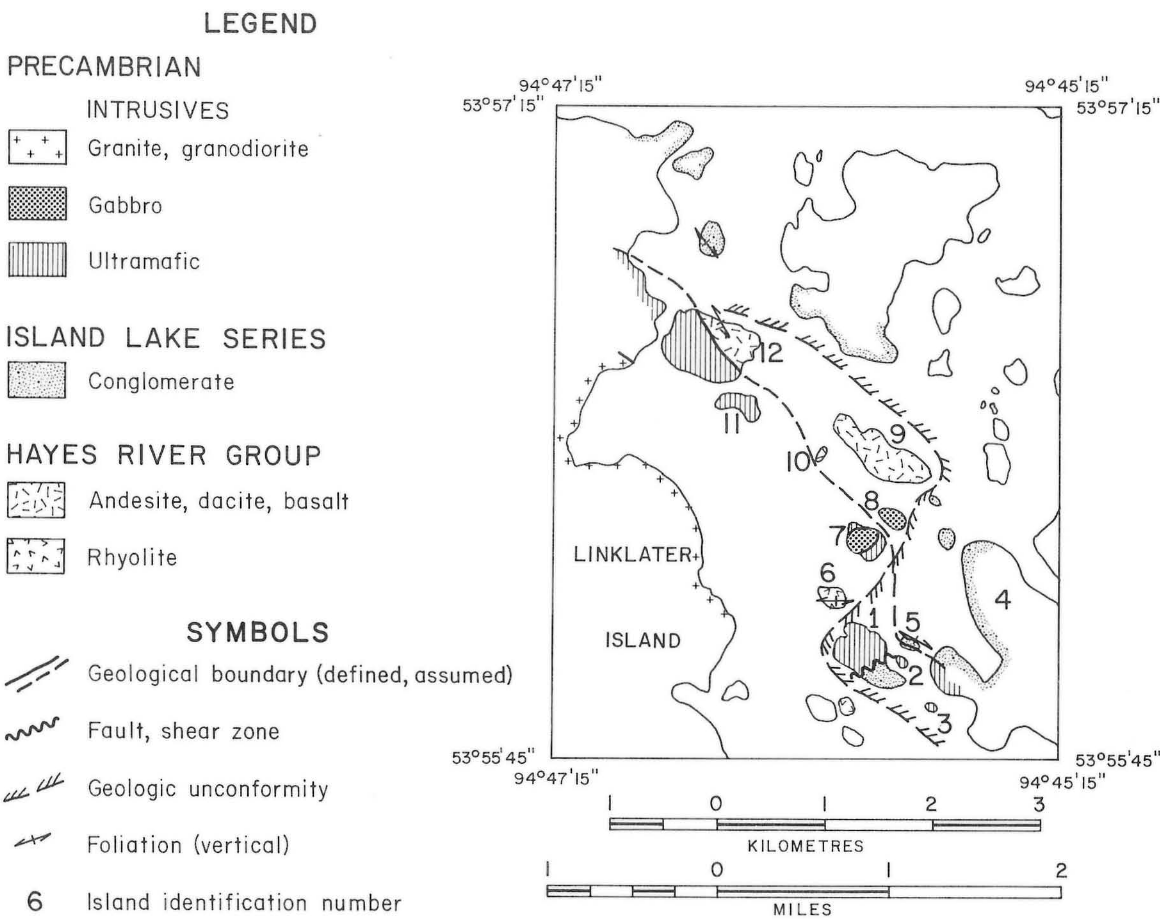

Figure MEA-4-3 Geology of the eastern Linklater Island area

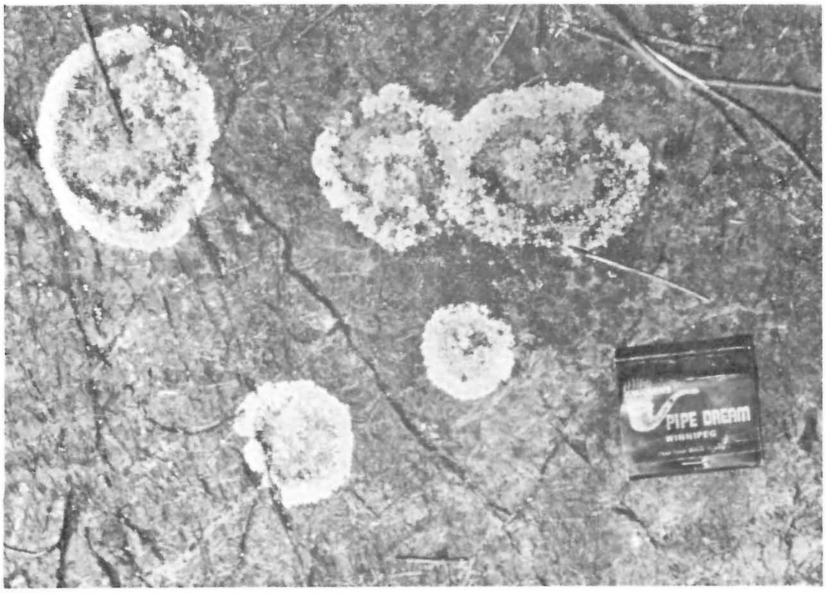

Plate MEA-4-1 Quench Textures Located on Island #5. (Refer to Figure MEA-4-3)

conglomerate containing granite pebbles, correlatable with the Cochrane Bay conglomerates of the Island Lake series, (Godard, 1963). East-west striking, steeply dipping rhyolite of the Hayes River Group is present on Island #6, and is possibly separated from the ultramafic body of Island #1 by a fault located in the channel separating the two islands. Coarse grained gabbro intrudes the ultramafic sequence on Island #7. Island #8 is entirely underlain by gabbro.

These observations pose the dilemma of an ultramafic body in which quench textures occur in undisturbed contact with units stratigraphically above and below.

Several possible explanations are:

(a) The ultramafic unit in contact with andesite on Island #2 is not related to the quenched ultramafic exposed on Islands #1, #4 and #5.

(b) The quench textures do not indicate rapid cooling of a flow, but are caused by rapid cooling of the margins of an intrusion.

(c) The quartz conglomerates and quartzites in contact with quenched ultramafic rocks on Island #4 and #5 do not belong to the Island Lake series but rather to the (top?) of the Hayes River Group. The ultramafic body would then have intruded members of the Hayes River Group only.

(d) The ultramafic body is a shallow intrusion into sediments and volcanic rocks of the Hayes River Group and the base of the Island Lake series. The intrusion exploited the unconformity between the two as a preferred spreading horizon. Part of the magma may have reached the surface to form quenched flows.

Conclusions and Recommendations

In view of the demonstrated potential for ultramafic hosted Ni-Cu mineralization possibly related to the Island Lake Series-Hayes River Group unconformity, it appears reasonable to undertake a re-mapping program in order to:

(a) Define the extent of both the Hayes River Group and the Island Lake Series.

(b) Search the unconformity and its vicinity for ultramafic bodies.

It is well documented that shallow ultramafic intrusions and effusions have a very high proven potential to contain economic Ni-Cu mineralization (Naldrett and Mason, 1968: Wilson et al. 1969; McCall, 1971; Naldrett, 1972; Purvis et al. 1972; Naldrett, 1973; Naldrett, 1976). It might well be the case that the Linklater Island body belongs to this type of environment and that more of this type might be found in a similar location.

Carrot River

The Carrot River complex is an elongated differentiated ultramafic to mafic sill intruded into rocks of the upper Hayes River Group. It was the subject of a recent exploration program undertaken by Canex Placer Limited from 1971 to 1972. An M.Sc. thesis by Davidson (1974) offers a comprehensive review of the geology, chemistry and mineralogy of this mineralized intrusion. Davidson (1974) describes four intrusive units in a sill-like body. These are (a) olivine-rich peridotite, (b) peridotite, (c) pyroxenite, and (d) melano gabbro. These units are easily recognized in the field and show gradational contacts between them. Grain size and compositional banding were observed in the peridotites (a and b). Mineralization is scarce and restricted to occasional grains of pyrite and pyrrhotite.

Davidson describes a zonal partitioning of Ni between silicates and sulphides based on the mineralogy of core from five drill holes. This zone is convincingly attributed to sulphurization at progressively lower sulphur pressures. The maximum total nickel content of the ultramafic body is quoted as 0.40% Ni.

Since sulphurization is not known to concentrate nickel in economic amounts, the economic potential of the Carrot River body is considered low.

Mynarski Lake

Maps and reports dealing with the Mynarski Lake area and including data on an ultramafic intrusion have been prepared by Carlson (1962) and Elphick (1972). There are however, wide discrepancies in the reported location and size of the ultramafic occurrence, and on the nature of adjacent rock units. Preliminary field evidence indicates that it is a well differentiated layered ultramafic cumulate intruded along the unconformity between the Sickle and the Wasekwan Groups. The Wasekwan Group is here represented by the intensely folded amphibolite found underlying the ultramafic unit. Hornblende biotite magnetite gneiss in faulted contact with the ultramafic unit is probably part of the Sickle Group.

Sulphide mineralization is restricted to occasional pyrite specks. The Ni-Cu mineralization potential of this intrusion appears to be low.

Tod, Laurie and Russell Lakes

Thin, possibly stratigraphically controlled, ultramafic bodies consistently underlying the Sickle conglomerate, and used as a marker horizon by McRitchie (1975), Lenton and Cameron (1976), and Zwanzig (1976) were inspected to assess their Ni-Cu mineralization potential.

The ultramafic unit occurs as locally repeated, but generally thin (10-20 cm locally up to 2 m thick) completely recrystallized bodies on top of the Wasekwan Group of rocks. They are exposed over a considerable strike length from Eager Lake to Laurie Lake. Pervasive metamorphism has obliterated all original textures and destroyed primary contact relations with adjacent rocks making it impossible to diagnose the type of emplacement. The stratigraphic control of these bodies might suggest they are volcanic flows or tuffs. A differentiated ultramafic sill north of Eager Lake (Zwanzig, 1977; pers. comm.) was not located.

Lenses of hornblende bearing ultramafic rock found on Russell Lake by Lenton and Cameron (1976) occur at a similar stratigraphic horizon but show a higher degree of metamorphism.

These ultramafic bodies only contain traces of iron sulphide. The restricted thickness and the discontinuity of the occurences effectively precludes the possibility of their containing economic concentrations of Ni-Cu sulphides.

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MEA-5 THE LYNN LAKE NI-CU DEPOSITS

(64C/14)

by R.H. Pinsent

Introduction

The field season was spent studying some of the Ni-Cu mineralized and non-mineralized gabbroic intrusions which penetrate the Precambrian Wasekwan Group in the Lynn Lake greenstone belt. The program was undertaken to obtain the basic information needed for an evaluation of the Ni-Cu deposit potential of the apparently non-mineralized intrusions.

The intrusions examined occur at the following localities (Figure MEA-5-1): (1) Lynn Lake "A" plug; (2) Lynn Lake "EL" plug; (3) Fraser Lake, SE plug; (4) Carr Lake; (5) Fraser Lake, Main Sill; (6) Cartwright Lake; (7) Tulune Lake; (8) Snake Lake; (9) Nickel Lake; (10) Larsen Lake; (11) Tow Lake; (12) Sickle Lake; (13) Black Trout Lake.

The distribution of gabbro in the Lynn Lake greenstone belt (Figure MEA-5-1) is after Milligan (1960), Gilbert (1976), Syme (1976), and Zwanzig (1977), with some modifications.

General Geology

The gabbroic intrusions in the Lynn Lake greenstone belt have attracted considerable interest since the discovery of the Lynn Lake Ni-Cu deposits in 1941 (Allan, 1950; Hunter, 1958; Milligan, 1960; Emslie and Moore, 1961), and it is implicit from the published descriptions that there is more than one variety of intrusion in the area. Hulbert (in preparation) has described two separate types of intrusion at Fraser Lake.

For the purposes of the present study, the intrusions have been divided into two categories on the apparent presence or absence of mafic differentiates.

Group I: Differentiated Intrusions
- Ia) Differentiated stocks
  - (1) Lynn Lake "A" plug
  - (2) Lynn Lake "EL" plug
  - (3) Fraser Lake, SE plug
  - (4) Carr Lake plug
- Ib) Differentiated sills
  - (5) Fraser Lake, Main sill
  - (6) Cartwright Lake sill

Group II: Undifferentiated Intrusions
- IIa) Undifferentiated stocks
  - (7) Tulune Lake plug
- IIb) Undifferentiated sills
  - (8) Snake Lake sill
  - (9) Nickel Lake sill
  - (10) Larsen Lake sill
  - (11) Tow Lake sill
  - (12) Sickle Lake sill
  - (13) Black Trout Lake sill

Ia) Differentiated stocks

The mineralized intrusions (Lynn Lake "A", "EL" and Fraser Lake, SE plug) have been described by a number of authors (Allan, 1950; Milligan, 1960; Emslie and Moore, 1961, Vellet 1963). The plugs consist of vertical, composite, gabbro plutons, elliptical in section, which have intruded with minor discordance into the Wasekwan Group. Characteristically the principal rock type is a uralitized gabbro (2-5 mm grain size). The pluton is sheared adjacent to the country rock contact, but is otherwise largely undeformed. Pulses of (a) Ni-Cu mineralized norite, (b) peridotite and (c) diorite have intruded the gabbro within structurally controlled pipes. The pipe margins have undergone intense hydrothermal alteration which includes

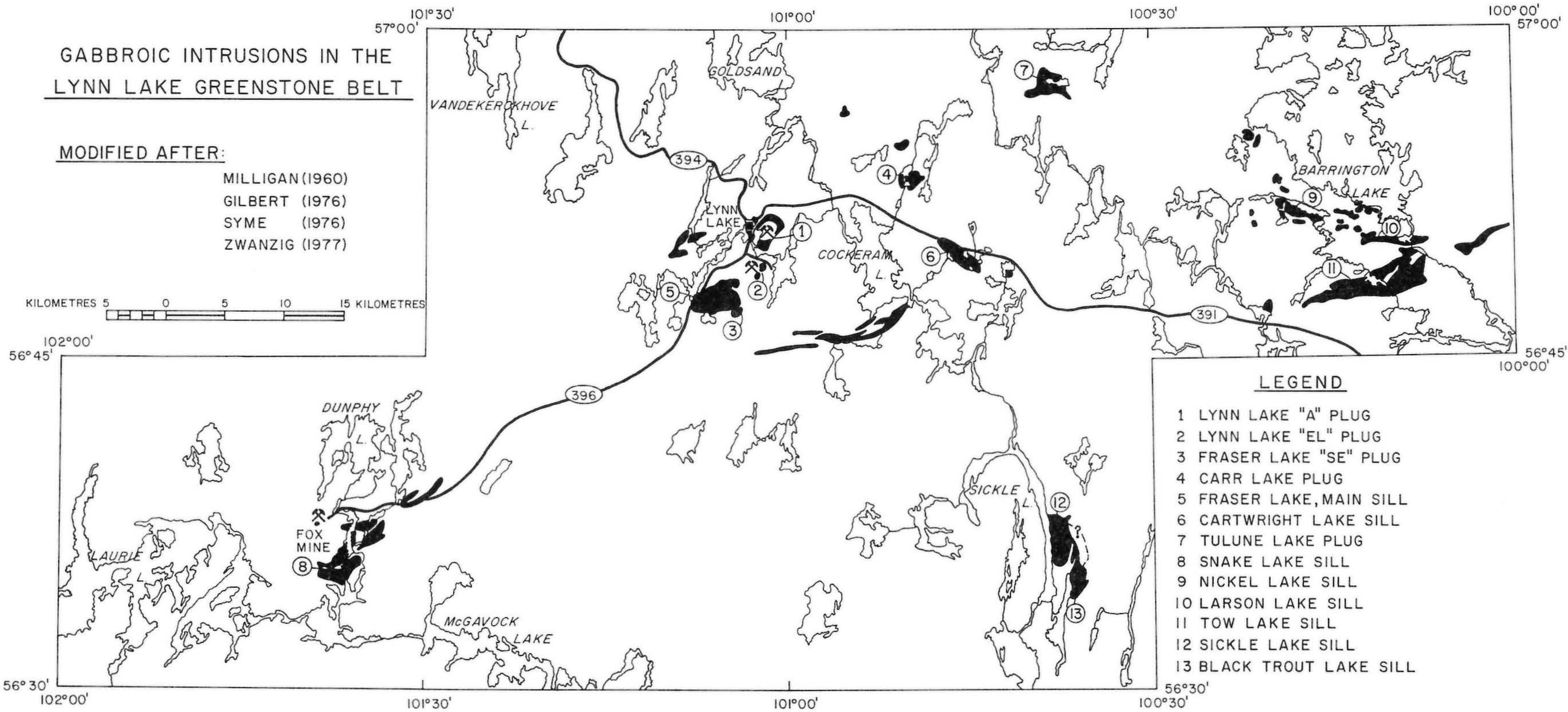

Figure MEA-5-1 Gabbroic intrusions in the Lynn Lake greenstone belt

uralitization, silicification and chloritization. Diabase dykes pre-date the pipes, which were subsequently cut by dykes of diabase and quartz feldspar porphyry.

The Carr Lake mafic plug appears to be a vertical stock surrounded by acid to intermediate intrusions. It consists mainly of an undeformed, coarse (5 mm - 1 cm grain size) feldspathic gabbro or norite with a pronounced feldspar lamination, similar to that displayed by the gabbro in Ib (below). The plug also contains a fine grained (2 mm grain size) norite facies found in the Cartwright Lake intrusion (Ib, below), and a gabbro of normal texture. The Carr Lake plug is cut by dykes (10 - 20 cm wide) of aphanitic diabase and aplitic granite.

Although the Carr Lake intrusion and a noritic phase of the Fraser Lake SE plug contain rare traces of mineralization, neither pluton appears to display the extensive mineralization found in the "A" and "EL" plugs. The latter have been described elsewhere (Pinsent, 1977).

Ib) Differentiated sills

The two differentiated sills at Fraser Lake and Cartwright Lake consist of undeformed and undifferentiated gabbro (1-3 mm grain size) with weak to strong feldspar lamination, overlain by a more feldspathic, noritic unit (1-6 mm grain size, which displays feldspar lamination and compositional banding. The noritic unit includes coarse (5-10 mm— feldspar- and orthopyroxene-rich cumulate layers which very locally contain olivine. A 15 m wide gossan zone in norite near the inferred top of the main sill in the Cartwright Lake intrusion is caused by abundant magnetite.

The Cartwright Lake intrusion appears to be a sill complex which is concordant with the local stratigraphy but discordant in terms of regional structure (Syme 1976). Although the detailed structure has yet to be resolved, the complex appears to consist of a 700 m wide differentiated intrusion and a suite of related, but less differentiated sills 10-50 m wide. The complex is partially truncated by a younger diorite.

The main body of the Fraser Lake gabbro has been studied in detail by Emslie and Moore (1961) and Hulbert (in preparation). It consists of a laterally compressed, funnel shaped, layered intrusion (L. Hulbert, personal communication), situated in the nose of a major syncline (Gilbert, 1976). The fold axis has been exploited by intrusions ranging from gabbro to granite in composition. The layered intrusion is truncated by diorite which intruded the interface between the gabbro and the country-rock volcanics.

IIa) Undifferentiated stocks

The Tulune Lake plug is a discordant vertical plug, possessing the same work tectonic fabric as the neighbouring volcanics. It consists of weakly layered amphibolitized meta-gabbro (5 mm - 1 cm grain size) cut by 20 cm — 1 m wide dykes of fine grained (2 mm) meta-diabase and aplitic granite. The plug is cut by numerous veins and lenses of quartz and epidote. The age of the diorite adjacent to the gabbro is uncertain although Milligan (1960) indicates that it is cut by gabbro dykes.

IIb) Undifferentiated sills

The gabbro sills appear to be stratigraphically concordant but structurally deformed. They are more or less recrystallized and textures range from igneous to metamorphic. The principal rock types range from a uniform sub-ophitic meta-diabase (1-3 mm grain size) to a schistose amphibolite (2-4 grain size). The schistosity, which may be either penetrative, or restricted to shear zones within the intrusion, is commonly concordant to the sill contact; it appears to be discordant in the vicinity of younger fold axes (Zwanzig, personal communication). The sills show little evidence of multiple-phase intrusion. They are cut by rare dykes of finer grained meta-diabase and more abundant dykes of seemingly unrelated granitic rock. The Tow Lake intrusion was studied in detail by Hunter (1958), who divided the body into three parts but found little evidence for mafic differentiation through crystal settling.

The Black Trout Lake gabbro is anomalous in this group as it consists of weakly deformed, uralitized, amphibole-phyric (2-6 mm grain size) meta-diabase. Its relationship to the Sickle Lake meta-diabase is not known.

There is a sharp, sheared contact between gabbroic rock and Sickle Group conglomerates and sandstones on Sickle and Black Trout Lakes. At one locality on Sickle Lake the conglomerate immediately adjacent to the meta-diabase contains sub-angular fragments of basic rock in a matrix of quartz, epidote, magnetite sand. It is believed that the conglomerate was laid down on the eroded surface of the mafic rock; subsequently a shear developed along the unconformity.

Discussion

A study of the Ni-Cu mineralization in the "A" and "EL" plugs shows that the sulphides are primarily associated with late intrusions of early magmatic differentiates (peridotites, pyroxenites and sulphide-bearing norites). These mafic differentiates intrude bodies of very weakly deformed gabbro, which are presumed to be tectonically late (post-Wasekwan).

The mafic differentiates and the Ni-Cu sulphides are not in their place of origin. The ore pipes represent channels, and a deposit model must include a primary magma source for the differentiates (below the pipe) and a secondary collection chamber (above the pipe); source, pipes and collection chamber would all have potential for Ni-Cu mineralization.

The differentiated plugs and sills have several features in common. They are relatively undeformed and, although extensively uralitized, they all contain (or are inferred to contain) fresh norite. In most cases they are known to contain mafic to ultramafic cumulates which occur as intrusions in the pipes and layers in the sills. As the plugs and the sills both consist of early gabbro followed by later norite, it is conceivable that the layered sills represent collection chambers structurally above the plugs. To date, however, mineralization has not been found in the sills, and a source for the sulphide and silicate differentiates of the pipes has yet to be identified.

The undifferentiated sills and stocks are more highly deformed than those that are differentiated, and may be older. They are considered to be sub-volcanic intrusions related directly to the Wasekwan mafic volcanism. The original intrusions appear to have been more gabbroic than noritic in composition, although Hunter (1958) has shown that much of the Tow Lake intrusion consists of hypersthene-rich gabbro. Despite considerable exploration of these intrusives, no significant sulphides have so far been found within them.

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MEA-6 URANIUM EVALUATION PROGRAM

by J.W. Stewart

Introduction

Field activities in 1977 included:

1. Investigation of specific problems of geological interpretation in the Kasmere Lake region in an effort to establish more clearly the controls of uranium mineralization.

2. Reconnaissance north of latitude 58°N from about longitude 100° 00′ W eastward to Hudson Bay, to gain familiarity with the main geological units and, simultaneously, attempt to evaluate the radiometric and geochemical anomalies revealed by the G.S.C. Uranium Reconnaissance Programs fielded in 1975 and 1976.

3. Examination of uranium occurrences elsewhere in the Province in order to establish their nature and geological setting.

Kasmere Lake Region (a) Synder Lake — Putahow Lake Belt (Refer to Fig. MEA-6-1)

Practically all significant uranium mineralization found in this region to date is located in the Synder Lake — Putahow Lake belt, a northeast trending zone underlain predominantly by biotite gneiss and characterized by a strong regional uranium anomaly (Stewart, 1977). An important exception is the uranium occurrence near Veal Lake, where a keel of biotite gneiss (unit 7) is preserved in basement (unit 5). Unit members used here are those of Weber et al. (1975), see legend, Figure MEA-6-1.

Mineralization is mainly restricted to (a) granitic leucosomes which form essentially concordant **lits** and sills within the gneisses, and (b) layers of calc-silicate rock which constitute one of the subsidiary lithologies of the gneiss belt. The texture of the anatectic granite bodies typically is very irregular, and the grain size highly variable, locally exceeding 1 cm. Coherent masses of coarse homogeneous "true" pegmatite with extensive graphic intergrowth are not known.

Uranium in the granitic rocks is concentrated mainly in disseminated uraninite crystals; in the calc-silicate rocks, most of the uranium is located in scattered anhedral grains, some apparently of uraninite, some resembling pitchblende.

The biotite gneisses of the Snyder Lake — Putahow Lake belt correspond to units 7, 10 and 14 on the geological maps of Weber et al. (1975). Other units which are shown covering sizeable areas in the belt are: unit 12 (meta-arkose) and unit 17 (white quartz monzonite). In addition, very large areas which lack outcrop are shown blank.

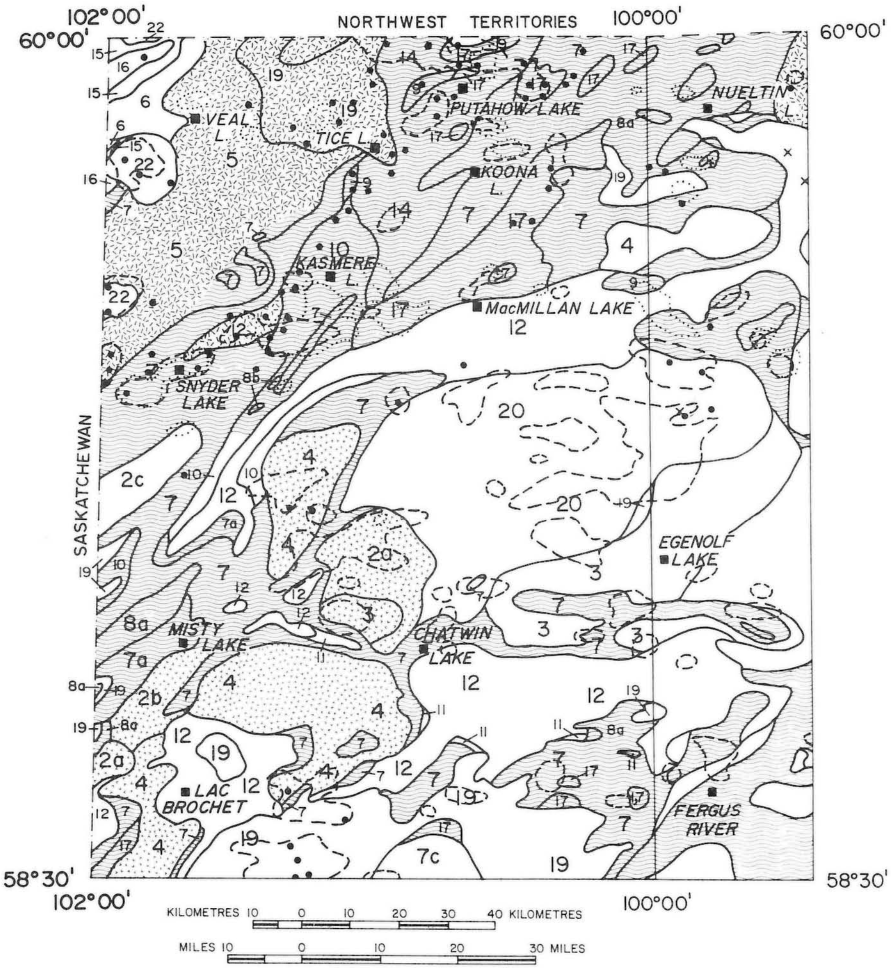
Difficulties arise in distinguishing among 7, 10 and 14 in the field, because of lithological similarities. It is considered likely that units 14 and 10 are coeval and in lateral continuity, a possibility raised by Weber et al. (1975, p. 69). Correlation of unit 14 (10) with the Hurwitz Group is judged premature in view of the limited nature of supporting evidence.

Units 8a (calc-silicate rock), 8b (marble) and 9 (albite-pyroxene rock) are perhaps best considered as lithofacies, occurring individually or in association within the combined biotite gneiss formations (unit 7 and 10/14) and probably formed at various stratigraphic horizons.

Unit 17 (white granite to quartz monzonite) generally occurs as discontinuous sub-conformable lenses or sheets in the host gneisses. The existence of large stocks of this rock type, such as an area of 200 km^2 shown on the geological maps of Weber et al. (1975) immediately north of MacMillan Lake is questioned; much of this poorly exposed area is probably underlain by biotite gneiss.

The area of unit 12 (meta-arkose) shown between Snyder Lake and Kasmere Lake belongs, at least partly, to unit 5 (felsic gneiss basement).

The large blank areas shown north of Kasmere Lake and around Tice Lake and Koona Lake on the map of Weber et al. (1975) are mainly underlain by rocks of unit 7 and/or 10 (14), and uranium mineralization typical of these units is present. This has been confirmed by diamond drilling at several points.



LEGEND

GEOLOGY

Geological map and unit descriptions based on Map 74-2-25 "Kasmere Lake - Whiskey Jack (North Half)" by W. Weber, D.C.P. Schledewitz, C.F. Lamb and K.A. Thomas, 1971, 1972.

Units (of Weber et al, 1975)

8b	Marble	22	Fluorite-bearing quartz monzonite
8a	Calc-silicate rock	20	Porphyritic quartz monzonite
7c	Quartzite	19	Pink leucogranite to quartz monzonite; biotite-quartz monzonite
7a	Porphyroblastic biotite gneiss	17	White granite to quartz monzonite; pegmatite
7	Pelitic biotite gneiss; minor calc-silicate rock and impure quartzite	16	Dolomite
6	Cataclastic biotite gneiss	15	Argillite
5	Grey quartz-dioritic to granodioritic gneiss	14	Meta-greywacke; meta-siltstone
4	Foliated quartz monzonite	12	Meta-arkose
3	Foliated alaskite	11	Conglomerate
2c	Hypersthene-quartz monzonite	10	Psammitic biotite gneiss
2b	Hypersthene trondhjemite	9	Albite-pyroxene rock
2a	Hypersthene-quartz diorite		

Foliated granites of units 2a, 2b, 2c, 3 and 4 —— intrusions?

Mainly biotite gneiss of units 7, 7a, 10 and 14, with intercalations of 8a, 8b and 9.

Ancient felsic gneiss —— basement?

GEOCHEMISTRY

Based on Geological Survey of Canada Open Files 321 and 322 (Uranium, National Geochemical Reconnaissance, Manitoba 1975) by E.H.W. Hornbrook, R.H. Garrett and J.J. Lynch.

- Sample of lake sediment containing over 50 ppm uranium.

GEOPHYSICS

Based on Geological Survey of Canada, Open Files 317 and 318, Airborne Gamma-Ray Spectrometry Survey 1975, by Resource Geophysics and Geochemistry Division.

Contour 2.0 ppm equivalent uranium (eU).

Contour 0.25 eU/eTh ratio.

Figure MEA-6-1 Simplified geological and radiometric map, Kasmere Lake region

In view of the broad lithological similarities of the biotite gneiss units (7, 10/14) and the intense deformation which has taken place, stratigraphic correlation within the Snyder Lake — Putahow Lake belt can be of but limited help in uranium exploration.

The boundary between unit 5 (felsic gneiss) and the biotite gneisses might bear a relationship to uranium mineralization. At Charlebois Lake, Saskatchewan, and in the Mont Laurier area, Québec, uranium mineralization comparable to that of the Snyder Lake — Putahow Lake belt is found in metasediments close to a basement of ancient felsic gneiss. The same occurs near Veal Lake where several interesting intersections of uraniferous anatectic granite, including one reported intersection of 30 feet averaging 4.5 lb. U_3O_8/ton were encountered in biotite gneiss close to the basement surface (Weber et al., 1975).

The above concept might be applied to uranium exploration in the Kasmere Lake region as follows:

1. A deliberate search for infolded keels of biotite gneiss in the extensive area of unit 5 which borders the Snyder Lake — Putahow Lake belt on the NW

2. Investigate the possibility that a narrow zone of basement may extend NE from Snyder Lake, perhaps for many kilometres.

3. Determine whether sheets of anatectic granite developed in biotite gneiss close to basement have any pecularities of mineralogy, texture, colour, chemistry, etc. which would help distinguish them from sheets formed further into the body of the gneisses.

Kasmere Lake Region (b) The Area of Archaean Plutons

Field observations and consideration of evidence presented by Weber et al. (1975) have led the writer to believe that the granitic bodies of units 2a, 2b, 3, 4, and 4a, which lie south of the Snyder Lake — Putahow Lake belt, most probably intruded the country metasediments as magmas generated in the cores of gneiss domes. Areas of hypersthene gneiss (unit 1) associated with the plutons are considered by the writer to be a contact metamorphic facies developed in the country biotite gneiss (unit 7); areas of 2c (hypersthene — quartz monzonite) found within plutons of unit 4 (foliated quartz monzonite) may represent areas where the magma was contaminated by assimilation of country rock.

Important implications of the foregoing reinterpretation are:

1. The basement to the metasediments does not crop out in this area; the nature of the concealed basement, and its depth below surface are not known. These considerations profoundly affect uranium exploration models involving a basement unconformity.

2. The metasediments of units 7, 10 and 12 are older than the granitic plutons (Archaean Rb-Sr isochron ages have been obtained from the latter — Weber et al., 1975).

Reconnaissance East of the Kasmere Lake Region (Refer to Fig. GS-1-1)

In general, the high regional levels of uranium demonstrated by radiometric and geochemical techniques of the G.S.C. Uranium Reconnaissance Program in the Snyder Lake — Putahow Lake belt fall off rapidly, east from the Kasmere Lake region. The most easterly of the coincident uranium and U:Th anomalies apparently related to areas of biotite gneiss (unit 7 or equivalent) lies NE of the great pluton of quartz monzonite (unit 20).

Some uraniferous pegmatitic rocks, probably of anatectic origin, occur within biotite gneiss and arkosic quartzite near Munroe Lake, and radioactivity is associated with calc-silicate rocks near Askey Lake. Both occurrences are in rocks that are probably lateral equivalents of the biotite gneisses of the Snyder Lake — Putahow Lake Belt.

East from Munroe Lake a zone characterized by a very flat radiometric response extends to about 97° 00′ W. Still further east, broad zones of radiometric uranium anomaly are accompanied by high thorium levels. The anomalies overlie extensive areas of ancient gneiss and younger granite plutons indiscriminately. This observation, added to the fact that the zone of depressed radioactivity to the west occurs over similar geology, suggests that the anomalies are related to extensive boulder fields rather than to bedrock geology. Some areas of boulders have a high U and Th background (uranium content probably 20 ppm, or above); anomalous uranium in lake sediments has been found in association.

The only uranium showing east of longitude 98° 00′ W known to the writer consist of a very weak and discontinuous development of a pitchblende-like radioactive material on joints in a porphyritic granite akin to unit 20 of the Kasmere Lake region (Schledewitz, GS-1, this report). The uraniferous substance, which is confined to a few joint planes, is not flanked by visible alteration, nor is it accompanied by gangue minerals; it may have formed by deposition from percolating ground waters which leached uranium from the host pluton.

The Churchill quartzites show only weak conglomeratic character, and no discernible resemblance to the uraniferous conglomerates of Blind River, Witwatersrand and Jacobina.

Southeast Manitoba (Refer to Fig. MEA-6-2)

1. Near West Hawk Lake, weak and erratic uranium mineralization is associated with pegmatitic segregations in the Frances Lake pluton (Lamb, 1975), near its southern margin, and with injection gneiss and rare pegmatitic dikes in adjacent greenstone. Occurrences of the same general type are found further east, in Kenora, Ontario (Beard, 1977).
2. Radioactivity is associated with fractures at a few places in the San Antonio formation, a 20 km^2 area of arkosic metasediments in the Rice Lake greenstone belt (Stockwell, 1938). The showings are not in themselves of economic interest and the source of the uranium is unknown.
3. **Lits** and pods of white pegmatitic material are present in dark biotite gneiss near the east shore of Tooth Lake. A dike-like pegmatitic body about 15 m wide shows weak erratic uranium mineralization accompanied by minor pyrite and molybdenite. The pegmatitic rock may be of anatectic origin.

Dion Lake (150 km east of Flin Flon)

Great, dike-like bodies of coarse pegmatite intrude metasediments east of Wekusko Lake. One of these bodies, at Dion Lake, has a petrographically distinct phase which is significantly enriched in uranium, with a reported average grade of 4.7 lb. $U_3 0_8$/ton. This occurrence well exemplifies uranium mineralization related to "true" or magmatic pegmatites, in contrast to mineralization in anatexites.

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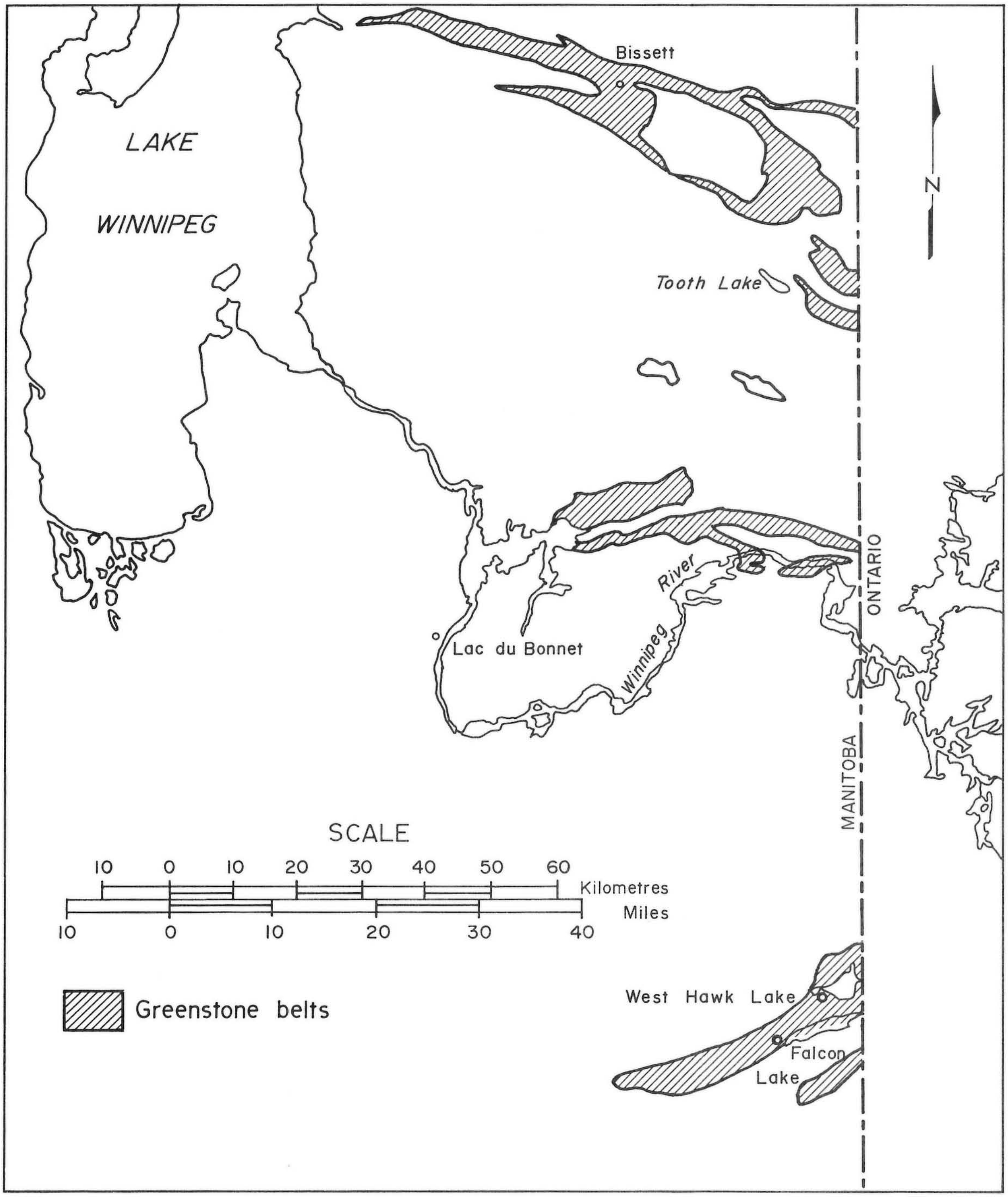


Figure MEA-6-2 Greenstone belts in SE Manitoba

MEA-7 QUATERNARY GEOLOGY OF THE BRANDON REGION

by S. Ringrose and C. Duyf

Further work on the Quaternary geology of the Brandon region took place following submission to the Department of the Underwood McLellan and Associates (UMA) Report "Sand and Gravel Resources of the Brandon Region". This study was commissioned by the Department during June 1976, and covers the Municipalities of North and South Cypress, Langford, Odanah, Cornwallis, Elton, Oakland, Glenwood, Whitehead, Daly, Blanshard, Hamiota, Saskatchewan, Woodworth and Sifton.

The stratigraphy of the Brandon region is complex and fundamental to the understanding of the Pleistocene history of the southern portion of the Province. Geological interpretations of the Tiger Hills region were provided by Elson in 1956 and Klassen in 1969 and 1975. A tentative stratigraphic column (Figure MEA-7-1) indicates the main divisions of Quaternary sediment. The upper portion of the column is based mainly on work undertaken by The UMA Group. The tills have been differentiated mainly by Klassen (1969) although an additional till is included here.

Unit 1: Minor exposures of Odanah shale of the Riding Mountain Formation are located throughout the area. The material is quarried and used as a source of aggregate on Municipal roads.

Unit 2: Early Pleistocene sand and gravel occurs as terrace deposits in the vicinity of Souris. The gravel comprises mainly agates and quartzites of non-local provenance, with minor carbonate and crystalline clasts indicating some glaciofluvial reworking.

Unit 3: Till was examined in recently exposed river cliffs in the Minnedosa, Souris and Assiniboine valleys. In the Minnedosa valley, Klassen's series of silty sandy till (Shell till), clayey till (Minnedosa till), interbedded sand and gravel, clayey oxidized till, sand and gravel, and compacted clayey till (Lennard till) were observed. In the Souris valley, a two till sequence was examined comprising a lower clayey till with some silt, an intertill sand layer with gravel lenses and an upper dark brown silty till which is oxidized and contains Souris type quartzite clasts. In the Assiniboine valley, in the vicinity of Treesbank, a similar two till sequence was observed. The lower dark clayey till with fine clasts is prevalent in the area, above which occurs a sandy calcareous till containing finely comminuted shale clasts.

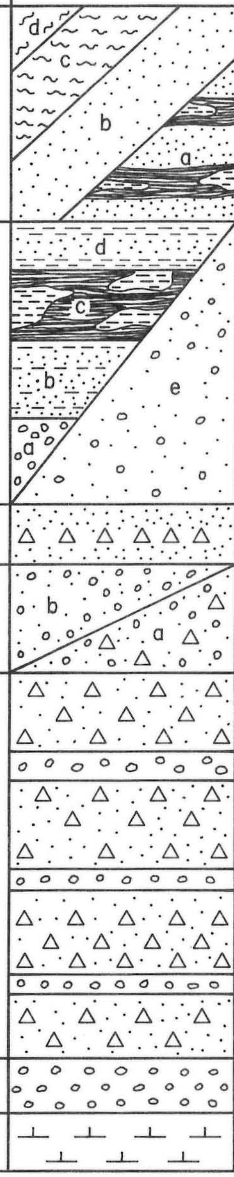
Unit 4: Large areas (5% of total) east of Brandon comprise "reworked till" which consists of up to 4m coarse pebble gravel, with a peleo-current flow to the east and northeast. The gravel mainly overlies finely bedded sand. The outwash areas (Unit 4b) consist of sandy fine to sandy coarse pebble gravel, interbedded with ripple drift laminated sand, and grade into sand downcurrent.

Unit 5: Consists of sandy fine pebble gravel which is horizontally bedded and structureless sandy cobbly coarse pebble gravel. A number of deposits in this unit are below water table. These represent channel fill and terrace deposits in the major valleys.

Units 6 a-d: Consist of coarse deltaic deposits to the east of the city of Brandon and in the vicinity of Rivers. Unit 6a is a sandy coarse pebble gravel with interbedded medium to fine sand. Units 6b, c, and d represent the fining sequence of deltaic and lacustrine deposits described below. Unit 6e comprises shoreline deposits, principally the Campbell shoreline of Lake Agassiz which separates the upper from the lower Assiniboine delta sediments. The strandline comprises the upper and lower Campbell beach ridge consisting mainly of fine pebble gravel and a series of offshore bars, consisting mainly of sand.

Unit 7: Comprises slumped coluvium, sand dunes, alluvial sediment and organic accumulations. Up to 5 m of coarse pebble gravel occurs in the unit mapped as 7a, alluvium.

The area has been divided into physiographic regions in the UMA report (see Figure MEA-7-2). The Assiniboine delta area, particularly the western apex region, has the highest potential sources for good quality gravel, as the shale content is 5% or less. The Souris basin and Minnedosa till plain have moderate potential in alluvial, terrace and outwash deposits, the



THICKNESS IN METRES	UMA UNIT NO.	COMPONENT LITHOLOGY	MATERIAL	ORIGIN	ESTIMATED AREA
–	7 d		d UNSORTED SLOPE DEBRIS	COLLUVIUM	6 %
–	7 c		c MUCK AND PEAT	ORGANIC	1 %
9	7 b		b SAND	EOLIAN	11 %
6	7 a		a SAND, SILT AND CLAY	ALLUVIUM	5 %
3	6 e		e SAND AND GRAVEL	SHORELINE	1 %
11	6 d		d FINE SAND AND SILT	LAGOONAL	1 %
5	6 c		c CLAY AND SILT	DELTAIC	11 %
12	6 b		b FINE SAND AND SILT	FINE OFFSHORE	18 %
3	6 a		a GRAVEL	DELTAIC	2 %
–	5		SAND-INTERBEDDED TILL	CHANNEL FILL AND TERRACES	2 %
5	4 b		b SAND AND GRAVEL, WITH MINOR SAND	OUTWASH	0.9 %
4	4 a		a SAND AND GRAVEL WITH MINOR TILL	REWORKED TILL LAG	5 %
0-20	3		TILL (4)	LENNARD TILL	35 %
			INTERTILL GRAVEL		
			TILL (3)	MINNEDOSA TILL	
			INTERTILL GRAVEL		
			TILL (2)	GLACIAL TILL	
			INTERTILL GRAVEL		
			TILL (1)	GLACIAL TILL	
6	2		SOURIS SAND AND GRAVEL	EARLY PLEISTOCENE OUTWASH	1-2 %
–	1		BEDROCK	CRETACEOUS	0-1 %

Figure MEA-7-1 Stratigraphic column of the Brandon region

shale content of which is 4-14%. The Brandon Hills and Tiger Hills upland are regarded as low potential aggregate source areas. Gravel information will be submitted to the computerized data base now being developed by the Mineral Resources Division, to enable retrieval for resource management and land-use planning.

A number of sections were observed in the Assiniboine valley to provide further input into the Quaternary history of the area. The generalized Section (Figure MEA-7-3) is a composite of 14 sections examined in detail along the Souris and Assiniboine between Treesbank and P.T.H. No. 34.

In summary, dark clayey till is evident in the upstream portion of the reach examined. This is succeeded by coarse gravel and sand beds of the lower unit which are interlayered with varying thicknesses of sticky, massive, blue-grey clay beds. The upper bed contains large pelecypods, wood and peat and the lower bed contains abundant smaller mollusc shells.

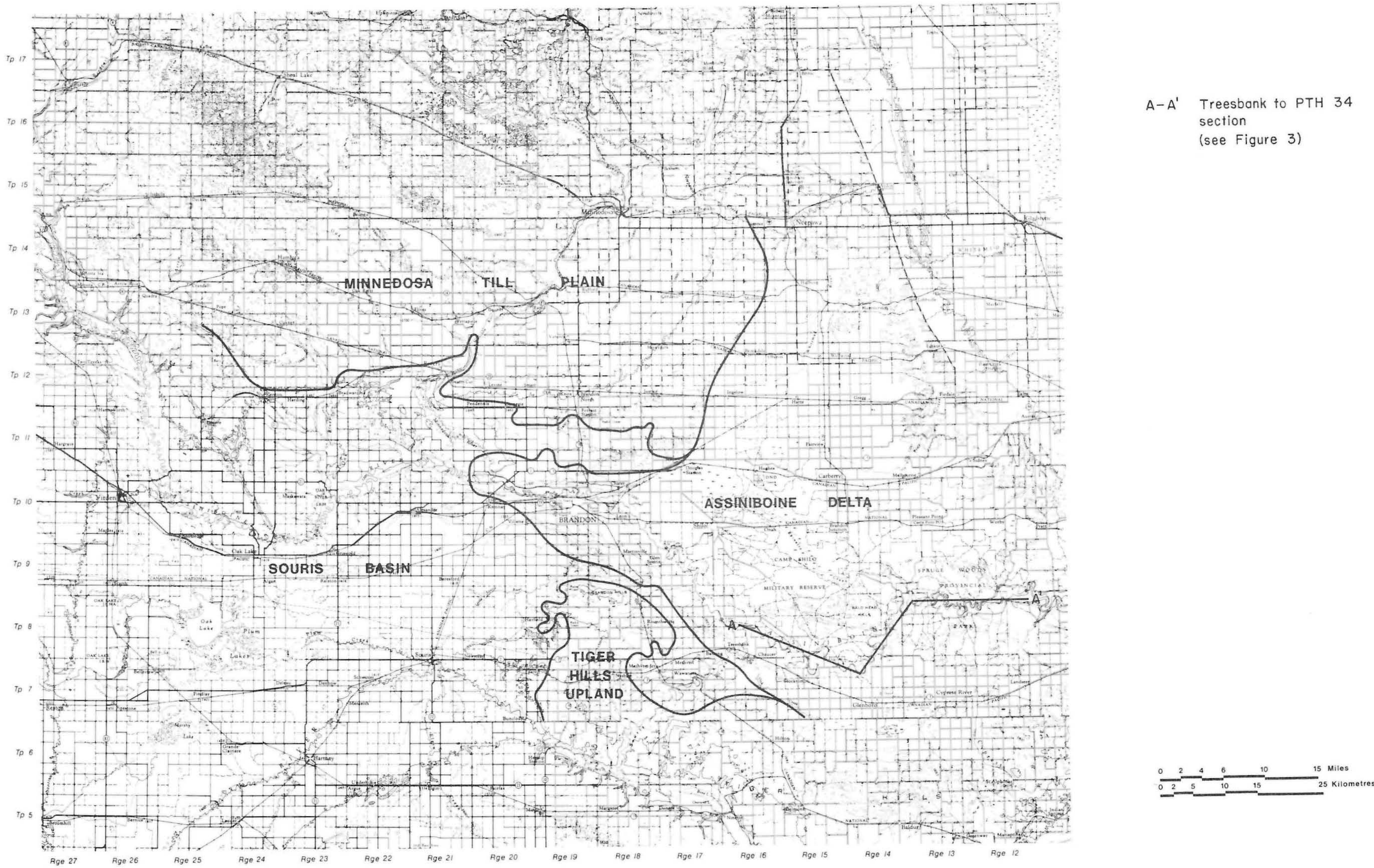


Figure MEA-7-2 Physiographic divisions of the Brandon region

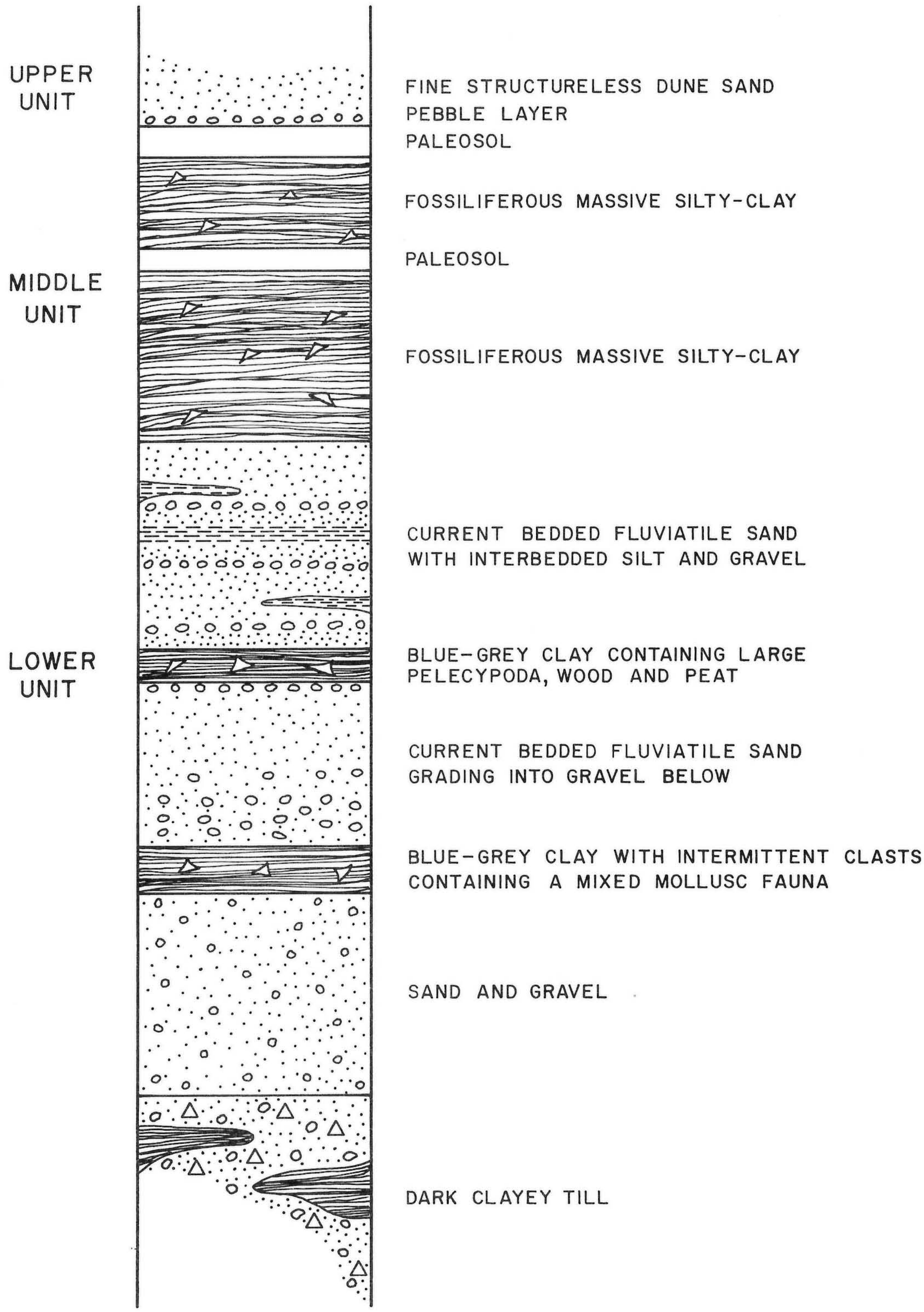


Figure MEA-7-3 Composite section along the Assiniboine River between Treesbank and PTH 34

The middle unit consists of fossiliferous massive silt with bleached paleosol horizons towards the centre and top. The upper unit consists of dune sand.

Similar deposits in the Rossendale gully section have been interpreted by Klassen and Elson, 1972, p. 11, as representing three intervals of inundation of the Assiniboine River at the Campbell terrace level by Lake Agassiz. Radiocarbon dates obtained from organic detritus in Klassen and Elson's unit 2 (sand, silt and clay), unit 5 (clay) and unit 8 (clay with silt interbeds), are 10 600 + 150 B.P. and 9700 + 140 B.P. respectively (GSC-902, 870 and 797). The additional data suggest that the nature of inundation changed westwards towards the Assiniboine-Souris confluence, with less frequent inundation upstream. The evidence of at least two paleosols in the upper silty-clay beds which are traceable throughout the reach to north of Glenboro may add to our knowledge of climatic conditions during later stages of subaerial exposure. Further analysis is required to integrate the information obtained from the sections into the overall history of Lake Agassiz in the Province.

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MEA-8 MAJOR GRAVEL DEPOSITS IN THE WINNIPEG REGION AND METHODS OF GRAVEL INVENTORY

by S. Ringrose, P. Large and F. Gruszka

Further field work on gravel deposit areas of the Winnipeg region was undertaken during the summer of 1976 and 1977 to supplement mapping carried out for the Department by Underwood McLellan and Associates, and presented in their report "Aggregate Resources of the Winnipeg Region" (1976). Preliminary maps at 1:50 000 are now available for the following NTS ares: 62H-1, 2, 6, 7, 8, 9. 10, 11, 14, 15, 16, 62I-1 to 11 and 62J-1.

Six deposit areas represent the major sources of gravel in the Winnipeg region: Belair, Brightstone, Milner Ridge — Seddons Corner, Birds Hill, Reynolds and Bedford Hills (see Figure MEA-8-1). Additional fieldwork, including extensive backhoe testing and helicopter reconnaissance has taken place in the first four of these deposit areas.

Channel samples were collected from each, processed in the laboratory, and analyzed against forty-eight standard aggregate use specifications by a newly developed Industrial Usage Assessment computer program. All the data obtained from field and laboratory work is stored in a computerized system, referred to as PLSTCNG[1]. Retrievals of information from this system can be obtained for any mapped area in the Province. Retrievals are made on any deposit (referred to by number on the NTS maps) or for any area (defined by Township, Range, Section or quarter Section). The information obtained includes reserve estimates, quality information, ownership and a record of all geological observations pertaining to the deposit.

[1]Pleistocene Geology Data Base.

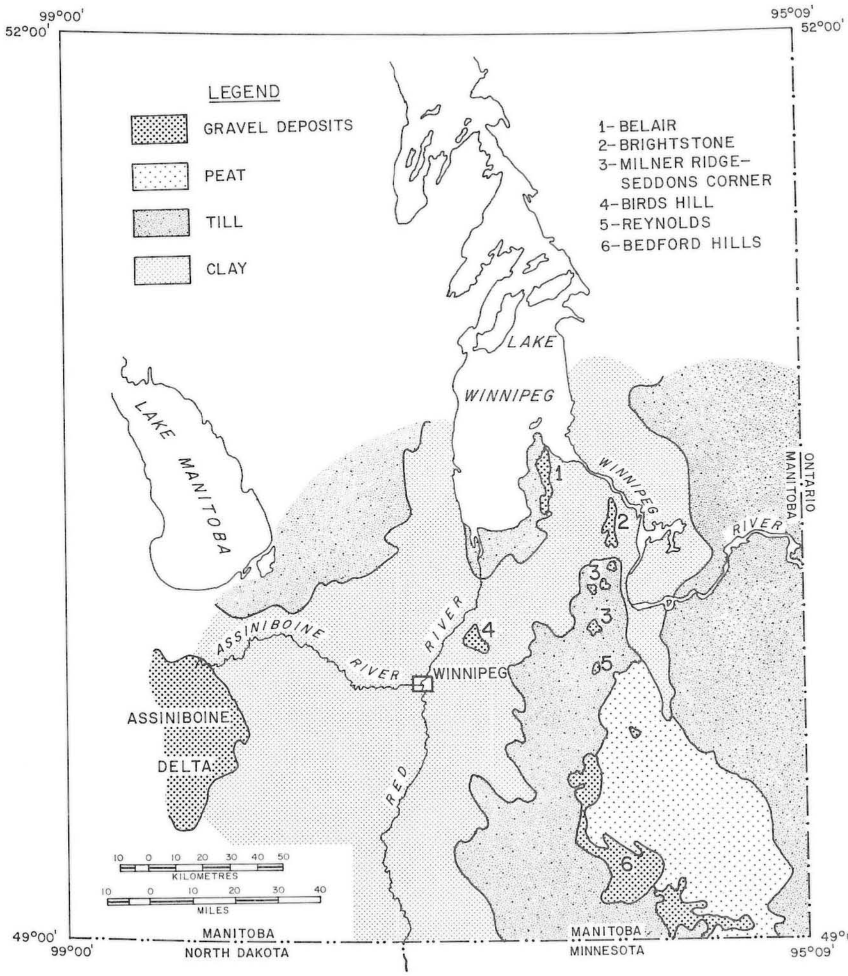

Figure MEA-8-1 Major gravel deposits in the Winnipeg region

MEA-9 QUATERNARY GEOLOGY OF THE CRANBERRY PORTAGE — FLIN FLON AREA (63K-N 1/2)

by V. Singhroy

Introduction

This project was undertaken to map the Quaternary geology of the Cranberry Portage — Flin Flon area and to provide data for aggregate resources management. Eight preliminary Quaternary geology maps at a scale of 1:50 000 are available for the entire study area. These include N.T.S. areas 63K, 9-16 (Singhroy, 1977).

During five weeks of field work, a helicopter was used as a means of transport in remote areas. A Nimbus seismic unit and a Bison resistivity meter were used to determine approximate depths of sand and gravel deposits. Thirty-three sand and gravel deposits were identified and one hundred and twenty-four sites were examined and sampled.

Quaternary Geology

Figure MEA-9-2 summarizes the general Quaternary geology of the map area.

Unit 1: The northern two thirds of the area is underlain by Precambrian rocks of the Churchill geological province. The southern one third is underlain by Paleozoic bedrock of the Red River Formation. Precambrian rocks (Unit 1a) include the Flin Flon — Snow Lake greenstone belt and the Kissey-new metasedimentary belt (Bailes, 1971). Dolomitic limestone outcrops (Unit 1b) occupy approximately 3 per cent of the map area and occur along the southern shoreline of Athapapuskow Lake and along Highway 391.

Bedrock ridges, rock drumlins, rock basins, roche moutonée and crag and tail features dominate the landscape in the Shield area. Glacial striae indicate an ice movement from the northeast. On Precambrian outcrops, N 20° E was recorded in the Flin Flon area and N 44° E in the Snow Lake area. On dolomite outcrops, N 26° E south of Reed Lake along Highway 391.

Unit 2: Glacial deposits consist of weakly developed ablation till which can be subdivided into three types based on textural and lithologic composition (Fig. MEA-9-1).

Unit 2a: The first type is a yellowish brown non-calcareous sandy till comprising angular to sub-angular Precambrian clasts. It varies in thickness from 0 to 2 metres and overlies Precambrian rocks.

Unit 2b: In the Athapapuskow — Simonhouse Lake area, a greyish brown calcareous clay till overlies the Paleozoic rocks. This till comprises between 40 and 70 per cent Paleozoic clasts, most of which are angular to sub-angular. The thickness of this till varies from 0 to 3 metres. Ablation till having similar characteristics occurs also in The Pas region (Singhroy, 1976).

Unit 2c: In the area south of Reed Lake, the till is a light brownish grey (2-5 Y 6/2, moist), very calcareous silty deposit, rich in angular to sub-angular carbonate boulders and forms a thin veneer, not exceeding 0.7 metres, above the Paleozoic bedrock.

Unit 3: Proglacial sand and gravel deposits including thick sandy outwash were examined in isolated pockets along Kississing Lake road, between Twin and Payuk Lakes, and in the Morton Reed Lakes area (Fig. MEA-9-2). More dispersed gravelly outwash deposits occur over the Paleozoic rocks southwest of Athapapuskow Lake and east of Simonhouse Lake, and east of Tramping Lake (Fig. MEA-9-2), these outwash deposits are associated with meltwater channels, minor eskers and kame and kettle features.

Unit 4: Glaciolacustrine deposits consisting of clay, silt and boulders occur in small pockets within bedrock highs. Two relatively large areas occur north of Flin Flon and northeast of Channing. The dark greyish brown silty clay is characteristically blocky, non-calcareous and varies in thickness from 0 to 2 metres. Large sub-rounded to sub-angular Precambrian

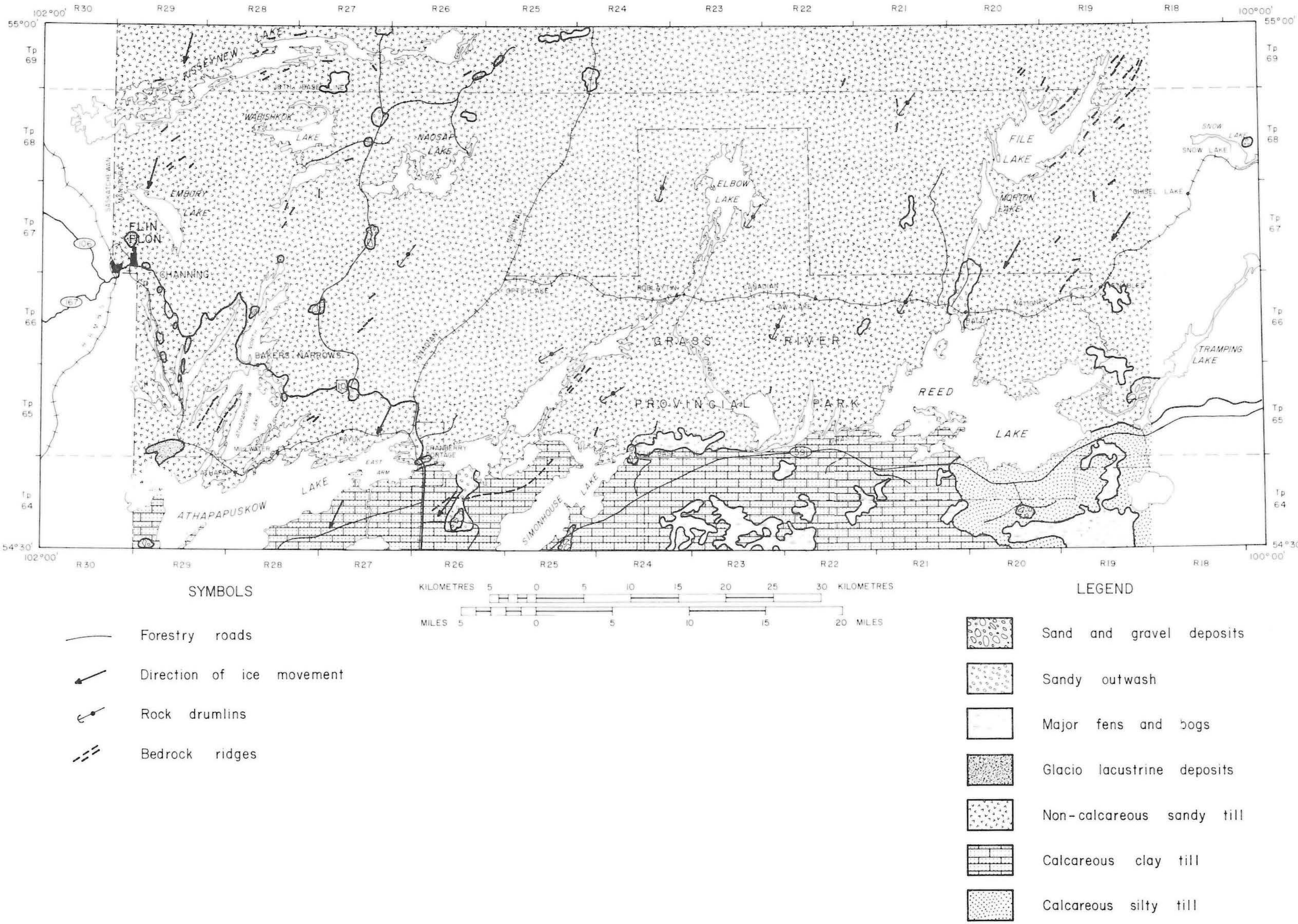

Figure MEA-9-1 General Quaternary geology of the Cranberry Portage — Flin Flon area

THICKNESS	UNIT NO:	COLUMN	MATERIAL	ORIGIN	ESTIMATED AREAL EXPOSURE EXCLUSIVE OF LAKES
0 - 5 m	4		Swamps, fens and bogs	Organic deposits	40%
0 - 10 m	3	3b	3b: Clay silt & boulders	Glaciolacustrine	2%
		3a	3a: Sand & gravel	Glaciofluvial	10%
0 - 5 m	2		Ablation till		20%
			2c: strongly calcareous silty till		
		2c 2b 2a	2b: calcareous clay till	Glacial	
			2a: non-calcareous sandy till		
	1	1b	Bedrock	1b Paleozoic	3%
		1a		1a Precambrian	25%

Figure MEA-9-2 Stratigraphic column of the Cranberry Portage — Flin Flon area

boulders varying from 20 x 15 x 10 cm. to 60 x 40 x 25 cm. were deposited above the clay. This deposit is similar to the glaciolacustrine areas around Wanless (Singhroy, 1976).

Unit 5: Peat deposits occupy approximately 40 per cent of the map area and are associated with fens, bogs and swamps.

Economic Geology

Sand and gravel resources are scarce in the Cranberry Portage — Flin Flon areas. Crushed rock is used in Highway construction between Cranberry Portage and Flin Flon because most sand and gravel deposits in this area form crag and tail deposits that are depleted or near depletion. This scarcity of construction aggregate in the area has required the city of Flin Flon to purchase all its sand and gravel requirements from the Province of Saskatchewan. Manitoba Forestry Resources Ltd., another major user of sand and gravel in the area, makes use of sandy till wherever possible or taps outwash deposits along the Kississing Lake road. The Simonhouse deposit, 60 per cent of which is depieted, is the main source of sand and gravel for users from Cranberry Portage and the Department of Highways. Along Highway 391 are four major deposits (Fig. MEA-9-2) that provide sand and gravel for road construction and parks development. However, because these deposits are far apart, crushed dolomite becomes a viable alternative in shoulder repairs and road maintenance.

The following table summarizes the availability of sand and gravel deposits in the Cranberry Portage — Flin Flon area.

LANDFORMS	ACCESSIBLE DEPOSITS	INACCESSIBLE DEPOSITS	VISUAL QUALITY	ESTIMATED DEPLETION
Crag and tail	13	—	Medium low	80-90%
Sandy outwash	6	—	Medium low	40-60%
Gravelly outwash	8	1 (no depletion)	Medium high	40-60%
Esker and kame complex	3	—	Medium high	20-60%
Glaciolacustrine Plain (Clay fill)	2	—	Low	50-70%

Of the 33 sand and gravel deposits in the area, approximately 75% are near depletion. Relatively large, high quality deposits are 40 kilometres away from major users, which substantially increases construction costs in the area. All data pertaining to sand and gravel resources in the area will be put into the computerized Pleistocene data system to enable rapid retrieval for aggregate resource management and land use planning.

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MEA-10 QUATERNARY GEOLOGY OF THE PAS AREA 63K & 63F

by V.Singhroy

Field work for The Pas project was carried out during 16 weeks in the summer of 1976, resulting in the preparation of nine preliminary maps. The maps are now published at a scale of 1:50 000 as the Quaternary geology of The Pas area and cover the following areas:

Number	Title	N.T.S. Number
1977 S-PAS-1	The Pas	63F/4
1977 S-PAS-2	Pasquia Lake	63F/11
1977 S-PAS-3	Root Lake	63K/3
1977 S-PAS-4	Yawningstone Lake	63K/7
1977 S-PAS-5	Egg Lake	63K/6
1977 S-PAS-6	Namew Lake	63K/4E
1977 S-PAS-7	Goose Lake	63K/5E
1977 S-PAS-8	Culdesac Lake	63F/12E
1977 S-PAS-9	Barrier Lake	63F/13E

The stratigraphy established by Singhroy, 1976 provides appropriate map units which represent the Quaternary deposits in The Pas area. Glacial, proglacial and fluvial landforms together with the location of active and abondoned sand and gravel pits and quarries are depicted on the preliminary maps.

Reference

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MEA-11 QUATERNARY GEOLOGY OF SELECTED PORTIONS OF EASTERN MANITOBA

by E. Nielsen

Surficial mapping was undertaken in three separate areas in eastern Manitoba (Fig. MEA-11-1) to evaluate the aggregate resources and to obtain detailed knowledge of the Quaternary stratigraphy.

The Manigotagan — Wallace Lake — Falcon Lake Area

Surficial Geology

Figure MEA-11-2 summarizes the stratigraphic sequence for southeasern Manitoba.

The earliest recorded Pleistocene event is the advance of Labradoran ice from the northeast during classical Winconsinan time. This ice advance eroded and modified previously deposited surficial sediments and left isolated pockets of primarily coarse sandy pebbly till.

Melting of the Labradoran ice in late "classical" Wisconsinan time resulted in the deposition of sometimes extensive 'glaciofluvial sand and gravel deposits such as at Sandilands in the southwest corner of this region (Fenton, 1974). In the east minor deposits of sand and gravel were laid down in proglacial Lake Agassiz as kame-deltas and esker-deltas abutting the ice front. Silt and clay were deposited in the deep water basin of Lake Agassiz.

Oxidized silty sand unconformably overlying unoxidized grey silt west of Falcon Lake and the presence of an **in situ** fossil ground squirrel of the genus **Spermophilus** (identification by C.R. Harington of the National Museum of Canada) in lacustrine sand of late Lake Agassiz I age near Grand Beach indicate that the lake drained and the previously deposited sediment became subareally exposed. Both these occurrences are overlain by carbonate-rich till, the Libau till, deposited by ice advancing from the northwest. This till outcrops very extensively in the southwestern part of the region and extends eastward to near Falcon Lake in the south an Pinawa and the Lee River to the north. Carbonate till was not observed east of the Winnipeg River north of the town of Lac du Bonnet.

Proximal carbonate varves, such as those exposed below the Powerview Dam, suggest that the Red River lobe was flanked by a lake to the east believed to be early Lake Agassiz II. Subsequent retreat of the ice from southern Manitoba and expansion of Lake Agassiz II resulted in extensive deposition of varved silt and clay in the low lying areas and coarser sand and gravel on the higher areas to the east. Regression of Lake Agassiz in early Holocene time resulted in extensive reworking of all the previously deposited sediments, as is shown by offlapping beach sediment overlying glaciofluvial gravel near Pinawa (Fig. MEA-11-2).

Holocent peat deposits are very extensive throughout the area.

Economic Geology

Sand and gravel deposits are not extensive and local needs are largely met by the Milner Ridge deposits (Large & Ringrose, 1976). In the east where the Shield is highest and more dissected, kame-delta esker-deltas and beach deposits are thin and patchy.

Lake Agassiz sand, silt and recent alluvium comprise most of the surficial sediment.

Local deposits have been used extensively in the construction of the Cat Lake to Wallace Lake road and should continue to supply maintenance aggregate.

Local thin offlapping beach deposits in the Manigotagan area should continue to supply that area with aggregate in the immediate future.

The Berens River — Little Grand Rapids Area

Surficial Geology

Glacial striae (and other directional indicators) indicate that only ice movement from the northeast affected this area. Till and glaciofluvial deposits from this ice advance, and any subsequent deposits which were formed by reworking, are now covered by swamp extending from 30 to 50 kilometres away from Berens River.

Peat comprises the principal surficial material in the area.

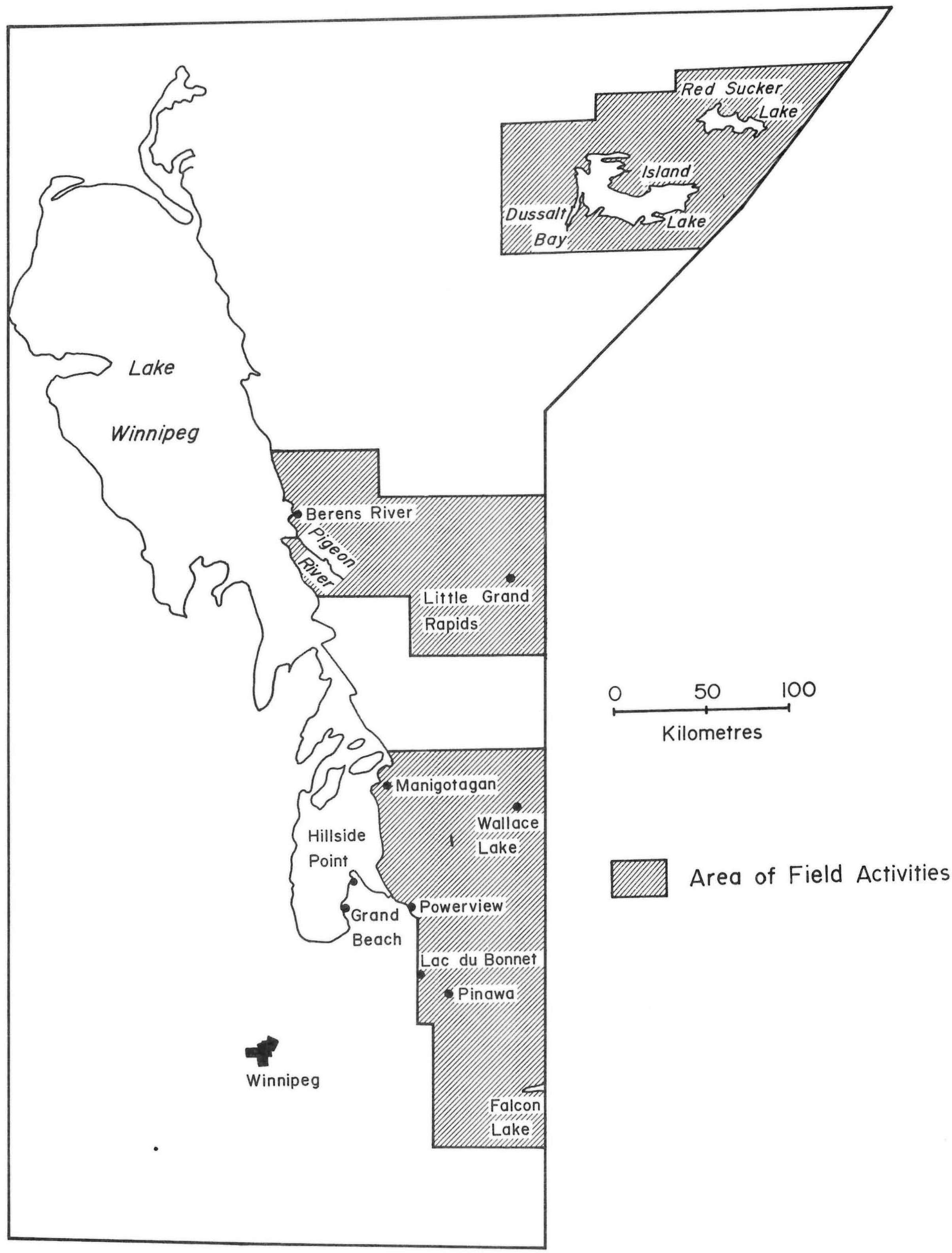

Figure MEA-11-1 Location of field activities

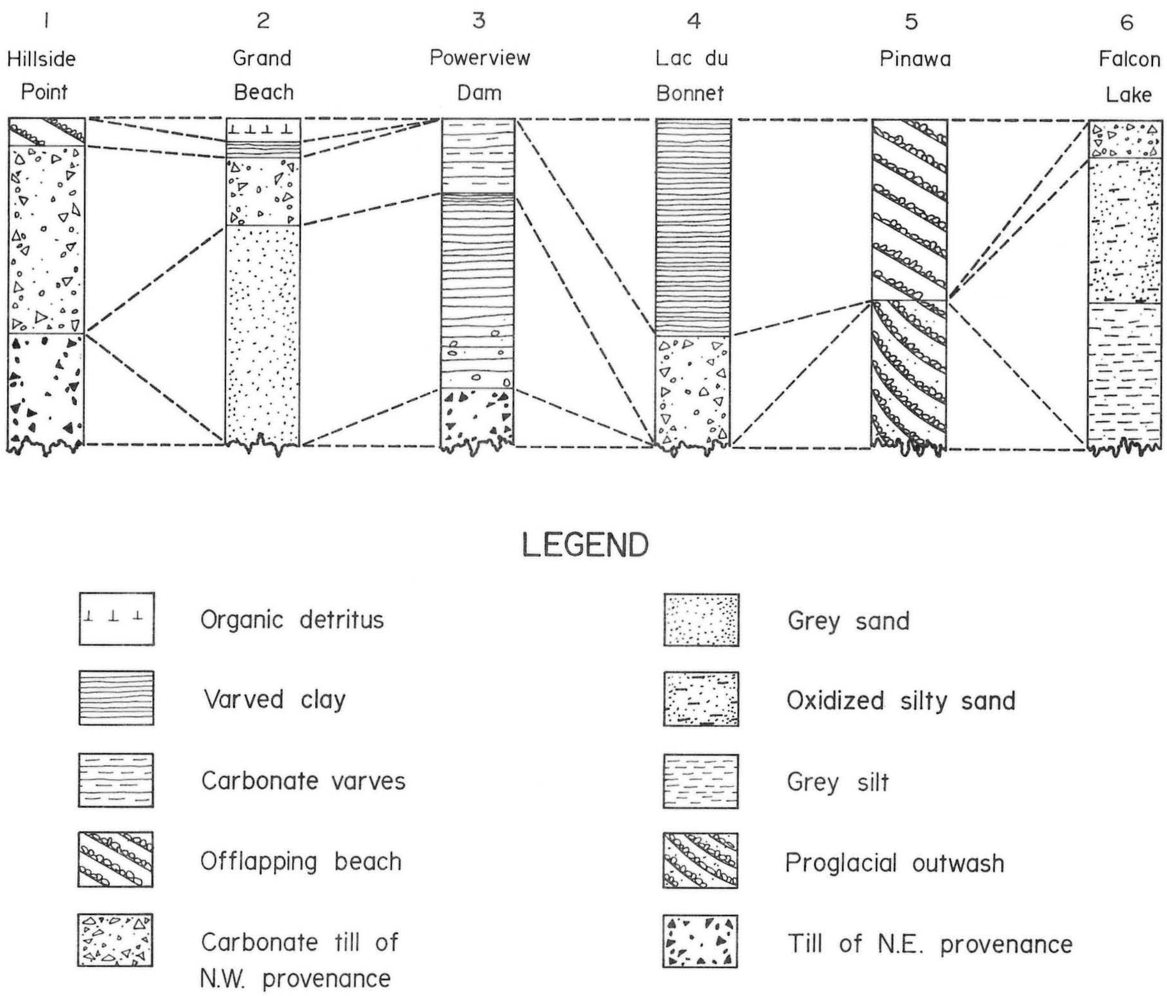

Figure MEA-11-2 Chronostratighraphic correlation of late Wisconsinan and Holocene units in southeastern Manitoba

Economic Geology

The immediate aggregate needs of Berens River should be met by a small deposit located south of the community, on the Pigeon River. Good quality sandy gravel is available there and is accessible by winter road.

A number of large gravel shoals are present in Lake Winnipeg immediately west of Berens River which might be an alternate source to crushing if the need for aggregate increases.

Two small deposits, one approximately 30 km northwest and the other approximately 30 km southeast of Little Gravel Rapids (near dogskin Lake), are the only aggregate reserves in that region.

The Island Lake — Red Sucker Lake Area

Surficial Geology

Intersecting striae at the airstrip at Red Sucker Lake indicate that the Labradoran ice advance from the northeast was followed by a glacial readvance from the north. Evidence of Labradoran glaciation was largely eroded throughout the entire area and the existing glacial deposits are primarily the result of the last ice advance.

Till is generally patchy and poorly exposed except in the area south of Beaver Hill Lake and west of Red Sucker Lake. There hummocky disintegration moraine attests to the presence of a large block of stagnant ice long after the surrounding area was ice free. Subsequent modification by Lake Agassiz after the disappearance of the ice resulted in the formation of gravel lags and boulder beaches. Fine-grained Lake Agassiz sediments are absent.

Numerous large eskers with current directions towards 190° are found throughout the area. North of Island Lake the eskers show little surface modification by Lake Agassiz. South and west of Island Lake large wave-modified, south-trending sand and gravel ridges are not recognizable as eskers and may in fact be moraine remnants.

Evidence for the presence of glacial Lake Agassiz is plentiful throughout the region. In the Beaver Hill, Red Sucker and Island Lake basins, counts on lower proximal and upper distal varves testify to the presence of Lake Agassiz for a period of at least 200 years. Seven terraces, between 0 and 95 metres above the lake, record stand stills in the waterlevel during the final drainage of Lake Agassiz II.

Economic Geology

Good quality aggregate is plentiful and widely distributed throughout the area and should more than fulfil the needs of the communities in the region.

Numerous eskers, north of Island Lake and southwest of Red Sucker Lake, and beach deposits west of Island Lake are easily accessible by winter road or barge, though many deposits are somewhat distant.

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MEA-12 PEAT PROJECT

by B.B. Bannatyne

Testing of sphagnum peat bogs was continued in 1977 in order to complete the project initiated in 1975 (Bannatyne, 1977). The severe forest fire situation of 1976 prevented sampling of five previously selected bogs. These bogs, together with four additional bogs identified from remote sensing photographs (the Giroux, McMun, Medika west and Julius Lake south bogs), were sampled in 1977. Only one location was sampled in each bog, except for the Julius Lake south bog where two locations were sampled. The sphagnum bogs in southeastern Manitoba sampled during this project are indicated on Figure MEA-12-1.

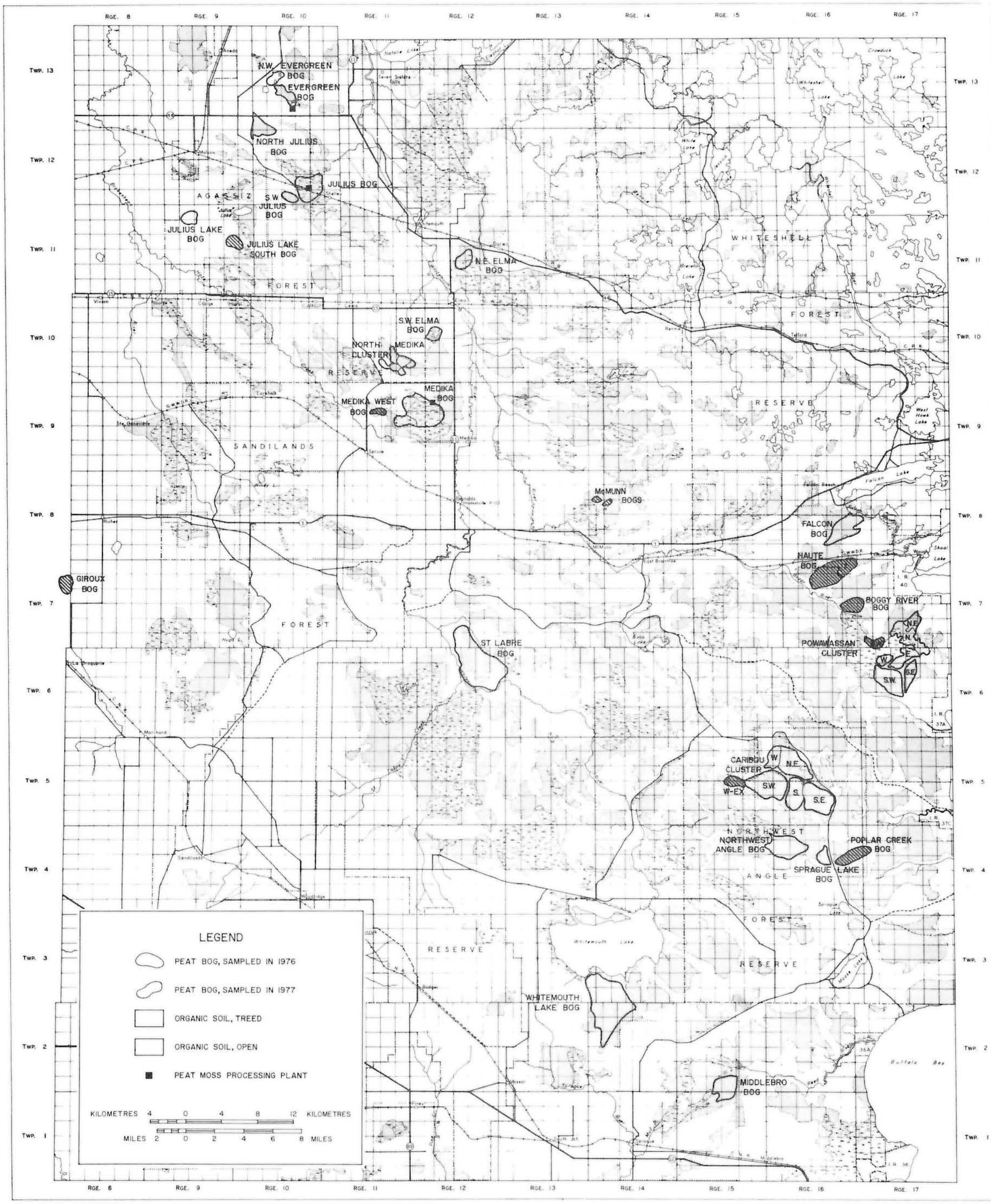

Figure MEA-12-1 Sampled bogs in southeastern Manitoba

TABLE MEA-12-1 SPHAGNUM BOGS SAMPLED IN 1977

Bog	Location Sec. Tp. Rge.	Depth of bog	Depth tested	Absortive Value Dry basis	25% moisture	pH	Area: acres
Poplar Creek	24-4-16E	2.1 m	2.0 m	14.02	10.26	—	1030
Caribou — western extension	15-5-15E	3.1 m	3.0 m	16.56	12.16	—	550
Giroux bog	25-7-7E	2.85 m	2.5 m	21.11	15.58	3.2 — 4.9	450
Powawassan NW	6-7-17E	3.9 m	3.8 m	19.53	14.40	—	420
Boggy River	23-7-16E	2.75 m	2.5 m	20.66	15.24	4.1 —	450
Haute (GWWD) Railway	33-7-16E	2.5 m	2.5 m	17.40	12.75	3.8 — 5.2	1300
McMunn	19-8-14E	1.7 m	1.5 m	14.16	11.69	3.6 — 4.3	75
Medika west	NW22-9-11E	1.85 m	1.5 m	11.96	8.72	4.9 — 5.4	100
Julius Lake south	23-11-9E	3.0 m	2.5 m	24.81	18.37	3.4 — 5.2	450

In addition, a reconnaissance of the Moss Lake — Birch River area (north of Highway 1 and east of Highway 11) was made, but the McMunn bog was the only sphagnum area identified.

The results of the 1977 field work are summarized in Table MEA-12-1; the composition of bog samples was determined also. The results indicate that the bogs with most potential are:

(1) the Giroux bog (75 to 88% sphagnum from 0.2 to 2.0 m)
(2) the Julius Lake South bog (86 to 97% sphagnum from surface to 1.5 m), and
(3) the Boggy River bog (81 to 91% sphagnum from 0.15 to 2.0 m).

The Poplar Creek bog, where sampled, was 60 to 63% sphagnum, but visual examination indicates that the eastern part of this bog, inaccessible by helicopter, is probably a good sphagnum bog. The Powawassan bog has an upper layer of sphagnum, 1 m thick, underlain by 1.5 m of mixed sphagnum plus reed and sedge peat; however, it has a fairly dense tree cover (**Picea mariana**). The western extension of the Caribou bog is a mixed sphagnum plus reed and sedge bog, but may contain more sphagnum in the eastern part. The McMunn bog has an open sphagnum surface mergint to a **Picea mariana — Ledum** complex; a similar bog is present 1 km west of the area sampled. The Haute bog warrants more sampling because of its location near the Greater Winnipeg Water District Railway; the one sample taken showed 80% sphagnum to a depth of 1 m, underlain by 1.5 m of mixed sphagnum plus reed and sedge peat. The Medika West bog is a shallow reed and sedge bog with a surface growth dominated by dwarf birch (**Betula glandulosa**).

Reference

Bannatyne, B.B.
1977: Peat Project; **in** *Man. Min. Res. Div.,* Report of Field Activities, 1976.

MEA-13 INDUSTRIAL MINERALS DRILL PROGRAM

by B.B. Bannatyne

Several areas of interest for various industrial minerals were drill tested during the past summer. Cored sections of Paleozoic, Mesozoic and Cretaceous rocks were obtained from the Stony Mountain, Pembina Mountain, Gypsumville and Red Deer River areas. The location of the Red Deer River hole was chosen by D.S. Evans, Exploration Operations Branch. The drilling was done with a JKKS 300 rig, operated by D. Berk, assisted by M. Carney. The entire program was co-ordinated with the work of H.R. McCabe, stratigrapher with the Geological Services Branch, to whom the writer is greatly indebted for his efforts in helping to achieve the objectives of the program. (Results of this program are described also by H.R. McCabe, GS-18, this report).

(1) Dolomite and Limestone, Stony Mountain — Stonewall area

An earlier program under the Canada-Manitoba Mineral Exploration and Development Agreement to assess aggregate resources in the Winnipeg area indicated that the major source of bedrock aggregate for the Winnipeg region would be carbonate bedrock in the Stony Mountain — Stonewall — Gunton area (The UMA Group, 1976). A seismic survey located 12 areas near Winnipeg where bedrock might be 3 m or less below the surface. Five of these locations were drilled in 1976 (McCabe, 1976) and another 5 were drilled in 1977 (Table MEA-13-1). Of the 10 locations drilled, 6 had bedrock at less than 5 m, 2 between 5 and 7 m, and 2 did not intersect bedrock at 11 m or more (Figure MEA-13-1).

In addition to the dolomite resources, beds of high-calcium limestone occur near the top and middle of the Fort Garry Member, and at the top of the Selkirk Member. Sections of limestone that were intersected in the aggregate drilling program have been submitted for chemical analysis, to supplement recently published data on these beds (Bannatyne, 1975).

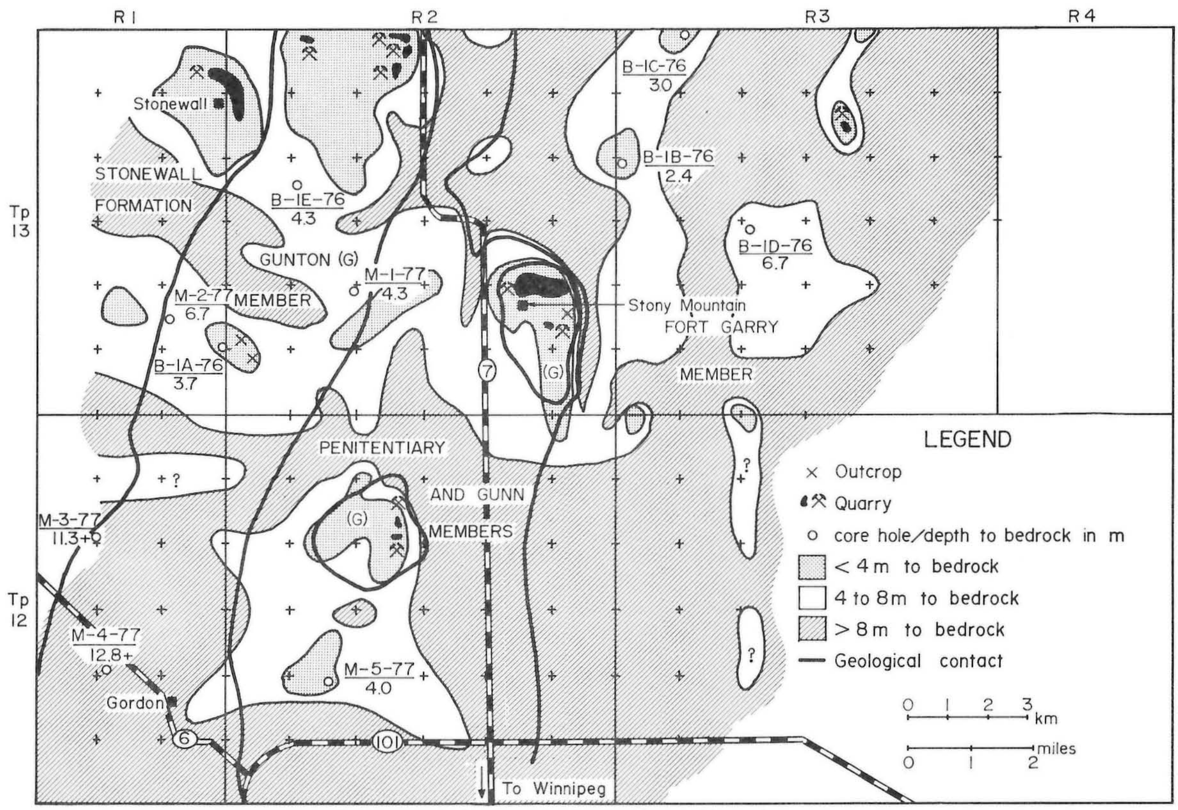

Figure MEA-13-1 Depths to bedrock and geology of the Stony Mountain area

TABLE MEA-13-1 DRILL HOLES IN STONY MOUNTAIN AREA, 1977

HOLE	LOCATION	FORMATION	MEMBER	INTERVAL	LITHOLOGY
M-1-77	NE 16-8-13-2 EPM	Overburden		0-4.5 m	Clay, boulder till
		Stony Mountain	Gunton	4.5-6.4	Dolomite, mottled
			Penitentiary	6.4-12.5	Varigated argillaceous dolomite
			Gunn	12.5-2.2	Argillaceous limestone, shale
M-2-77	NE 8-11-13-1 EPM	Overburden		0-64	Clay, boulder till
		Stony Mountain	Williams	6.4-10.8	Dolomite, sandy; shale
			Gunton	10.8-21.6	Dolomite, buff
			Penitentiary	21.6-23	Dolomite, argillaceous
M-3-77	SE 1-27-12-1 EPM	Overburden		0-11.3	Clay, sand and gravel, till
M-4-77	SW 4-14-12-1 EPM	Overburden		0-12.8	Clay, sand and gravel, till
M-5-77	NW 15-8-12-2 EPM	Overburden		0-4	Clay, till
		Stony Mountain	Penitentiary	4-4.9	Dolomite, argillaceous
			Gunn	4.9-23.2	Limestone, argillaceous, shale

(2) Cretaceous shale, Pembina Mountain area

Because drill core was not available for the Cretaceous section from the top of the Riding Mountain Formation to the base of the Favel Formation (Bannatyne, 1970), an attempt was made to obtain this from the Pembina Mountain area. The section proved difficult to drill and recovery in some members (e.g. Odanah, Pembina Members) was poor. However, nearly complete cores of the Boyne and Morden Members and the Favel Formation were recovered (Table MEA-13-2).

TABLE MEA-13-2 DRILL HOLES AT PEMBINA MOUNTAIN

HOLE	LOCATION	FORMATION	MEMBER	INTERVAL	LITHOLOGY	USE
M-8-77	SW 5-24-4-7 WPM	Riding Mountain	Odanah	0-13.7 m	Siliceous shale	In brick and road metal
			Millwood	13.7-32.6	Bentonitic shale	Potential pelletizer
		Vermilion River	Pembina	32.6-38.4	Shale, bentonite	Bentonite
			Boyne (upper)	38.4-62.2	Calcareous shale	Natural cement
			Boyne (lower)	62.2-74.4	Calc. + non-calc. shale	Potential for brick
M-10-77	NE 14-32-3-6 WPM	Surficial		0-5.2	Till	
		Vermilion River	Boyne	5.2-30.5 (?)	Calc. + non-calc. shale	Potential for brick
			Morden	30.5(?)-55.5	Carboneous shale	In brick
M-12-77	SW 1-14-4-6 WPM	Favel		0-45.1	Limestone, calcareous speckled shale, oil shale	Potential for limestone and oil shale

(3) Gypsum and limestone, Gypsumville area

The gypsum deposits north and east of Gypsumville occur within the Lake St. Martin crater structure, which is about 24 km (14 miles) in diameter (McCabe and Bannatyne, 1970). Four holes were drilled to obtain more stratigraphic data on rocks within the crater, and on the structure in the area near the rim of the crater. Gypsum has been quarried since 1900, and the area has potential for high-calcium limestone and silica sand near-surface silica sand has not been intersected as yet along the western side of the impact structure.

TABLE MEA-13-3 DRILL HOLES IN GYPSUMVILLE AND RED DEER RIVER AREAS

HOLE	LOCATION	GEOLOGIC UNIT	INTERVAL	LITHOLOGY
M-13-77	5-2-33-9 W	Amaranth Evaporite	0-18 m	Gypsum, some anhydrite, minor limestone.
		Amaranth red beds and sediment infill	18-35.7	Distorted shale, sedimentary breccias
		St. Martin Series	35.7-127.7	Polymict breccias, altered melt rock, granitic breccias
M-15-77	SW 2-29-32-9 W	Glacial drift	0-9.6	Clay, till
		St. Martin Series	9.6-137.6	Paleozoic carbonate slump blocks (abundant limestone)
M-16-77	9-8-32-9 W	Glacial drift	0-25.3	Clay, till
		St. Martin Series	25.3-51.0	Slump blocks of Paleozoic limestone, dolomite, some shale
M-17-77	SW 10-8-32-9 W	Glacial drift	0-16.8	Clay, till
		Fort Garry Member	16.8-26.8	Dolomite
M-18-77	C3-17-45-25 W	Dawson Bay	0-5.2	Magnesian limestone
(Red Deer R.)		2nd. red bed	5.2-14.3	Shale, dolomitic
		Winnipegosis (upper)	14.3-24.7	Limestone, crystalline in part
		Winnipegosis (reef)	24.7-97.3	Dolomite
		Elm Point equivalent	97.3-109.1	Mottled dolomite, calcareous
		Ashern	109.1-112.1	Red and grey shale

(4) Limestone — Devonian strata

A hole drilled on a domal structure overlying a Winnipegosis reef, west of Highway 10 and north of Red Deer River, intersected some magnesian limestone of the Dawson Bay Formation. A complete section of a Winnipegosis reef, composed mainly of off-white dolomite, was cored (see Table MEA-13-3). An unusual section composed largely of aggregates of calcite crystals occurs in the upper part of the section.

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EXPLORATION OPERATIONS BRANCH

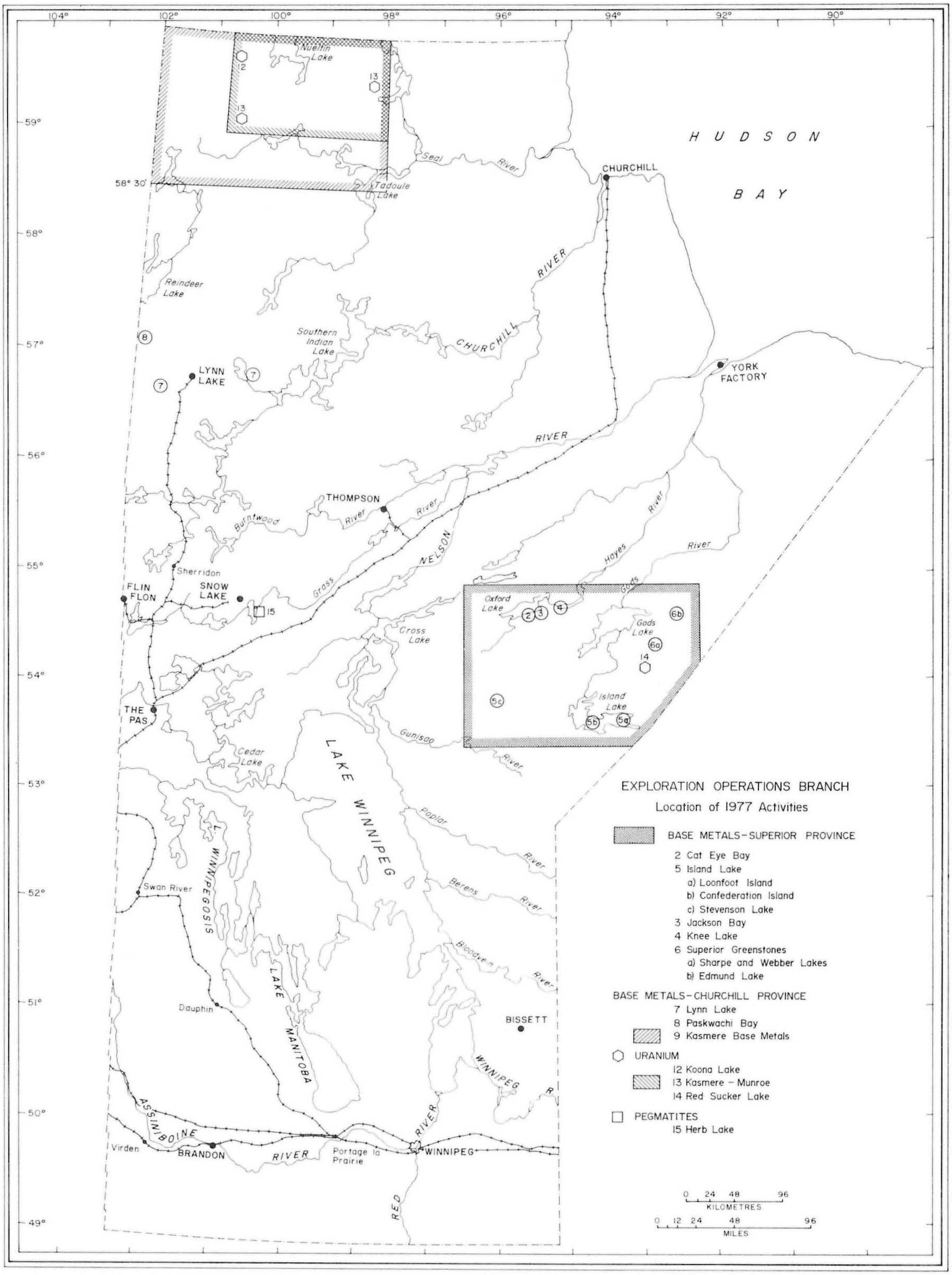


Figure EOB Location of 1977 Activities

EXPLORATION OPERATIONS BRANCH

INTRODUCTION

by J.F. Stephenson

The Branch, now in its third year of operation, undertook a total of eleven projects in various parts of northern Manitoba, mainly in the search for copper, zinc and uranium (see location map opposite).

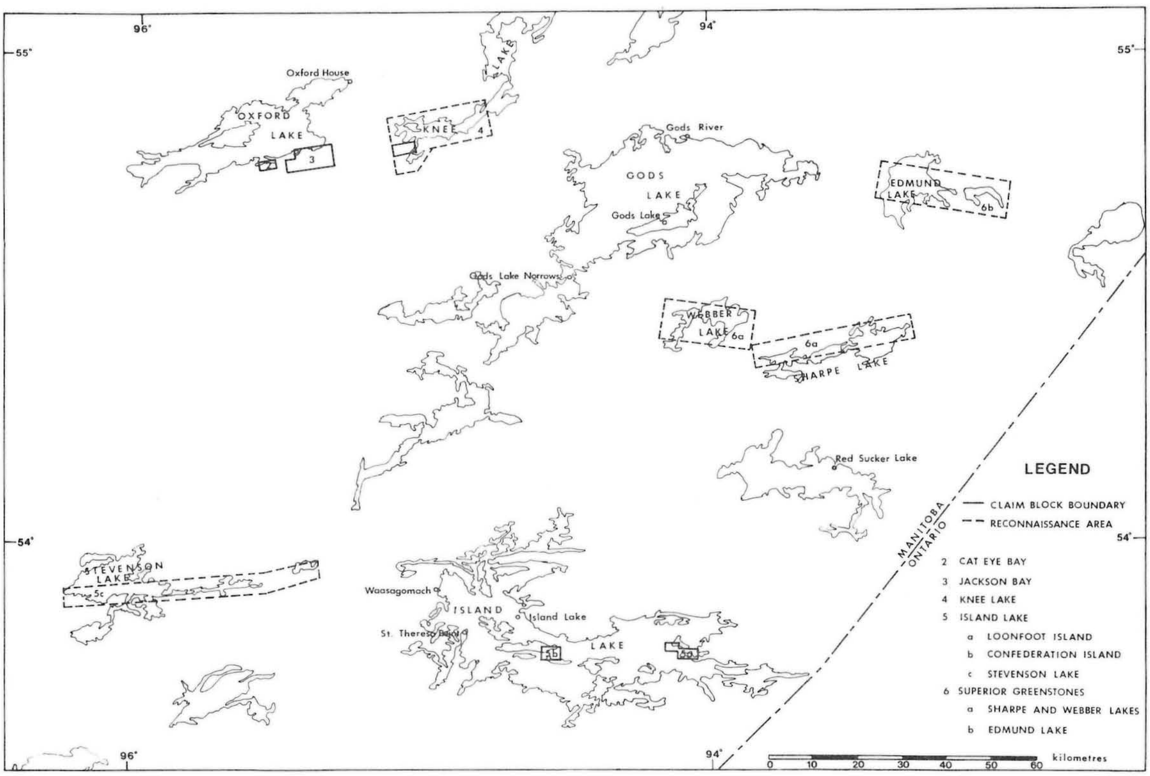
All projects carried out this summer, and reported here, were funded under the Canada-Manitoba Subsidiary Agreement on Mineral Exploration and Development in Manitoba.

In the Superior geological province, several phases of base metal exploration were undertaken in northeastern Manitoba in continuation of the past two years' work in this region. A sequence of mainly volcaniclastic rocks forming part of the Hayes River Group in the Oxford-Knee Lakes area appears to be emerging as a highly favourable volcanogenic environment for massive sulphides. Considerable effort was devoted to following up the numerous airborne anomalies in this region and a major program is planned for the Oxford-Knee Lakes area in 1978.

In the Churchill geological province, detailed lake sediment surveys were initiated east of Kasmere Lake in northwestern Manitoba to ascertain the causes of regional base metal lake sediment anomalies arising from the Uranium Reconnaissance Program.

At Lynn Lake, the highlight of the 1977 activities was the release in June of the Phase II INPUT survey covering the Fox Mine and Barrington-Sickle Lakes portion of the Lynn Lake greenstone belt. This completes the INPUT coverage of the belt at a line spacing of 200 metres.

Uranium exploration continued in northwestern Manitoba between Kasmere and Munroe Lakes where several anomalies arising from the Uranium Reconnaissance Program were followed up in detail. The Koona Lake uranium occurrence northeast of Kasmere Lake was drilled to test continuity and grade of mineralization.



BASE METAL PROJECTS

SUPERIOR PROVINCE

Figure EO-1-1 Base Metal Projects, Superior Provinces

Results were released for surveys conducted in the Churchill region and on the east side of Lake Winnipeg under the Uranium Reconnaissance Program in March and August respectively. A large block in northeastern Manitoba and the area around Lynn Lake were surveyed by airborne spectrometry under the Program for release in 1978.

The University of Manitoba continued its re-evaluation of pegmatite mineral resources in the Winnipeg River region and began a detailed investigation of lithium-bearing pegmatites in the Herb Lake area. The project, now in its third year, is being carried out by the Centre for Precambrian Studies.

EO—1 BASE METAL EXPLORATION

by D.S. Evans

Overview

In 1977, base metal exploration activities were conducted in both the Churchill and Superior geological provinces with an emphasis on the search for copper-zinc deposits.

In the Superior Province, five main areas were explored on a continuing or initial phase basis (Fig. EO-1-1). The areas investigated are located at Oxford Lake ("Cat Eye Bay" and Jackson Bay), Knee Lake, Island Lake (Confederation Island and Loonfoot Island), Stevenson Lake and in the Webber-Sharpe and Edmund-Margaret Lakes area.

A geophysical survey at "Cat Eye Bay" on Oxford Lake was unsuccessful in defining an extension of an occurrence of disseminated and semi-massive Zn-Pb-Cu mineralization examined and drilled in 1976 (Haskins and Evans, Report of Field Activities, 1976). A weak to moderate electromagnetic response north of the Zn-Cu-Pb zone will be drilled in early 1978.

INPUT anomalies obtained from a Selco survey in the Jackson Bay area of Oxford Lake were staked in early 1977 and followed up by ground geophysical surveys. A drilling program is planned for early 1978 to test promising conductors.

A group of moderate to strong INPUT anomalies in southwest Knee Lake (Selco survey) were staked in early 1977 and a ground geophysical survey carried out. Field examination of the anomalies revealed a discontinuous horizon of barren semi-massive pyrrhotite.

Geological, geochemical and geophysical surveys were continued on Island Lake on Crown claim blocks in the Confederation Island area. No encouraging field results have been obtained thus far. The results of diamond drilling in an apparently favourable volcanogenic environment on and around Loonfoot Island on Island Lake were discouraging and no further work is planned for this area at present. Geological reconnaissance was also initiated on the western extension of the Island Lake greenstone belt in the Stevenson Lake area.

Geological reconnaissance was undertaken in greenstone environments in the Webber-Sharpe Lakes and Edmund-Margaret Lakes areas where little previous work has been done. Mapping has confirmed that these are narrow belts comprising basic to intermediate volcanic rocks with minor felsic units. As a follow-up to the mapping, an airborne geophysical survey will be conducted over both belts which form extensions to greenstones containing known occurrences of massive sulphides.

An airborne geophysical survey will also be carried out over the area between Oxford Lake and Knee Lake where favourable Hayes River Group rocks extend west from Knee Lake and appear to underly a thin section of Oxford Group metasedimentary rocks.

Exploration efforts in the Churchill Province have centered on the continuing airborne geophysical coverage of the Lynn Lake greenstone belt. Phase II coverage was completed and released in June, 1977 and a significant amount of staking has been undertaken by the private sector.

A ground geophysical program was undertaken in early 1977 on a group of Crown-owned claim blocks in the Paskwachi Bay area of Reindeer Lake. Two subparallel conductive horizons have been identified in a greywacke-arkose-amphibolote environment. Drilling is planned for early 1978 to test these conductors.

In extreme northwestern Manitoba, in the Kasmere Lake area, a follow-up lake sediment sampling program was initiated in 1977 employing geochemical results provided by the 1975 Uranium Reconnaissance Program (URP). Seventeen anomalous areas characterized by single element or multi-element anomaly patterns in a variety of geological settings were outlined, and detailed helicopter-supported lake sediment sampling carried out. The sampling density attained was one per square kilometre compared to the 1975 URP sample density of one per 13 square kilometres. The objective is to contain and localize broad regional geochemical patterns to the point where conventional ground and/or airborne surveys can be undertaken.

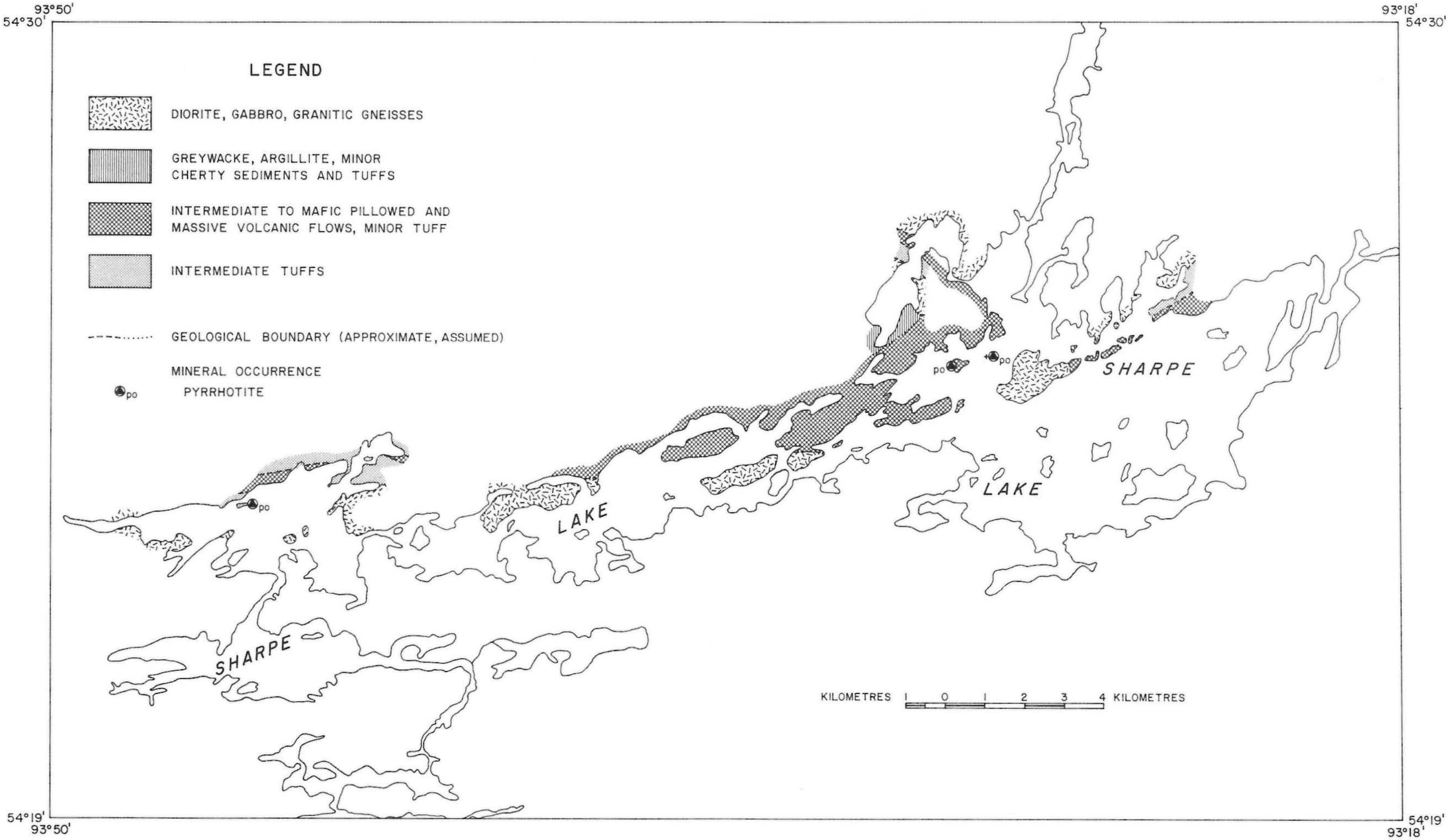


Figure EO-2-1 Geology of the Sharpe lake area.

EO-2 WEBBER-SHARPE LAKES AND EDMUND-MARGARET LAKES

GREENSTONE BELTS

53 L/8, 53 K/5, 6, 10, 11, 14

by C. Cutforth and H.W. Petak

The two greenstone belts examined are narrow extensions of the larger Gods Lake and Stull-Kistigan Lakes greenstone belts. Geological reconnaissance indicates that these belts consist mainly of mafic and intermediate metasedimentary and metavolcanic rocks striking generally east-west with near-vertical dips and flanked on the north and south by diorite and/or granitic gneiss. These belts are normally one to three kilometres in width and up to 150 kilometres long. They are generally poorly exposed except along the lake shores.

Previous work in the Sharpe and Edmund Lakes area comprises G.S.C. mapping at a scale of 1" to 4 miles (D.L. Downie, 1938) and in the Webber Lake area at a scale of 1" to 1/2 mile (B. Marten, 1973; B. Marten and F.J. Elbers, 1973). An INPUT survey was flown over Webber Lake in 1971 by Canadian Freeport Exploration Company which outlined several conductive zones, some of which were drilled (Non-confidential Assessment Files).

Geology

1. Sharpe Lake Area

Diorite and gneiss bound the greenstone belt to the north and south. Intrustive diorite and gabbro truncate the belt through the centre of the lake (Figure EO-2-1). The eastern portion is mafic to intermediate in composition and consists of volcanic tuffs and flows. The central area is folded with the fold axis striking east-west. The north limb appears to be part of a small greenstone pod north of the main belt. The south limb outcrops as pillowed and massive flows of intermediate to mafic composition. Greywacke is exposed in the central part of the fold and several small gossan zones occur in the nose of the fold. Sulphide mineralization consists of disseminated to massive pyrite and pyrrhotite with no observable base metal content.

Mafic and intermediate tuffs are the major rock type in the western part of Sharpe Lake with minor pillowed intermediate volcanic rocks.

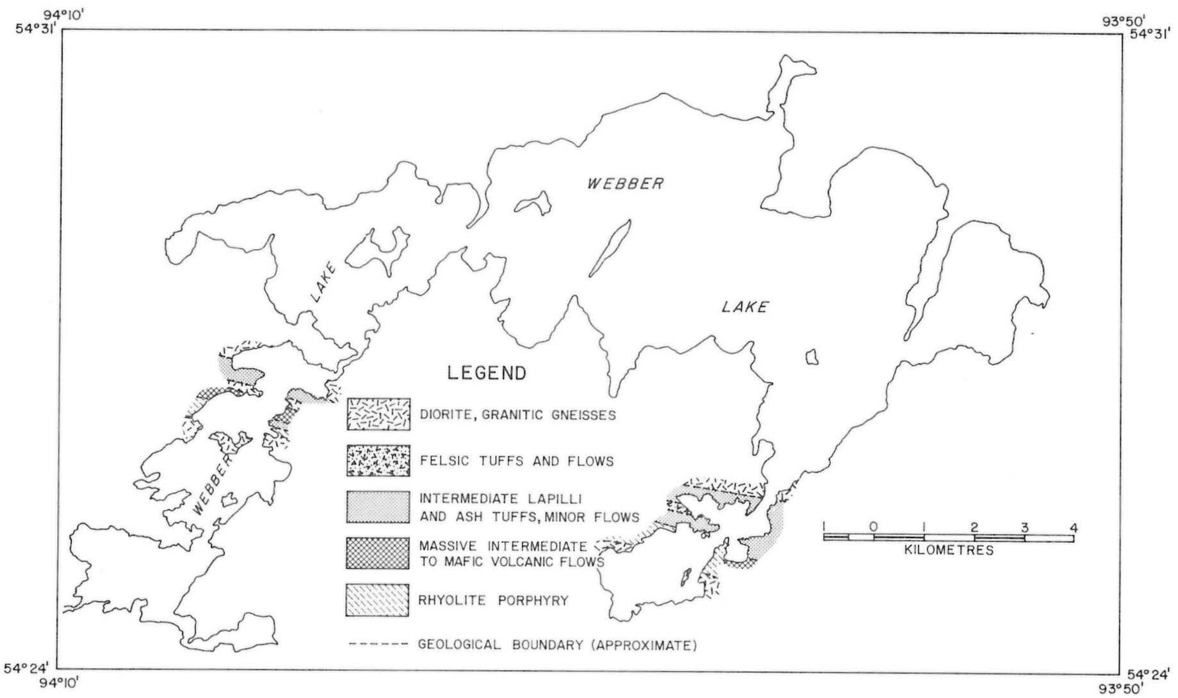


Figure EO-2-2 Geology of the Webber Lake area

2. Webber Lake Area

This area is an extension from the Sharpe lake belt and the greentones consist mainly of mafic to felsic tuffs with minor intercalations of intermediate to mafic volcanic flows (Figure EO-2-2). No sulphide mineralization was observed but drilling by Canadian Freeport in 1971 reported graphitic and sulphidic iron formations sparsely mineralized with chalcopyrite and sphalerite.

3. Edmund-Margaret Lakes Area

Extensive sections of pillowed and massive intermediate to mafic volcanic rocks are exposed on Edmund Lake (Figure EO-2-3). Further east on Margaret Lake, intermediate tuffs with minor intermediate volcanic rocks outcrop. Minor occurrences of barren sulphide mineralization were observed in the better exposed portion of this belt.

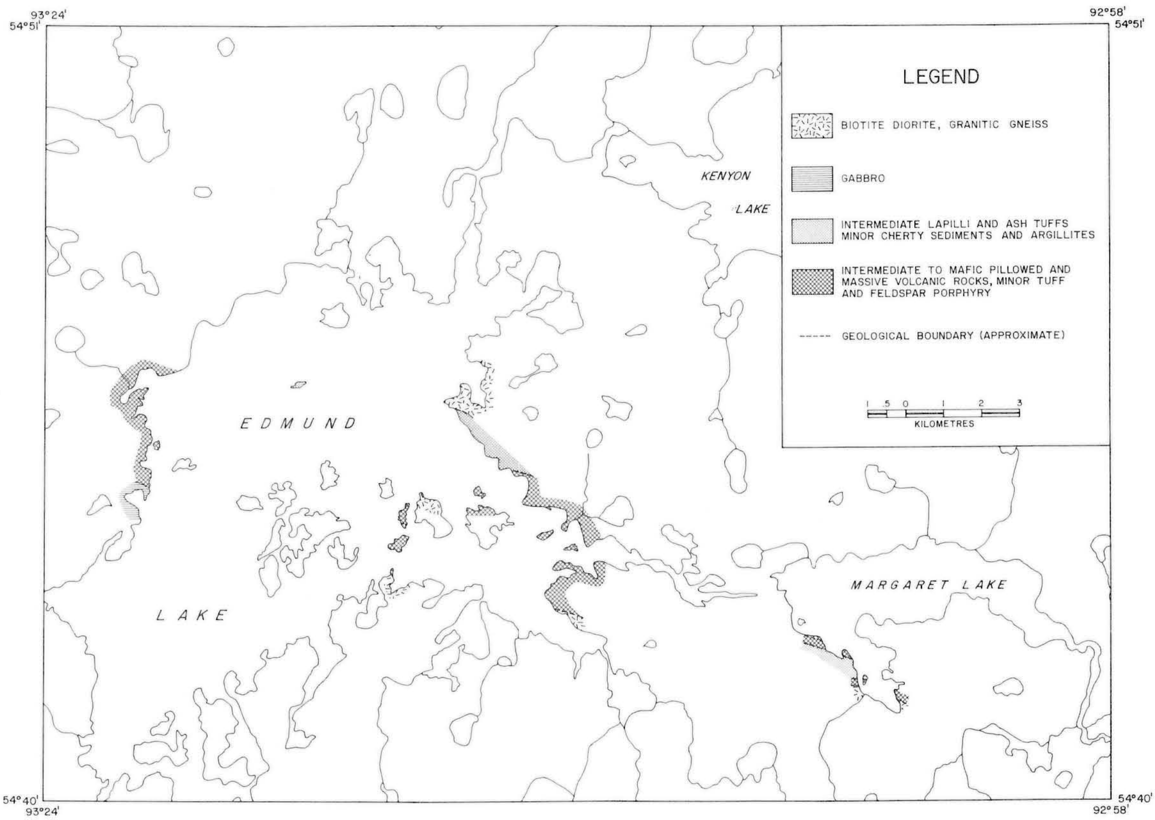


Figure EO-2-3 Geology of the Edmund-Margaret Lakes area.

Economic Potential

No significant occurrences of base metal mineralization were found to occur in the Webber-Sharpe Lakes and Edmund-Margaret Lakes greenstone belts, but there are several localities with favourable environments for localization of massive sulphides.

The above reconnaissance results will serve as a basis for interpretation of an INPUT survey planned for late 1977.

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EO-3 LYNN LAKE

64 C/10 to 16, 64 F/1,2

by J.F. Stephenson

The Lynn Lake Project was initiated in 1976 to stimulate base metal exploration by the private sector as a result of the closure of Sherritt Gordon Mines Limited Farley Mine at Lynn Lake due to the depletion of ore.

The project has involved two large scale airborne geophysical surveys, an accelerated program of geological mapping by the Geological Services Branch and a detailed inventory and evaluation of the mineral deposits of the Lynn Lake region by the Mineral Evaluation and Administration Branch.

Airborne Geophysical Surveys

During the spring and fall of 1976 Questor Surveys Limited flew INPUT surveys on behalf of the Province of Manitoba totalling 26 740 line kilometres at 200 metre line spacings encompassing an area of 5 348 square kilometres. These surveys, designated Phase I and Phase II, were released to the public on June 22, 1976 (Phase I: Lynn Lake area) and June 8, 1977 (Phase II: Fox Mine and Barrington Lake and Sickle Lake areas) as electro-magnetic anomaly maps at a scale of 1: 20 000 (Figure EO-3-1).

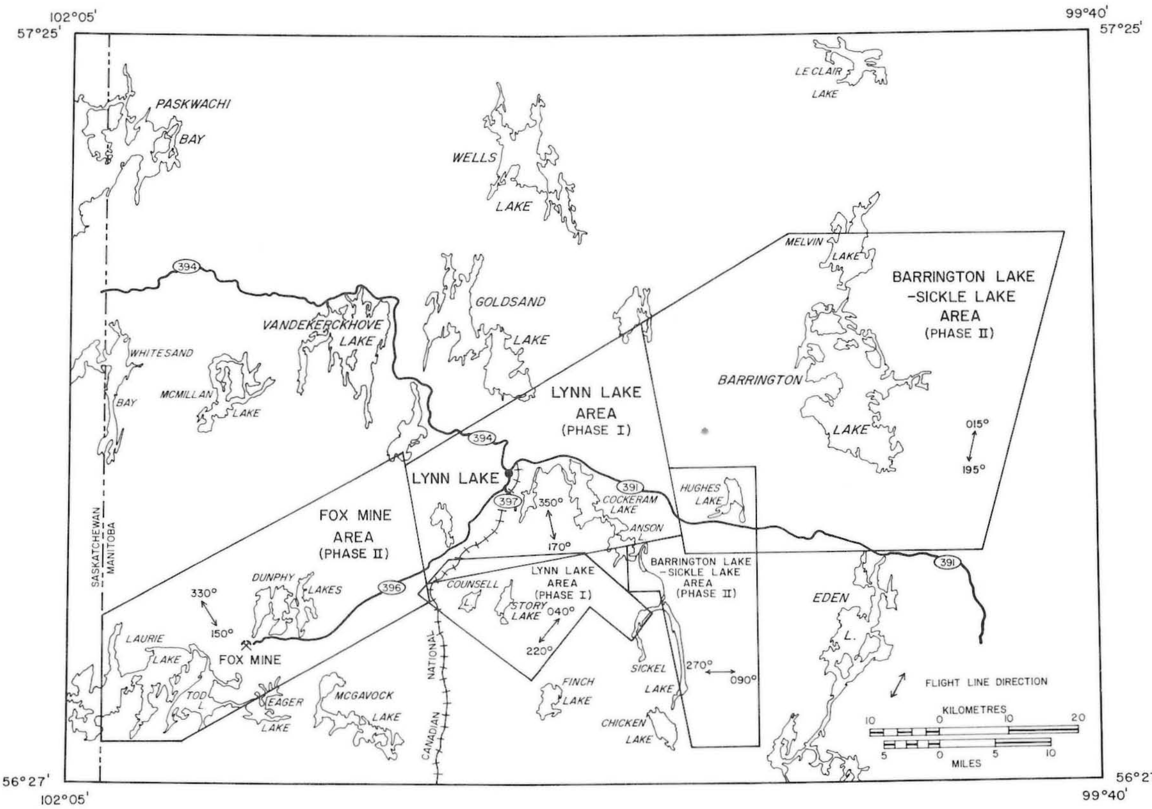

Figure EO-3-1 Areas covered by Phase I and II airborne INPUT geophysical surveys in the Lynn Lake region.

Results of Public Release

As of September 1, 1977 the following companies and individuals had acquired mineral dispositions within the Lynn Lake area totalling 103,675 acres from the date of the first release:

Sherritt Gordon Mines Ltd		34,320
Hudson Bay Exploration and Development Co. Ltd.		24,111
Falconbridge Nickel Mines Ltd.		8,056
Doreen Friesen		8,016
A.L. Parres Ltd.		7,173
Saskatchewan Mining Development Corporation		6,798
Granges Exploration Aktiebolag		5,761
Manitoba Mineral Resources Ltd.		4,280
Huston and Dunlop		3,040
Knobby Lake Mines Ltd.		2,120
	Total	103,675 acres

This represents an acreage increase of approximately 150 per cent over ground held in good standing at the time of the first public release in June 1976. Most of the significant airborne anomalies indicated by the two INPUT surveys have been staked and detailed ground follow-up surveys and diamond drilling are proceeding on a number of these properties.

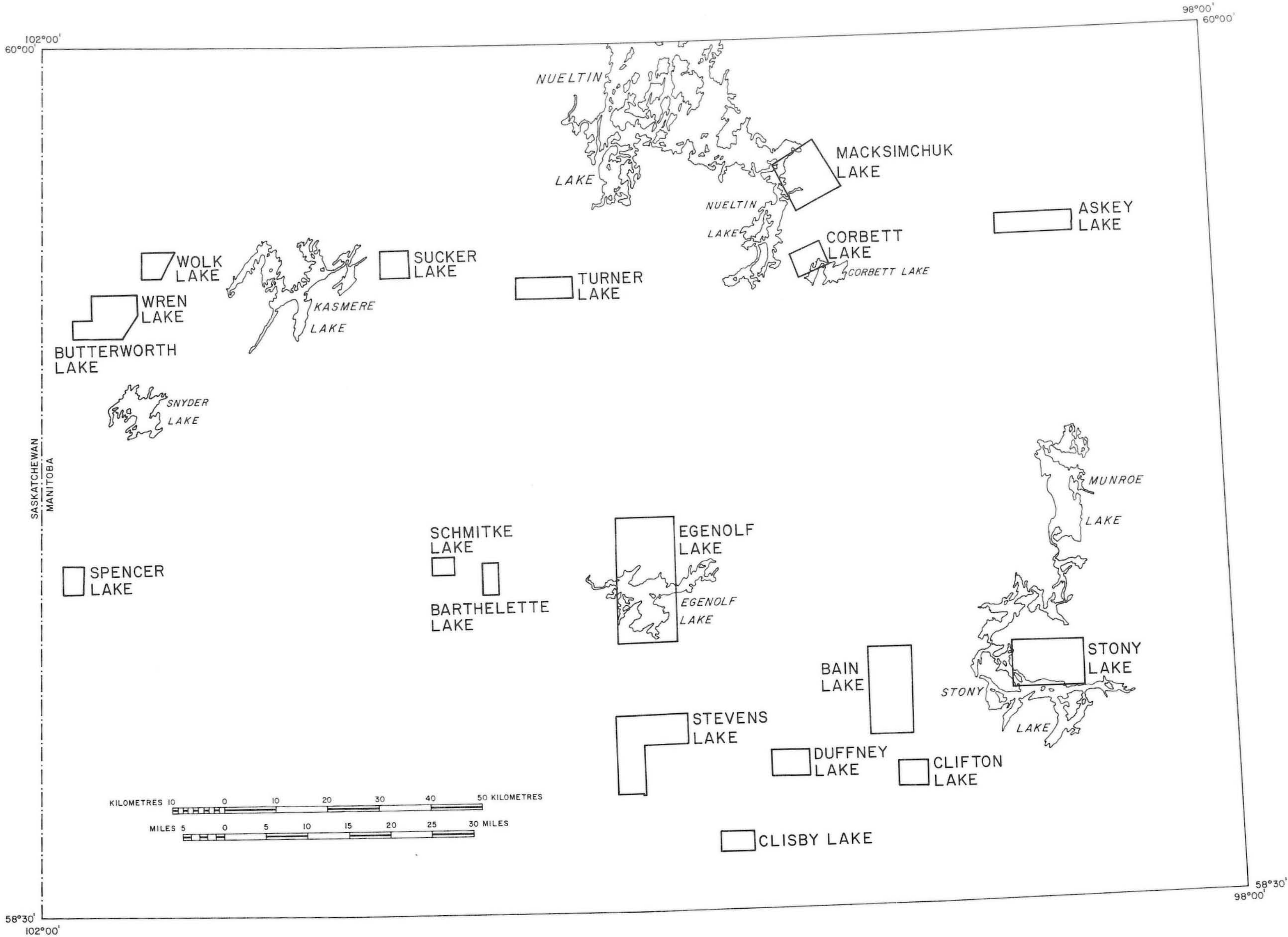

Figure EO-4-1 Followup areas for lake bottom sediment sampling, NW Manitoba

EO-4 KASMERE BASE METALS

64 N, O, J, K

by D. Robertson and J. Clue

The Kasmere Base Metals project comprises a regional appraisal for base metal exploration in NW Manitoba between latitudes 58°30" and 60° north and longitudes 98° and 102° west. The project employs lake sediment geochemical results obtained in 1975 and released in 1976 under the joint Federal-Provincial Uranium Reconnaissance Program. Promising areas were selected following a review of cancelled assessment files, published and unpublished geological reports and all available data from the Uranium Reconnaissance Program. Seventeen separate areas were selected for follow-up activities and have been designated by major lakes in or near the sampling areas (Figure EO-4-1).

Previous Work

Exploration companies have been and are currently engaged in mineral exploration in NW Manitoba. The search has been primarily for uranium with only limited attention given to base metals.

The area was mapped by W. Weber et al. (1975) and D. Schledewitz (1976, 1977) at a scale of 1:50 000 and 1:100 000 respectively.

The most significant survey results available in the current project areas prior to 1976 include an airborne geophysical survey and ground follow-up by Dynamic Petroleum Products Ltd. in 1969 (Weber et al., 1975) and the airborne gamma-ray spectrometer and lake sediment results acquired in 1975 under the Uranium Reconnaissance Program.

Geological Setting

Bedrock exposures are included under three main groups: (1) an Archean granitic basement complex overlain unconformably by (2) a sequence of aphebian metasedimentary derived schists, paragneisses and migmatites, and (3) Hudsonian igneous and metamorphic rocks. The entire region has been extensively glaciated and outcrop is limited in most areas to less then 1%. The glacial drift consists mainly of ablation and lodgment tills and associated glacio-fluvial features dominated by intricate and extensive esker systems composed of sand and gravel. All glacial features are products of advance and retreat of the Keewatin ice sheet. Boulder fields are prominent in low-lying areas.

Economic Geology

Base metal mineralization has been observed in the following rock units (Schledewitz, 1976):

(1) calc-silicate rocks
(2) semi pelites
(3) albite-pyroxene rock
(4) gabbro and altered gabbro.

All occurrences are of limited significance and most appear to reflect a sedimentary genetic origin.

Follow-up Lake Bottom Sediment Survey

The initial phase of the follow-up program involved detailed sampling of pre-selected lakes in seventeen areas (Figure EO-4-1). Anomalous areas were selected on the basis of single element patterns, multi-element patterns and known mineralized or favourable geological environments. All areas were sampled at a density of one sample per square kilometre versus a reconnaissance density of one sample per 13 square kilometres under the Uranium Reconnaissance Program. The purpose of this work was to verify the anomalous dispersion patterns outlined by the reconnaissance survey; define known base metal anomalies and delineate suitable areas for conventional ground surveys, mapping and prospecting.

Lake sediment samples were collected directly from a float-mounted Bell 206A helicopter, employing the modified "Hornbrook" sampler (Coker, 1976). Samples were placed in waterproof Kraft sample bags and shipped to Winnipeg for preparation and analysis. All samples were analyzed geochemically for Cu, Zn, Mo, Mn, Ni and Fe employing the method of Hornbrook et al. (1976).

Geobotanical Survey of an Esker

Specific species of deciduous and evergreen vegetation were collected on an esker system in the Egenolf Lake area (see Figure EO-4-1). The purpose of the survey was to determine the relationship between the Cu, Zn, Fe, Mg, Ni content of plants, their growing media and nearby lake sediment elemental patterns. An initial observation of reconnaissance data had shown many anomalous lakes were flanked by or closely associated with eskers and related glacio-fluvial systems.

Geological Investigations

Geological reconnaissance mapping was carried out to relate geochemical results to:

(1) known mineralization and/or new occurrences,
(2) surficial deposits and/or bedrock composition, and
(3) previous geological mapping.

These investigations were carried out in the Macksimchuk, Corbett, Askey, Stoney, Clisby Lakes areas (Figure EO-4-1).

Results

The results of the detailed lake sediment, geobotanical, biogeochemical, pedogeochemical and bedrock geochemistry surveys are currently being analyzed. Statistical procedures are being employed with the aim of classifying and priorizing base metal exploration targets.

Interpretation problems are being experienced in relating trace metal patterns to geological environments. Scavenging of base metals by hydrous oxides of Fe and Mn appears to have modified and distorted regional threshold approximations of trace element distributions.

Summary

Follow-up and detailed lake sediment sampling to resolve and limit geochemical patterns is providing both direct and indirect evidence for localizing base metal lake sediment anomalies.

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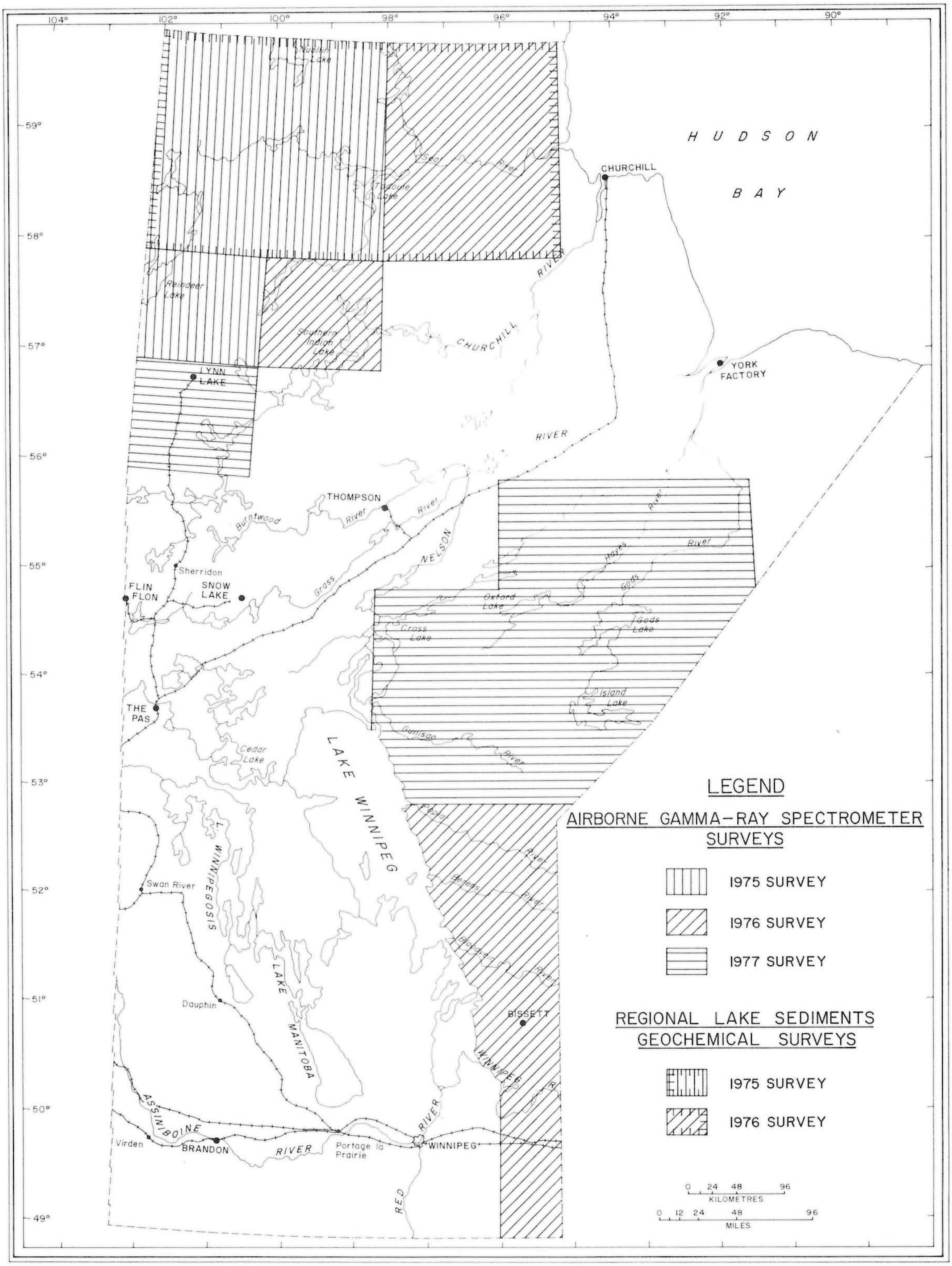

Figure EO-5-1 Airborne gamma-ray and regional lake sediment surveys

EO-5 URANIUM RECONNAISSANCE PROGRAM

by J.F. Stephenson

The Federal-Provincial Uranium Reconnaissance Program, now in its third year of operation, has covered approximately 257 000 square kilometres (100,000 square miles) of the Precambrian Shield of northern and eastern Manitoba. This represents nearly three-quarters of Manitoba's Precambrian. The object of the program, which comprises both high sensitivity airborne gamma-ray spectrometer surveys flown at 5 kilometre line spacings and regional lake sediment geochemical sampling at a density of one sample per 12 square kilometres, is to define areas of regional uranium anomalies as a basis for follow-up exploration.

Data for the spectrometer surveys flown in 1975 and 1976 and covering approximately 155 000 square kilometres in northern and southeastern Manitoba have been released to the public. Within this area and north of latitude 58°, approximately 85 000 square kilometres was covered by geochemical surveys. These data were released simultaneously with the spectrometer data.

During the summer of 1977 airborne spectrometer surveys covering approximately 90 000 square kilometres were undertaken in northeastern Manitoba and 12 000 square kilometres in the Lynn Lake region. Data for these surveys will be released in 1978.

In summary, the survey data, compiled on 1:250 000 scale NTS map sheets, are available for the following areas (see Figure EO-5-1):

1. Airborne Gamma-ray Spectrometer Surveys: Data presented as contour maps of total count, potassium, equivalent uranium and equivalent thorium concentrations; eU/eTh, eU/K and eTh/K ratios and flight line profiles:

Location	NTS Reference	Survey Area (km^2)	Survey Year	Release Date
Kasmere Lake region, northwest Manitoba	64 N, 64 O, 64 K, 64 J and 64 F	60 000	1975	Mar. 24, 1976
Churchill region, northern Manitoba	64 P, 54 M(W 1/2), 64 I, 54 L(W 1/2), 64 G	50 000	1976	Mar. 28, 1977
East of Lake Winnipeg (and northwest Ontario)	52 E(W 1/2), 52 L(W 1/2), 52 M(W 1/2), 53 D(W 1/2), parts of 62 I, 62 P, 63 A	45 000*	1976	Aug. 24, 1977
Gods Lake region, northeast Manitoba	53 K, 53 N, 53 M, 53 L, 53 E, 63 I and 63 H	90 000	1977	1978
Lynn Lake region	64C	12 000	1977	1978

*Manitoba portion only

2. Regional Lake Sediment Geochemistry: Data presented as 13 geochemical maps for the elements Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, U, Mo, As and Hg; and loss-on-ignition:

Location	NTS Reference	Survey Area (km^2)	Survey Year	Release Date
Kasmere Lake region, northwest Manitoba	64 N, 64 O, 64 K, 64 J	50 000	1975	Mar. 24, 1976
Churchill region, northern Manitoba	64 P, 54 M(W 1/2), 64 I, 54 L(W 1/2)	35 500	1976	Mar. 28, 1977

As of August 14, 1977 twelve companies held mineral exploration permits within the areas surveyed totalling approximately 1.3 million acres and fourteen companies and individuals held claims covering approximately 165,000 acres.

Major activity has centered on a major northeast trending regional uranium anomaly defined by both the airborne spectrometer and regional geochemical surveys in the extreme northwest corner of the province (NTS 64 N).

EO-6 URANIUM EXPLORATION

by N.M. Soonawala

In 1977 the Exploration Operations Branch implemented three uranium exploration projects, i.e., the Koona Lake, Kasmere-Munroe Regional Follow-up and Red Sucker Lake projects (see Figure EOB). A fourth proposed project in southeast Manitoba has been postponed to the 1978 season because of the late release of the Uranium Reconnaissance Program data for that region.

It has generally been felt that the Koona Lake occurrence (see Report of Field Activities, 1976) was the most significant find of the 1976 phase of the Kasmere Regional Follow-up project. Therefore in 1977, investigations of this occurrence were treated as a self-contained project which included 4,550 feet of diamond drilling and geophysical surveys. The mineralization detected so far is sub-marginal in grade.

In the Kasmere-Munroe Regional Follow-up project, essentially a continuation of work done in the preceding field season, the object was to investigate NTS map areas 64 N and 64 O in order to continue the exploration sequence initiated with the Uranium Reconnaissance Program (URP) in 1975. Only a portion of this area of some 25 000 square kilometres was surveyed in any detail. Therefore smaller areas within 64 N and O were selected, principally on the basis of URP results, but also geological data (compiled by the Geological Services Branch) and open file reports. These areas were investigated by means of a systematic exploration sequence, beginning with a helicopter-borne scintillometer survey at 250 metre line spacing, and continuing with a variety of ground surveys including detailed boulder and outcrop sampling. About twenty discrete activities comprised this project.

The impetus for the Red Sucker Lake project was a reconnaissance airborne radiometric survey conducted by the Geological Survey of Canada in 1969, during the course of which a first rate uranium anomaly was detected. This year's work consisted of a helicopter scintillometer survey followed up with ground scintillometer and radon surveys and boulder sampling.

A general review of this field season's findings indicates that anomalous concentrations of uranium are found in three different rock types. The only uranium occurrences which may prove significant were found in medium to coarse-grained leucogranites (acidic granitoids), as at Koona Lake. The Widlake Lake occurrence, nine kilometres north of the Koona Lake occurrence, and the Poulsen Lake occurrence about 130 kilometres to the southeast, are both of this type. The airborne scintillometer results and the regional geology indicate the possibility of more such occurrences in the intervening area. Similar leucogranites occur at Red Sucker lake, however at this stage there are insufficient assay results at hand to determine their probable uranium content.

The second rock type referred to is a coarse pink pegmatite located near the south shore of Munroe Lake and at Kitson Lake. Fairly intense radioactivity was detected, but only over surface areas of a few square metres.

The third rock type of interest is a porphyritic quartz monzonite (Unit 20 of Weber et al.) referred to as the Topp Lake pluton which, at its periphery, produces several high amplitude airborne gamma-ray anomalies. Ground investigations at Rodgers Lake revealed that the rock is uniformly enriched slightly above background.

EO-7 KOONA LAKE

64 N/15

by R.J. Garber and N.M. Soonawala

The Koona Lake occurrence, located at 59°48′N and 100°36′W, is about 335 kilometres north of Lynn Lake. It is included in a 640 acre claim block staked in July 1976.

Field work in the 1976 season over the occurrence consisted of the following activities: (1) scintillometer survey over 2.6 km^2, (2) radon survey over an area of 700 metres by 350 metres, (3) in-situ gamma-ray spectrometer assays at 33 sites, (4) delayed neutron activation analysis of core samples from 44 boulders, (5) VLF-EM and magnetometer surveys, (6) boulder mapping, and (7) three diamond drillholes totalling 550 feet. The highlights of this work have already been reported (Report of Field Activities, 1976).

Subsequently, mineralogical and metallurgical studies were done. In the leucogranite, the host for uranium mineralization in the area, the major minerals are quartz, potassium feldspar and Na-plagioclase, with biotite content ranging from 0 to 18%. Accessories include garnet tourmaline, pinite, zircon, and locally pyrite and graphite. A modal analysis (Figure EO-7-1) indicates the composition of the rocks to lie in the granite range. Autoradiograph spot images used in conjunction with polished thin sections aided in the identification of uraninite as the principal uranium mineral. The determination was substantiated by results from X-ray diffraction tests. An autoradiograph (Figure EO-7-2) shows the mineralization to be disseminated. In general, the uraninite occurs as small (1mm) euhedral crystals mantled with a narrow green silicate reaction rim (Figure EO-7-3). It is hard, opaque, highly reflective and presents an octahedral habit, thus closely resembling magnetite in thin section (Figure EO-7-4). The concentrations of uraninite appear to be associated with two distinct phases of the rock; a more mafic (biotitic) phase including an increase in smokey quartz (SiO_2) and a red stained finer grained phase (0.5 mm) that is weakly foliated in places. Individual grains have been found within K-feldspars, quartz, and adjacent to biotite. Electron microprobe analyses performed on uraninite grains indicated a high U/Th ratio of 35.2. It may therefore be concluded that the radioactivity in these rocks is due principally to uranium. In addition to uranite, the accessory mineral allanite has been identified, but no significant radioactivity is attributed to its presence.

In order to investigate the recovery of uranium by sulphuric acid leaching, two core samples, each weighing one kilogram and assaying 0.9 and 0.53 lb/ton U respectively, were submitted to Lakefield Research of Canada. Recovery of 89% was reported for both samples. The mean acid consumption was 37 lb/ton and $NaClO_3$ requirements were 2 lb/ton.

1977 Field Work

In the field season under review, seventeen diamond drillholes were completed for a total of 4,550 feet of drilling. Figure EO-7-5 shows their locations and indicates the mineralized intersections exceeding 0.2 lb/ton.

It may be noted that the best intersection over five feet was of 0.68 lb/ton uranium. Forty-nine feet of mineralization averaging 0.27 lb/ton was intersected in hole K-77-3. The cut-off value in all the calculations has been 0.2 lb/ton, i.e., a core section is considered to be mineralized only if all samples along it return an assay of 0.2 lb/ton or higher. Figure EO-7-6 indicates the geology along section 8+50 N.

Induced polarization/resistivity, VLF-EM and magnetometer surveys were also done on the showing. The results are still being processed. All the holes were logged with a down-hole gamma-ray probe.

Further drilling is recommended with a view to investigate (a) the possible extension of mineralization to the grid north, and (b) mineralization at depth.

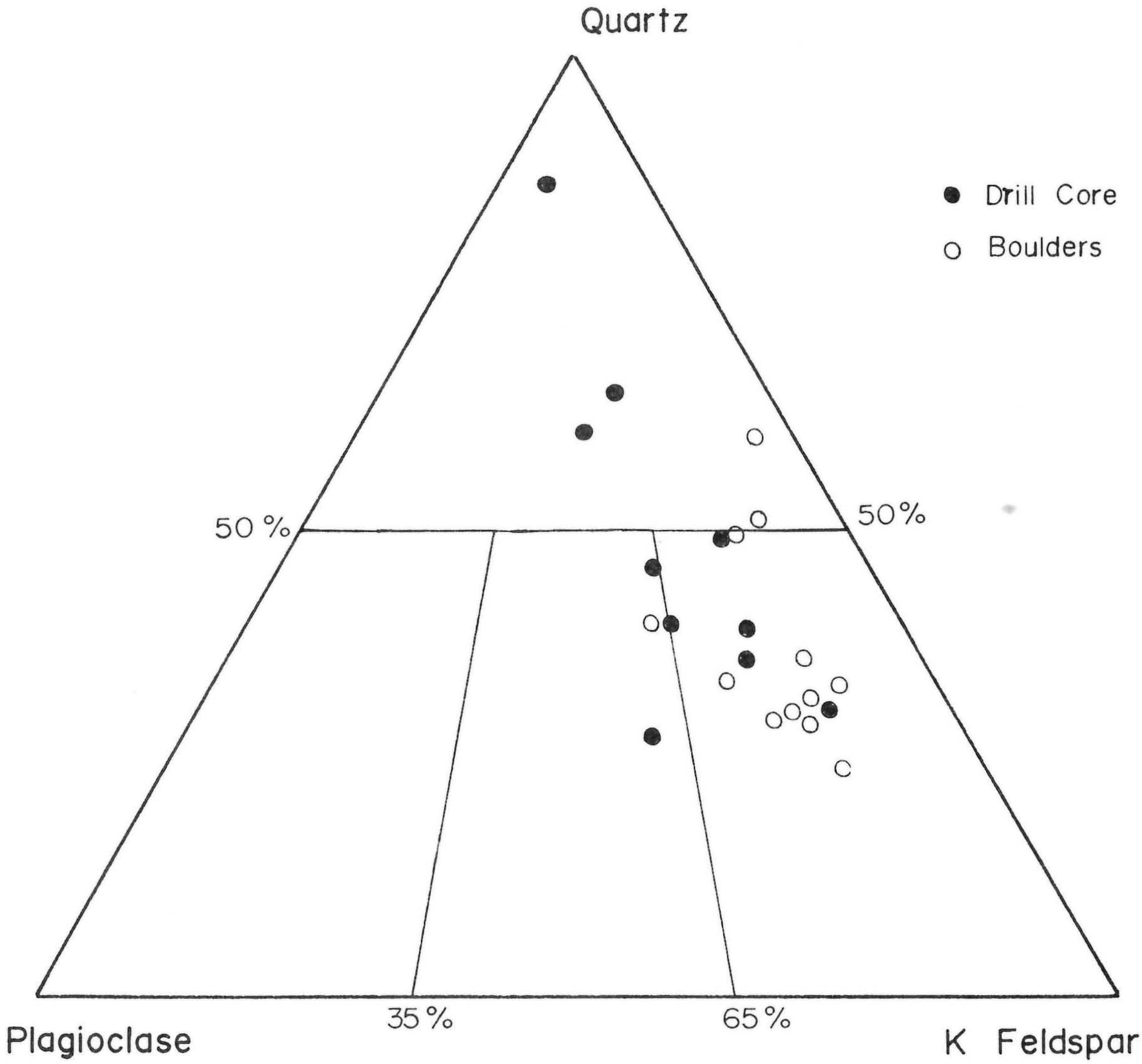

Figure EO-7-1 Ternary plot for leucogranite from the Koona Lake occurrence.

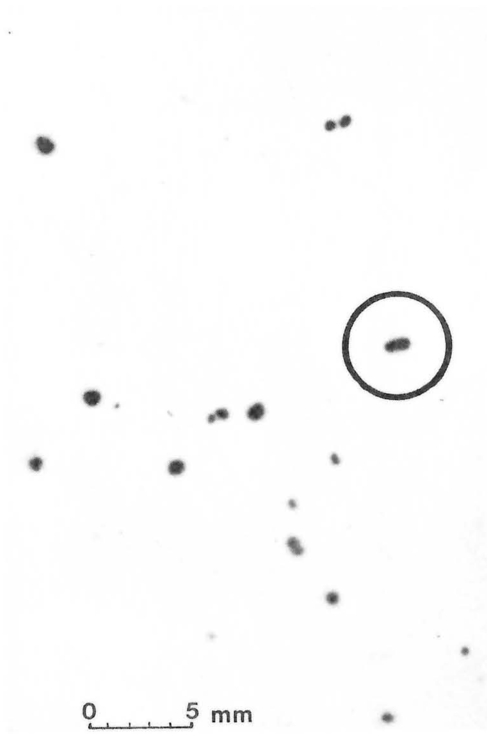

Figure EO-7-2 **Autoradiograph of polished thin section from the Koona Lake occurrence. The circled spot image corresponds to Figures EO-7-3 & 4**

Figure EO-7-3
Photomicrograph of uraninite grain (transmitted light), Koona Lake occurrence

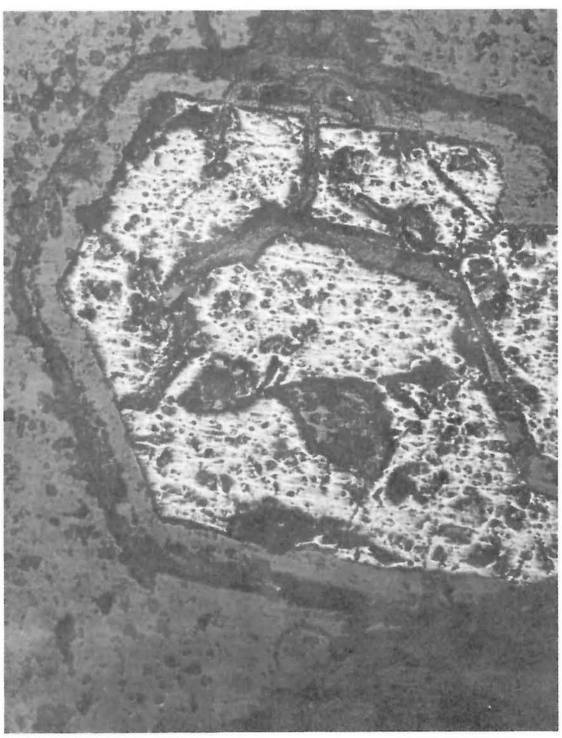

Figure EO-7-4
Photomicrograph of uraninite grain (reflected light), Koona Lake occurrence

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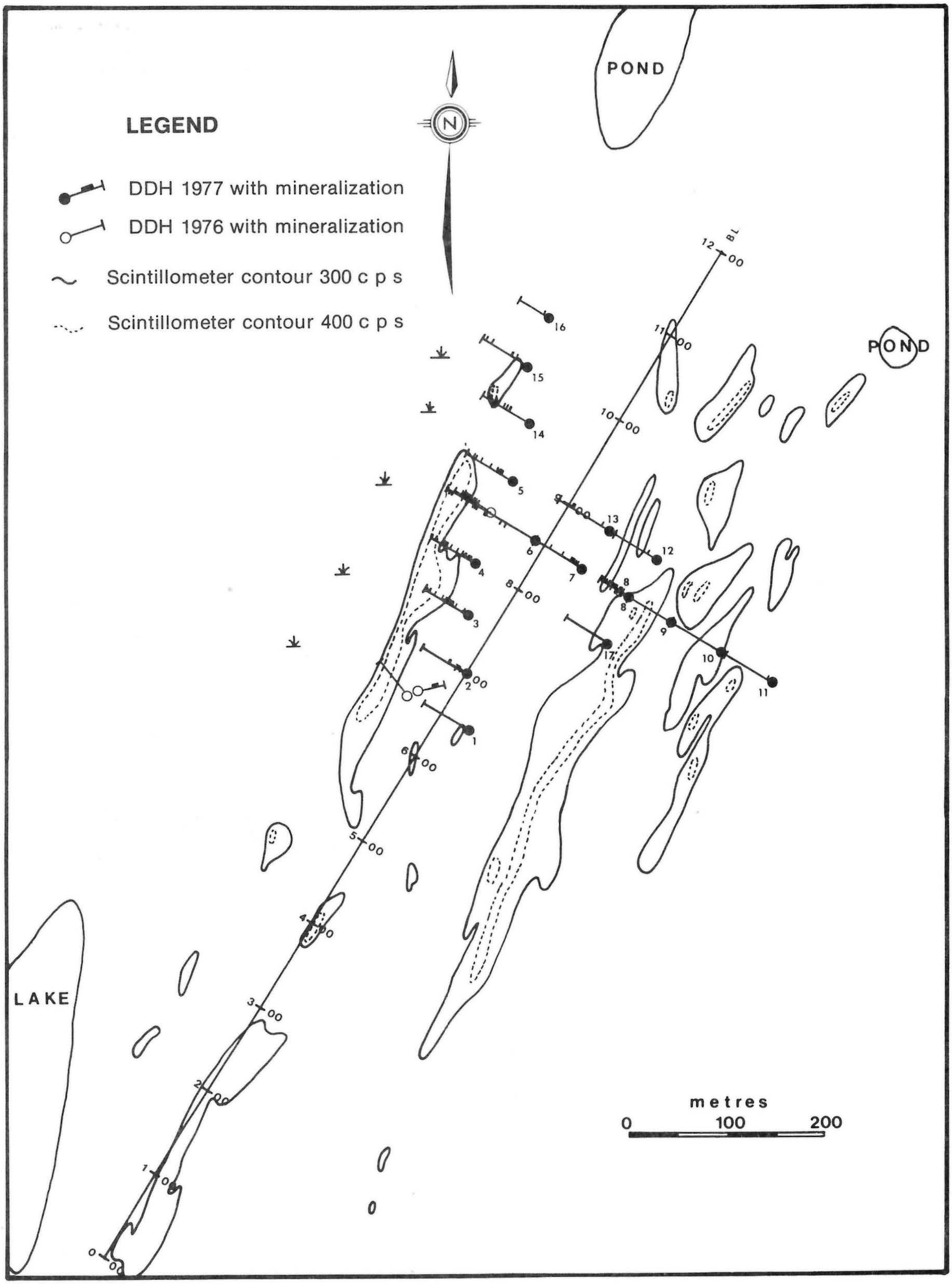

Figure EO 7-5 Koona Lake Occurrence; Diamond Drill Hole and Surface Radioactivity Plan

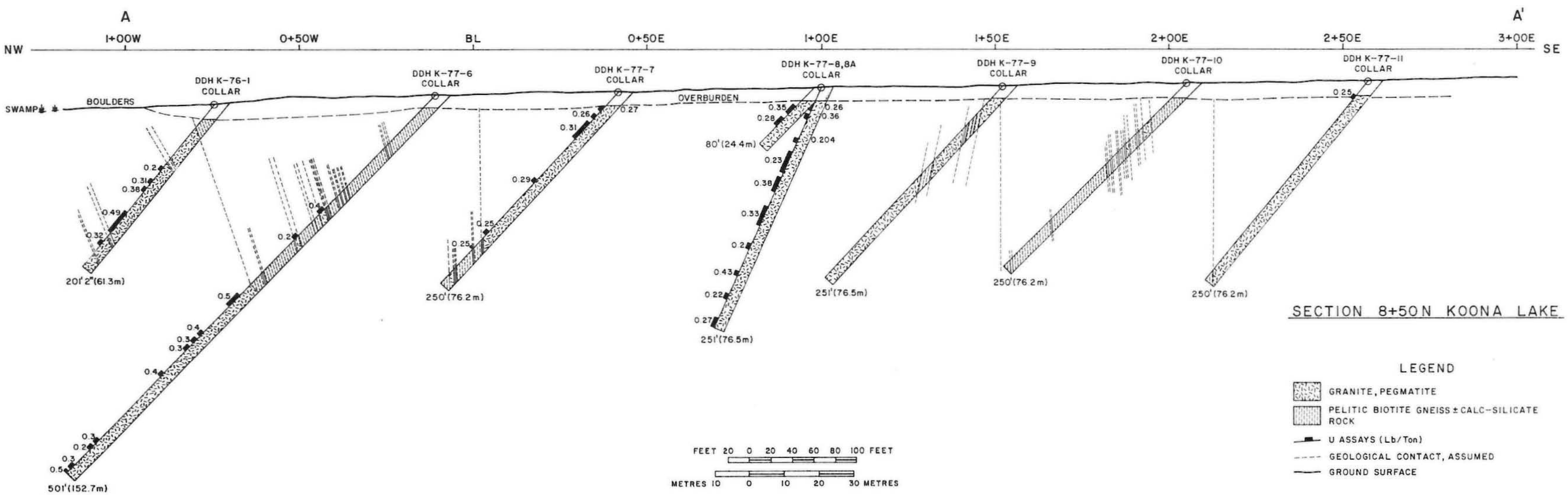

Figure EO-7-6 Section 8+50 N, Koona Lake occurrence, showing drill hole locations, geology and mineralization.

EO-8 KASMERE-MUNROE REGIONAL FOLLOW-UP

64 N and 64 O

by R.A. Whitworth, R.J. Garber and N.M. Soonawala

The Kasmere-Munroe Regional Follow-up project consisted of about 20 activities in NTS map areas 64 N and 64 O, with a limited overlap into 64J. It was esentially a continuation of the 1976 phase of the project (see Report of Field Activities, 1976). The location of the areas investigated are indicated in Figure EO-8-1 and Table EO-8-1 summarizes the activities.

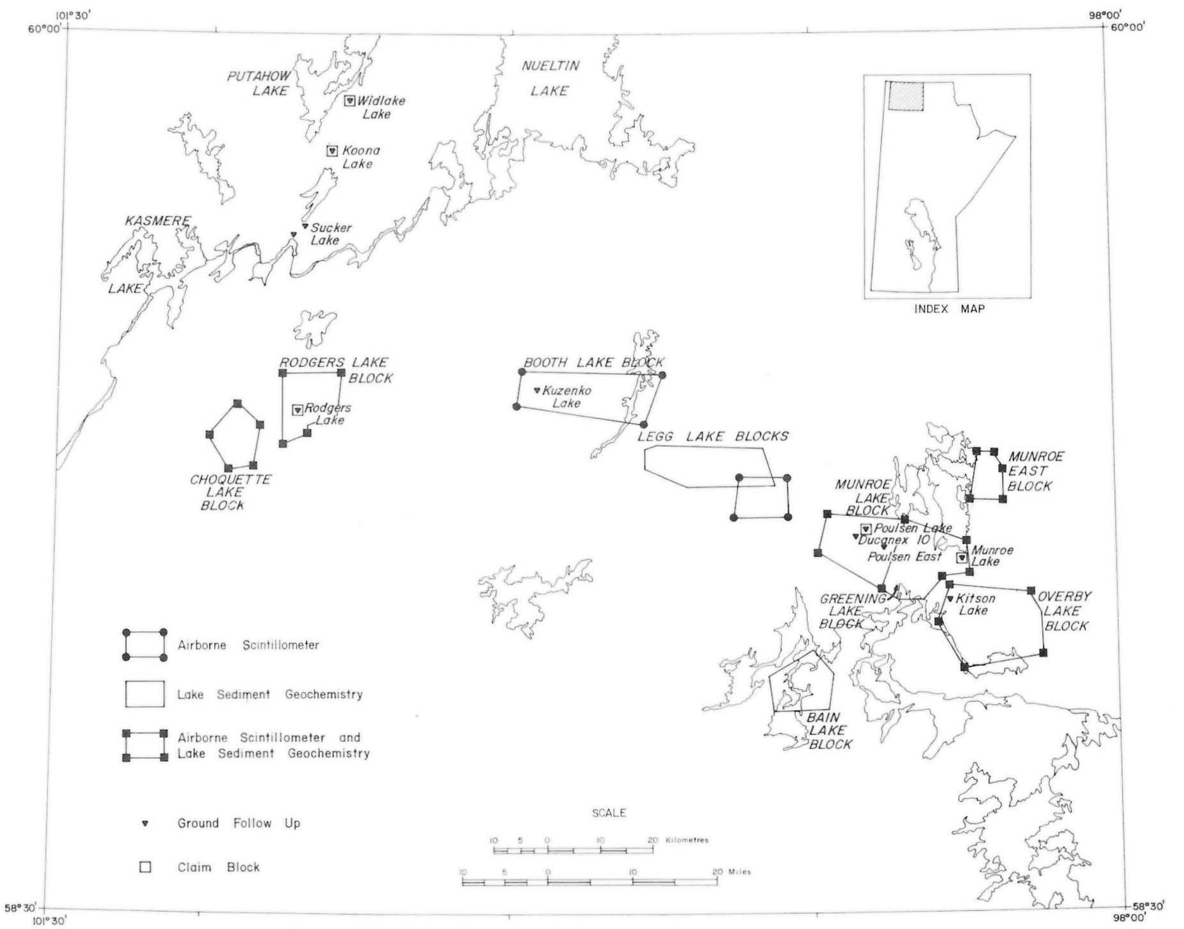

Figure EO-8-1 Kasmere-Munroe regional follow-up, location of activities.

TABLE EO-8-1

ACTIVITIES COMPRISING KASMERE-MUNROE REGIONAL FOLLOW-UP

Name of Area	Location		Size (km^2)	Exploration Methods Applied	Statistics	
	NTS	Coordinates of Centre			Line km	Samples
Rodgers	64 N/7	59°23'; 100°42'	115	Airborne scintillometer, 0.25 km line spacing; lake sediment sampling	445	46
Choquette	64 N/7	59°22'; 100°56'	55	Airborne scintillometer, 0.25 km line spacing; lake sediment sampling	215	
Overby	64 0/1,2 J/15,16	59°00'; 98°20'	215	Airborne scintillometer, 0.25 km line spacing; lake sediment smapling	855	89
Munroe	64 0/2	59°10'; 98°51'	90	Airborne scintillometer, 0.25 km line spacing; lake sediment sampling	350	113
Munroe East	64 0/1	59°15'; 98°21'	50	Airborne scintillometer, 0.25 line spacing; lake sediment sampling	195	32
Greening	64 0/2	59°08'; 98°35'	135	Airborne scintillometer, 0.5 km line spacing	265	
Booth	64 0/5	59°25'; 99°45'	140	Airborne scintillometer, 0.25 km line spacing	550	
Legg	64 0/5,6	59°15'; 99°20'	120	Geochemical sampling		62
Legg	64 0/6	59°12'; 99°10'	80	Airborne scintillometer, 0.25 km line spacing	310	
Bain	64 J/14,15	58°53'; 99°02'	120	Geochemical sampling		34
Widlake	64 N/15	59°54'; 100°32'	0.84	Scintillometer, radon, VLF-EM, magnetometer, spectrometer, sampling	16.8	
Rodgers	64 N/7	59°22'; 100°42'	0.81	Scintillometer, radon, VLF-EM, magnetometer, spectrometer, sampling	14.4	
Munroe	64 0/2	59°06'; 98°30'	0.11	Scintillometer, radon, VLF-EM, magnetometer, spectrometer, sampling	0.83	
Poulsen	64 0/2	59°10'; 98°49'	0.90	Scintillometer, radon, VLF-EM, magnetometer, spectrometer, sampling	17.0	
Poulsen East	64 0/2	59°07'; 98°47'	0.68	Scintillometer, spectrometer	4.7	
Ducanex	64 0/2	59°08'; 98°47'	0.16	Scintillometer, spectrometer	5.0	
Kuzenko	64 0/2	59°24'; 99°55'		Prospecting		
Kitson	64 0/5	59°02'; 98°45'		Prospecting		
Sucker A	64 N/10	59°41'; 100°42'	0.9	Scintillometer, spectrometer, radon, magnetometer	19.2	
Sucker B	64 N/10	59°40'; 100°44'	0.8	Scintillometer, spectrometer	17.3	

In addition to the Branch's investigations in 1976, past work in the area consisted of (a) airborne gamma-ray spectrometer and lake sediment geochemistry surveys conducted by the Geological Survey of Canada under a joint Federal-Provincial Uranium Reconnaissance Program, (b) geological mapping at scales varying from 1:50 000 to 1:200 000 by the Geological Services Branch, and (c) exploration oriented airborne and ground surveys done by the private sector.

On the basis of the above data, eight areas, each of the order of 100 square kilometres, were selected for a helicopter-borne scintillometer surveys at a line spacing of 250 metres and altitude of 40 metres. Over six of these areas, a lake sediment geochemical survey was also implemented at a sample density, where possible, of one sample per kilometre. On the basis of the airborne survey results, eight areas of the order of 0.8 square kilometre were selected for ground surveys consisting of a combination of scintillometer, radon, boulder tracing and sampling, magnetometer, VLF-EM and geological mapping. On the results of this work, three claim blocks of about 640 acres each at Rodgers, Poulsen and Munroe Lakes were acquired. In the case of Widlake Lake occurrence, the airborne survey and staking were done in the 1976 season, with the balance of the work being completed in the current year.

Airborne Scintillometer and Lake Sediment Surveys

Airborne scintillometer surveys comprising 3185 line kilometres were flown over 880 square kilometres, as indicated in Figure EO-8-1 and Table EO-8-1. The same general area was also surveyed by lake sediment geochemistry where 407 samples were collected.

The airborne survey system consisted of a 1.85 litre NaI (Tl) sensor; the Scintrex GSA-61 coupled to a GAD-1 spectrometer and a single-channel Hewlett Packard 7155B strip-chart recorder. It was flown in a Bell Jet Ranger (206A) helicopter at a nominal altitude of 40 metres, a flight line spacing of 250 metres (500 metres in the Greening Lake block) and a speed of about 110 kilometres per hour.

The background radiation over dry ground was a little less than 500 counts per second. In the Munroe Lake block over the Poulsen Lake occurrence amplitudes of up to 1700 cps were observed, and the resolution was good to excellent. A similar anomaly in the Overby Lake block led to the discovery of the Kitson lake occurrence.

The porphyritic quartz monzonite (Unit 20) in the Rodgers Lake and Choquette Lake areas was responsible for radiation levels in excess of 2300 cps. However, the resolution of the anomalies was poor, and subsequent ground follow-up indicated that they were caused by large areas of uniformly high background (about 300 cps on a 43 cm^3 scintillometer) rather than discrete "hot spots". Anomalies in the western part of the Booth Lake block probably have a similar explanation.

Preliminary examination indicates the anomalies in the Legg Lake block to be quite enocouraging, though no ground follow-up has been done so far.

No significant responses were obtained in the Munroe East block.

About 400 lake centre sediment samples were collected by helicopter using the modified Hornbrook sampler. The samples are dried and sieved, and the -80 mesh portion analyzed for uranium by Atomic Energy of Canada Limited employing the delayed neutron activation method.

Widlake Lake Occurrence

The Widlake Lake occurrence, located at 59°54′; 100°32′, was found and subsequently staked in 1976 as a consequence of a 1976 airborne scintillometer survey. The presence of this prominent airborne gamma-ray anomaly was later confirmed by the Geological Survey of Canada's high-sensitivity spectrometer survey (one kilometre line spacing), the results of which were released in June 1977.

Figure EO-8-2 shows the most significant results obtained from a ground survey. The contours indicate radiation levels recorded by a Scintrex BGS-1SL scintillometer (43 cm^3 sensor) held one metre off the ground surface. In-situ spectrometer assays indicate uranium concentrations as high as 1.2 lbs/ton in some boulders; and fair concentrations of boulders in the 0.5 to 1 lb/ton range.

Outcrop is negligible, and all the geological information is deduced from boulders. The uranium mineralization is confined to leucogranites similar to those at the Koona Lake occurrence. Yellow stains due to secondary uranium minerals are common, as are the red

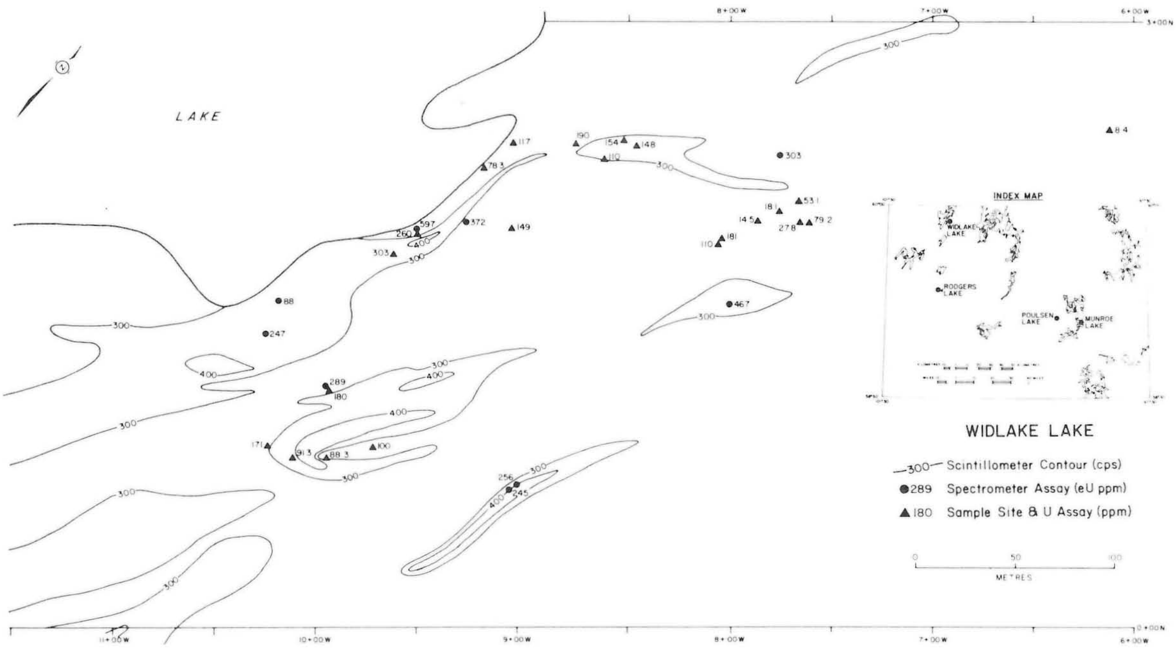

Figure EO 8-2 Wildlake Lake Occurrence; Radioactivity Contours and Uranium Assay Valves

lichens(?) often found on uranium-bearing boulders in this area. Pelitic biotite gneiss is a common associated rock type. Core samples taken with the portable GSC drill are currently being assayed.

A limited amount of drilling is recommended to investigate the potential of this uranium showing.

Poulsen Lake Occurrence

This occurrence located at 59°10′ N; 98°49′ W was discovered by an airborne scintillometer survey over the Munroe Lake block. A 640 acre claim block was staked in August 1977.

Figure EO-8-3 shows the ground survey results obtained, over a flagged grid of survey lines 50 metres apart. The contours show the results of a scintillometer (BGS-1SL) survey, which aided in delineating boulder trains. In-situ gamma-ray spectrometer assays were subsequently carried out at several locations along the boulder trains. The results, also shown on Figure EO-8-3, indicate uranium concentrations in the boulders of up to 1.74 lb/ton. Several boulders in the 0.5 to 1 lb/ton range form discrete groupings, which may be an indication of more continuous mineralized zones in the bedrock.

The predominant rock type is a garnet-bearing white, coarse-grained acidic granitoid very similar in composition to the leucogranites of the Koona Lake and Widlake Lake areas.

Bedrock is extensively exposed together with frost heaved boulder pods and trains. Several factors suggest that the boulders are "in-situ":

1. The petrology of the boulders is identical to nearby outcrop.
2. The shapes of neighbouring boulders indicate that they can be pieced together to form larger units.
3. Bedrock can be seen in several stages of frost heaving, from cracked outcrop to sharply angular boulders.
4. The majority of boulders are sub-equal in size (0.5 to 1 metre) and angular indicating a minimum of glacial transport.

Detailed geological examination and a limited amount of drilling is recommended to test the potential of this occurrence.

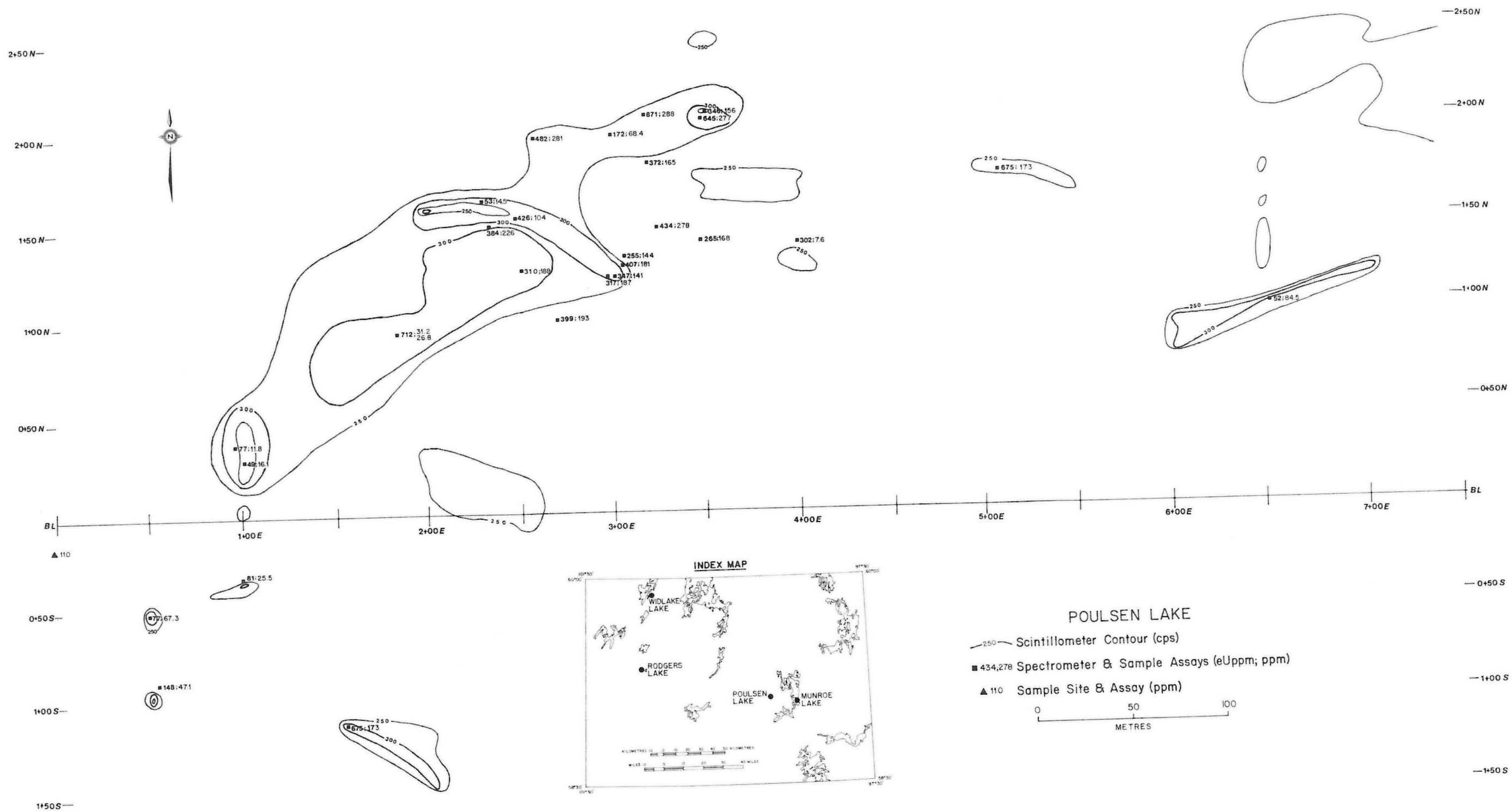

Figure EO-8-3 Poulsen Lake occurrence; radioactivity contours & uranium assay values.

Munroe Lake Occurrence

This occurrence, near the south shore of Munroe Lake, is located at 59° 06′ N; 98° 30′ W. It is believed that this occurrence was initially located by Ducanex Resources Limited. A 360 acre claim block was staked to cover the occurrence in August 1977.

Figure EO-8-4 shows the results of the scintillometer survey and in-situ assays by gamma-ray spectrometer. Good readings have been obtained but over very limited widths only, of the order of a few centimeters. The spectrometer assays indicate zones with up to 10 lb/ton uranium, however this has yet to be confirmed by neutron activation assay. Several core samples were taken with a portable GSC diamond drill.

Bedrock exposures comprise approximately 10% of the claim block and consist of pink pegmatite dykes intruding feldspathic quartzite. The pegmatite is composed principally of K-feldspar and although not uniformly radioactive, it hosts the narrow zone of mineralization accompanied by a concentration of magnetite.

Trenching and additional sampling is recommended.

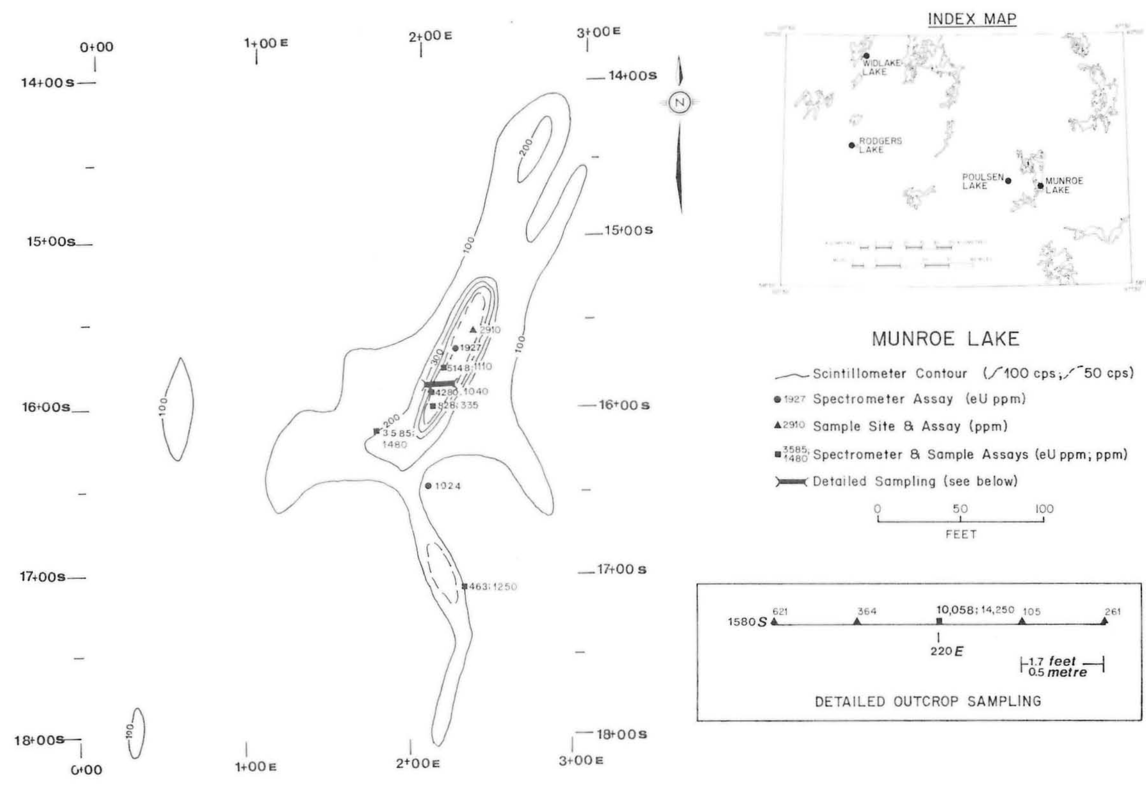

Figure EO-8-4 Munroe Lake occurrence; radioactivity contours and uranium assay values.

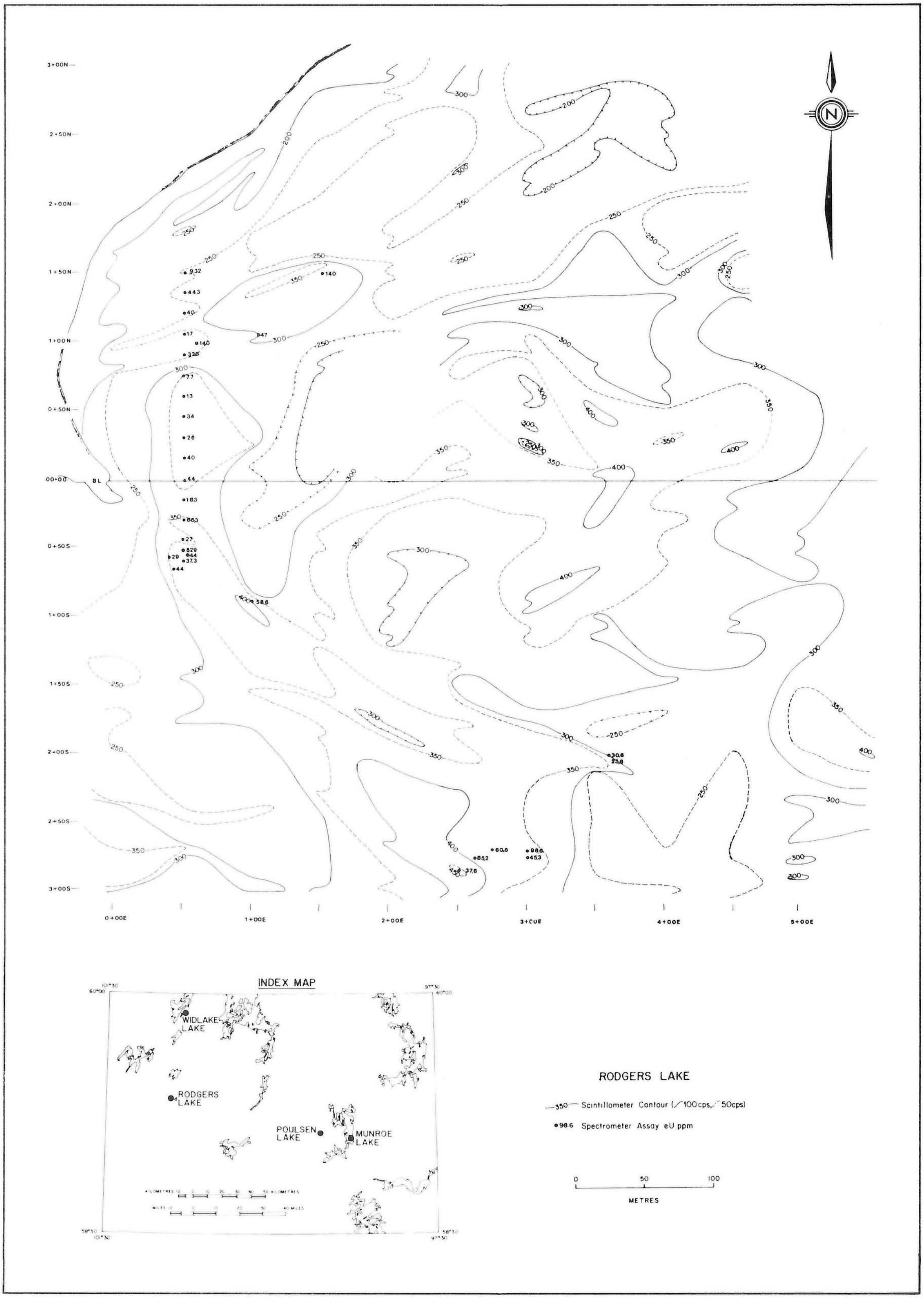

Figure EO 8-5 Rodgers Lake Occurence; Radioactivity Contours and Uranium Assay Valves

Rodgers Lake Occurrence

This occurrence was located as a result of a 1977 airborne scintillometer survey at 59°22′ N; 100°42′ W. A 640 acre claim block was staked over the occurrence in July 1977.

Figure EO-8-5 shows the relevant results obtained from the ground follow-up. A ground scintillometer survey delineated anomalous zones in the boulder fields. In-situ spectrometer assays were taken with the Scintrex GAD-1. Uranium concentrations within the boulders are erratic and generally low (Figure EO-8-5). One assay exceeds 1.2 lb/ton, but it represents an area of only a few square centimetres. Most readings are below 30 ppm U.

Outcrop is negligible, therefore the geological information is derived from the boulders. The predominant rock type is porphyritic quartz monzonite (Unit 20 of Weber et al.) forming subrounded to subangular boulders one to two metres in diameter.

The anomaly is caused by slight uranium enrichment (up to about 30 ppm) at the edges of a large granitic body known as the Topp Lake pluton. The higher than normal radiation background is accentuated by an absence of moss cover caused by a recent burn. No further work is recommended.

Miscellaneous Surveys

This section reports on preliminary surveys conducted in areas which have not been staked but where uranium mineralization has been encountered. For the locations refer to Table EO-8-1.

1. Kitson Lake: Mineralization was discovered at Kitson Lake as a result of an airborne scintillometer survey on the Overby Lake block. Spotty uranium mineralization, less than a metre in width, occurs in pink pegmatite which intrudes granodiorite gneiss. The pegmatite is similar in appearance to that at Munroe Lake, however, the radiation is considerably less, and a single in-situ spectrometer assay indicated a uranium content of 0.8 lb/ton U.

Further work including spectrometer assays, GSC drill core sampling, and trenching is recommended.

2. Poulsen East: A medium-amplitude airborne anomaly within the Munroe Lake block prompted a ground scintillometer survey in this area. Two small pods of white granitoid boulders less than 70 metres in diameter and similar to boulders at the Poulsen Lake occurrence were outlined. These rarely gave scintillometer readings in excess of 500 counts per second at the boulder surface.

No further work is recommended.

3. Ducanex Grid: This area has been investigated in detail in the past by Ducanex Resources Limited and is located one kilometre southwest of the Poulsen Lake occurrence. Bedrock exposure over a 2500 feet by 600 feet grid previously established by the company is extensive consisting of a coarse-grained white granitoid rock. Detailed coverage by a ground scintillometer survey located several points approximately 0.5 metre in diameter on the outcrop face where readings exceeded 1000 cps. Gamma-ray spectrometer assays over these points ranged in value from 0.15 to 3 lb/ton uranium, and averaged about 0.7 lb/ton.

Detailed geological examination and portable GSC core drill sampling is recommended.

4. Kuzenko Lake: A high amplitude, poor resolution anomaly resulting from an airborne scintillometer survey within the Booth Lake block was investigated on the ground. The cause of the anomaly was found to be a uniformly high background radiation (200 to 260 cps on a BGS-1SL) caused by large boulder fields.

The major rock type is a quartz monzonite similar to Unit 20 of Weber et al. Other rock units, ranging between 1 to 5% in abundance include dolomite, calc-silicate rock and greywacke. All boulders, between 0.2 and 1 metre in dimension, were angular to subrounded and appeared to be transported. No further work is recommended.

5. Sucker Lake Anomalies: An airborne radiometric survey conducted by Scintrex Limited for Dynamic Petroleum Products Limited in the Sucker Lake area revealed two anomalous zones (Figure EO-8-1). These anomalies were examined in an effort to evaluate their uranium mineralization potential.

Over the northern anomaly (anomaly A) located at 59°41′ N; 100°42′ W a grid was established and a scintillometer survey using a BGS-1SL was carried out. Proton magnetometer, radon emanometer and spectrometer surveys were done over areas of interest. In-situ uranium assay results using a Scintrex GAD-1 spectrometer ranging from 30 to 95 ppm eU.

Three major rock types occur at anomaly A, the most common being a medium-grained foliated, garnetiferous leucogranite. The second rock type is a fine to medium-grained pelitic biotite gneiss. The third unit is a fine-grained red granite containing minor amounts of magnetite. The leucogranite was more enriched in uranium than the other rock types.

A scintillometer survey over anomaly B, located at 59°40′N; 100°44′ W, was followed by in-situ spectrometer assays over high response areas. Uranium values were low (0 to 26 ppm eU) whereas thorium values were high.

No further work is recommended for this area.

EO-9 RED SUCKER LAKE

53 K/4

by B.R. Smith, R.A. Whitworth and N.M. Soonawala

The Red Sucker Lake activity was centered on four contiguous 640 acre claim blocks, located at 54° 14′ N; 94° 54′ W (see Figure EO-9-1 and EO-7-1).

The purpose of this activity was to investigate a prominent airborne gamma-ray spectrometer anomaly of 9 ppm eU located by a reconnaissance survey conducted by the Geological Survey of Canada in 1969.

The following exploration data were available for follow-up investigation:

(1) two radiometric profiles obtained by the Geological Survey of Canada's high-sensitivity airborne gamma-ray spectrometer (see GSC Paper 70-46), and
(2) a geological map at a scale of 1″ to 4 miles compiled in 1938 for the Geological Survey of Canada.

Field Work

The first stage in the current season's field work involved a 900 kilometre flight line scintillometer survey using 1.8 litre volume crystal coupled to a single-channel system operating in the broad-band mode and flown at an altitude of 40 metres and line spacing of 250 metres in a Bell 47J2 helicopter. Background radiation varied from 100 to 500 cps depending on the general nature of the ground being flown over. Figure EO-9-1 indicates the most prominent airborne anomaly. Counts in excess of 2000 cps at several points were obtained with a moderate resolution of the peaks. The area staked on the basis of the airborne survey results and the outline of proposed survey grids is shown in Figure EO-9-1. Only grid A-1 was surveyed.

Initially, a ground scintillometer (BGS-1SL) survey was carried out at stations 5 metres apart on lines spaced at 50 metres. The background varied from about 100 to 200 cps. Contourable anomaly patterns were obtained with readings in excess of 400 cps. When the anomalous zones were investigated in detail, "on-rock" scintillometer readings of up to 700 cps were recorded corresponding to mineralization of about 0.2 lb/ton uranium. Neutron activation assays are awaited for boulder samples collected by the GSC portable coring drill.

A radon emanometer survey was undertaken to test the continuity below overburden of several isolated scintillometer anomalies. A high degree of coincidence is observed between radon and scintillometer results, confirming the continuity.

Geological information was derived exclusively from boulders indicating a granitic terrain. Subrounded to subangular pink granitic boulders from 0.5 to 10 metres in diameter occur comprising about 80% feldspars, 15% quartz and 2 to 5% biotite.

A continuation of the ground scintillometer survey on to grid A-2 and a continuation of the radon survey is recommended. Further work will depend on the assay results.

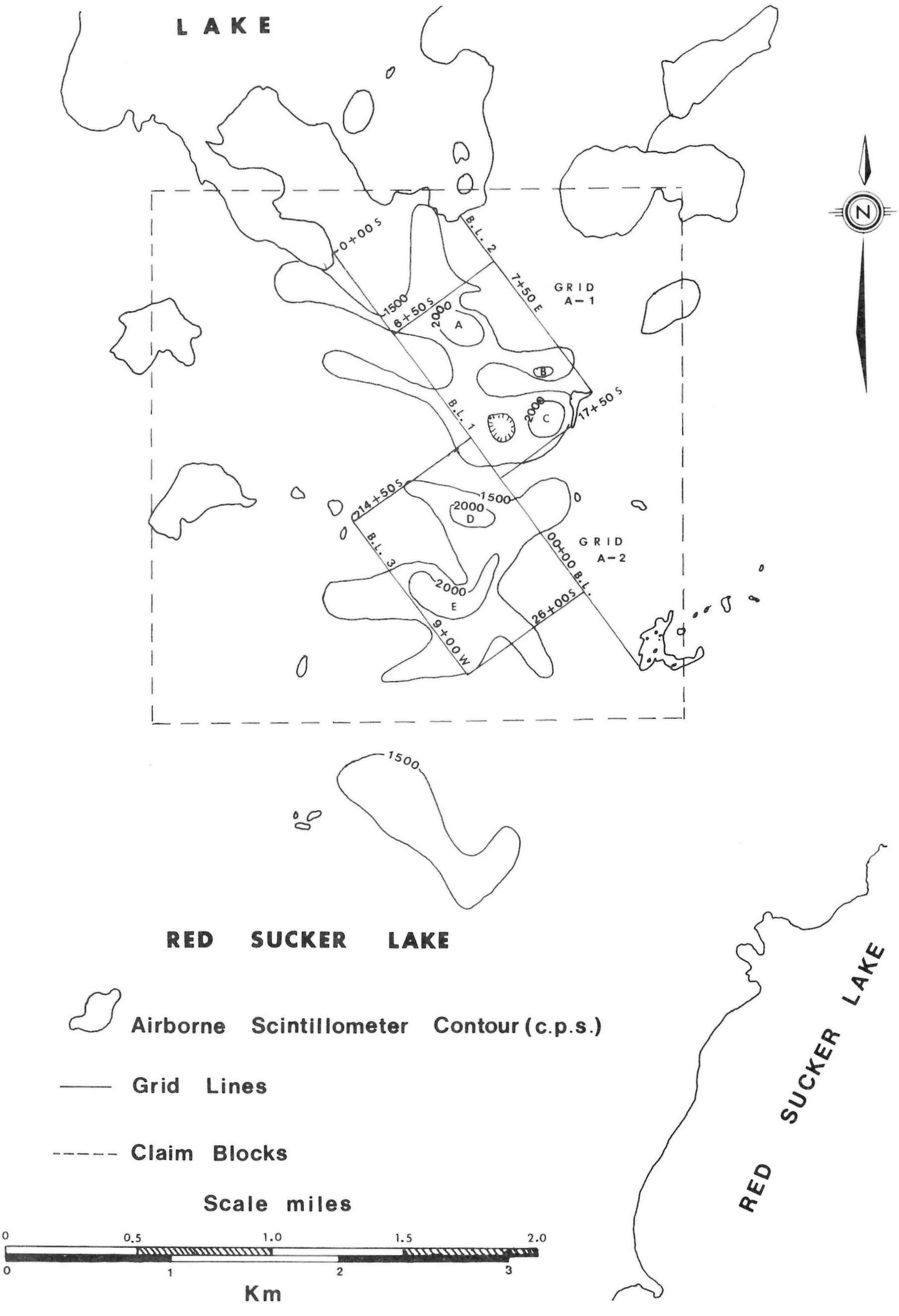

Figure EO 9-1 Red Sucker Lake Project; Location Map of Survey Activities

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